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Democratic Socialist Republic of Sri Lanka

Ministry of Mahaweli Development

Maduru Oya Project

Feasibility Report

Annex F
Livestock

ACRES Acres International Limited, Niagara Falls, Canada

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FOREWORD

The Feasibility Report on the Maduru Oya Project, of which this Annex forms a part, is made up as follows:

Main Report

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Annex [illegible] - Soils and Land Classification

Annex C - Hydrology and Water Balance

Annex D - Engineering Works

Annex E - Agronomic Studies

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SUMMARY

1 - EXISTING AND POTENTIAL LIVESTOCK PRODUCTION

Existing livestock production in the Maduru Oya project area is relatively low because it is adversely affected by the poor nutritional value of natural pastures, high temperatures and disease. Poor animal husbandry and lack of marketing outlets are also constraints. A large proportion of production is at a subsistence level.

Neat cattle, buffalo, goats and poultry are the most important livestock types. The cattle and buffalo, numbering some 50 000, are mainly indigenous breeds and multipurpose, supplying milk, meat and draft power. Production levels per head can be raised by crossbreeding with improved specialized Indian breeds of both cattle and buffalo. Crossbreeding with temperate cattle can raise milk production even further. Current levels of stocking on available natural pastures are relatively high.

To raise nutritional standards, limited levels of concentrate feeding are suggested. Improved tropical pastures are emphasized. Better disease control will also assist in lifting production. The draft power potential could be better utilized with more continuous cropping in the region.

2 - LIVESTOCK MARKETING AND PROCESSING

Milk

Sri Lanka is about 50 percent self-sufficient in supplying milk and milk products for domestic consumption. Prevailing consumption levels are about 40 percent of suggested nutritional requirements. It will be necessary to rely on some imports in the foreseeable future.

About 30 percent of domestic production is purchased by the National Milk Board (NMB), who offer nationally uniform milk prices. In the Maduru Oya area the milk collected by the Board is manufactured into sweetened condensed milk at its factory near Polonnaruwa. Increased numbers of milk chilling centers and collecting points will stimulate local production and reduce the condensery's reliance on imports.

Buffalo curd and ghee production are also important low-cost cottage industries which supply village centers in the project area.

Meat and Draft

The present consumption of beef and mutton is less than suggested nutritional requirements but there are important religious and income constraints. Small quantities are imported, mainly for the luxury market.

Most of the cattle and goats in the project area which are destined for slaughter are sold to Colombo butchers or their agents after passing through the hands of "middlemen". Local slaughter on village slabs accounts for only 1 to 2 head/day in each town.

Because of a decline in numbers, there is currently a nation-wide ban on the slaughter of buffalo and female cattle. However, surplus stock from an individual farmer can still provide cash when sold as breeding or draft animals. The government also breeds and holds both milk and draft cattle and buffalo for distribution to private farmers in the area.

3 - POTENTIAL LIVESTOCK DEVELOPMENT

Three possible systems to develop livestock production in the Maduru Oya region are identified

- Murrah buffalo, with confined feeding on 0.33 ha of improved pasture on upland homesteads. These cows would produce draft animals for irrigated farming, as well as milk and some surplus stock other than draft bulls. The draft animals would graze on crop stubble and bunds.

- Zebu/Temperate cattle, with confined feeding on 0.33 ha of improved pasture on upland homesteads. These animals would be integrated with dry land cropping systems and produce only milk and surplus stock.

- Indigenous (Zebu) cattle on public lands.

On a per-cow basis (including followers), the respective annual net farm income estimates at herd maturity are as follows

- Murrah buffalo: Rs 2,744/yr
- Zebu/Temperate cattle: Rs 1,227/yr
- Indigenous (Zebu) cattle: Rs 420/yr.

These estimates are made using mid-1979 farm price estimates. The estimate for the Murrah buffalo option is obtained by disposing of all surplus stock including potential draft animals.

The production estimates employed presuppose the existence of an effective producer organization and adequate government support services. It is recommended that the implementation of any livestock schemes for System B be the responsibility of a Regional Dairy Development Bureau (RDDB) which would provide extension services to local farm cooperatives.

4 - POTENTIAL LIVESTOCK BENEFITS OF PROJECT

The minimum potential livestock benefit attributable to the System B agricultural development proposal is estimated by calculating the net economic revenue which can be obtained by way of the Murrah buffalo development option. In total, about 8,600 buffalo cows would be assigned to approximately one out of every four settlers at the time of their arrival in the project area. Eventually, this would generate an additional 29 000 draft animals, thus providing for nearly all the farm power need by paddy farmers in System B. Supplementary revenue from milk and surplus stock would also result.

In addition, existing draft animals in the region would be more fully employed throughout the crop year.

The total annual net economic benefit at project maturity is estimated to amount to some Rs 39.0 million/yr. This effectively amounts to about Rs 1,136/family.

These projections presuppose the simultaneous development of effective producer organizations and adequate government support services in the region. The substantial benefits which are projected will justify rigorous government effort in this area.

1 - INTRODUCTION

Existing livestock production in the Maduru Oya project area is closely related to unimproved environmental factors, the most important of which is the quality and quantity of the natural grazing resource determined by climate and soils. Disease is another environmental factor affecting output in the area.

1.1 - Climate

1.1.1 - Rainfall

The Maduru Oya project area lies in the low country of the dry eastern climatic zone of Sri Lanka. The northeast monsoon blows from December to February bringing the dominant wet season (Maha). The area falls within the rain shadow of the southwest monsoon which brings some rainfall in April and May and thereafter experiences dessicating conditions from June through September (dry season). Rainfall averaging around 1,800 mm/yr (Welikanda in the center of the system has an average of 1,765 mm) is lower than other areas of Sri Lanka. Pasture growth therefore follows a bimodal distribution coincident with rainfall. There is a flush period in October and November followed by a slower steady vegetative growth in December and January. With the minor peak of Yala rains in April there occurs a second growth period followed by a time of restricted growth in May and June; and a final drying off of pastures with the advent of the dry weather.

Natural pastures tend to be low in nutritive value in the dry season. Important exceptions to this are the flood plains ("Villus") on the Mahaweli Ganga and to a lesser

extent on the Maduru Oya. The areas are flooded for about 3 months and provide valuable grazing for most of the remainder of the year. These rivers as well as numerous irrigation tanks serve livestock.

1.1.2 - Temperature and Humidity

Relatively high minimum and maximum temperatures (e.g. 24° and 31°C respectively at Batticaloa, just outside the area) are associated with the low altitudes of 0 to 80 m. These, combined with humidity averaging 72 percent, contribute to heat stress in cattle particularly in exotic breeds.

1.2 - Soils and Pastures

1.2.1 - Villus

Most of the commercial as well as subsistence milk and meat production takes place on natural pastures on the Mahaweli's Villu ecosystem and neighboring areas estimated to cover 10 000 ha. Because they are seasonally flooded and very difficult to drain, the soils have limited cropping potential.

The dark brown loam to sandy loam soils which are poorly to very poorly drained, carry mainly water-loving species such as *Paspalum vaginatum*, *Sacciolepsis interrupta* as well as naturalized *Brachiaria mutica* (1). The poor drainage conditions are unfavorable for the growth of trees and shrubs.

The pastures have an estimated carrying capacity of one cow equivalent to the hectare during the 9-month period when they are not flooded.

1.2.2 - "Damana" or Parkland

When the Villu country is submerged or eaten out, alternative grazing has to be provided on adjacent upland areas, mainly on the Non-Calcic Brown soils. The wooded parkland type of natural grazing is referred to as "Damana", the trees being part of a dry mixed evergreen forest; the grasses belong mainly to the Andropogoneae and Paniceae families. The soils grade into Reddish Brown Earths and utilization of pastures on both types depends upon the stage of woodland succession or if chena farming (shifting cultivation) has taken place. Poorer or undesirable species such as "Illuk" (Imperata cylindrica), sensitive plant (Mimmosa pudica) and Lantana camara can invade parkland as a result of burning or chena farming.

Grazing is, therefore, limited by densely timbered areas as well as numerous rocky outcrops. Utilization also depends on access to stock drinking water. Development of areas far from rivers and streams is centered around irrigation tanks.

In general, the upland soils are low in nitrogen and phosphorus and this combined with the dry period reduces the nutritive value of natural pastures. During the dry season, pastures may be insufficient for milk and meat production and indeed for maintenance; body weight losses as well as mortalities, especially in calves, can occur and reproductive efficiency lowered.

The carrying capacity is variable depending on density of the cover but on the Noncalcic Brown soils is estimated to be one cow equivalent to 3 ha.

1.2.3 - Sandy Alluvials and Paddy Soils

Sandy alluvials can also provide useful grazing but at a lower carrying capacity. Cattle grazing these as well as the parkland areas may also have access to paddy and other crop stubble on paddy soils near streams and existing or abandoned tanks.

Draft animals are mainly associated with paddy soils although dairy/beef cattle may also graze crop stubble, bunds and other waste areas. In the flush October and November period, before tillage, the paddy areas provide new growth for grazing.

It is estimated that stubble from 1 ha with 2 crops/yr will provide 4 tonnes of dry matter/yr. Assuming a draft animal such as an indigenous buffalo weighing 270 kg requires 2 percent of its weight in dry matter per day, its annual need is about 2.0 tonnes. Hence a hectare will provide sufficient dry matter for 2 draft buffalo. The crop stubble itself may be grazed on the field after harvest. In addition, the straw may be cut and stored and the husks, stem and chaff from the threshing floor used by draft animals. If the protein content is only 2 to 3 percent, the stubble itself will not be sufficient to keep animals in good condition.

1.3 - Disease

Disease stress which can lower production and cause mortalities is also part of the environment. Some of the more important livestock diseases in the area are

Bovine - Haemorrhagic septicaemia, foot and mouth, anthrax, tuberculosis, brucellosis and mastitis.

Goat - Anthrax and contagious pustular dermatitis.

2 - LIVESTOCK RESOURCES

2.1 - Livestock Numbers and Types

System B lies partly in the Districts of Polonnaruwa and Batticaloa with a small portion also in Amparai. Cattle and buffalo numbers were collected for each district during a Socioeconomic Survey of the project area in early 1979.(2) The estimated total numbers were 49 200 with the distribution between the former two districts and livestock types as shown in Table F-2.1. Furthermore, the survey estimated there were about 5,000 goats in the area. It said nothing about poultry but most villagers keep a few chickens for domestic use.*

Most of the bovine animals were in the Batticaloa District with a particular concentration in the Vakaneri area. Buffalo represented 42 percent of bovine animals and were more important in the Polonnaruwa District. The overall stocking rate was quite high at one animal to 1.9 ha and again was highest in the Batticaloa District at 1 to 1.5 ha.

