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SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM SUNGAI PUTIH, INDONESIA

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SR-CRSP SUNGAI PUTIH

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INTRODUCTION

THE SMALL RUMINANT - CRSP IN SUNGAI PUTIH

The potential benefits that accrue from integrating sheep with rubber plantations include utilization of traditionally wasted feed resources, an increased and diversified income, stabilization of the soil, improved nutrient cycling and cheap weed control.

The overall objective of the SR-CRSP program at Sungai Putih is to develop improved systems of sheep husbandry in rubber plantations. Research is undertaken in three sub-programs:

1. Breeding, management and health.
2. Fodder production and animal nutrition.
3. Economics and sociology.

The breeding program aims to develop a productive strain of hair sheep with superior genetic potential for resistance or tolerance to internal parasites, that is well-adapted to the climate and food resources of the humid and sub-humid tropics, and which lends itself to a variety of management systems to control major diseases and parasites with low cost inputs to minimise losses from morbidity and mortality.

The feed resources and nutrition program is investigating feeding strategies, based on forages and agricultural byproducts, that are appropriate for both rubber estates and smallholder producers. This includes identifying grazing and shade tolerant forages (grasses and legumes) and investigating economic forms of supplementation based on tree legume leaf and plantation byproducts.

The socio-economics program is working with farmers who raise sheep in conjuction with rubber plantations. The Outreach Research Project (ORP) is in an area adjoining rubber plantations near Sungai Putih and currently involves 27 farmers. The project has provided credit to these farmers in the form of sheep which have to be repaid after a period of time. Technical assistance with sheep raising is provided by trained extension staff. Biological and socio-economic aspects of production systems are monitored. A second outreach project started in June 1991 in Membang Muda about 200 km south-east of Sungai Putih. The objective is to test the technologies of sheep production with smallholder rubber producers in a nucleus rubber estate. Collaborative works are also conducted with some PTPs (government owned estates), namely PTP III, PTP IV, and PTP VII.

SR-CRSP results indicate that on average, farmers wtih sheep under rubber have an average net balance of Rp 44,200, and a return for labor equivalent to Rp 135 per hour greater than farmers without sheep. This represents a 33% higher profit and a 300% higher

return for labor. The annual income one farmer gains by raising sheep is $ 600. Sheep provide 25% of monthly income to farmers with an average flock size of 20 animals. Sheep production provides what is often the only opportunity for teenage employment in the SR-CRSP project area.

Ten sheep can control the weeds in one hectare of rubber plantation. Grazing sheep under rubber trees reduces the labor needed for weeding by 18-31%. Reduced use of herbicides nationally saves $ 51 million per year, and minimises environmental contamination.

Research using crossbreeding and genetic selection has the potential to increase the productivity of individual sheep by at least 30%. Following guidelines developed by SR-CRSP, the use of cheap available supplementary feeds given to ewes for a few weeks after lambing can give a 40% increase in productivity and more than 200% gain in net benefit. Development of methods of control of gastro-intestinal nematodes (worms) and pancreatic fluke can increase ewe productivity by about 30%.

THE SR-CRSP FLOCK OF SHEEP

The majority of the flock are at Suka Damai, one of the original sites chosen by Alice Reese in 1984. Adult rams are now kept on the Sub-Balai Penelitian Ternak station to reduce the chance of unplanned matings. We now have about 1000 sheep. Fifty ewes and two rams have been transfered to PTP IV for breeding.

Most of the the sheep graze in the surrounding rubber plantations in four shepherded flocks, from 8 am to 4 pm each day. Starting January 1991 we have followed a rotational grazing pattern to control parasites (i.e. worms). Every three months all animals are given anthelmintic, then two days later are moved to the new grazing area.

The flock follows a mating system with 34-day mating periods starting in January, April, July and October. All ewes are mated individually so that the sire of each lamb is known.

At lambing, ewes are confined in individual pens for two days to establish a close bond between the lambs and their dam. They are then stall-fed in group pens until lambs are two weeks old. After this they go out to graze. Ewes with single lambs are given concentrate supplementary feed for only the first two weeks of lactation. Ewes with twins or triplets are fed concentrate for six weeks. All animals receive minerals, urea and a small amount of molasses.

Lambs are weaned at three months of age. At this time they are given anthelmintic and moved to group pens according to sex and size. There they are fed a concentrate mixture, grass and gliricidia, and are given salt licks.

Data recorded regularly include mating of ewes, ewe weight at mating, lambing of ewes, ewe weight at lambing, litter size, weight of lamb at birth and every two weeks until weaning at 3 months, wool score, mortality, worm burden and veterinary treatment. These data enable us to evaluate the performance of individual sheep and genotypes, and thus identify and select the best animals for use in the breeding program.

Sheep from the Suka Damai flock are used in nutrition and grazing trials, are distributed in SR-CRSP outreach programs, and are sold for distribution through the government animal husbandry service particularly to farmers in transmigration areas.

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EVALUATION OF ANTHELMINTIC DISTRIBUTION BY THE ANIMAL HEALTH DELIVERY NETWORK (AHDN) IN GALANG AND ITS VICINITY

Artaria Misniwaty and Izuddin Kartamulia

INTRODUCTION

Although sheep rearing in Galang and its vicinity now is at subsistence level, most of the ORP and some non-ORP farmers recognize the benefits of using anthelmintics. To provide farmers in the field with anthelmintics at a reasonable price, SR-CRSP/SBPT is developing an Animal Health Delivery Network (AHDN).

This survey evaluates farmers' responses to the anthelmintic distribution by AHDN.

METHODOLOGY

A survey was conducted by interviewing farmers and anthelmintics suppliers followed by a direct observation on sheep performance after treatment of anthelmintics. Four anthelmintics suppliers were designated as respondents in this survey. They were namely, Suwondo (*penggalas* or goats and sheep trader in Galang), U.D. Sihotang (poultry shop in Galang), Jeplin Sihombing (SR-CRSP extension worker), and Sudijana (Dinas Peternakan extension worker). However, Sudiyana was very busy with his main job as extension worker so he had not enough time to dispense the anthelmintics. Meanwhile, there was no buyer for anthelmintics from U.D. Sihotang as at the same time farmers were busy to work at their paddy field so the farmers had no time to buy the anthelmintics. Therefore, there were only two anthelmintics suppliers, namely Jeplin Sihombing (SR-CRSP extension worker) and Suwondo (*penggalas* or goats and sheep trader). As respondent farmers then were divided into two groups: (1) farmers who bought drugs from SR-CRSP extension worker (BDFE) and (2) farmers who bought drugs from trader (BDFT). Forty six ORP and non-ORP farmers participated in this survey, 34 were BDFE and 12 were BDFT.

RESULTS AND DISCUSSION

Although both SR-CRSP extension worker's and *penggalas'* mainjobs were not disturbed by dispensing the anthelmintics, the SR-CRSP extension workers distributed more (73,9 %) than *penggalas* did (26,1%). The reasons for this were: (a) as anthelmintics supplier, SR-CRSP extension worker had been recognized longer by farmers than the *penggalas*, and (b)the *penggalas* had relatively less opportunity to dispense anthelmintics than the extension worker did, as the *penggalas* covers a wide area to perform his main job to collect goats and sheep at the villages.

Reasons in using anthelmintics

Farmers quite understood on the importance of anthelmintics application to their sheep. Most of the farmers (42.5%) used the anthelmintics because the farmers wished to see healthier sheep (Table 1).

