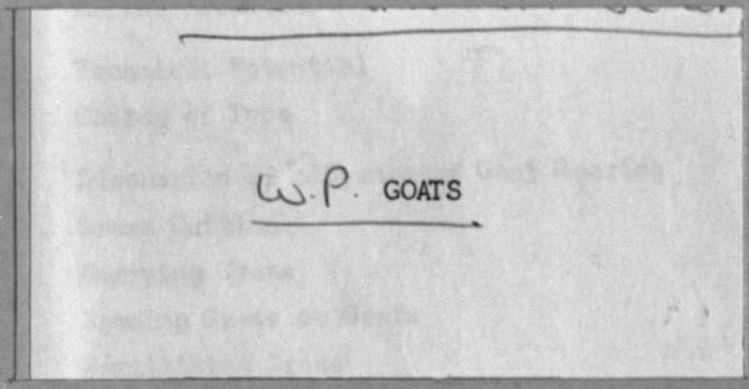


HUNTING TECHNICAL SERVICES

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THE GOVERNMENTS OF MALAYSIA AND THE STATE OF JOHOR



WORKING PAPER

JOHOR TENGAH AND TANJONG PENGGERANG REGIONAL MASTER PLAN

1971

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MARKET PROSPECTS FOR MUTTON

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GOATS

The calculations in this working paper assume that the goat enterprise is a single farm activity. The data, however, are presented to permit incorporation in an assessment of a mixed farm system and this has been done in the working paper on mixed farming.⁽¹⁾

As with many other potential activities, firm data on goats and their performance under various management systems are sparse. The majority of data used in this report is obtained from the work carried out at the Central Animal Husbandry Station at Ayer Hitam.

1. MARKET POTENTIAL

Goat meat enters the mutton market where it has to compete with imported sheep supplies. It generally commands a substantial local retail price premium over sheep mutton due to strong local consumer preference.

The market situation is discussed in more detail in Appendix A. The broad conclusions are that goat meat could provide up to 50 percent of future requirements in Johor but that this would require expansion of the present herd by four times to 300,000 animals of which 100,000 would be slaughtered annually. The present situation is that goat meat supplies about 28 percent of current demand.

An increase in market share of this order would require a reduction in the present retail price differential which can be as much as \$1.80 per kattie with imported mutton retailing at \$1.40-2.00 per kattie and local mutton at \$2.80-\$3.20 per kattie. This report assumes that the price differential will be halved and that goat meat will sell at a farm gate price of \$0.75-\$1.00 per lb.

2. TECHNICAL POTENTIAL

Johor State is said to have a herd of about 73,000 animals. The majority of these are in very small units of a few animals each, kept in the house compounds. Production would appear to be hampered by the climate which tends to be uniformly wet, and gives rise to respiratory diseases, to which goats are very susceptible.

The most promising management system would appear to be the housing of goats full time in raised sheds with slatted floors in order to keep the pens dry and well aerated. This would then involve the cutting and carrying of fodder to the animals.

The assumption has been made that guinea grass/centrosema fodder will be grown. Work should be done on the desirability and possibility of also incorporating some woody browse material such as Flemingia spp., Gliricidia spp. and Sesbania spp. This would be lopped and carted to the goats.

2.1 Choice of Type

Some evaluations of goat types has been carried out at the CAHS and comparisons have been made between the local goat, Indonesian goats, Jamnapari from India and Indonesia x local crossbreds.

The local Malaysian goat is much smaller than the other types but has the advantage of exceptional breeding performance with a potential kidding percentage of 340% per year, i.e. an average of 3.4 offspring per female per year. This compares with about 260% for the other types. Detailed calculations as to the implications of this on total production are shown in Appendix B.

Broadly, the smaller body weight of the local goat allows a greater carrying capacity per acre than any of the other three types and gives a liveweight output of meat per acre which is 10 percent higher than that of the crossbred. The total production of meat in liveweight terms can be over 1750 lbs per acre per year.

3. DISCUSSION OF A SYSTEM OF GOAT REARING

The basis of the enterprise discussed is that one man is able to cut and carry the grass to goats fed indoors.