*Independent data on bovine numbers in the Batticaloa System B area are very consistent with these estimates, nearly identical. (Data collected by the Batticaloa District Administration according to GSO Division, 1979). The Socioeconomic Survey may, however, have grossly underestimated the number of goats in the region. The BDA data indicates a total in excess of 7,000 for the System B Batticaloa area, exclusive of the Polonnaruwa District total. This same source indicates that the System B Batticaloa area has a poultry population of some 6,000 birds.

TABLE F-2.1

LIVESTOCK NUMBERS - 1979
BY DISTRICT, TYPE AND INTENSITY

District	Neat Cattle No.	Neat Cattle %	Buffalo No.	Buffalo %	Total No.	Total %	Area ha	Stocking Area ha/hd
Polonnaruwa	9 650	44	12 150	56	21 800	100	54 160	2.5
Batticaloa	19 050	70	8 350	30	27 400	100	40 751	1.5
	28 700	58	20 500	42	49 200	100	94 911	1.9

Source: Settlement Planning and Development Division. Basic Socioeconomic Data of Maduru Oya System B, - Mahaweli Development Board, 1979.

Note: The above areas exclude the Forest Reserve and the Pimburettewa and Vakaneri Tank Schemes.

The data are very sketchy and no information on herd composition was collected. Nevertheless, the herd composition postulated in Table F-2.2 is based on estimates of milk collection and extraction rates from the NMB, arable areas being prepared by draft from the Socioeconomic Survey,* data from government farms, and herd efficiency factors.

There is also no information on trends in livestock numbers for the project area. However, the trend in Sri Lanka as a whole is a decrease in numbers as is indicated in Table F-2.3. It is assumed that numbers have also decreased in the project area.

The decline has been due to the slaughter rate over-running the net natural rate of increase partly because of relatively low beef and milk prices. As a stop-gap there is a ban on the slaughter of buffalo and breedable female cattle. In addition, and this would apply to the project area, agricultural and forestry development has made inroads into natural pastures of the traditionally free grazing herds of cattle and buffalo.

2.2 - Breeds of Livestock(3)

The vast majority of the cattle and buffalo within the area are of the indigenous type. Indigenous neat cattle (*Zebu* or *Bos indicus*) are referred to as Sinhala breed; these are small with a mature live-weight of 160 to 200 kg reached after about 4 yr of age.

*Of an arable area of 10 000 ha, assume 50 percent is cultivated by draft. Draft animals at 1/ha results in an estimate of 5,000 draft bulls.

TABLE F-2.2

ESTIMATED HERD COMPOSITION IN THE MADURU OYA PROJECT AREA, 1979

Class	Type: Neat Cattle	Buffalo	Total
Private			
Commercial milking cows	6 000	4 000	10 000
Subsistence or Traditional Sector			
Cows	6 000	4 000	10 000
Breeding bulls	600	400	1 000
Draft bulls	1 000	4 000	5 000
Calves	8 000	6 000	14 000
Replacements	3 000	2 000	5 000
Private Subtotals	24 600	20 400	45 000
Government			
Commercial milking cows	1 300	340	1 640
Draft breeding cows	300	-	300
Breeding bulls	120	30	150
Calves	600	140	740
Replacements	680	490	1 170
Government Subtotals	3 000	1 000	4 000
Grand Totals	27 600	21 400	49 000

TABLE F-2.3

LIVESTOCK POPULATION
TRENDS IN SRI LANKA

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Yr	Cattle	Buffalo	Sheep	Goats	Pigs	Poultry
1965	1,904	1,051	35	600	117	6,090
1969	1,585	765	28	534	108	6,578
1973	1,673	713	27	545	91	7,565
1977	1,692	796	27	545	36	5,833
1978	1,542	814	NA	450	NA	4,991

Source: Department of Census and Statistics

There has been relatively little crossing with pure Indian breeds (also Bos indicus) such as Sindhi, Sahiwal, Tharpakar or the draft types--Killari, Kangayam and Tamankaduwa White. The live weights of crosses are 205 to 225 kg, while the pure breeds themselves weigh 270 to 285 kg.

Indigenous buffalo (Bubalus bubalis) average over 270 kg at maturity over 4 yr of age. The crosses between indigenous buffalo and exotic Indian breeds such as the Murrah grow to mature weights of around 320 to 369 kg. Surti (the other main Indian breed) crosses are smaller.

The indigenous buffalo is a swamp type which wallows in marshy and muddy waterholes, whereas the Murrah is a river type; they may have common ancestry since genetically the karyotype is similar and therefore fertility of crosses should not be lowered.(4)

3 - LIVESTOCK PRODUCTION, OWNERSHIP AND MANAGEMENT SYSTEMS

3.1 - Multipurpose Production

In the Maduru Oya area, neat cattle and buffalo are essentially multipurpose animals which can produce milk, meat, hides, draft power and manure as a source of organic material for crops. (The biogas system utilizing manure has not been developed as yet in the area.) When surplus animals are sold for any of the above purposes, they can also provide a source of cash income for an individual farmer. Before estimating levels of production it is pertinent to examine some of the ownership, grazing and management systems in the area.

3.2 - Ownership

Ownership is mainly private although as described below there are some large government farms within or just outside the area. Most of the private large herd owners reside outside the area and stock are tended by herdsmen.*

Religious beliefs of both owners and consumers can influence whether meat or milk production is the major objective.**

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* The Socioeconomic Survey revealed that of the 17 800 private cattle and buffalo in the Polonnaruwa portion, only 4,274 were owned by 1,323 resident families. Of the 27 400 in the Batticaloa portion, only 1,397 were owned by 396 resident families.

**Buddhism, Hinduism and Islam are the major religions represented in the area.

3.3 - Grazing and Management Systems

3.3.1 - Villu/Damana Association

Private Herds

Herd size tends to be larger than other areas of Sri Lanka, especially on the Villu/Damana association. Individual farmers may own over 300 cattle. At the Purana (ancient) village a common occurrence is for an individual to own 10 to 15 cattle with perhaps three in milk at any particular time of the year. If the cows are milked at all, it is once a day in the morning before they are sent out to graze collectively on public land. If milked they may be night paddocked. However, there are large herds of cattle which provide only subsistence milk production because of lack of marketing outlets. These may move many kilometres in search of grazing and to take advantage of Villu floods. In some areas, herds of 20 to 30 goats are run in conjunction with cattle and provide meat as well as milk.

Government Herds

There are two types of large government farms within or adjacent to the project area. On the northwest Villu/ Damana association at Kandakadu and Trikonamadu lie the Department of Animal Production and Health's two main dairy farms. Their areas total 4,700 ha and they run 3,500 neat cattle as well as 1,060 buffalo for milk production and multiplication and distribution of breeding animals.* Just outside Polonnaruwa, two similar government farms (Nelum Wewa

*Now excluded from the project area and included in System A.

of 891 ha and 1,038 cattle and Parana Wewa of 567 ha and 1,041 Murrah buffalo) are important to the project area since they are a source of breeding stock. Again, within the area near Welikanda, the National Livestock Development Board (NLDB) is establishing a 2,400 ha draft breeding station and stocking it with mainly Tamankaduwa White cows, of which there are 300 at present.

3.3.2 - Tank or Colonization Schemes

Private

Around existing and disused tanks and associated arable areas (e.g. Vakaneri, Pimburettewa, Wadummune, Punanai) cattle and buffalo are integrated into arable agriculture. They may utilize paddy stubble and other crop residues and may graze on bunds or fallow areas.* They also utilize the tank catchment areas.

Bovine animals may be for milk/meat or draft production. If draft power is used for irrigated and dry land farming, the animal can be regarded as an outlay or receipt. If not owned, it has to be hired. It is then a real cost for such activities as ploughing, tilling, puddling and threshing. It is estimated that a pair of buffalo can provide sufficient power for 2 ha. Total ploughing and puddling is estimated to take one pair 15 days/ha. Threshing can be done by buffalo trampling the hand-harvested plants to separate grain from the heads.

If owned, the draft animals can augment income by hiring out, through the by-products of milk, meat (or cash from sale of surplus animals) and manure.

*The bunded areas can amount to as much as 5 percent of each farm.

A study which included the Polonnaruwa District (5) found that 60 percent of farmers there owned buffalo and 9 percent owned tractors. There was an average of five animals on those farms which owned buffalo. Buffalo were mostly used for land preparation and tractors for threshing and winnowing. Based on a hire rate of Rs 20/pair of buffalo per day,* 19.6 buffalo pair days/ha were used for land preparation, in addition to tractors.*

The Socioeconomic Survey (6) estimated that buffalo were used for land preparation to the extent of 70 percent in Polonnaruwa District and 20 percent in Batticaloa, the balance in each case being tractors or mamoties. For road transport, male cattle are generally used in preference to buffalo. In some areas the buffalo is not considered suitable for dry land cultivation because of its fewer sweat glands and wallowing habit--therefore cattle are used.

3.4 - Current Production Levels

3.4.1 - Milk Production

Under a more specialized milk enterprise, the herd average annual yield is of the highest order in the performance indicator hierarchy. As well as the "in-milk" yield of a particular cow, the herd average also depends upon the frequency and reliability with which cows can be brought into and maintained in production. Therefore, calving rate (or calving interval) and lactation length are important variables, since every cow is milked when she has calved. The other factors affecting efficiency are

*Current hire rates for buffalo are about Rs. 50/pair/day, including the driver.

age at first calf, productive life and mortality. With indigenous cattle and buffalo, the multipurpose enterprise system, plus poor management mitigates against maximum milk production from existing grazing resources. As mentioned earlier, every cow is not milked because of lack of marketing outlets; in addition, defective udders, adverse temperament and calves sucking during milking will all lower the herd average yield.

Under these conditions the milk yield is only about 1 L/head/day. The most important parameters affecting yield in indigenous cattle are given in Appendix Table 1. Similar levels may be expected from indigenous buffalo.

However, it should be stated that milk production requires a high level of nutritive value and forage should always be available. Dairy cows require a lighter stocking rate than their equivalent in beef animals on the same pasture. The livestock environment described earlier may be better suited technically to meat production.

3.4.2 - Meat or Surplus Live Animal Production

Meat production tends to be a sideline activity, especially in commercial milk producing areas, or in predominantly Hindu or Buddhist areas. There is also a general unawareness concerning the commercial production of beef even amongst owners with no religious aversions. Because there is a shortage of animals, the surplus live animal also has a value for breeding purposes. Estimates of expected relatively low live-weights were given earlier under the discussion on breeds. The expected ages and weights of surplus turn-off are also given in Appendix Table 1.

3.4.3 - Draft

The output from draft animals was discussed under Section 3.3.2 and the value per head will be related to this as well as competition from tractors. With regard to the latter, the draft animal has important advantages in that it does not rely on imported fuel or spare parts and therefore represents an important saving in foreign exchange.

3.5 - Improving Production Levels

There are two approaches to improving bovine production. One is to adapt the animal to the improved environment by breeding and the other is to modify the environment.