Tabel 1. Farmers' reason in using anthelmintics

Reasons	BDFE (%)	BDFT (%)
Wish to look a healthier sheep as told by the drug suppliers	42.5	71.4
Want to eradicate worms	30.0	21.4
Have seen so many worms within sheep	22.5	0
Have seen the effect of the drug on sheep performance	0	7.2
Expect more productive sheep	2.5	0
Total	100	100

How long have farmers used anthelmintics?

How long have farmers used anthelmintics? Since trader sold the drug to farmers for the first time, all farmers bought drug from trader (BDFT) had used anthelmintics for three months. Some farmers (26.5%) bought drug from extension worker (BDFE) had used the anthelmintics for more than two years (Table 2).

Table 2. How long the farmers have used the anthelmintics?

Time (months)	BDFE (%)	BDFT (%)
3	17.6	100
6	14.6	
9	5.9	
12	14.7	
15	11.8	
18	5.8	
24	3.0	
> 24	26.5	
Total	100	100

Reasons for not buying anthelmintics from poultry shop

Although anthelmintics are available at the poultry shop in Galang, farmers did not buy anthelmintics from the poultry shop but they did from extension worker or trader. The reason for not buying the anthelmintics from the poultry shop was because the farmers had not been informed. Table 3 indicates reasons for not buying anthelmintic from the poultry shop.

Table 3. Reasons for not buying anthelmintics from poultry shop

Reasons	BDFE (%)	BDFT (%)
Had no information	41.0	100
No enough time to poultry shop	15.4	
Did not know about anthelmin. quality	10.3	
Did not know how to use anthelmint.	10.3	
Afraid of missing the schedule of treatment	7.7	
Too expensive if have to buy 1 liter	7.7	
By a routine visit of extension worker farmer will get new information	2.5	
Did not think yet will apply the anthelmint. by himself	5.1	
Total	100	100

Farmers' reasons for not buying the anthelmintics from the poultry shop were mostly because of no information (41% BDFE) and 100 % BDFT). We need to give farmers more information about sorces of anthelmintic.

Why farmers did not treat their sheep by themselves?

Farmers were reluctant to apply anthelmintics themselves. They preferred to rely on the treatment on the extension worker or trader mostly because they did not know how to use the anthelmintics (63.2 % and 92.3 % for BDFE and BDFT, respectively) although farmers had already been trained in using the anthelmintics (Table 4).

Changes of sheep performance as perceived by farmers

The effects of anthelmintics treatment to sheep as perceived by farmers are depicted on Table 5.

Table 4. Reasons for not applying anthelmintics by themselves

Reasons	BDFE (%)	BDFT (%)
Did not know how to apply	63.2	92.3
Not satisfy if treating by himself	15.8	
No enough time	10.4	
No knowledge of anthelmintics	5.3	7.7
Afraid of missing the schedule of treatment	5.3	
Total	100	100

Table 5. Changes of sheep performance as perceived by farmers

Changes	BDFE (%)	BDFT (%)
Sheep looked fatter, healthier, and cleaner	43.1	26.3
Sheep's appetite increase	24.2	42.1
Faster growing	8.6	10.5
Sick and morbid sheep decrease	5.2	
Sheep were never sick	17.2	15.8
Farmers did not see any changes	1.7	5.3
Total	100	100

Why farmers chose extension worker or trader?

Since there were only two drugs suppliers, namely the extension worker and trader, it was interesting to know why farmers chose extension worker or trader as their supplier (Table 6 and Table 7), while the costs of anthelmintics treatment asked by SR-CRSP extension worker and the trader were Rp 300-Rp 500, respectively.

CONCLUSIONS

1. Farmers were aware of the helminth problem and willing to use anthelmintics. They did not have enough knowledge of anthelmintic application, so training for the farmers would be essential.

2. Farmers should be informed more on the availability of the anthelmintics at the poultry shop.

Tabel 6. Farmers' reasons for choosing extension worker as drug supplier

Reasons	(%)
Got information from ORP farmers and have seen that sheep performance were good	35.2
Anthelmintics available upon credit	5.4
Has been a member of SR-CRSP for years	24.3
Being informed by non-ORP farmer	16.2
Incidently met the extension worker at the shop	2.7
Has known the extension worker before	5.4
More confidence in the extension worker	5.4
Lives not far away from the extension worker	5.4

Tabel 7. Farmers' reasons for choosing trader as drug supplier

Reasons	(%)
The trader visits the farmer frequently while asking for sheep or goat to trade	56.2
The trader offers the anthelmintics	6.3
Has been looking for the drugs for a long time	25
Has known the trader already	12.5
Total	100

FARMERS' SHARE, MARKETING MARGIN AND DEMAND FOR SMALL RUMINANTS IN NORTH SUMATRA

Setel Karokaro, Juniar Sirait, and Izuddin Kartamulia

INTRODUCTION

Sheep and goats are an important source of meat in North Sumatra. Resources for production of small ruminants vary from region to region. One of the main problems with the small ruminant marketing system in North Sumatra is insufficient number of markets for farmers wanting to sell animals.

A good market for livestock is a place where a producer can take or send animals and be reasonably sure of receiving offers from a number of buyers. A trader views a market as a place where stock can be bought in a short time without having to travel long distances to many producers. The basic function of the market is thus to bring together sellers and buyers to trade under convenient conditions at a prearranged time and place.

There is a small ruminant market in South Tapanuli, but it is far away from sheep farmers in other parts of the province. The feasibility of establishing local markets (such as in Java) needs to be researched by focussing on farmer share, marketing margin, and local demand.

Costs and margins of marketing animals reflect the efficiency of a marketing system. Since the costs of marketing are affected by the marketing channels used and the marketing services received, knowing costs and margins helps animal producers to determine the most efficient way to market their product.

A marketing margin is the difference between prices at different levels of the marketing system. The margin between farm and retail is the difference between what the consumer pays and what the producer receives for the animal produce.

METHODOLOGY

Marketing margin and farmer share

A marketing margin is the difference between prices at different levels of the marketing system (Amir and Knipscheer, 1989). The margin between farm and retail is the difference between what the consumer pays and what the producer receives for the agricultural produce. It is expressed as the following :

$$\text{Marketing Margin (MM)} = P_2 - P_1$$

where P_1 = Price at one level in the market (such as the retail level)
P_2 = Price at another level in the market (such as the farm level)

In this research the marketing margin was be determined by analyzing prices of sheep and goats sold by farmers and middlemen.

A farmers' share is the price spread between farm level and retail, expressed as a percentage. The farmers' share was determined by the following equation :

$$\text{Farmers' Share (FS)} = \frac{\text{Price at farm level}}{\text{Price at retail level}} \times 100\ \%$$

The first stage of this research focussed on gathering information from farmers, middlemen (penggalas) or key informants and slaughter houses in Medan, Kisaran, Rantau Prapat, Pematang Siantar, Binjai and Tebing Tinggi.

These chosen towns represent the highest populations of small ruminants and the highest annual slaughter of small ruminants (Dinas Peternakan Propinsi Sumatra Utara, 1990). Data on small ruminants slaughtered, market prices and marketing costs were collected using surveys.

Demand for sheep and goats in North Sumatra

An earlier study on small ruminant marketing channels in North Sumatera (Karokaro et. al.1990) has recognized four levels of middlemen namely village, sub-district, district and provincial traders. However, marketing margin, marketing efficiency and local demand are still unclear. The aim of this study was to determine demand for sheep and goats by analyzing data of total registered and unregistered slaughtering of sheep and goats in North Sumatra.