Size of enterprise is therefore determined by labour requirements for the various tasks. The major tasks to be carried out are:

Cutting grass

Carrying grass

Fertilising grass

Feeding goats

Routine management of goats (medication, weighing, cleaning, etc.)

In addition to this, some constraint will be imposed by the physical number of goats that a single stockman can look after.

3.1 Grass Cutting

There will be a direct relationship between the area to be cut per day and the cutting interval.

Cutting interval days	Square yards (assuming 14 females and young stock)/acre
15	322
18	270
21	230
24	200
27	180
30	161

As cutting interval increases, protein content decreases but Total Digestible Nutrients - TDN - and dry matter - D.M. - increases. No research has been done on these relationships in Malaysia at these particular rates of cutting. Most cutting trials start at 5-6 week intervals. There is, further, lack of evidence as to the interaction of fertiliser with cutting interval as measured in terms of crude protein, TDN and D.M. in the Malaysian environment although it is known that these interactions are important indicators of productivity.

However, it is thought that time taken to cut a unit area will also vary according to stage of growth if the job has to be done by hand. Short grass will be more difficult to cut than long grass with a sickle or scythe.

In the absence of proven data, the following assumptions are made:

Cutting interval	Sq. yards to be cut	% D.M.	Lbs. D.M.	Handcutting time	
				Per sq. yd.	Total
15	322	10	36.8	45 secs.	4 hrs.
18	270	12	44.2	42 "	3.15 "
21	230	14	51.5	38 "	2.45 "
24	200	16	58.9	35 "	1.94 "
27	180	18	66.3	33 "	1.65 "
30	161	20	73.6	30 "	1.34 "

Nutrient requirements for goat maintenance are .04 lbs DP per day and 1.0 lb TDN per day for a goat about 60 lbs in weight. On a pro rata basis - which may not be strictly accurate, this would mean that the maintenance requirements per goat unit are:

	Lbs per year	
	DP	TDN
Local	30.66	768
Indonesian Local	33.6	840

Allowing a 50 percent increase on these levels to take account of growth, milking and pregnancy requirements - there are

still adequate nutrients in a guinea grass pasture (based on analyses in Morrison's Feeds and Feeding) to maintain the stocking rate suggested.

It is suggested that a grass/legume fodder alone is insufficient for goats as they are essentially browsing animals. The performance figures shown earlier are however taken from goats raised on grass and some concentrates. However, research could profitably take place on the possibilities of finding suitable trees or shrubs which could be slashed and fed to goats. An attractive idea is the use of Flemingia congesta which could be planted in a few rows on each farm.

If cutting is done mechanically then time is drastically reduced. A small Allen Scythe type machine with a 3 ft. cutter bar travelling at 2 miles per hour would cut 1/15 acre in 6 minutes and 1/30 acre in 3 minutes. Allowing for transport to the field and setting up, total time would be, say, 15 minutes.

3.2 Carrying Grass

Approximately 350 lbs weight of fresh material would have to be carried each day. This involves collecting from an area of 4 yards by 40 yards, say, 20 minutes. If carried by hand then possibly 3 journeys would have to be made at 15 minutes each and 110-115 lbs per load. If cutting has been mechanised then a small trailer on the two wheeled tractor could be used and would move the entire daily 350 lb load per acre in say 30 minutes total for collecting and carrying.

3.3 Feeding Grass to Goats

This could be done quickly with proper housing design. The basis of this operation would be housing which would allow feeding to be carried out from outside. With weldmesh walls and an outside manger the feeding operation should take only 5-10 minutes or so for each load or part load.

3.4 Fertilising Grass

This operation is done directly after each cutting as a general rule. Probably it could be satisfactorily done once a week when 0.23 of an acre would have to be fertilised with 60 lbs of nitrogenous fertiliser (this at 26 percent N content would allow 800 lbs N per year). The fertiliser bag would be carried out when cutting was done and application would take place after that day's cutting. Spreading would be done by hand and to ensure even coverage would have to be done by going over the land twice in opposite

4. COSTS INVOLVED IN GRASS PRODUCTION

The currently taken clearance costs are \$300 per acre for clean clearance with root removal. This would be necessary for grass growing. Establishment costs of grass are said to be \$120 per acre by contract (figure obtained from CAHS). This included ploughing, harrowing twice and rotovating to produce a fine tilth. It also includes seed and the initial fertiliser dressing.