3.5.1 - Adapting the Animal

Dairy

The unimproved environment has already been described as adverse for dairy production, especially for temperate or European (Bos taurus) breeds. The indigenous Sinhala, although genetically well adapted for survival under the stresses of climate, nutrition and disease is not a high milk producer and requires a relatively high percentage of food energy for body maintenance.

On the basis of experiments carried out in Sri Lanka (7), milk production from F1 European/Zebu crosses is markedly superior to that obtained from the base Zebu population. Interbreeding of the F1 progeny results in a marked decline in milk yield but interbreeding to the F3 generation does not lead to any further significant decline. Back crossing the F1 to the European breed results in levels between the F1 and F2, depending on climatic and managerial conditions.

For the Maduru Oya project there are two options of introducing European blood

- new breed formation
- rotational crossbreeding.

(a) New Breed Formation

The most suitable European breed appears to be the Jersey, with its relatively small size being an advantage in this harsher climate and its milk with high butter fat content being preferred by the population and commanding a premium price.

Because of the low level of nutrition and management, as a first stage--before the European breed is introduced--an improved Zebu breed such as a grade Sahiwal or Sindhi could be used in the Sinhala to give higher performance in the F1 and subsequent generations. An alternative to the pure Indian type may be the relatively newly formed breed, the Australian Milking Zebu or AMZ (actually derived from the Sahiwal, Sindhi and Jersey). The second stage could be to introduce the Jersey into the Sahiwal or Sindhi grade stock, probably with the aid of artificial insemination (AI).

(b) Rotational Crossbreeding

In contrast to the above, both Zebu and European breeds could be crisscrossed or rotated using two (or three) breeds. When equilibrium is reached, the cows in alternate generations have one-third European and one-third Zebu blood. For ease of management at the small farm level, the humped cows could be inseminated with European semen and the humpless with Zebu.

On the Nelum Wewa Government livestock farm, there is a herd of 1,038 comprising Sindhi/Jersey, Sindhi and Tharpakar breeds. In 1978, 87 bulls of these three superior breeds were distributed mainly to farmers at prices varying according to age and breed. The Kandakadu farm also distributed 386 bulls of similar breeds. Few crossbred heifers are made available to farmers as the government prefers to conserve them on government farms.

There is also a Government AI service which is designed to be operated through Veterinary Centers (one at Polonnaruwa and one at Batticaloa). However, according to the A.I. Office, Department of Animal Production and Health, in 1978 only 209 and 176 cows were inseminated in the Batticaloa and Polonnaruwa Districts, respectively. The latter were mainly on government farms.

The AI office is presently considering the use of prostoglandins to artificially synchronize oestrus to assist its program.

The milk production level of the indigenous buffalo may also be increased by crossing with the improved pure Indian Murrah or Surti buffalo. There are 1,041 purebred Murrah buffalo on the Parana Wewa dairy farm. These have been bred from 1,000 originally imported in 1966. In 1978, 97 purebred bulls were distributed mainly to farmers. Also 136 Murrah and Murrah/Surti crossbreeds from the Kandakadu herd were distributed to the private sector.

Meat

As already discussed under breeds, meat production would be increased by crossing indigenous cattle and buffalo with larger Indian types.

Draft

Similarly, an increase in the scale of animal is possible by crossing with improved draft breeds. The NLDB is accumulating Tamankaduwa White females for this purpose on their Welikanda farm. Kangya, Tharpakar and Haryana sires are being used on these, the objective being to breed, train and distribute working bulls to farmers. The rotational crossbreeding system for dairy production has an advantage here since the two-thirds Zebu male will be more suitable for draft purposes.

Estimates of herd efficiency factors for Zebu/Temperate and Murrah cross animals are given in Appendix Table 1, with "in-milk" yield expected to be increased to about 3 L/head/day. In general in the project area to date, the impact of improved production by crossbreeding has been marginal. A limited number of cattle and buffalo, particularly Indian breeds, should be imported to support dairy development. This will be of particular importance to any settlement scheme. Such imports have been suggested in earlier government plans, but abandoned to concentrate on the development of the midcountry zones.

The government itself recognizes that the A.I. service needs to be more effectively organized. It also has a calf exchange system where one improved bull calf is exchanged for two scrub bull calves. To implement these and inform farmers of the benefits of crossbreeding, extension services need upgrading.

3.5.2 - Modifying the Environment

Nutrition

Since natural pastures are readily available in the Maduru Oya area, it is advisable to maximize their use for livestock production and limit that of scarce resources regarding cash outlays.

It is possible to increase production by improving nutrition standards, ranging from supplementation to a completely balanced ration. However, since this involves increasing the level of inputs to optimize economic returns, the physical relationship between inputs and outputs, as well as their relative prices, must be known. It can be stated that in System B indigenous animals are likely to have a low genetic potential for milk and meat production and will therefore react to the law of diminishing returns at a lower level. Maintenance or fixed costs will also form a higher proportion of inputs than with improved breeds.

Hence purchased mineral and vitamin supplements and concentrates, if fed at all, should be restricted to crossbred animals and at key times, e.g. calf rearing, 2 months before and 2 months after calving. Current possibilities include coconut "poonac", a high protein concentrate from expelled coconut cake, together with rice bran. Future alternatives from within the area will depend upon expansion of cotton or soybean growing to provide high protein meal. With the planned sugar industry expansion in the Dry Zone, the by-product of molasses could provide a high energy concentrate and also act as a carrier for a nonprotein nitrogen source such as urea. Since these are substitutes, it will be appropriate to use the cheapest per unit of food value.

Since the government dairy farms in the area practice supplementary feeding of crossbred buffalo and cows, it is appropriate to examine the nutritional, technical and financial factors involved.

The cows are assumed to be grazed on dry land improved pastures, mainly B. mutica, and fed at two levels of concentrate (60 percent poonac - 40 percent rice bran). These are

kg/hd/day	kg/hd/300-day lactation
0.5	150
1.0	300

This analysis will examine the higher level of concentrate feeding.

The Tropical Products Institute (TPI) has carried out an examina- tion of the pertinent relationships. These may be summarized as follows.

- The pasture contains 9 Megajoules (MJ) of Metabolizable Energy (ME) per kg.

- The dairy concentrate contains 10.94 MJ of ME/kg.

- Sufficient protein, minerals and vitamins are available in the diet. This may not apply in the dry season if cows are fed on dry land pastures alone.

- The consumption of forage by cows is estimated to be 2 percent of live-weight (320 kg L.W. Murrah cow; 250 kg L.W. Zebu/Temperate).

We therefore have the following energy supply requirements.

	Consumption (kg)	(MJ of ME)	Consumption (kg)	(MJ of ME)
Nil concentrate	-	-	-	-
Forage	2 336	21 024	1 825	16 425
Totals	2 336	21 024	1 825	16 425
1 kg/hd/d				
Concentrate	300	3 282	300	3 282
Forage	2 036	18 324	1 525	13 725
Totals	2 336	21 606	1 825	17 007

The nutrient demand by dairy cows is energy for maintenance a production, as well as adequate proteins, minerals and vitamins.

Energy for body maintenance is estimated from the following formula.

$$Mm = 8.3 + 0.091\ W$$

Where Mm = maintenance energy requirements in MJ of ME/d
W = Liveweight of the animal in kg

Energy for milk production is estimated from the following formula

$$Mp = ((0.386 \times \%\ \text{butterfat}) + (0.205 \times \%\ \text{solids} - \text{nonfat}) - 0.236))\ 1.694$$

Where Mp = Production energy requirements in MJ of ME/kg of milk produced.

Hence, for 7 percent butterfat and 9 percent SNF buffalo milk the value is 7.30 MJ of ME/kg or L; for 4 percent butterfat and 9 percent SNF cow milk the value is 5.34 MJ of ME/kg or L.

Production is obtained after first satisfying maintenance requirements from the energy supply as indicated below.

Energy Supply, Demand and Milk Production

Level of Concentrate	320 kg L.W. Murrah Cow	250 kg L.W. Zebu/Temperate Cow
Nil (forage only)		
Supply (MJ of ME)	21 024	16 425
Demand - Mm (MJ of ME)	13 658	11 333
Mp (MJ of ME)	7 366	5 092
Milk equivalent (L)	1 009	954
300 kg + Forage		
Supply (MJ of ME)	21 606	17 007
Demand - Mm (MJ of ME)	13 658	11 333
Mp (MJ of ME)	7 948	5 671
Milk equivalent (L)	1 089	1 062

The production levels indicated - 1,089 L of buffalo milk and 1,062 L of cow milk/300-day lactation - are close to those obtained on the government farms.

The relative financial implications of feeding concentrates may be summarized as follows

	Murrah Cow	Zebu/Temperate Cow
Additional milk		
Amount (L)	80	108
Value/L (Rs)	3.86	2.21
Gross Return (Rs)	308.80	238.68

	Murrah Cow	Zebu/Temperate Cow
Concentrate		
Amount (kg)	300.00	300.00
Cost/kg (Rs)	0.80	0.80
Total cost (Rs)	240.00	240.00
Net return (Rs)	+68.80	-1.32

At current price levels, the net return is positive for higher valued buffalo milk and about break-even for cross-breed cow milk. However, net returns could be lower in the dry season when the protein content of grasses falls below maintenance needs.

Certain rainfed tropical improved pastures appear to be technically suitable to the area. However, clearing of parkland would be necessary to increase moisture and light availability. The imperfectly drained Noncalcic Brown soils are appropriate for the establishment of para grass (Brachiaria mutica) and signal grass (B. brizantha). The former can withstand waterlogging and long-term flooding and, as mentioned earlier, is already naturalized on some Villu areas.

Growth could also be encouraged in and around existing tanks. The carrying capacity of Villu/Damana association could therefore be raised with the development of these pastures, as has already been demonstrated by the Government Kandakadu cattle project which runs a cow equivalent to 1.5 ha over 1,200 ha of Villu and 1,200 ha of fertilized Brachiara and Guinea "A" grass pastures on upland areas. These pastures will respond to fertilizer. They can provide about 13 000 kg of dry matter/ha giving a carrying capacity of one cow to 0.2 ha (or 5/ha) on a cut and carry basis if fed with Ipil-Ipil (Leucaena leucophala). Under rainfed conditions, the

quality and quantity of improved pastures will nevertheless deteriorate as they mature during the dry season. Limited hay and silage production, as practised on the Kandakadu farm, is therefore recommended.

Ipil-Ipil is a leguminous shrub or tree which can provide a protein supplement.* It can tolerate low soil fertility, especially low phosphate status and prefers low altitudes. However, well drained soils are required for good growth and high yields; waterlogging or flooding are not tolerated. Hence Ipil-Ipil could be established on reddish-brown earth soils which are unsuitable topographically for annual crops. On raised areas around cultivated lands, it could provide a "tree" fence as well as a source of firewood. Ipil-Ipil could also contribute to improving the protein intake of draft animals if fed with crop residue.

Another browse leguminous tree currently growing well in the area is Sesbania grandiflora. It could also be utilized for firewood and human consumption.