RESULTS AND DISCUSSIONS

Total registeredly slaughtered sheep and goats

Table 1 shows the total sheep and goats slaughtered at five slaughter houses in North Sumatra namely Medan, Kisaran, Pematang Siantar, Binjai and Tebing Tinggi from April until November 1992. It shows approximately that 1843 sheep and goats were registered slaughtered monthly at Medan's slaughter house. There was a higher total of sheep and goats slaughtered during 1992 compared to

previous year in the provincial capital Medan and in the municipal slaughter house Kotamadya Pematang Siantar. The increase was approximately 12.3 % in Medan and 6.3 % in Pematang Siantar. However, there was a decrease of approximately 5.2% of total slaughtering at Tebing Tinggi and a constant total slaughtered at Kisaran. The maximum total sheep and goats slaughtered during 1992 and 1993 for all cities surveyed occured in July. Of the four regional slaughter houses, Binjai had the highest average of sheep and goats slaughtered during 1992/93, namely 222 per month. The number of sheep and goats slaughtered at Pematang Siantar, Tebing Tinggi and Kisaran were 197, 138 and 162 animals, respectively.

Table 1. Total registered sheep and goats slaughtered atseveral slaughter houses (RPH) in North Sumatra

Month	RPH Medan		RPH T.Tinggi		RPH P.Siantar		RPH Kisaran		RPH Binjai	
	1991	1992	1991	1992	1991	1992	1991	1992	1991	1992
April	1099	1571	120	159	227	198	155	155	270	224
M e y	1555	1980	153	164	202	210	165	165	290	240
June	1595	1989	149	144	188	186	160	160	270	250
July	1877	2145	158	95	192	261	165	165	260	242
August	1742	1969	150	140	192	198	160	160	200	240
September	1743	1892	138	128	188	176	160	160	170	240
October	1602	2021	145	130	176	202	165	170	190	240
November	1735	1984	135	116	184	214	160	160	228	230
December	1907		138		182		165		224	
January	2263		150		190		165		232	
February	2262		129		171		165		232	
March	1934		124		216		165		240	
T O T A L	36865		2765		3943		3245		4442	
AVERAGE	1843		138		197		162		222	

Source : Local livestock service in North Sumatra.

Total unregistered sheep and goats slaughtered

Government regulations implemented by the Directorate General Livestock specify that any slaughter for human consumption should be in a slaughter house operated by the local livestock services. However, especially for sheep and goats many sheep and goats are slaughtered outside the slaughter house (unregistered slaughtering). Table 2 describes the average monthly registered and unregistered sheep and goats slaughtered at several locations in North Sumatra.

Table 2 indicates that there are a tremendous number of sheep and goats slaughtered outside of the slaughter house. The percentage of unregistered sheep and goats slaughtered outside of the slaughter house ranges between 54-154 percent. This indicates that the slaughter house is not as effectively used as it should be. The

Table 2 : Average registered and unregistered sheep and goats slaughtered at different levels of marketing system in North Sumatra.

No.	Cities	Average slaughtered monthly (1993)			Percentage unregistered (%)
		registered	unregistered	real	
1.	Medan	1944	2988	4932	154
2.	Kisaran	162	110	272	68
3.	R.Prapat	100	115	225	115
4.	P.Siantar	204	111	315	54
5.	T.Tinggi	135	195	330	144
6.	Binjai	238	167	405	70
Total		2783	3686	6469	

Source : Estimated by authors based upon local Livestock Services information.

problems seem to be that: (1) the butchers lack knowledge on the advantages of using the slaughter house so that they slaughter sheep or goats at home and bring the meat to the market directly, (2) farmers in the villages cannot afford the additional costs of bringing animals to the slaughter house in the town, and (3) butchers try to reduce the slaughtering fees paid by underestimating the number slaughterings.

Cost and profit at different levels of marketing system

The are approximately 35 middlemen who play an important role in small ruminant marketing within the surveyed areas. However, during the survey only 30 middlemen were interviewed. Based on the information from the middlemen there are at least 8 components of marketing costs such as transportation, slaughtering fee, cooling, electricity, tax, cleaning services, night watches and labor (Table 3).

Margin analysis

Changes in prices from a certain market level to another are called marketing margins. Presently there are four levels in the sheep or goats marketing channel namely village collector, regency middlemen, municipality middlemen and provincial middlemen. The higher

Table 3. Cost and profit selling each sheep/goat (BW 18 kg) at different levels of marketing system (in December,1992)

Types	Total Cost (TC)/animal (Rp.)					
	P	M			R	
	Medan	P.Siantar	T.Tinggi	Binjai	Kisaran	R. Prapat
1. Buying animal	43,400	43,200	41,400	42,000	38,500	39,600
2. Marketing cost/animal						
Transportation	100	85.71	100	100	-	-
Slaughtering fee	1650	1500	1500	1500	1750	1500
Cooling	150	-	-	-	-	-
Electricity	1.54	-	-	-	-	-
Tax	36.92	25.48	-	-	250	2500
Cleaning services	8.79	-	-	-	100	150
Night watch	1.54	-	-	-	-	-
Labor	128.21	-	-	-	1250	-
∑ Marketing cost	2,077	1,611	1,600	1,600	3,350	4,150
3. Total cost (1 + 2)	45,477	44,811	43,000	43,600	41,850	43,750
4. Selling products						
Meat	38,500	35,000	35,000	35,000	35,000	36,750
Liver	4,400	4,000	4,000	4,000	3,000	3,500
Internal organs	1,500	3,000	2,250	1,500	2,000	1,700
Head	2,000	1,500	1,500	1,500	1,500	1,500
Legs	600	400	400	600	200	600
skin	2,400	2,200	2,000	2,400	1,500	1,500
Total income	49,400	46,100	45,150	45,000	43,200	45,550
5. Profit/animal (4-3)	3,923	1,288	2,150	2,400	1,350	1,800
6. Average profit/ animal/ each level of mkt chains	3,923		1,946		1,575	

Note : P = provincial level ; M = municipality level ; R = regency level

the marketing margin the lower the farmer's share. In other words, the higher the marketing margin the higher the price should be paid by consumers. Table 4 describes the marketing margin of sheep and goats in the different levels of the marketing system in North Sumatra.

Table 4 shows that the highest marketing margin is between farmers and provincial traders, followed by that between farmers and municipality traders. This indicates that in the marketing system in North Sumatra the longer the marketing channel the higher the marketing margin. Even for sales to provincial traders the farmer's share relatively high ; therefore the profit received by farmers is relatively high. However, it is assumed that the shorter the marketing chain the higher the profit farmers received.

Table 4. Marketing margin of sheep and goats at different levels of marketing system in North Sumatra

Types of analysis	Level of marketing system			
	Farmer	Regency	Municipality	Provincy
Price of animal	37800	39050	42400	43400
Total marketing cost	-	42200	43804	45477
Income selling products	-	44375	45417	49400
Marketing profit	-	1575	1946	3923

Marketing margin/farmer share (%) :	M. Margin	F. Share(%)
farmer - regency	6575	85
farmer - municipality	7617	83
farmer - provincial	11600	77
regency - municipality	1042	
regency - provincial	5025	
municipality - provincial	3983	

Structure of the small-ruminant markets

Compared to other regions in Indonesia, North Sumatra has a unique marketing system. Middlemen (penggalas) usually buy sheep and goats directly from farmers and then transport them to the next middlemen. There are four types of middleman in the marketing system, namely village/district collectors, middlemen at regency level (Kabupaten), middlemen at municipality level (Kotamadya) and middlemen at provincial level. The main business of middlemen is usually buying sheep or goats from village/district collectors and selling meat to consumers. In addition to being village collectors most of middlemen are also butchers. This makes sense since the

main profit of small ruminant traders is from the selling of internal parts. The profit is gained if the middleman is working as both ritailer and butcher.