It can be assumed on a freshly cleared area that only rotovation will be necessary and thus the contract cost can be reduced by about \$40 per acre to \$80 per acre.

The annual cost of fertiliser will be 0.2 tons (L) of NPK compound and 1.37 (L) tons of nitrogenous fertiliser per year. This would cost \$440 per acre.

Cutting and carting by pedestrian tractor would cost at 273 hours/year and 0.34 gallons fuel/hour \$70 in fuel, and about \$76 in maintenance and spares.

This machinery cost would just be for the goat enterprise. Depreciation, interest and insurance costs about \$2.40 per hour at a usage rate of 400 hours/year. (Communication from Tractors Malaysia Bhd.). Interest and insurance are calculated at \$336/year and depreciation at \$1.55/hour.

5. COSTS OF GOAT KEEPING

5.1 Buildings

The housing required would be raised 5 ft. above ground with slatted flooring and a concrete base at ground level. It should be constructed robustly but of fairly cheap materials. At the CAHS fully grown goats are allowed 10 square feet each. An average of 5 square feet for each young goat should be allowed. Thus one goat plus young would require 27 square feet. Building costs should be no more than say \$3.00/square foot + say \$0.50 per square foot for concrete flooring. The building would thus cost \$1360 per acre (14 females + 1 male + young stock) and about \$4000 for a 3 acre unit.

5.2 Water and Electricity

A small diesel water pump may be necessary at \$600 plus say 200 feet of pipe at 50 cents per foot: \$100. This would also supply water to the household. Electricity is perhaps not strictly necessary for the enterprise - a hurricane lamp would do. The

majority of use would be household use and it would be possible to get a small diesel generator for \$2000 with average running and spares cost of \$20 per month.

5.3 Labour

No casual labour is anticipated at this scale of enterprise. Farm labour is costed at \$4.50 per day.

5.4 Medication

A cost of 50 cents per animal is assumed for medicines.

5.5 Feeding

Some concentrates may be fed during the last 2 months. This could be at the rate of 1/4 lb/day average for young stock i.e. 15 lbs/animal and 670 lbs per acre. The cost of these will be in the region of 15 cents per lb - \$100 per acre.

6. EVALUATION

Two production situations are examined.

- I - With mechanical aids - which reduces labour input.
- II - Without mechanical aids - labour input doubled.

Two price situations are examined.

- A & C - Sales on farm at \$1 per lb liveweight.
- B & D - Sales on farm at 75¢ per lb liveweight.

Two yield situations are examined.

- A & B - Yield/acre static until year 6 and then rises due to selection of breeding stock + increase in food conversion efficiency by 2 percent compound per annum.

- C & D - Yield/acre static for 20 years.

Calculating the goat enterprise on the basis of 3 acres and according to the above variables the following results are obtained.

INTERNAL RATE OF RETURN FOR DIFFERENT ASSUMPTIONS

<u>With mechanisation</u>	\$1/lb sale price	\$0.75/lb sale price
Production static	11%	-
Production increase 2%	14%	1.3%
<u>Hand labour only</u>		
Production static	15%	-
Production increase 2%	18%	4%

Labour has been charged at \$4.50 per day. This has led to a total labour cost of \$825 per year for the mechanised system and \$1650 per year for the hand labour only system. Both systems require work every day of the year. The mechanised system, however, can be performed in half a day's regular work while the hand labour system requires a full day's work, year round. Although the rates of return with mechanisation are lower, time is available to more fully utilise both labour and tractor and it may be more practicable to use this system in conjunction with other enterprises.

The yield increase of 2 percent compound per annum is felt to be realistic given the rapid rate of goat breeding and a conscious effort to select for fecundity and weight gain/food conversion rates.

Repayment of capital over 15 years at $7\frac{1}{2}$ percent would amount to a monthly charge of \$100 in the case of the hand labour system and \$130 for the mechanised system. The major difference between the two is the need to spend \$4000 to buy and replace equipment. In annual net income return this leads to a negative cash flow in years 8 and 15 in the mechanised system.