Although not introduced to the area, the leguminous plant Stylosanthes may have a part to play and plans for trials by NLDB are in hand. If oversown into natural pastures, it provides a system of low-cost pasture development.

Guinea Grass (Panicum maximum) is an improved cultivar which grows on similar well drained, lightly textured soils, and does not tolerate waterlogging. Guinea grass/Ipil-Ipil pastures can carry up to 6 cows/ha using the cut and carry system, although this has not yet been demonstrated in

*On April 4, 1979, the Government announced a program for the Water Resources Board to import and distribute seed from the Philippines.

Sri Lanka. Other possible Panicum maximum cultivars which appear promising in the NLDB's Welikanda trial plot are "Gatton" and "Hamil".

Depending upon woodland cover as referred to earlier, it may be necessary to clear brush and timber before establishing pastures. They could also provide a sound alternative to the chena system or, on a more intensive scale, part of a rotation with crops such as cassava. The latter is also a feed source for ruminants which can utilize leaves, stems and tubers.

If improved pastures are irrigated, it is estimated they should provide about 17 000 kg of dry matter per hectare or 30 percent more than if rainfed. However, their use will depend on the opportunity cost of allocating land to high value food or cash crops. In general, if used for livestock, they should be confined to areas producing higher priced products such as whole milk, stud animals or high protein forage crops. Inexpensive diversion schemes which collect runoff water or retain water on seasonally flooded areas can extend the period of forage growth.

If significant areas of coconuts are grown in the project area, the possibility of integrating livestock and tree production exists.

Weed species growing beneath trees have to be removed at very considerable cost and they could be replaced by improved pastures whose growth could be controlled by grazing animals. The conversion of forage into milk or meat would increase production per unit area, diversify production output and labor input. In the long term there may be an improvement in soil fertility. Experience in this multiple use of land has been confined to the "Coconut Triangle" in

western Sri Lanka. Brachiaria miliformis and Digitaria decumbens were found to be superior in dry matter to other grasses tested. However, B. brizantha may be more suitable for the Dry Zone. Pueraria Phaseoloides is a suitable legume for inclusion with B. miliformis on lighter textured soils.

Fertilizer application is necessary so that coconut yield is not depressed. The greatest opportunity for pasture establishment and livestock integration exists within mature coconut plantations of over 25 yr, where tall unimproved strains are grown. Pasture growth would not be severely limited by low light intensity and there would be no competition from light detrimental to the coconut. The Coconut Research Institute (CRI) states that under rainfed conditions, yields of 17 000 kg of dry matter per hectare are possible using set stocking at 3.5 cows/ha. Jersey/Sinhala cattle supplemented with 2 kg of coconut poonac/day yielded 7 to 8 L of milk/day. These yields could not be expected in the Dry Zone, where unsupplemented cows would probably yield about 2 L/day.

Disease

The livestock diseases prevalent in the Maduru Oya area were enumerated in Section 1.3. Methods of control or eradication are detailed in Table F-3.1.

There are veterinary surgeons (VS) to assist with disease control on each of the government farms in the area. In addition, there are three "range" VS in the Polonnaruwa District (one at Welikanda) and another serving Batticaloa District. An example of self help is the employment of a VS in 1979 by the Polonnaruwa District Milk Producers' Cooperative Society.

TABLE F-3.1

DISEASE CONTROL METHODS

Disease	Control of Eradication
Cattle	
Haemorrhagic Septicaemia	Vaccination every 12 months of animals over 6 months (Government free service)
Foot and Mouth	As above (A and O Strains)
Anthrax	As above
Tuberculosis	Tested
Brucellosis	Vaccination of heifers with Strain 19 at 3 to 6 months
Mastitis	Therapeutic antibiotic plus sound hygiene
Goats	
Anthrax	Vaccination (Government free service)
Contagious Pustular Dermatitis	As above (Government free service)

4 - LIVESTOCK PRODUCT MARKETING AND CONSUMPTION

4.1 - Milk Products

In addition to fresh milk, many other milk products are consumed in Sri Lanka, including buffalo curd, condensed milk, full cream milk powder, skim milk, butter, ghee, cheese, ice cream, yogurt and infant milk.

4.1.1 - Demand for Milk Products

There are basically two methods of estimating the likely future demand for milk and milk products in Sri Lanka. One is the nutritional requirement of the population and the other, the economic demand.

Nutritional Requirement

This is a complex calculation because of the possibility of substituting other foodstuffs for milk in order to supply recommended calorie or protein levels. It must also take account of consumer preferences.

However, according to the recommendations of the Medical Research Institute of Sri Lanka, an average person in the country should consume a total of 62 g of protein per day (both vegetable and animal) and, of this, 14.6 g needs to be of animal origin. To supply this level of animal protein, medical nutritionists of Sri Lanka have recommended the requirement levels in Table F-4.1. As noted above, the division amongst food items is essentially a value judgment, since substitutions according to taste and price will occur.

TABLE F-4.1

REQUIREMENTS AND CONSUMPTION OF ANIMAL PRODUCTS IN SRI LANKA
(kg/capita/yr)

Item	Nutritional Consumption Requirements	Estimated Consumption 1970	1976	1977
Milk	41.61	20.73	16.0	16.8
Beef	1.55	2.26	1.43	1.35
Goat and mutton	0.25	0.43	na	0.12
Pork	0.15	0.33	0.12	0.27
Poultry meat	0.26	0.32	0.16	na
Eggs	2.19	0.98	0.71	0.68
Fish	19.71	16.83	na	na

Source: Anon, "Country Report, Sri Lanka" F.A.O. Seminar on Dairy Development and Related Training in Sri Lanka, February 19 to March 9, 1979, p 4.

It may be seen that the suggested nutritional requirement of milk or milk products is 41.61 kg/capita/yr while consumption in 1977 was estimated at 16.8 kg (i.e. 40 percent of nutritional needs). Of this 8.3 kg (49 percent) was locally produced and 8.5 kg (51 percent) was imported, partly as food aid. In 1978 imports were more than doubled as a result of a liberalized import policy.

Economic Demand for Milk Products

Estimates of nutritional requirements are of limited use in determining the actual or potential demand for milk products at given levels of incomes and prices. Estimating economic demand involves measuring quantity response to income or price changes (defined as an elasticity). Calculations are usually made from either cross-sectional data such as consumer surveys of household expenditure or by using series data relating the quantities consumed at correspondingly variable incomes or prices.

Only cross-sectional data are available in Sri Lanka and the TPI has made estimates of demand for milk using the 1969/70 socioeconomic survey (10) as a base. According to this survey, milk consumption in 1970 was 191.6 million L. Assuming an annual rate of population increase of 1.7 percent GNP average annual real growth rate of 3 percent, an income elasticity of demand of 1.2, a price elasticity of between -0.4 and -0.5 and a real price increase of 17 percent between 1970 and 1978, the 1978 demand was estimated to be 255 million L. TPI then projected demand for 1985 at 359 million L, rising to 485 million L by 1990, using the same assumptions with the exception of price which was taken as constant in 1978 terms.

4.1.2 - Supply of Milk Products

Estimates of supply converted to cows' milk equivalent are made up of three components as indicated in Table F-4.2 for the period 1970 to 1977. The supply rose from a total of 221 to 263 million L over this period.

The first component is collection by the NMB for distribution mainly to urban areas. Collection rose from 30.60 million L in 1972 to a peak of 59.56 in 1976, representing extraction rates of 17 percent and 29 percent respectively.

The second component is that of rural consumption, including home subsistence and milk sold outside of NMB--mainly in local villages. This can only be an estimate and is made by the Department of Census and Statistics from village headman's reports and cross-sectional data.

The third component is the deficit between domestic supplies and consumption, which is made up of substantial imports, averaging approximately 40 million L of milk equivalent per year. The components of imports are indicated in Table F-4.3 and include food aid.

Until the budget of November 15, 1977, the NMB was granted a monopoly over milk product imports (except infant milk). Since then, imports were allowed by other bodies and these rose steeply in 1978 despite the following general rates of duty.

TABLE F-4.2

ESTIMATES OF MILK SUPPLIES
IN SRI LANKA, 1970 TO 1977
(million L)

Supply	1970	1971	1972	1973	1974	1975	1976	1977
NMB Intake	na	na	30.60	31.14	30.51	43.96	59.56	54.50
Rural Consumption	na	na	153.24	197.29	127.72	150.61	146.61	166.10
Imports	58.02	47.87	49.58	49.58	40.79	35.16	30.94	42.20
Totals	221.02	228.58	233.42	278.01	199.02	229.73	237.11	262.80

Source: Department of Census and Statistics and the National Milk Board

TABLE F-4.3

IMPORTS OF MILK PRODUCTS, 1974 TO 1978
(tonnes)

Item	1974	1975	1976	1977	1978
Condensed milk	-	-	-	-	4 572
Dry milk	9 800	7 775	9 552	13 900	26 565
Butter	229	275	168	-	1 083
Cheese and curd	-	10	17	17	140

Sources: 1974 to 1977: F.A.O./U.N., Rome, 1978.
1978: Customs Department, Sri Lanka

Item	Percent
Ghee	100
Fresh milk, whey, unsweetened condensed milk and cheese	50
Sweetened condensed milk	25
Butter	12.5
Skimmed milk	5

Within the dry milk import sector there is both whole milk and skim milk, with the latter being partly recombined with butter oil for condensed milk production. There is a case for continuing in the foreseeable future to satisfy part of the demand with imports from countries with low costs of production (e.g. New Zealand) which can be sold at a price attainable by those persons most subject to nutritional risk. These imports, together with food aid such as skim milk powder, can be used to "prime the pump" by providing initial inputs to processing plants while local milk production increases. Proceeds from the sales of food aid can be used to finance projects to improve local milk production.

World milk production continued to rise in the 1970's, both in developing and developed countries. In the latter, output has generally exceeded commercial demand in spite of declining cow numbers. This trend is expected to continue in the long term with the developed countries (particularly the E.E.C.) experiencing difficulties in restructuring their livestock sectors to meet new technological and market conditions. Surplus milk has been converted to increasing stocks of butter and skim milk powder, therefore depressing their world market price to about two-thirds of the domestic price of major producers and importers (implying subsidies). The price of quality skim milk powder was about U.S. $450 FOB/tonne in December 1978. In January 1979, within the

framework of GATT, the Tokyo round of talks on the International Dairy Arrangement set the following world minimum prices.

	U.S.$/tonne
Skimmed milk powder	425
Whole milk powder	725
Butter	925

Milk products for food aid and animal feed were exempted.

4.1.3 - Milk Prices

Domestic Producer Prices

Nationally uniform producer prices shown in Table F-4.4 are paid by the NMB for fresh milk on the basis of butterfat content, minimum solids, nonfat and keeping quality. There is a premium paid for fat content, making buffalo milk relatively more valuable.