The main problem in the marketing system in North Sumatra is that no market exists at sub-district or district levels. Therefore, the only way farmers can sell their animals is through a chain market of middlemen (Figure 1.). This structural inefficiency in marketing sheep and goats domestically will continue until producers have greater direct access to markets and can bargain directly for higher prices.

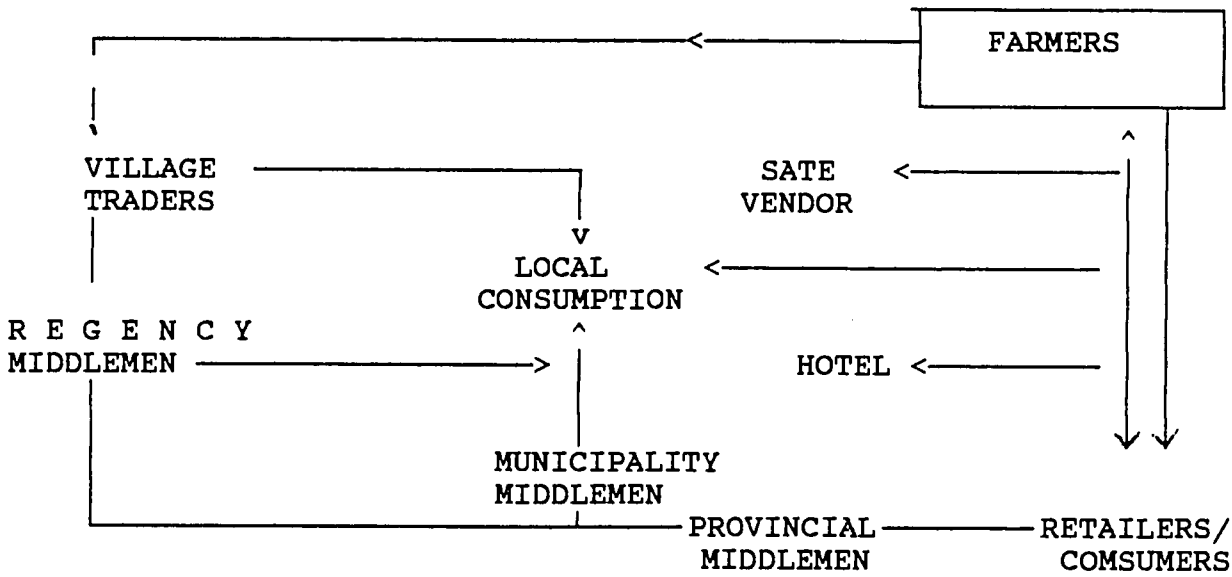

Figure 1. Small Ruminant Market Structure in North Sumatra.

Demand for sheep and goats in North sumatra

To estimate the demand for sheep and goats in North Sumatra the data collected in this base line survey of total registered and unregistered slaughterings of sheep and goats were combined with estimates released by the Regional Livestock Services of sheep and goats slaughter in each slaughter house (Table 5). Sheep and goats slaughtered by farmers in ritual ceremonies are numerous but are not included in these estimates.

Table 5 shows that approximatly 190000 sheep and goats are slaughtered every year. The average liveweight of sheep and goats slaughtered is 18 - 20 kg. The sheep and goats slaughtered fulfills only about 45 % of North Sumatra demand (Buyung et. al. personal communication). Therefore, local demand for sheep and goat in North Sumatra totals about 290000.

Table 5. Estimated monthly demand for sheep and goats in North Sumatra, 1992/93.

No.	Location	Sheep andgoats slaughtered		
		registered	unregistered	total
1.	Medan	58320	89640	147960
2.	Kisaran	4860	3300	8160
3.	R.Prapat	3000	3450	6750
4.	P.Siantar	6120	3330	9450
5.	T.Tinggi	4050	5850	9900
6.	Nias	00	68	68
7.	Sibolga	38	63	101
8.	P. Sidempuan	968	103	1071
9.	Tarutung	19	10	29
10.	Sidikalang	17	20	37
11.	Kaban Jahe	222	20	242
12.	Setabat	61	117	178
13.	Deli Serdang	480	20	500
14.	Asahan	1600	80	1680
15.	Simalungun	16	65	81
			Total	186207

Source 1- 5 : Local Livesatock Service (1992)
6-15 : Provincial Livestock Service (1991)

CONCLUSION

In North Sumatra there is a general shortage of sheep and goats slaughter due to low efficiency of production. The demand for sheep and goats is approximately 290000 animals per year, which suggests that supply is not keeping pace with demand. The sheep and goats slaughtered fulfills only about 45 % of North Sumatra demand (Buyung et. al. personal communication). In other words, the local offtake of sheep and goats is approximately 55 per cent. This study confirms that middleman play an important role in the marketing system. However, there is evidence of monopsonistic behaviour or collusion of the traders. The bargaining system between trader and farmer is not effective. The establishment of markets to shorten the marketing chain is recommended to increase farmer share.

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CHARACTERISTICS OF THE INTERNATIONAL MARKET FOR LIVE SHEEP AND POTENTIAL FOR LIVE SHEEP EXPORTS FROM NORTH SUMATRA

Izuddin Kartamulia, Setel Karo Karo,
Artaria Misniwaty, John De Boer, Henk Knipscheer

INTRODUCTION

The Government of Indonesia has been vigorously promoting non-oil exports. This policy has been included in AARD policy for the next 5 year plan and research should include possibilities for increasing agricultural exports of both raw, semi-finished and final products. The possibility for rapidly increasing sheep production in North Sumatra has generated interest in exploring possibilities for developing an export market from this province.

The first step in this process is to focus this research on the most promising markets based on several criteria. A second step of research would then carry out detailed analysis of these promising markets.

A preliminary descriptive report of the international market for live sheep was prepared including some of the key prices, costs, and markets. The second part of the report will carry out a more detailed feasibility study of the most promising markets.

RESEARCH METHODOLOGY

The first stage of this research focused on descriptive aspects of the trade in live sheep. This is the most lucrative market and the export of chilled, frozen or processed meat from small ruminants was not considered at this stage. International prices, transport and handling costs were used to assess farm-level prices that North Sumatran farmers could obtain by suppling export-quality sheep for a specific export market. Institutional support and policy changes needed to develop this market were then examined as well as the potential foreign exchange that could be generated from these exports.

RESULTS AND DISCUSSION

The following is based on an interview with:

1) Mr. Christopher Hughes, Hughes Export and Marketing Pty. Ltd. from Adelaide, South Australia. His firm is actively involved in the meat and livestock trade and is seeking joint venture opportunities in the livestock sector in Indonesia on behalf of Australian investors.
2) Mr. Abdullah S.S. Bin Duf, livestock importer in Al Khobar, Saudi Arabia. He has personal experience on sheep trade in Saudi Arabia.
3) Mr. Les J.B. Binns, exporter of quality breeding sheep, from Victoria, Australia.
4) Mr. Subagyo, Department of Trade Republic Indonesia
5) Mr. Frans Mambo, National Agency for Export Promotion (NAFED), Department of Trade Republic of Indonesia.