The price of goat meat affects the return markedly. A reduction to 75 cents per lb reduces the internal rate of return to less than zero in the static production cases and by 80-90 percent of the rate of return at \$1 per lb which is just below the current price of goat meat.

It is likely that the price will have to fall slightly to encourage greater consumption although price elasticity is not known.

6. Factors Affecting Organisation

The main characteristics of goat keeping using the system described above are:

- i) High output per acre
- ii) High degree of personal supervision required
- iii) Relatively short time to first saleable crop i.e. within year 2
- iv) Low size of unit that can be managed by one man
- v) High cash inputs per acre - particularly fertiliser
- vi) High capital cost per unit
- vii) Need for readily available veterinary advice and service
- viii) Sensitivity to price.

Factors i)-iv) suggest that goat meat production would be a suitable smallholder activity. The enterprise is particularly suited

to mixed production systems and possibly, with a small tractor available, could be incorporated in an annual crop/goat herd system. This factor would enable a farmer to overcome the problem of high capital costs as he could build up his herd gradually through time.

It is felt that actual training requirements would be minimal and that access to advice and more important a veterinary service would work well. The main management quality required is self discipline and the realisation that daily feeding and inspection - for 365 days per year - are required. Probably ^a1-2 weeks orientation course which emphasised the self discipline needs would weed out potentially poor goat keepers. It would be particularly suitable where complementary grass/main crop relationships could be exploited - such as grass under coconuts.

Depending on the capital position of the farmer, the enterprise could be carried on at many levels. Grass has a linear response to fertiliser and probably to light. Goats/acre could for instance be adjusted to the amount of fertiliser a farmer could afford.

The rate of production is high but returns are not exceptional. This is in part due to the high costs of housing and land clearance.

It must also be pointed out that the risks could be very high too. At least one private goat keeper near Johor Baharu had very high losses of young stock from, so far, unidentified causes and has gone out of business. Intensive work by MARDI should go into the husbandry requirements and early attempts should be made to extend any results to existing holdings where goats could be introduced on a strictly commercial basis slowly and increased as experience grows.

APPENDIX AMARKET PROSPECTS FOR MUTTON

Present supplies of mutton come from 2 sources, local goat and imported sheep. In 1967 some 113,427 goats were slaughtered with an average dead weight of 20 lbs. In addition 35,864 sheep averaging 35 lb dead weight were slaughtered and 4,298,560 lbs of mutton imported. Total estimated supplies were as follows:

Goats slaughtered 113,427 @ 20 lb	-	2,269,120 lbs
Sheep slaughtered 35,864 @ 35 lb	-	1,258,880 lbs
Mutton imported	-	<u>4,298,560 lbs</u>
Total		<u>7,826,560 lbs</u>
Per capita consumption		0.891 lbs.

Assuming a 2.5 percent per annum increase in per capita income and an income elasticity of demand of 1.0 per capita consumption of mutton at constant price would be expected to increase as follows:

<u>Year</u>	<u>Per capita consumption (lb)</u>
1967	0.891
1970	0.959
1975	1.085
1980	1.228
1985	1.389
1990	1.572

Given expected population growth this would mean the following total consumption levels:

<u>Year</u>	<u>Total consumption (Thousand lbs)</u>
1967	7,827
1970	9,244
1975	12,079
1980	15,840
1985	20,776
1990	27,253

In 1967 local goat meat supplied approximately 28 percent of the market. A good deal of this was undoubtedly slaughtered and eaten by kampong producers. Expansion of the market for the local meat among non-producers will however depend in part upon price trends. At the present time the local product enjoys a considerable price premium. The most recent reported retail prices for Kuala Lumpur and Johor Baharu are given in Table 1.

TABLE 1 AVERAGE MONTHLY RETAIL PRICES FOR MUTTON, JUNE 1969,
MAY 1970 & JUNE 1970 (\$ PER KATI)

Commodity	June 1969		May 1970		June 1970	
	K.L.	J.B.	K.L.	J.B.	K.L.	J.B.
Local mutton	3.00	3.20	2.86	3.20	2.95	3.20
Imported mutton	2.00	1.86	2.00	1.40	2.00	1.40

Source: F.A.M.A. Monthly Commodity Bulletin, June 1970.