Although the above prices have been increased over the last 10 yr to encourage local production, they are not necessarily received by the producer because of local cooperative charges and policies.

The local producer price for buffalo curd is about Rs 2.65/L, and it retails at about Rs 4/L.

TABLE F-4.4

NMB FRESH MILK PRODUCER PRICES
(4 PERCENT BUTTERFAT)*
(Rs/L)

1970 - 1972	1973 - 1974	1975 - 1976	1977 - 1978	1979
0.70	1.06	1.58	1.60	2.21

*Increase of 5 cents for each butterfat percent point rise.

Source: National Milk Board

Domestic Retail Prices

Table F-4.5 gives official controlled retail prices for some important milk products for selected years. These have an element of consumer subsidy, e.g. imported "Milk Maid" sweetened condensed milk with a duty of 50 percent retails for Rs 5.15 compared with NMB "Perakum" price of Rs 4.00 (February 1979).

Economic Price

The determination of an economic price for milk is fraught with difficulties since international trade in milk products is erratic. There are no reliable long-term projections and therefore an estimated 1977 value of whole milk powder of U.S.$825/tonne (bulk) for commercial transactions cif Colombo is used as a base. To this are added estimated average handling, packaging, transportation and marketing costs between Colombo and the main consuming areas resulting in a local market price of $865/tonne of whole milk powder or 10.69 U.S. cents (Rs 1.71)/kg of milk equivalent.

A farm gate price of Rs 1.31/L is obtained after deducting an allowance of Rs 0.40/L for domestic transport, processing and marketing costs. This compares with the 1979 NMB price of Rs 2.21/L payable at the collection center for 4 percent butterfat milk. However, the NMB 1977/78 price of Rs 1.60 is probably a better comparison.

TABLE F-4.5

OFFICIAL AVERAGE RETAIL PRICES
FOR MILK AND MILK PRODUCTS*
(Rs/unit)

Product	Year and Month			
	1970 May	1977 June	1978 July	1979 Jan
Condensed milk (Perakum) per 393-g tin	1.25	3.25	4.00	4.00
Full cream powder milk (Lakspray)/kg	6.42	12.32	12.32	13.64
Milk/L	-	1.93	1.93	2.29
Butter NMB/kg	-	-	-	24.20
Butter imported/kg	-	24.20	24.20	33.88

*Converted to metric equivalent.

Source: "Ceylon Daily News" February 21, 1979

4.1.4 - Milk Collection and Processing

The NMB has a network of milk collection centers and pasteurization and sterilization plants (at Colombo, Pallekelle, Polgahawela and Galle). It also has a condensed milk plant at Gallela near Polonnaruwa, which serves the Dry Zone including the project area, a plant for the repacking of full cream milk powder at Welisara* and a spray drying plant at Ambewela. Limited quantities of butter, cheese, yogurt and ice cream are also produced.

Table F-4.6 shows milk collection records for the main milk producing regions of Sri Lanka.

Peak collection was reached in 1976 and the subsequent decline may be attributed to the dwindling of the national cow herd, the increase in the price of coconut cake from Rs 400/tonne in 1975 to Rs 2,400/tonne in early 1977, the low price offered to the producer for his milk by the cooperatives and frequent rejection of milk due to high standards of acceptance. Over the period 1976 to 1978, collections from, in, or near the project area from various centers and types of suppliers, (see Table F-4.7), represented 32 percent of the NMB Condensery intake.

*Damaged by fire in mid-1979.

TABLE F-4.6

NMB COLLECTION OF MILK IN
SRI LANKA, BY REGION, 1974 TO 1978
('000 L/yr)

Region	1974	1975	1976	1977	1978
Hill Country	12 528	16 536	21 487	19 876	17 625
Midcountry	8 751	13 376	20 129	18 040	17 214
Coconut Growing	4 196	6 055	9 139	8 708	5 339
Dry Zone	5 039	7 992	8 802	7 878	6 619
Totals	30 514	43 959	59 557	54 502	46 797

Source: National Milk Board

TABLE F-4.7

CONDENSERY MILK SUPPLIES IN SYSTEM 'B'

Chilling Center	Type of Supplier: M.P.C.S.	Type of Supplier: Dairy Cooperative	Type of Supplier: Government	('000 L) 1976	1977	1978
Chenkalady	Kalkudah	Eravur	Karadiyanaru	1 059	1 052	783
Sittandy	-	Sittandy	-	-	140	177
Manampitiya	-	Manampitiya	-	636	583	390
		Muthugala	Kandakadu	959	907	845
		Katuwanvila				
		Welikanda				
Total				2 654	2 682	2 195

Source: National Milk Board

NMB bulk tankers of 5,500 L capacity collect fresh milk from their chilling centers as shown in the Table F-4.7. Each chilling center has a storage tank capacity of around 3,300 L. On February 1, 1979, an additional chilling center opened in Trikonamadu as part of the new Tamankaduwa Dairy Development Project to be run by the Polonnaruwa District Milk Producers' Cooperative Society with a total of 27 collecting points. There are at present (September 1979) 477 registered producers supplying over 4,700 L of milk/day.

The collecting points supply the chilling centers which can also act as collecting points. These can be run by cooperative societies, multipurpose cooperatives, (MPCS), or government farms as shown in Table F-4.7.

The producers supply milk in cans to the collecting points by transporting it mainly by carrier bicycle, bullock cart or tractor and trailer. Spoilage is possible in this link of the chain and the minimum time to avoid this is 4 hours from the farm storage to the chiller. This can become a supply constraint, especially when producers have to travel over 15 km on rough bush tracks. On arrival at the collecting point, the milk is tested for fat content, solids nonfat and keeping quality.

Condensed milk manufacture helps overcome the problems of seasonal supply by the producer, poor hygiene in raw milk, the possibility of adulteration, and distribution channels which lack refrigeration. It keeps for a longer time when opened than fresh milk and in some areas there is a definite consumer preference for the sweetened product. Fresh milk utilization and production of condensed milk by the Polonnaruwa Condensery for the period 1974 to 1978 are shown in Table F-4.8.

TABLE F-4.8

MILK UTILIZATION AND SWEETENED CONDENSED MILK PRODUCTION, POLONNARUWA CONDENSERY, 1974 TO 1978

	1974	1975	1976	1977	1978
Milk utilization* ('000 L)	6 802	8 987	10 981	8 621	7 864
Production ('000 393-g tins)	14 718	17 037	16 767	14 753	13 922

*Difference between total milk collection and total utilization figures are principally due to balances carried forward, wastage and milk in transit.

Source: National Milk Board

There were essentially two processes of manufacture employed by the Condensery in 1978. Both included the addition of 170-g sugar/393-g tin of condensed milk. These processes were

- standardized fresh milk utilization - evaporate 0.69 L of fresh milk and add 30 g of skim milk powder

- recombined process - recombine 100 g of skim milk powder with 30 g of butter oil.

In the past, a significant proportion of the skim milk powder and butter oil has been donated by New Zealand, EEC and Canada. The plant itself was donated by the New Zealand Government in 1968. The Condensery is still charged for this aid by the Sri Lanka Government.

The present capacity of the factory is reduced because of plant age and is about 18 million tins/yr. Theoretically, if all fresh milk was used, the factory could utilize 18 million L of fresh milk/yr. The 1978 figure of 7.9 million L is therefore 44 percent of present rated capacity for fresh milk utilization and there is scope to increase collection and reduce dependence on foreign aid. It may be practical to manufacture butter from fresh milk if the condensery capacity is eventually exceeded.

However, the 1978 estimates of processing, sales and profit and loss account in Table F-4.9 indicate the Condensery is running at a loss of some Rs 5 million. This is partly because of the government policy to sell condensed milk at a subsidized price. The loss to the Condensery is subsidized by the Government.

TABLE F-4.9

CONDENSERY PROCESSING, SALES, PROFIT AND LOSS ACCOUNT, 1978
(Preliminary)

Item	Total Rs '000		Per Unit*	
Production				
Raw milk	23 400		1.30	
Skim milk powder	9 180		0.51	
Butter oil	1 440		0.08	
Total Milk		34 020		1.89
Sugar	13 680		0.76	
Other materials	180		0.01	
Cans	13 860		0.77	
Cartons	1 800		0.10	
Total Materials Other Than Milk		29 520		1.64
Production labor and overheads	4 594		0.26	
		4 594		0.26
Total Cost of Production		68 134		3.79
Selling and distribution costs		250		0.01
Total Cost of Sales		68 384		3.80
Sales				
Sales value (18 million tins)		63 000		3.50
Gross loss on subsidized selling		(5,384)		(0.30)

*Total divided by 18 million tins.

Source: National Milk Board

4.1.5 - Buffalo Curd and Ghee

The spoilage constraint applying to fresh milk can also be overcome by the production of buffalo curd. In the project area, as well as providing subsistence requirements, it is an important low-cost cottage industry supplying curd to local villages in clay pots. The pots are also manufactured locally and assist the keeping quality of the curd.

Ghee (or clarified butter) is also a cottage industry in certain areas (e.g. Sittandy). The skim milk by-product from ghee could be used as a livestock feed.

4.2 - Meat Marketing

4.2.1 - Meat Demand

Nutritional

From Table F-4.1, in 1977 the combined beef, goat and mutton consumption was estimated to be only 1.47 kg/capita or 82 percent of the suggested nutritional requirement of 1.86 kg. In Sri Lanka, however, consumption of meat has important religious and income constraints. Assuming a population of 14 million in 1977 and a total of 82 kg of carcass per bovine animal, an annual per capita consumption rate of 1.35 kg of beef or a total of 19 000 tonnes was equivalent to 230 000 cattle. This represents a turn-off rate of 10 percent from the national herd numbering approximately 2.4 million.

Economic Demand for Meat

The TPI, using similar assumptions as for milk (except for an income elasticity of 0.7) calculated that the total demand for all meat products in 1978 was 50 000 tonnes, representing an average of only 3.5 kg/capita/yr. By 1990 it is estimated that 86 000 tonnes will be required to meet demand, giving a per capita consumption of 5.0 kg/capita/yr.

4.2.2 - Meat Supply

Both beef and mutton imports now supplement domestic production to a limited degree, with beef being directed mainly toward the luxury market.

On November 15, 1977, the ban on beef imports was lifted but a 100 percent general rate of duty was applied.

According to the Department of Customs in 1978 beef imports were 45 tonnes and mutton and lamb imports from Australia and New Zealand were 476 tonnes.

4.2.3 - Meat Prices

Domestic Producer Prices

A producer price series for past years is not available. Present prices in the project area appear to be around Rs 3.30/kg live weight for males or cull cows. Female breeding stock sell at a premium price of about Rs 6.00/kg.

Domestic Retail Price

Table F-4.10 indicates official average retail prices for beef for 1977 to 1979. Beef prices are controlled but this is difficult to implement, despite fines. In addition, local prices are relatively low and, unlike milk prices, are not subsidized.