1. Existing Patterns of Trade

Current trade, primarily to the Middle East, is about 10 million head of live animals per annum. The trade has been dominated by Australia (4.5 m head) and New Zealand (1.5 m head) with the balance from Turkey, Somalia, Sudan, Ethiopia, Eastern Europe and other residual suppliers.

Locally, during the past 12 months, Singapore imported about 33,000 live sheep and Peninsular Malaysia imported 12,000 sheep from Australia.

2. Shipping Methods and Costs

Commercial large scale trade from Australia and New Zealand relies on 18 specialized ships ranging in capacity from 20,000 head to 131,000 head. Thus existing specialized ships are far too large to serve the Malaysia-Singapore market which together only require about 4,000 head/month. Both markets would take more live sheep from Australia but cannot because of surface transport constraints.

In Australian exports to Middle East Markets, the market standard is a 55 kg. wether costing* $ 8.0 at the wharf. The costs F.O.B. adds another $ 7.00, shipping is $ 12.00, insurance adds $ 1.40., profit at $ 1.00 head making landed cost in the Middle East of about $ 30.00. However, Abdullah bin Abduh states that local price of sheep in Saudi Arabia varies by month and by quality. During the haj good quality sheep may cost $ 100-150/head.

Current prices in North Sumatra are about $ 1.2/kg liveweight. For a 35 kg ram, the local cost would be $ 42 which is already well above the landed cost of much larger (55 kg) sheep from Australia and New Zealand. Mortality in shipping is about 1.8%. It thus appears that Indonesia, which is deficient in red meat, will not be able to export sheep profitably to the Middle East market unless the sheep population be increased dramatically. This may happen if government-owned estate companies in North Sumatra, for example PTP III and PTP IV, are willing to rear sheep integrated with palm or rubber trees.

Because of a lack of large-scale vessels for shipping live sheep to the Singapore-Malaysia market, Indonesia is in a much better position to consider supplying live sheep to this market. Both Singapore and Peninsular Malaysia prefer live rams. Singapore is currently air freighting rams from Perth, Western Australia at a cost of about $ 70/head. The rams cost about $ 15 head for a total delivered cost of $ 85. In Peninsular Malaysia prices are somewhat lower but good rams bring at least $50.00. Given the local costs in North Sumatra for somewhat smaller rams, live

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* The following figures are estimates only, in US$ per head.

sheep exported from North Sumatra in smaller local ships should be competitive in the Singapore market but would probably not be profitable in Malaysia based on a cost/kg basis.

GROWTH, MORTALITY AND WOOL COVER OF SUMATRA SHEEP AND THEIR CROSSES WITH THREE BREEDS OF HAIR SHEEP

Ruth M Gatenby, G Eric Bradford, Meruwald Doloksaribu, Endang Romjali, A Djoko Pitono and Hakan Sakul

The objective of the crossbreeding trial in Sei Putih is to evaluate various genetic stocks of hair sheep and their suitability in the humid tropics. In this trial Sumatra, the local breed in North Sumatra, is crossed with

1. **Barbados Blackbelly**, from the Caribbean, which was introduced using frozen semen rather than live animals.

2. **East Java Fat-tail**, known in Indonesia as Ekor Gemuk. Thirty-five ewes and 15 rams were introduced from East Java to Sei Putih in 1991.

3. **Virgin Island**, also known as St Croix, originally from the Caribbean. Seven ewes and seven rams were introduced to Sei Putih in 1986 from the USA via Java.

In addition, **Garut crossbred** ewes (Sumatra x Garut) were used as dams to avoid purchasing more Sumatra ewes. The Garut is a large strain of Java Thin-tail, similar to the Sumatra, and is also known as the Priangan. The Garut crossbred ewes in Sei Putih had been produced during a previous experiment.

The symbols used to denote genotypes in this paper are summarized in Table 1.

Table 1. Symbols of genotypes.

Symbol	Genotype
B1	S x Barbados Blackbelly, first generation.
E1	S x East Java Fat-tail, first generation.
G1	S x Garut, first generation.
H1	S x Virgin Island, first generation.
S	Sumatra.

MATERIALS AND METHOD

Animals and management

The sheep are housed in group pens in four large sheep houses with raised slatted floors. Ewes and suckling lambs are grazed from 0800 h to 1600 h daily in rubber plantations. Ewes with

single lambs are given concentrate for only two weeks after lambing, and those with two or more lambs receive concentrate for 6 weeks. All ewes are fed a small amount of molasses mixed with urea. Ewes are exposed to rams for 34-day periods four times a year. Lambs are weaned at exactly 3 months of age.

Mating program

In October 1991 more than 400 S and G1 ewes were either inseminated with frozen semen from Barbados Blackbelly rams or were mated by East Java Fat-tail, Virgin Island or Sumatra rams. Natural services were individually supervised following twice-daily detection of estrus by vasectomized rams. All ewes were given the chance to mate again in January-February and April-May 1992.

A total of 407 ewes (312 S and 95 G1) ewes in this trial lambed in three seasons, starting mid-March, mid-June and mid-September 1992. The numbers of ewes lambing in these three seasons were 314, 70 and 184, respectively. The majority (161) of the 184 ewes which lambed in September had previously lambed in March. A total of 882 lambs were born.

All the genotypes are treated as similarly as possible. However, the management of the B1 lambs was not identical with that of the other genotypes.. Therefore the major statistical analyses presented in this paper compare only the E1, H1 and S lambs born in all three seasons. Secondary analyses compare the B1 lambs with the other lambs born in March 1992.

RESULTS

Litter size

A large proportion of lambs were born in multiple litters. The percentages of litters (of all four breeds in all three seasons) of 1, 2, 3 and 4 lambs were 54, 38, 7 and 1%, respectively. Overall litter size was 1.55.

Litter size was affected by breed of dam ($P<0.001$), but not by age of ewe nor season of birth. Average litter size ($\pm$SE) was 1.78($\pm$0.07) for G1 and 1.46($\pm$0.04) for S dams. The higher litter sizes of the G1 dams can be attributed to (i) hybrid vigour, and (ii) the higher frequency of the prolificacy gene in the Java Thin-tail breed (which sired the G1 dams) than in the Sumatra.

Weights of lambs

The analysis of three breeds in three seasons, which is summa-

rized in Table 4, shows that average weights were 1.83 kg at birth and 8.7 kg at weaning for lambs of both sexes. For female lambs only, weights averaged 14.4 kg at 6 months and 17.9 kg at 9 months of age. Six- and 9-month weights were corrected for age to give weights at exactly 183 and 274 days of age.

Lamb weights were affected by breed of sire, sex of lamb, litter size, breed of dam and season of birth. Individual sire had no statistically significant effect.

Table 4. Least squares means and standard errors (kg) for lamb weights. Values for birth and 3 months are for both sexes; values for 6 and 9 months are for females only.