The price differential is particularly wide in Johor Baharu. A survey was recently carried out by South East Johor Project in South Johor in which households were questioned on food expenditures. The proportions of households in different income and racial groups who reported buying local and imported mutton are given in Table 2. The wide discrepancy in numbers buying the two types of meat is undoubtedly a reflection of the price differential. If local goats are to supply an increased proportion of future mutton consumption there will have to be a decline in price. At present wholesale prices are in the region of \$1.30-\$1.40 per kati liveweight i.e. the retail/wholesale price ratio is approximately 2:3. A wholesale price of \$1.00 per kati (75 cents/lb) liveweight would mean a retail price of \$2.30

TABLE 2 PROPORTION OF HOUSEHOLDS REPORTING BUYING LOCAL AND IMPORTED MUTTON BY INCOME GROUP AND RACE

Income Group (Monthly household income)	MALAY		CHINESE		INDIAN	
	Local Mutton	Imported Mutton	Local Mutton	Imported Mutton	Local Mutton	Imported Mutton
Less than \$100	2	38	0	10	0	100
\$100-199	5	49	3	11	6	96
\$200-299	4	51	2	17	27	64
\$300-499	8	58	5	18	10	90
\$500 & over	7	68	13	27	58	75

which would approximately halve the present price differential. As a basis for analysis we might therefore consider two sale prices for goats, 75 cents per pound liveweight and \$1.00 per pound, the latter being a continuation of present prices and the upper bound of expected future prices given expanded production.

The Johor Market

A crude estimate of consumption of mutton of both types in Johor in 1970 may be obtained by assuming per annum consumption levels of 1 lb per Malay and 7 lb per Indian. Population estimates have been prepared, dividing the State into three regions:

- Region 1 - Johor Baharu, Kota Tinggi districts
- Region 2 - Batu Pahat, Kluang, Mersing districts
- Region 3 - Muar, Segamat districts

Population estimates for 1970 are as follows:

	<u>Malays</u>	<u>Chinese</u>	<u>Indians</u>
Region 1	191,382	192,818	36,941
Region 2	214,147	177,802	30,367
Region 3	216,437	198,396	35,644

Total estimated requirements are then as follows:

Region 1	449,969 lbs
Region 2	426,716 lbs
Region 3	<u>465,945 lbs</u>
	<u>1,342,630 lbs</u>

Assuming a rate of growth similar to that for the nation as a whole the following quantities will be required:

<u>Year</u>	<u>Total requirement</u> (Thousand lb)
1970	1,343
1975	1,755
1980	2,301
1985	3,018
1990	4,008

These estimates should be taken and an indication of the potential size of the market rather than as an accurate projection of future consumption.

The make up of present mutton supplies in the State cannot be much more than guessed at. Vet. Division figures estimated the number of goats in the State in 1969 at 73,392, divided as follows:

Region 1	10,498
Region 2	20,315
Region 3	43,579

Assuming that one-third of these animals are slaughtered per year, the supply and requirement positions would be as shown in Table 3.

TABLE 3 REQUIREMENTS OF MUTTON AND LOCAL AVAILABILITY BY REGION,
JOHOR 1970 (LB)

Region	Requirement	Local availability	Deficit
1	449,969	69,987	379,982
2	426,716	135,433	291,283
3	465,945	283,860	182,085
TOTAL	1,342,630	489,280	853,350

Thus local goat could supply just over one-third of mutton requirements of the State, or just above the national average. It should be noted that the expenditure survey carried out by SEJP was done mainly in Region 1, where local goat supplies are scarcest.

If local goat is to make up for example, 50 percent of supplies in Johor by 1990, output must rise to about 2,000,000 lbs. This would require an annual slaughter of 100,000 animals or a herd of about 300,000. This is four times the present size.

APPENDIX BCHOICE OF GOAT TYPE

Three basic breeds are being investigated at CAHS together with varying degrees of crossbred. The following table extracts some salient performance characteristics of the three breeds plus one crossbred.