Economic Prices

The economic price for beef is assumed to be the same as the financial price.

Goat producer and retail prices appear to be competitive with beef.

4.2.4 - Meat Processing

Most of the cattle and goats in the Maduru Oya area destined for slaughter are purchased from farmers by "middlemen" and sold to Colombo wholesale butchers or their agents. The middlemen are paid on a carcass weight basis.

Before they are railed or road transported (about 12 head of cattle/truck) to the Colombo Municipal Abattoir, the District Regional Office should issue a certificate of health and another for transport. However, illicit slaughterings do take place.

Before slaughter, an important source of loss is bruising in transit (e.g. during the journey of 216 km from Polonnaruwa to Colombo) or rough handling at the abattoir. Another factor reducing the hide value (potentially worth about Rs 20) is the current disfiguring branding practice. A registered branding system is desirable to reduce theft and

TABLE F-4.10

OFFICIAL AVERAGE RETAIL PRICES FOR BEEF, 1977 TO 1979
(Rs/kg)

1977 June	1978 July	1979 Jan
7.70	12.10	12.30

*Converted to metric equivalent.

Source: Ceylon Daily News, February 21, 1979

could include a year brand to assist in determining age. Because of the mainly cull type of production, dressed weight averages only 39 percent of live weight.

The Colombo Municipal Abattoir is situated at Dematagoda. It has ante and postmortem veterinary inspection services but is over 100 yr old and the 125 registered butchers use the "bed-dressing" method, mostly under Moslem rites. The daily capacity is about 300 cattle, 400 sheep and goats and 80 pigs. There are no chilling facilities and the daily kill is distributed by retail butchers early in the morning to authorized market stalls, hotels, and hospitals and to the army.

The next largest killing center is at Kandy with a capacity of 25 to 30 head of cattle/day. In or near the project area itself, any slaughtering of 1 to 2 head on a slab at the village or urban level should be done under the supervision of the Public Health Inspector and the appropriate health certificate issued. Throughout the island there are 530 beef stalls, 180 mutton stalls and 50 pork stalls (15).

There does not appear to be scope at present for any additional regional abattoirs. The NLDB, responsible for their establishment, recently abandoned a proposed facility at Alawwa (with a capacity to handle 500 cattle, 500 sheep and goats and 100 pigs) in the face of an estimated cost of Rs 100 million and a dwindling herd, indicating it was not possible to operate at optimal capacity.

The producer marketing system is imperfect in its present state with the "middleman" taking advantage of the producer. There would be more buyer competition in the area if there were more butchers' agents. The NLDB has the power to establish livestock purchasing centers for the purchase of animals for meat from livestock farmers at a fair price.

However, this has not been implemented in the area. Any auction system contemplated would have to try to ensure there was no collusion between buyers.

Collection of statistics on livestock numbers, implementing existing inspection procedures to monitor marketing, and collection and publication of livestock producer prices will undoubtedly assist in formulating improved meat marketing policies. An increase of the controlled minimum beef price would also encourage the use of land for beef and also make milk production more economic by increasing the value of surplus dual-purpose stock.

5 - LIVESTOCK DEVELOPMENT ALTERNATIVES IN THE MADURU OYA AREA

5.1 - Alternative Management and Ownership Systems

Based on planned settlement proposals and existing production and resources, three possible systems to increase livestock production may be isolated. These involve

- the integration of draft animals into irrigated agriculture
- supplementation of farmers' incomes with livestock production on arable nonirrigated uplands, and
- development of private indigenous herds on public grazing land.

5.1.1 - Integration of Draft Buffalo Into Irrigated Agriculture

As indicated in the preceding sections, there are various systems for utilizing draft buffalo power which either complement or substitute for tractors, depending on availability, relative costs and farmer preference.

One pair of buffalo would supply sufficient power for 2 ha (or a requirement of 1 bull to 1 ha). Sufficient dry matter from crop stubble and bunds is available from 1 ha to supply feed for 2 adult indigenous buffalo (or say 1.7 Murrah crosses).

Crossbred (Murrah) buffalo cows could be bred to supply draft bulls. These cows would be zero grazed (cut and carry) on a rainfed fertilized pasture mixture of B.mutica

and B.brizantha plus a row of L. Leucocephala. Better control could be obtained if the pasture was on the homestead block and the animals were tethered.

It is estimated that 0.33 ha* of improved pasture would be necessary for one cow plus an average of 1.185 followers, as indicated in Appendix Table 4. They could also utilize the crop stubble not consumed by draft animals.

To develop this livestock alternative, it would be necessary for the NLDB to import Murrah or Surti from India and breed and multiply these on Government farms. These could then be crossed with indigenous buffalo which would also have to be purchased from local herds. It would be desirable for the heifers to be 2-1/2 yr of age and in calf before distribution to settlers.

5.1.2 - Supplementary Livestock Production on Arable Nonirrigated Uplands

In this case livestock development is assumed to take place on areas out of command. Zebu/Temperate cross dairy cows would be integrated into the dry land cropping pattern.

Initially cattle could be accumulated and bred on Government farms using imported Sahiwal, AMZ and Jersey semen. Alternatively, they could be purchased from improved private herds already in existence. It would be desirable for the heifers to be in calf and about 2 yr of age before distribution to settlers.

*A carrying capacity of 5 cow equivalents per hectare is assumed, as discussed in Section 3.5.2.

Crossbred Zebu/Temperate cows and followers could be zero grazed on a similar improved pasture to that described for the Murrah buffalo. They would also have access to crop stubble and, in fact, could be rotated with crops. A similar carrying capacity of one cow and followers on 0.33 ha can be assumed.

5.1.3 - Development of Private Herds on Public Grazing Land

Alternatively, the development of indigenous cattle for dairy/beef production on the Villu/Damana lands might be encouraged by providing access to milk collection points. Erection and use of night holding paddocks would also get cows accustomed to a dairy husbandry environment.

The herd size should be sufficient to provide a family income from livestock production alone. As well as subsistence and commercial milk production, the development of this third system could supply surplus breeding stock directly (or via Government farms) to the other two development options. The NLDB draft breeding farm is an example of this type of development on Damana land. Cooperation with NLDB would be necessary to increase the supply of breeding stock in the project area.

Grazing reserves, especially on Damana areas, should be set aside to protect this form of production from encroachers. With increasing pressure on grazing resources, it may also be necessary to issue grazing licences to individuals. The extent of the grazing land available would be about 10 000 ha of Villu plus those Damana areas not set aside for arable agriculture. The overall carrying capacity, assuming equal areas of Villu and Damana, is estimated to be one cow equivalent to 2 ha. Production might be further increased by carrying out similar improved pasture programs on upland areas.

5.2 - Livestock Support Services

For intensifying production and marketing in the area, the general plan being considered by the Ministry of Rural Industrial Development, which is responsible for livestock development, is endorsed.

Before development can take place, it will be necessary to accumulate additional cows for distribution and sale to farmers.

The ongoing plan would then involve decentralization of the administration by establishing a RDDB for the Dry Zone (or the Mahaweli Scheme as a whole) with a particular section responsible for the Maduru Oya project area. The extension networks (including veterinary, A.I., pasture development services, and condensery) and all associated staff would come under the administrative control of the RDDB. This bureau would be responsible for the Dairy Development Board. Farmer participation through cooperative membership in the RDDB and in the Dairy Board would be necessary to safeguard their interests.

The farmers themselves could be organized into efficient village level cooperatives and a regional Cooperative Association. These, together with the RDDB, may be able to arrange an auction market for sale of surplus stock with Colombo and local butchers or their agents participating directly, thus eliminating the "middlemen". The RDDB could also buy surplus stock to establish guaranteed minimum price levels.

The cooperative would be responsible for the village level collecting point and act as a center for production records and payment to members. Eventually, the collecting point officer could be trained in A.I. Credit payable through the cooperative for this as well as pasture development could be made available on soft terms and repayment scheduled in accordance with anticipated increases in milk supplies.

A local chilling center with eight collection points is also desirable for each 1,700-cow cooperative* or regional association. The capital and operating cost of a basic chilling center with a capacity of 4,000 L/day (and accompanying collection points) is indicated in Table F-5.1.

5.3 - Livestock Enterprise Budgets

A financial budget for three multipurpose breeds under different feeding and management systems has been developed. As indicated in Section 5.1, the three cases are

- Murrah buffalo, with confined feeding on 0.33 ha of improved pasture on upland homesteads. These cows would produce draft animals for irrigated farming, as well as milk and some surplus stock other than draft bulls. The draft animals would graze on crop stubble and bunds.

*At 2.35 L/head/day, total daily production for such a cooperative would be 1,700 x 2.35 = 3,995 L/day.

TABLE F-5.1

BASIC CHILLING CENTER AND COLLECTING POINTS - ESTIMATED CAPITAL AND OPERATING COSTS (Rs)

Capital Costs		
Chilling center (4,000 L)	300,000	
Generator	100,000	
Building	50,000	
		450,000
Collection Points		
8 x 450 L @ Rs 5,000	40,000	
200 x 20 L milk cans @ Rs 500	100,000	
9 measuring implements @ Rs 20	180	
9 sets testing equipment @ Rs 4,200	37,800	
2 x 2 wheel tractors @ Rs 25,000	50,000	
20 x carrier bicycle @ Rs 2,000	40,000	
		267,980
Total Capital Cost		717,980
Operating Costs		
Labor		
1 Chilling center operator @ Rs 600/month	7,200	
1 Assistant @ Rs 300/month	3,600	
8 Collecting center operators @ Rs 220/month	21,120	
Fuel	30,000	
Repairs and maintenance at 3% of capital costs	21,539	
Replacement (CRF over 20 yr at 10% = .11746)	84,334	
		167,793
Cost/L		0.12

- Zebu/Temperate cattle, with confined feeding on 0.33 ha of improved pasture on nonirrigated uplands. This livestock would be integrated with dry land cropping systems and produce only milk and surplus stock.

- Indigenous (Zebu) cattle on public lands.

The expected annual gross revenue from one cow (and followers) for each of these three systems is indicated in Table F-5.2. Milk production accounts for between 65 percent and 85 percent of total gross revenue, with the sale of surplus stock accounting for the residual. The gross revenue expected from a Murrah buffalo in a confined feeding situation is about 5 times the gross revenue generated by an indigenous cow on public lands.

Comparable annual total costs per cow are indicated in Table F-5.3, with supplementary data provided in Table F-5.4.

This gives rise to the following estimates of the annual financial net income on a per-cow basis (including followers) for the three different feeding and management systems here considered.

Cattle	Murrah Buffalo (Rs)	Zebu/Temperate Cattle (Rs)	Indigenous (Zebu) (Rs)
Gross Revenue	3,836.04	2,223.21	765.93
Total Costs	1,092.41	996.98	346.18
Net Income	2,743.63	1,226.93	419.75

Utilizing a confined feeding system (requiring 0.33 ha of improved pasture, crop residue and bunds), the Murrah buffalo would generate about Rs 2,744/yr. This is about two times the level indicated for the Zebu/Temperate cattle with

a confined feeding system which is integrated into a dry land cropping pattern and 6 times the estimated annual net income from indigenous cattle on public lands.