	Birth	Three months	Six months	Nine months
THREE BREEDS, ALL SEASONS				
n	799	616	275	159
Overall mean	1.83	8.7	14.4	17.9
Breed				
E1	1.73^{a} 0.05	8.6^{b} 0.25	14.3^{b} 0.5	18.2^{a} 0.5
H1	1.95^{b} 0.05	8.9^{b} 0.26	15.4^{b} 0.4	19.9^{b} 0.5
S	1.71^{a} 0.03	7.8^{a} 0.17	12.8^{a} 0.4	17.0^{a} 0.6
	P<0.001	P<0.001	P<0.001	P<0.001
ALL BREEDS, MARCH ONLY				
n	488	391	163	156
Breed				
B1	1.97^{b} 0.06	10.3^{c} 0.29	14.7^{b} 0.5	19.9^{b} 0.6
E1	1.82^{ab}0.08	8.8^{b} 0.37	13.5^{ab}0.6	17.2^{a} 0.7
H1	1.95^{b} 0.06	9.0^{b} 0.31	13.9^{ab}0.5	19.0^{b} 0.5
S	1.71^{a} 0.05	7.8^{a} 0.24	12.8^{a} 0.5	16.6^{a} 0.6
	P<0.001	P<0.001	P<0.05	P<0.001

Effect of breed of sire on weight of lambs

The average weights shown in Table 4 show that

1. the ranking of average lamb weights was consistent with S < E1 < H1 < B1.
2. the average increase in weight of the crossbreds above the S was 7% for E1, 15% for H1 and 20% for B1. These differ-

2. the average increase in weight of the crossbreds above the S was 7% for E1, 15% for H1 and 20% for B1. These differences are highly significant statistically. However, the variation within the genotypes was large compared with the difference between the means. This is demonstrated in Figure 1.

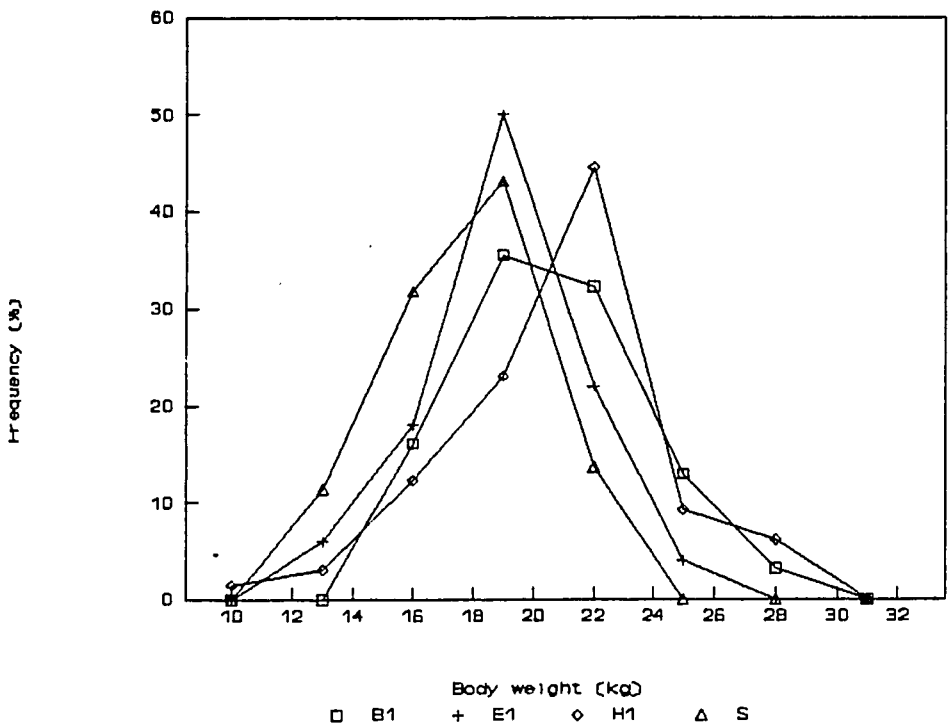

Figure 1. Frequency distribution of body weight in 9-month-old ewe lambs.

Lamb mortality

Pre-weaning mortality averaged 22.5% (from birth to 3 months), For females post-weaning mortality plus other losses (3 to 9 months) averaged 13.1%.

Mortality was affected by type of birth and rearing, breed of dam, age of ewe and season of birth. Breed had a significant effect only on mortality from two weeks to 3 months of age, when the mortality of E1 lambs was lower than that of other breeds.

Causes of mortality

A substantial number of lambs were born dead. Post-mortem examination of still-born lambs which were superficially normal showed accumulation of fluid in the body cavity of the lamb.

There were four main causes of death in lambs before weaning:

1. Insufficient milk consumption which predisposes lambs to parasites.
2. Worms, particularly *Haemonchus contortus* which cause severe anaemia. Worms were most obvious in the final weeks before weaning.
3. Coccidia, which caused diarrhoea in lambs aged about 2 months.
4. Pneumonia in ewes in December 1992 when there was prolonged rain.

Wool coat

The coats of lambs at birth were assessed as either straight or curly. Approximately half (48%) had curly coats, and half (52%) straight.

Wool score is the product of wool cover (0-9) and wool length (0-9), so can range from 0 to 99. The effect of breed on wool score is summarized in Table 10. Wool scores at 3 months of age were similar for all breeds, but in older animals the scores were consistently B1 < H1 < E1 < S. B1 had the least wool, and S were the most woolly.

Effect of wool coat on lamb weights. Birthcoat type and wool score were included in the analysis of lamb weights, and statistically significant effects were found (in addition to the variables listed in Table 4).

Lambs with straight birthcoats had higher average weaning weights than lambs with curly birthcoats ($P<0.05$). The least squares means (±SE) for the 3-breed 3-season comparison were 8.09(±0.21) kg for curly coats and 8.57(±0.21) kg for straight coats.

The effect of wool score on lamb weight is summarized in Table 11. At 3 and 6 months of age, there was a positive correlation between wool score and lamb weight; bigger lambs were more woolly than smaller lambs. By 9 months the correlation had become non-significant.

Table 10. Least squares means and standard errors for wool scores. Values for 3 months are for both sexes; values for 6 and 9 months are for females only.

Breed	Three months	Six months	Nine months
THREE BREEDS, ALL SEASONS			
n	575	276	166
Overall mean	51.6	60.5	51.8
E1	54.7[a] 2.0	64.9[b] 3.2	61.1[ab] 4.4
H1	55.9[a] 2.1	51.9[a] 2.5	54.0[a] 4.3
S	54.7[a] 1.4	68.0[b] 2.2	68.7[b] 4.6
	ns	P<0.001	P<0.05
ALL BREEDS, MARCH ONLY			
n	375	164	163
Overall mean	42.1	53.3	41.4
B1	41.4[a] 1.6	38.8[a] 4.6	17.9[a] 5.5
E1	42.8[a] 2.0	58.1[b] 5.1	38.6[b] 6.0
H1	41.6[a] 1.7	41.6[a] 4.0	34.3[b] 4.7
S	43.4[a] 1.3	64.4[b] 4.5	52.3[c] 5.4
	ns	P<0.001	P<0.001

Table 11. Least squares estimates of regression coefficients for wool score on lamb weight (kg) for three breeds in all seasons (Mean±SE).

Three months	Six months	Nine months
0.013±0.006	0.029±0.010	0.016±0.013
P<0.05	P<0.01	ns

All the ewes born in March and June 1992, and ten rams from each genotype are being mated in 1993. Ewes are mated to sires of the same breed and, starting June 1993, lambs of the F_2 generation will be born. The reproductive performance of the four genotypes will be evaluated on the basis of the first two lambings of the B1, E1, H1 and S ewes.

COLOUR AND EAR TYPE OF SHEEP IN NORTH SUMATRA

Meruwald Doloksaribu, A Djoko Pitono and Ruth M Gatenby

The characteristics of sheep in North Sumatra are variable because of the wide range of agro-ecosystems and the absence of commercial sheep rearing on a large scale. The objective of the research presented in this paper was to observe the variation in coat colour and ear type of sheep.