TABLE 1 PRODUCTION PARAMETERS OF FOUR TYPES OF GOAT⁽¹⁾

	Jamnapari		Indonesian		Local		Local/Indonesian	
	Male	Female	Male	Female	Male	Female	Male	Female
Wt. lbs mature	130	80	100	70	75?	55	90	65
Days Gestation	150-154		150		150		150	
Kidding %								
i) per part.	130		133		170		131	
ii) 2 part./yr.	260		266		340		262	
iii) 1.5 part./yr.	195		200		255		196	
Birth wt. lbs	77	6.5	6.7	5.0	3.7	3.2	5.5	5
Wt. gain/mth. lbs	3.9	3.0?	4.3	3.5	3.3	2.6	3.8	3.5
Wt. at 1 yr. lbs	54	43	58	47	43	34	51	47

(1) Report of the Central Animal Husbandry Station 1966-1968 - Vet. Div. Ministry of Agriculture.

Comparison of productivity between Local goat and Local x Indonesian

The factors which will influence choice of type are adaptation to the environment, fecundity in terms of kidding percentage, i.e. number of breeding cycles per year and number of offspring born per parturition, and weight gain of offspring.

These factors will add up to a single parameter, weight of saleable meat per acre of land.

For this exercise, the local goat is compared with the product of the Indonesian crossbred with the local goat.

The following assumptions are made.

- i) Criteria from above table used.
- ii) Ratio of males/females born 1:1.
- iii) Ten percent mortality in first 3 months.
- iv) One acre of grass will produce 60 tons cut forage per year with 20 percent dry matter content.
- v) Consumption will be based on total bodyweight of female plus average annual weight of offspring. Rate

of consumption at 4.0 percent of bodyweight in terms of dry matter per day.

- vi) Two crops of kids per year.
- vii) Females replaced after 6 gestations.

Starting from the first intake of goats, the production pattern in terms of meat weight gain in the first year will be as shown in Table 2.

TABLE 2 POUNDS LIVELWEIGHT PRODUCTION PER FEMALE GOAT
FIRST YEAR OF PRODUCTION

	Birth	3 months	6 months	9 months	12 months
Local goat - Female bodyweight 55 lbs.					
First crop	5.86	20.91	32.43	45.9	59.51 (Sold)
Second crop			5.86	20.91	32.43
Total	5.86	20.91	38.29	66.81	91.94
Indonesian x Local goat - Female bodyweight 65 lbs.					
First crop	6.87	27.81	32.03	44.95	57.87 (Sold)
Second crop			6.87	27.81	32.29
Total	6.87	27.81	38.9	72.76	90.16

The local female just has the advantage over the crossbred with marginally more liveweight production and first year sales.

After the first year, the production pattern settles down and herd replacement is taken into account. Sales per female occur twice per year and the saleable output doubles.

TABLE 3 PRODUCTION PATTERN OF FEMALE IN MATURE HERD
33.3% REPLACEMENT RATE

	0	3 mths.	6 mths.	9 mths.	12 mths.
<u>Local goat</u>					
Born preceding year	32.43	45.9	(a) (b) 5.73/53.78		(a) (b) 5.73/53.78
First crop	5.86	20.91	32.43	45.90	5.73/53.78
Second crop			(5.86)	20.91	32.43
Culls sold			9.16		9.16
Total sold			62.94		62.94

- (a) Represents liveweight (lbs) retained in herd for female replacement.
- (b) Represents liveweight (lbs) of offspring available for sale.

	0	3 mths.	mths.	9 mths.	12 mths.
<u>Indonesian/Local</u>					
Born preceding year	32.03	44.95	(a) 7.82/50.04	(b)	(a) (b)
First crop	6.87	27.81	32.02	44.95	7.82/50.04
Second crop			(6.87)	27.81	32.03
Culls sold			10.82		10.82
Total sold			60.86		60.86

(a) Represents liveweight (lbs) retained in herd for female replacement.

(b) Represents liveweight (lbs) of offspring available for sale.

Total sales per female per year are thus 126 lbs for the local female and 120 lbs for the crossbred.

The average weight per female goat and offspring over a year is:

	<u>Female</u>	<u>Offspring</u>	<u>Total</u>
Local	55 lbs	71.2 lbs.	126 lbs.
Indonesian/Local	65 lbs	72.9 lbs.	138 lbs.