The following section focuses almost exclusively on the economic impact of the Murrah buffalo development option in the Maduru Oya project area.

TABLE F-5.2

ANNUAL GROSS REVENUE PER COW

Item	Enterprise Type: Murrah Buffalo[1]		Zebu/Temperate Cattle[1]		Indigenous (Zebu) Cattle[2]	
A - Milk						
Price/L (Rs)	3.86[3]		2.21[4]		2.21[4]	
Production/cow/yr	858		811		223	
Subtotal Gross Revenue (Rs)	3,311.88		1,792.31		492.83	
B - Surplus Stock						
Price/kg L.W.						
Culls and bulls (Rs)	3.30		3.30		3.30	
Heifers (Rs)	6.60		6.60		6.60	
	L.W.[5] (kg)	Gross Revenue (Rs)	L.W.[5] (kg)	Gross Revenue (Rs)	L.W.[5] (kg)	Gross Revenue (Rs)
Cull cows[6]	32.96	108.76	25.75	84.97	13.28	43.82
Cull bulls	1.08	3.56	0.84	2.77	1.08	3.56
Weaner heifers	34.05	224.73	28.37	187.24	16.60	109.56
Weaner bulls	56.70	187.11	47.25	155.92	35.20	116.16
Subtotal Gross Revenue From Surplus Stock (Rs)		524.16		430.90		273.10
TOTAL ANNUAL GROSS REVENUE		3,836.04		2,223.21		765.93

[1]0.33 ha improved pasture. Cattle confined.
[2]Public lands.
[3]7 percent butterfat.
[4]4 percent butterfat.
[5]Annual sales x average weight/1,000. See Appendix Tables 3 and 1 respectively.
[6]All cows, including dry nonpregnant and pregnant.

TABLE F-5.3

ANNUAL TOTAL OPERATING COSTS PER COW
(Rs)

Item	Enterprise Type: Murrah Buffalo[1]	Zebu/Temperate Cattle[1]	Indigenous (Zebu) Cattle[2]
Current Costs			
Labor[3]	-	-	70.00
Bldg/equipment/ maintenance[4]	22.50	22.50	3.60
Pasture maintenance[5]	159.00	159.00	-
Disease control/ incidentals	30.00	30.00	30.00
Subtotals	211.50	211.50	103.60
Capital Costs[6]			
Cow and bull	438.73	342.60	223.06
Bldgs/fences/equipment	122.03	122.03	19.52
Land clearing	227.82	227.82	-
Pasture establishment	92.33	92.33	-
Subtotals	880.91	784.78	242.58
TOTALS	1,092.41	996.28	346.18

[1]0.33 ha improved pasture. Cattle confined.
[2]Public lands.
[3]The family labor required for confined cattle on homesteads is approximately 0.2 man-years per cow (including followers), including the cut and carry operation. This labor is assumed to have a zero opportunity cost. The labor cost on public lands represents hired labor.
[4]3 percent of original cost.
[5]Annual fertilizer application. See accompanying Table F-5.4
[6]Amortized according to the capital recovery factors (C.R.F.'s) provided in accompanying Table F-5.4.

TABLE F-5.4

ESTIMATED CAPITAL COSTS PER COW
(Rs)

Item	Capital Recovery (10%) Years	Factor	Total Cost - Enterprise Type: Murrah Buffalo[1]	Zebu/Temperate Cattle[1]	Indigenous (Zebu) Cattle[2]
Cow	7	.2054	2,112	1,650	1,056
Bull	7	.2054	24	18	30
Shelter or night paddock	10	.1627	600	600	20[3]
Equipment (buckets, troughs)	10	.1627	150	150	100
Pasture establishment[4]	5	.2638	350	350	-
Land clearing[5]	40	.1001	2,277	2,277	-
TOTALS			5,513	5,045	1,206

[1]0.33 ha improved pasture. Cattle confined.
[2]Public lands.
[3]Night paddock.
[4]Ploughing and plating - Rs 568/ha
Annual fertilizer - Rs 481 (251 kg/ha area at Rs 980/tonne
126 kg/ha superphosphate at Rs 1,335/tonne
63 kg/ha muriate of potash at Rs 1,065/tonne)
[5]Estimated at Rs 6,900 ha.

6 - POTENTIAL LIVESTOCK BENEFITS OF PROJECT

6.1 - Introduction

The principal objective of this section is to estimate the potential livestock benefits which would arise if an integrated agricultural development program was implemented in System B.

These potential benefits are the economic benefits which would accrue to Sri Lanka; not necessarily the financial benefits actually realized by livestock farmers. (See Annex G - Agroeconomic Studies.)

The methodology employed isolates the incremental net benefit of livestock development in the Maduru Oya area if the proposed project becomes a reality.

The livestock development plan evaluated in this section allows for the introduction of Murrah buffalo into the project area so that irrigated paddy farms can eventually rely almost exclusively on draft animals for their farm power requirements.

6.2 - Existing Livestock Situation

As detailed in the preceding section, existing livestock development in the region, without irrigation, is generally characterized by the following

- a static (or perhaps declining) cattle population
- widespread, extensive, multipurpose operations
- relatively low levels of technology and management
- very diverse management and ownership patterns (private vs public)

- various degrees of commercialization (subsistence vs highly commercial
- relatively low profit levels and relatively low returns to labor
- various government programs to stimulate livestock development, many of which are ineffective
- sociocultural constraints which limit potential livestock development in the region.

There are about 50 000 cattle in the System B area (Table F-2.1). Out of this total, nearly 30 000 are cows and draft bulls, as indicated in Table F-6.1.

For the purpose of this analysis, it is assumed that this relatively static situation will remain largely unaltered, even with the proposed agricultural development of the project area. That is, existing cattle can be maintained on areas in the Maduru Oya which remain out of command and away from proposed settlements, roads, etc. Even after project implementation, this area will amount to

Total	131 000 ha
Less development (say)	70 000 ha
Net	61 000 ha

Livestock production is presently concentrated along the eastern boundary of the project area and in the flood plains of the Mahaweli Ganga and Maduru Oya.

At the same time, one benefit from the existing herd will arise as a result of project implementation. Approximately 5,000 draft bulls are now employed for one crop (Maha) per yr. After project implementation, these draft animals can

TABLE F-6.1

ESTIMATED CURRENT LAND USE BY LIVESTOCK

Land Type and Sector	Area (ha)	Cows and Draft Bulls[1]
Private		
Villu Association	10 180[2]	5 000 Neat cows
Damana (Parkland)	30 000	5 000 Buffalo cows
Other Damana	42 000	7 000 Neat cows 3 000 Buffalo
Arable Cropped	10 000	5 000 Draft bulls
Government		
Villu	2 400	1 600 Neat and Buffalo cows
Improved Damana[3] Association	2 200	
Other Improved Damana[4]	240	300 Draft breeding cows
TOTALS	97 020[5]	26 900 Cows and draft bulls

[1]In addition to 26 900 cows and draft bulls, there are 22 300 other classes to give a total of 49 200.

[2]Based on

	(ha)	
Mahaweli Flood Plain		
South of railway	1 580	
North of railway	1 280	2 860
Maduru Oya Flood Plain		
Right bank (est)	3 660	
Left bank	3 660	7 320
TOTAL		10 180

[3]Dairy Farms.

[4]NLDB Draft Breeding Farm.

[5]The total area differs from the gross area for System B which is quoted elsewhere in this report due primarily to the exclusion of the Forest Reserve and the Pimburettewa and Vakaneri Tank Schemes from the Socioeconomic Survey of System B.

be used for two crops/yr, an incremental economic benefit which should begin in the first year of agricultural production and amount to some Rs 2.25 million/yr.*

6.3 - Proposed Livestock Development

Three development options have been considered in Section 5.

- Murrah buffalo, with confined feeding and 0.33 ha of improved pasture on upland homesteads. These cows would produce draft animals for irrigated farming, as well as milk and some surplus stock other than draft bulls. The draft animals would graze on crop stubble and bunds.

- Zebu/Temperate cattle, with nonirrigated confined feeding and 0.33 ha of improved pasture on uplands. This livestock would be integrated with dry land cropping systems and produce only milk and surplus stock.

- Indigenous (Zebu) cattle on public lands.

These are not mutually exclusive alternatives and could, in practice, all be developed simultaneously. For the purpose of this analysis, only the Murrah buffalo development option is considered.

Two calculations are involved

- a 40-yr economic scenario of the net revenue from introducing one (or 1,000) cows into the project area

*Buffalo value at Rs 450/crop.
See Section 6.3 below for rationale.

- coordination of the program with settlement rates during the implementation period.

6.3.1 - Long-Term Net Returns

Numerous assumptions are required to estimate the gross revenue and total annual cost of a Murrah cow (and followers) in the project area. The technical coefficients employed are indicated in Appendix Table 1. The composition of a 1,000-cow herd and related surplus stock turnoff rates are provided in Appendix Tables 2 and 3 respectively.

The basic parameters for the gross revenue calculations for a 1,000-cow herd are as follows

Production	Total No.	Quantity/ Unit	Price/Unit (Rs)	Starting Date (yr)
Milk	1,000	858 L	1.31	1
Weaner heifers	227	150 kg	6.60	3
Cull breeding bulls	3	360 kg	3.30	9
Cull breeding cows	103	320 kg	3.30	11
Cull draft bulls	303	-	1,188/bull	14

If all bulls (except breeding bulls) are retained for draft purposes, starting in the fourth year, about 367 bulls would be added to the draft herd annually. Adjusting for losses, in the fourteenth year an equilibrium point is reached; 367 bulls would be added to the draft herd and 306 bulls would be culled from the draft herd. Death losses during Years 4 through 14 would account for the difference. The total number of draft animals at this point in time would be 3,360. That is, one cow can generate about 3.4 draft animals, as illustrated in Table F-6.2.

TABLE F-6.2

POTENTIAL DRAFT ANIMALS FROM 1,000-COW HERD

Year	Breeding Stock	Draft Stock	
		Bulls	Sales of Culled Bulls
1	1 000	-	-
2	1 000	-	-
3	1 000	-	-
4	1 000	367	-
5	1 000	727	-
6	1 000	1 080	-
7	1 000	1 426	-
8	1 000	1 765	-
9	1 000	2 097	-
10	1 000	2 422	-
11	1 000	2 741	-
12	1 000	3 054	-
13	1 000	3 360	-
14 - 40	1 000	3 360	360

The economic value of each draft bull is estimated to be Rs 900/yr, calculated as follows.

1 buffalo (excluding labor) costs	Rs 17.50/day
Total draft requirement/yr	72 days
Unadjusted total economic value	Rs 1,260/yr
Less other farm power sources	Rs 360/yr
Net economic value/buffalo	Rs 900/yr

This economic benefit offsets an economic cost to paddy farmers which has been included as a production cost in the paddy crop budget.