MATERIALS AND METHODS

This research was conducted in the flock at Suka Damai. The data recorded were colour and ear type. The total number of animals scored was 568. Both female and male animals were observed. There were six breed types, namely:

S	Sumatra	192
H	Virgin Island (plus 75% and 87% backcrosses)	57
B1	Barbados Blackbelly x S, first generation	58
E1	Java Fat-tail x S, first generation	55
H1	H x S, first generation	134
HC	H x S, second and subsequent generations	72

Because the 1992-born animals of the S, B1, E1 and H1 breed groups were part of a crossbreeding trial, for these breeds the data from older animals (pre-1992) is presented separately from those of young animals (born 1992).

The colour of each animal was scored using three digits: C1, colour or colours (including even very small patches of colour); C2, percentage of the body which is pigmented; and C3, pattern of colouring. Details of the scoring method are shown in Table 1.

For example a completely white animal was recorded as 111. A white animal with black spots on one ear was recorded as 512.

This scoring scheme results in a potential of several hundred colour categories. In order to interpret the results the coat scores were coagulated into six groups:

1. White or mostly white ($C2 \leq 3$).
2. About half the coat is coloured, and half white ($4 \leq C2 \leq 6$).
3. Brown or mostly brown ($C1=3,4,7,8$; $C2 \geq 7$).
4. Black or mostly black ($C1 \geq 5$; $C2 \geq 7$).
5. Brown and black with black belly ($C3=9$).
6. Mostly white, with black belly.

The method of scoring ear type was:

0 Vestigial ears, less than 3 cm long.
1 Intermediate. Ears 3-8 cm long.
2 Normal ears, more than 8 cm long.

Table 1. Scoring method for coat colour.

Colours	Amount of colour	Colour pattern
1 White only	1 None, white only	1 Solid
2 Light brown	2 <15% colour	2 Solid body; spots on ear, nose, feet
3 Dark Brown	3 15-30% colour	3 Solid body; spots around eyes only
4 Brown and white	4 30-45% colour	4 Small spots on head or body
5 Black and white	5 45-55% colour	5 Large spots on head or body
6 Black and light brown	6 55-75% colour	6 Coloured head
7 Black and dark brown	7 70-85% colour	7 Coloured head and shoulders
8 Black, brown and white	8 85-99% colour	8 Coloured head and feet
9 Black	9 No white	9 Blackbelly pattern

RESULTS AND DISCUSSION

Colour

The frequency of each colour group is summarised in Table 2. Although the Sumatra and Barbados crossbred animals had a wide range of colour types, more than 90% of the Fat-tail crosses and the purebred and crossbred Virgin Island sheep were completely white. The colour of the F_2 Virgin Island crosses (HC) was similar to that of the F_1 crosses (H1).

Although white is a common colour of Sumatra sheep, a large proportion are light brown. A few are black, and some have the dark brown and black colouring characteristic of purebred Barbados Blackbelly.

Only 10% of the Barbados Blackbelly crossbreds had the typical brown and black colour pattern. A large proportion of animals were brown or black. Nineteen per cent of the B1 were white, and a further 13% were largely white with a black belly. Thus colour

cannot be used as the sole criterion to identify Barbados Blackbelly crossbred sheep; tail length and type, shape of body and wool cover are other characteristics which help identify genotype.

Table 2. Colours of sheep.

		n	Colour group (%)					
			White	Half white	Brown	Black	BB	White +BB
S	young	59	51	7	22	10	10	0
	older	133	34	15	41	6	4	0
H		57	98	2	0	0	0	0
B1	young	58	19	12	22	22	10	13
E1	young	55	95	5	0	0	0	0
H1	young	81	94	5	0	0	0	1
	older	53	94	2	4	0	0	0
HC		72	92	7	1	0	0	0

Ear type

The ear types of the sheep are summarised in Table 3. About 6% of Sumatra sheep are earless (Type 0), but no Virgin Island sheep. About one-third of Sumatra sheep had intermediate ears, and 21-27% in the crossbreds.

Table 3. Ear type.

Breed	n	Ear type		
		0	1	2
S	159	6	34	60
H,H3,H2	67	0	1	99
B1	57	0	21	79
E1	67	1	22	76
H1,HC	215	2	27	71

GENERAL DISCUSSION

If in the future it is decided to standardise the colour of improved sheep produced in Sei Putih, a wide range of colour patterns will be available for selection. The majority of sheep are white, so that by selecting for a completely white coat it

will be possible to make use of a large proportion of the genetic material available; even the Barbados Blackbelly crosses can be incorporated in the new breed.

On the other hand if it is decided that brown or Barbados Blackbelly colouring would be more acceptable to the farmers, we could select for either of these colour patterns.

LONG-TERM PRODUCTIVITY OF SUMATRA THIN-TAIL AND VIRGIN ISLAND CROSSBRED EWES IN THE SELECTION PROGRAMME

Ruth M Gatenby, Endang Romjali, M Doloksaribu,
Leo P Batubara and G Eric Bradford.

INTRODUCTION

Records of local Sumatra Thin-tail sheep (S) at Suka Damai have been kept since 1984. Virgin Island sheep (H) were introduced in 1986, and crossbred genotypes have been produced. Offspring of the F1 generation are known as H1; those of subsequent generations are known as HC. Both H1 and HC comprise 50% S genotype, and 50% H. We now have approximately 100 S ewes and 100 H1 and HC ewes at Suka Dame. Selection has been conducted in both genotypes.

It is established that H1 ewes are larger than S ewes and the growth rates of their lambs are more rapid than those of lambs born to S ewes (Iniguez et al., 1991). Other productivity traits such as litter size, lamb mortality, age at puberty and lambing interval are similar for both H1 and S ewes, and the crossbred genotype does not seem to be more susceptible to disease. Until now, no analysis has been conducted on the long-term productivity of S and H1-HC ewes. Are the crossbred ewes capable of continuing to produce at high levels? The purpose of this analysis was to evaluate the productivity of S and H1-HC ewes in terms of weight of lamb weaned per year, and thus to provide recommendations about the most suitable breed for use in plantations.

METHOD

Data were analysed from all ewes currently in the Suka Damai flock which had lambed twice or more. Long-term productivity is conveniently measured by productivity indices. Three productivity indices were calculated for each ewe.

Index 1 = Weight of lambs weaned x 365 / (Age in days - 200).

Index 1 gives the weight of lamb weaned per year. The inclusion of 200 days in the equation is to allow for the period before sexual maturity.

The second and third productivity indices are

Index 2 = Index 1 / Body weight of ewe at mating

and

Index 3 = Index 1 / Metabolic body weight of ewe at mating

where metabolic body weight = (body weight)$^{0.75}$.
Index 2 gives the weight of lamb weaned per unit ewe weight per year, and Index 3 gives the weight of lamb weaned per unit ewe metabolic weight per year.

RESULTS

The long-term productivity was calculated for 86 Sumatra Thin-tail (S) and 29 S x Virgin Island crossbred (H1-HC) ewes. Ewe age at most recent lambing ranged from 1 year 7 months to more than 8 years. Average age was about 4 years 3 months for S ewes and 3 years 9 months for H1-HC ewes. The H1-HC ewes were considerably larger than the S ewes, averaging 30.2 kg compared with 23.1 kg.