The total appetite of each female/offspring unit will be:

Local	$126 \times .04 \times 365 = 1840$ lbs dry matter/year
Indonesian/Local	$138 \times .04 \times 365 = 2015$ lbs dry matter/year

This represents a carrying capacity from one acre of grass of:

Local	$\frac{26880}{1840} = 14$ females and offspring
Indonesian/Local	$\frac{26880}{2015} = 13$ females and offspring

and liveweight meat sales per year of:

Local	- 1762 lbs per acre
Indonesian/Local	- 1582 lbs per acre.

Thus the greater fecundity of the local goat plus its smaller size gives 10 percent higher yield per acre although only 3.5 percent more meat per female per year.

Although these calculations suggest that the local goat is a better producer of total meat per acre in terms of liveweight, it is pointed out that no effects of differential killing out percentage have been taken into account. No information has been found on this subject.

It is recommended that more attention is paid to the husbandry requirements of goats in the early stages of research than to the breeding and crossbreeding.

The exercise evaluated is based on the production from local goats.

APPENDIX C

COSTS AND FINANCIAL ANALYSIS

TABLE 1 ENTERPRISE COSTS - GOATS: 3 ACRES - 42 BREEDING GOATS

	Land Clea- rance Buil- dings Water	Grass Estab- lish- ment	Ferti- liser	Medi- cation	Concen- trates & Live- stock Pur- chase	Mecha- nisa- tion	Sur- vey Land Rent	Labour @ \$4.50/ day	Total
1	5400	240	660	90	2400	4000	150	825	13765
2	200		1320	90	150	440	15	825	3040
3	200		1320	90	300	440	15	825	3190
4	200		1320	90	300	440	15	825	3190
5	200		1320	90	300	440	15	825	3190
6	200		1320	90	300	440	15	825	3190
7	200	80	1320	90	300	440	15	825	3270
8	200	80	1320	90	300	4440	15	825	7270
9	200	80	1320	90	300	440	15	825	3270
10	200		1320	90	300	440	15	825	3190
11	200		1320	90	300	440	15	825	3190
12	200		1320	90	300	440	15	825	3190
13	200	80	1320	90	300	440	15	825	3270
14	200	80	1320	90	300	440	15	825	3270
15	200	80	1320	90	300	4440	15	825	7270
16	200		1320	90	300	440	15	825	3190
17	200		1320	90	300	440	15	825	3190
18	200		1320	90	300	440	15	825	3190
19	200		1320	90	300	440	15	825	3190
20	200		1320	90	300	440	15	825	3190
NPV @ 15% Hand	6631	368	8832	639	4121 (deduct)		234	11868 (1650/ann)	32693
	20.28	1.12	27.01	1.95	12.60	=	0.74	36.30	100%
NPV @ 15% Mechani- sation	6631	368	8832	639	4121	8786	234	5929	35540
	18.65%	1.03%	24.85%	1.79%	11.59%	24.72%	0.65%	16.68%	99.99%

TABLE 2

		<u>GROSS INCOME</u>			
		A	B	C	D
		<u>2% increase in wt/acre</u> due to breed selection		<u>No increase</u>	
Lbs meat live- weight per acre	Lbs/meat 3 acre unit	@ \$1/lb liveweight	@ 75¢/lb. liveweight	@ \$1/lb. live- weight	@ 75¢/lb. live- weight
1	-				
2	1762	5286	3964	5286	3964
3	1762	5286	3964	5286	3964
4	1762	5286	3964	5286	3964
5	1762	5286	3964	5286	3964
6	1762	5286	3964	5286	3964
7	1797	5392	4044	5286	3964
8	1833	5500	4125	5286	3964
9	1869	5609	4206	5286	3964
10	1907	5722	4291	5286	3964
11	1945	5836	4377	5286	3964
12	1984	5953	4464	5286	3964
13	2023	6072	4554	5286	3964
14	2064	6193	4645	5286	3964
15	2106	6317	4738	5286	3964
16	2148	6443	4832	5286	3964
17	2190	6572	4929	5286	3964
18	2234	6704	5028	5286	3964
19	2279	6838	5128	5286	3964
20	2325	6975	5231	5286	3964