The resulting gross revenue calculations are tabulated in Table F-6.3.

The associated economic costs are calculated by adjusting the financial cost calculations in Tables F-5.3 and F-5.4 for the economic price of fertilizer. The results of this adjustment are as follows

	Financial Cost*	Economic Cost**
Total annual operating costs per cow	Rs 211.50	Rs 603.07
Estimated capital costs per cow	Rs 5,513.00	Rs 5,908.00

* Calculated in Tables F-5.3 and F-5.4.
**Used in Economic Analysis.

TABLE F-6.3

ECONOMIC RETURN FOR A 1,000 MURRAH
BUFFALO COW HERD PRODUCING DRAFT ANIMALS, MILK AND SURPLUS STOCK
('000 Rs)[1]

Item	Year 1	2	3	4	5	6	7	8	9	10	11	12	13	14 - 20
A - Gross Revenue														
Milk	1,124	1,124	1,124	1,124	1,124	1,124	1,124	1,124	1,124	1,124	1,124	1,124	1,124	1,124
Weaner heifers			225	225	225	225	225	225	225	225	225	225	225	225
Cull breeding bulls									4	4	4	4	4	4
Cull breeding cows											109	109	109	109
Draft income				330	654	972	1,283	1,589	1,887	2,180	2,467	2,749	3,024	3,024
Cull draft bulls														360
TOTAL GROSS REVENUE	1,124	1,124	1,349	1,679	2,003	2,321	2,632	2,938	3,240	3,533	3,929	4,211	4,486	4,846
B - Total Costs														
Operation and maintenance[2]	603	603	603	603	603	603	603	603	603	603	603	603	603	603
Capital costs[3]	5,908													
TOTAL COSTS	6,511	603	603	603	603	603	603	603	603	603	603	603	603	603
C - Net Revenue (A-B)	(5,387)	521	746	1,076	1,400	1,718	2,029	2,335	2,637	2,930	3,326	3,608	3,883	4,243

[1]Mathematically, this can be interpreted on a per cow basis, i.e. Rs 1,000 per 1,000 cows. From a practical point of view, the technical coefficients employed rely on the "law of large numbers".

[2]Adjusted from Table F-5.3 for economic prices.

[3]Adjusted from Table F-5.4 for economic prices.

The resulting annual net revenue estimates are also indicated in Table F-6.3. Although the initial capital costs generate a large net deficit in Year 1, the annual net benefits become positive in Year 2 and then become larger each year during the next 12 yr. In Year 14, the equilibrium net income of Rs 4.2 million can be expected, which should be sustainable indefinitely.

6.3.2 - Draft Numbers and Implementation Rates

The total number of additional draft animals which must be introduced into the project area is estimated as follows.

Total irrigated paddy area	34 000 ha
Total draft animals required	34 000
Less existing stock (Table F-6.1)	5 000
Net draft requirement	29 000 animals

From Table F-6.2 this implies a total cow herd of 29 000/3.36 = 8,631 cows. In effect, about one out of four paddy farmers would need to purchase a buffalo cow so that 29 000 more draft animals could eventually be available to irrigated farmers in the project area.

At the same time, it is anticipated that the Murrah buffalo cows will be introduced into the project area only when settlement actually occurs. Settlement rates, in turn, depend on how much land can be brought under irrigation in each year. Table F-6.4 summarizes the cow introduction rates for the two development scenarios under consideration.

TABLE F-6.4

ANNUAL BUFFALO COW PURCHASES DURING THE DEVELOPMENT PERIOD TO OBTAIN 27 000 DRAFT ANIMALS

	Scenario A			Scenario B		
Year	Number of Settlements (Irrigation) (1)	Percent Settlements and Cows (2)	Number of Cows (3)	Number of Settlements (Irrigation) (4)	Number of Settlements and Cows (5)	Number of Cows (6)
1	9 020	26.3	2 270	5 540	16.1	1 390
2	11 293	32.9	2 840	5 315	15.5	1 338
3	7 954	23.1	1 994	5 669	16.5	1 424
4	6 063	17.7	1 527	5 764	16.8	1 450
5	-	-	-	5 194	15.1	1 303
6	-	-	-	5 133	15.0	1 295
7	-	-	-	1 715	5.0	431
TOTALS	34 330	100.00	8 631	34 330	100.00	8,631

Note: Year 1 is 1984 (i.e. the first year of agriculture production).

6.4 - Economic Benefits

With the above information, projected annual net benefits from livestock development are calculated. For example, in Year 1 about 2,270 cows must be introduced into the project area. Applying the index 2.27 to the annual net revenue per 1,000 cows calculated in Table F-6.3, a stream of benefits is obtained for the life of the project: -12.2 m, 1.2 m, etc. This procedure is repeated for the remaining years in the implementation period, and then an aggregate annual total can be obtained.

To this aggregate net benefit (which represents "new development" a value of Rs 2.25 million must be added as an incremental benefit from improved utilization of the 5,000 existing draft animals in the region. (See Section 6.2.)

The results, tabulated in Table F-6.5, show that livestock benefits should eventually reach about Rs 39 million/yr. For Scenario A, this level is reached in Year 17; for Scenario B, the equilibrium level occurs in Year 20.

By inference, the average per-farm economic value of this benefit at maturity amounts to

Rs 39.0 m/34 300 = Rs 1,136/family/yr

On a per-ha* basis

Rs 39.0 m/2,877 = Rs 13,550/ha/yr.

*Based on 8,631 cows grazing 1/3 ha each.

TABLE F-6.5

POTENTIAL LIVESTOCK BENEFITS FROM PROJECT
(Rs Million)

Year	Scenario A	Scenario B
1	(9.9)	(5.2)
2	(11.8)	(4.2)
3	(5.2)	(3.7)
4	(0.4)	(2.3)
5	10.9	0.5
6	13.4	2.9
7	16.2	10.4
8	18.9	15.2
9	21.5	18.0
10	24.3	20.6
11	27.1	23.4
12	30.6	26.1
13	32.2	28.6
14	35.0	31.4
15	37.1	33.7
16	38.3	35.7
17	39.0	37.2
18	39.0	38.1
19	39.0	38.7
20 - 40	39.0	39.0

Sources: Tables F-6.3 and F-6.4

This ignores the value of crop stubble, bunds and other "free" inputs which nevertheless contribute to total livestock output.

To obtain these benefits, adequate support services are a prerequisite. Details are provided in Section 5.2.

APPENDIX

APPENDIX TABLE 1

TECHNICAL COEFFICIENTS

Factors		Enterprise Type		
		Murrah Buffalo	Zebu/ Temperate Cattle	Indigenous (Zebu) Cattle
Age at first calving	months	40	30	40
Calving interval	(d)	429	429	456
Calving rate	(%)	85	85	80
Lactation length	(d)	300	300	280
Lactating cows	(%)	70	70	61
Dry pregnant cows	(%)	15	15	19
Dry nonpregnant cows	(%)	15	15	20
In milk yield/hd/lactation	(L)	1 009	954	280
In milk yield/hd/d	(L)	3.36	3.18	1.00
Hard average (over whole yr) milk/hd/d	(L)	2.35	2.23	0.61
Mortality				
Bull	(%)	02	02	05
Calf	(%)	10	10	10
Weaners and replacements	(%)	02	02	05
Cows	(%)	05	05	10
Age of Turn-off				
Cow	(yr)	10	10	10
Bull	(yr)	08	08	08
Bull:cow	(%)	02	02	04
Surplus Turn-off				
Live weights (L.W.)				
Weaner heifers and bulls	(kg)	150	125	100
Cull cows	(kg)	320	250	160
Bulls	(kg)	360	280	180

APPENDIX TABLE 2

EQUILIBRIUM HERD COMPOSITION FOR 1,000 COWS*
(End of Year After Surplus Turn-off)

Class	Age Group (yr)	Enterprise Type: Murrah Buffalo No.	Murrah Buffalo Class Total	Zebu/Temperate Cattle No.	Zebu/Temperate Cattle Class Total	Indigenous (Zebu) Cattle No.	Indigenous (Zebu) Cattle Class Total
Cows	03	149		149		176	
	04	142		142		158	
	05	134		134		143	
	06	128		128		128	
	07	121		121		115	
	08	114		114		104	
	09	109		109n		93	
	10	103	1,000	103	1,000	83	1,000
Bulls	03	04		04		08	
	04	04		04		07	
	05	03		03		07	
	06	03		03		06	
	07	03		03		06	
	08	03	20	03	20	06	40
Weaners	Female	425		425		400	
	Male	425	850	425	850	400	800
Weaners							
Heifers	01	155		155		194	
Bulls	01	04	159	04	159	08	202
Replacements							
Heifers	02	152		152		185	
Bulls	02	04	156	04	156	08	193
TOTALS			2,185		2,185		2,235

*This equilibrium herd composition is derived using the technical coefficients in Appendix Table 1. Estimates of the equilibrium annual surplus turn off is indicated in Appendix Table 3 following.

APPENDIX TABLE 3

EQUILIBRIUM ANNUAL SURPLUS TURN-OFF FOR 1,000 COWS

Class	Age Group (Yr)	Enterprise Type		
		Murrah Buffalo	Zebu/Temperate Cattle	Indigenous Zebu Cattle
Cull cows	11	103	103	83
Cull bulls	09	03	03	06
Weaner heifers	03	227	227	166
Weaner bulls	03	378	378	352
TOTALS		711	711	607

APPENDIX TABLE 4

EQUILIBRIUM HERD COMPOSITION AND COW EQUIVALENTS FOR SINGLE COW AND FOLLOWERS*

Class	Cow Equivalent (CE) Factor	Murrah Buffalo		Zebu/Temperate Cattle		Indigenous Zebu Cattle	
		Actual	CE's	Actual	CE's	Actual	CE's
Cow	1.00	1.000	1.000	1.000	1.000	1.000	1.000
Bull	1.00	0.020	0.020	0.020	0.020	0.040	0.040
Calves	0.50	0.850	0.425	0.850	0.425	0.800	0.400
Weaner heifers	0.75	0.155	0.116	0.155	0.116	0.94	0.146
Weaner bulls	0.75	0.004	0.003	0.004	0.003	0.008	0.006
Replacement heifers	0.80	0.152	0.122	0.152	0.122	0.185	0.148
Replacement bulls	0.80	0.004	0.003	0.004	0.003	0.008	0.006
TOTALS		2.185	1.689	2.185	1.689	2.235	1.746

*Actual composition is equal to total number in each class divided by the number of cows. See Appendix Table 2. Cow equivalents (CE's) are calculated by multiplying the actual composition by the respective cow equivalent factors.

Interpretation: One Murrah cow will have on the average 1.185 followers for a total of 2.185 and the total grazing pressure would be 1.689 cow equivalents.

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