TABLE 3

NET CASH FLOWS

	WITH MECHANISATION			
	2% Production increases		Production static	
	\$1/lb I A	75¢/lb. I B	I C	I D
1	-13765	-13765	-13765	-13765
2	2246	924	2246	924
3	2096	774	2096	774
4	2096	774	2096	774
5	2096	774	2096	774
6	2096	774	2096	774
7	2122	774	2016	694
8	-1770	-3145	-1984	-3306
9	2339	936	2016	694
10	2532	1101	2096	774
11	2646	1187	2096	774
12	2763	1274	2096	774
13	2802	1284	2016	694
14	2923	1375	2016	694
15	-953	-2532	-1984	-3306
16	3253	1642	2096	774
17	3382	1739	2096	774
18	3514	1838	2096	774
19	3648	1938	2096	774
20	3785	2041	2096	774
	<hr/>	<hr/>	<hr/>	<hr/>
	+29851	+1707	+17729	-7389
	<hr/>	<hr/>	<hr/>	<hr/>
NPV				
at 15% =	-1111	-9736	-2842	-
IRR =	13.85%	IRR = 1.3%	IRR = 10.9%	-

NET CASH FLOWS

TABLE 3A

	Without Mechanisation		<u>Production static</u>	
	<u>2% Production increase</u>			
	\$1/lb.	75¢/lb.	IIC	IID
	IIA	IIB		
1	-10590	-10590	-10590	-10590
2	1861	539	1861	539
3	1711	389	1711	389
4	1711	389	1711	389
5	1711	389	1711	389
6	1711	389	1711	389
7	1737	389	1631	309
8	1845	470	1631	309
9	1954	551	1631	309
10	2147	716	1711	389
11	2261	802	1711	389
12	2378	889	1711	389
13	2417	899	1631	309
14	2538	890	1631	309
15	2662	1083	1631	309
16	2868	1257	1711	389
17	2997	1354	1711	389
18	3129	1453	1711	389
19	3263	1553	1711	389
20	3400	1656	1711	389
	+ 33711	+ 5567	+ 21589	- 3529
NPV at 15% =	+ 1746	- 6684	+ 14	-
IRR =	17.9%	IRR = 3.9%	IRR = 15.05%	

TABLE 4

GROSS CASH INCOME UNDER DIFFERENT ASSUMPTIONS

	<u>With Mechanisation</u>				<u>Without Mechanisation</u>			
	<u>2% Production increase</u>		<u>Static Production</u>		<u>2% Production increase</u>		<u>Static Production</u>	
	<u>\$1/lb. l.w.</u>	<u>75¢/lb. l.w.</u>	<u>\$1/lb. l.w.</u>	<u>75¢/lb. l.w.</u>	<u>\$1/lb. l.w.</u>	<u>75¢/lb. l.w.</u>	<u>\$1/lb. l.w.</u>	<u>75¢/lb. l.w.</u>
1.	-	-	-	-	-	-	-	-
2.	256	146	256	146	293	182	293	182
3.	243	133	243	133	197	170	280	170
4.	243	133	243	133	197	170	280	170
5.	243	133	243	133	197	170	280	170
6.	243	133	243	133	197	170	280	170
7.	246	133	237	127	282	170	273	163
8.	-79	-193	-97	-207	291	177	273	163
9.	264	147	237	127	303	183	273	163
10.	280	161	243	133	316	197	280	170
11.	289	168	243	133	326	204	280	170
12.	299	175	243	133	336	212	280	170
13.	302	176	237	127	339	212	273	163
14.	312	183	237	127	349	220	273	163
15.	-11	-142	-97	-207	359	228	273	163
16.	340	206	243	133	377	242	280	170
17.	351	214	243	133	387	250	280	170
18.	362	222	243	133	398	259	280	170
19.	373	230	243	133	409	267	280	170
20.	384	239	243	133	421	276	280	170

Monthly repayment to year 16

at 7½%

\$130

Monthly repayment to year 16

at 7½%

\$100

Farm family income would be increased by \$825 per year or \$70 per month

Farm family income would be increased by \$1,650 per year or \$137 per month.