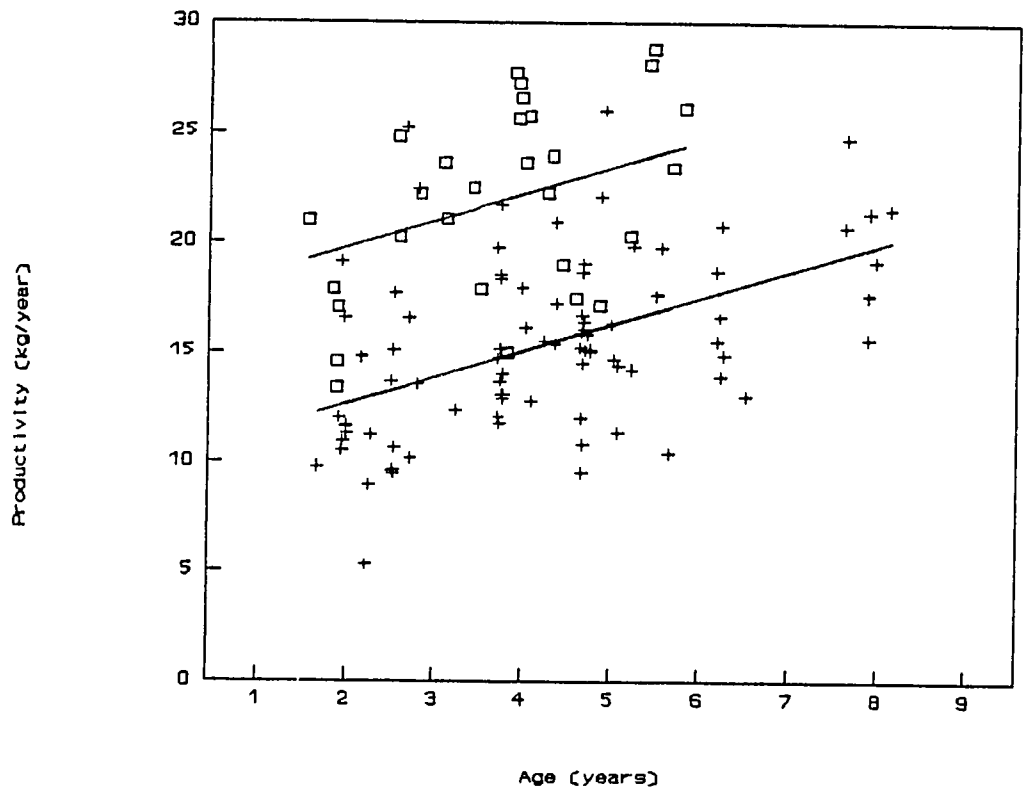

Figure 1. Productivity of Sumatra and crossbred ewes showing effect of age. Symbols: plus = S, square = H1-HC.

Index 1 ranged from 5.3 to 26.0 for S ewes, and from 13.4 to 28.8 for H1-HC ewes. The individual data are plotted against ewe age in Figure 1, and there appear to be well-defined effects of both age and breed. H1-HC ewes tended to have higher values of Index 1 than S ewes, and Index 1 increased with age.
The data were analysed using SAS. Analysis of variance showed that both breed and age of ewe had significant effects on Index 1, Index 2 and Index 3. The least squares means for the two breeds are shown in Table 1.

Table 1. Least squares mean values of productivity indices.

		Index 1 (kg/year)		Index 2 (per year)		Index 3 ($kg^{0.25}y^{-1}$)	
Breed	n	Mean	SE	Mean	SE	Mean	SE
S	86	15.2	0.40	0.67	0.017	1.45	0.037
H1-HC	29	22.4	0.69	0.75	0.030	1.75	0.064
Significance of difference		P<0.01		P<0.05		P<0.01	
Percentage difference		47%		13%		20%	

Both breed and age of ewe had significant effects on productivity (P<0.01). H1-HC ewes produced about 47% greater weight of lambs weaned (22.4 kg/y) than S ewes (15.2 kg/y). Productivity increased by 0.0033 kg/ewe for every year increase in age.

Productivity per unit weight of ewe was 13% higher and productivity per unit metabolic weight of ewe was 20% higher for H1-HC ewes than for S ewes. Thus the difference in productivity between the two genotypes is not merely a consequence of the difference in ewe body weight.

Only two ewes in the H1-HC group were of the F2 generation; the majority were F1. It is therefore likely that some of the difference between the productivity of the two groups is due to hybrid vigour in the crossbreds.

CONCLUSION

The average productivity of H1-HC ewes is considerably higher than that of S ewes, and we recommend that H1 and HC sheep are distributed on a wider scale in North Sumatra.

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GRAZING AND LAMBING BEHAVIOUR OF EWES

Thomas Hoogerwerf, Aron Batubara,
Ruth M Gatenby and M Doloksaribu

INTRODUCTION

The objective of this work is to develop methods to assess the behaviour of ewes while grazing and at lambing, and to compare the behaviour of various genotypes.

The behaviour while grazing and at lambing were chosen for study because they are likely to have economic impact on productivity.

METHOD

Grazing behaviour

A preliminary study of two-days duration has already been conducted to develop feasible methods.

In this experiment a total of 24 young ewes will be used, of Sumatra (S), Barbados Blackbelly crossbred (B1), Fat-tail crossbred (E1) and Virgin Island crossbred (H1) genotypes. Three ewes of each of the four genotypes have been randomly selected in kandang A and in kandang C. Large coloured numbers will be painted on the sides of each animal.

Each sheep will be observed for 5 days, while the flock is grazing 7 to 7.5 hours per day. The grazing groups are not being changed to accommodate this experiment, but the groups will be the same as those in existence for the past six months.

A total of 12 sheep will be observed in one day. Every 15 minutes the behaviour of each sheep will be recorded, and categorised into

1 grazing, including grazing while lying down.
2 ruminating, either standing or lying.
3 resting.
4 walking.
5 others, including scratching, playing and fighting.

The trial will start on June 29, and measurements will be made on 10 days over a period of 20 days (or more if there is rain). The data will be entered onto the computer for analysis.

Behaviour at lambing

During the lambing season of June-July 1993 the behaviour of all ewes lambing at Suka Dame is being assessed. The kandang staff fill in the questionnaire for each ewe. They fill in only those details they observe. No data will be collected during the night and at other times when senior staff are not present.

The data collected include duration of lambing, behaviour of lamb immediately after birth, behaviour of ewe towards newborn lamb, duration before first lamb stands, duration before first lamb suckles, behaviour of ewe while lamb tries to suckle, behaviour of ewe when lamb is removed for weighing, behaviour of ewe when lamb is carried to lambing pen, and behaviour of ewe in lambing pen when person approaches. Other details such as breed and age of ewe, litter size and date of lambing are available from the normal lambing records.

At the beginning of June 1992, eight staff at Suka Dame were given instructions on how to complete the questionnaire. Data are being collected during the lambing month, from approximately June 12 to July 15.

After July 15, the data will be put on the computer, then analysed. It is likely that the questionnaire will be modified for use in September-October when more ewes will be lambing.

OPTIMUM EWE SIZE IN SUMATRA EWES

A. Djoko Pitono, M. Doloksaribu and Ruth M. Gatenby

A total of 560 records of 234 local Sumatra ewes, collected from 1985 to 1989, were analysed for effects of ewe weight, year, ewe age, treatment and number of lambs born on (1) survival rate of lambs to weaning and (2) total weight of lambs weaned per ewe lambing. Ewe body weight related to survival rate and total weight of lambs weaned per ewe lambing showed a significant linear and quadratic relationship.

Although the largest ewes (those weighing more than 30 kg) produced lambs with the highest survival rates and the highest litter weights (Table 1), the most efficient ewes were middle-sized ewes with body weights of 15 to 30 kg, judged by total weight of lambs weaned (kg) per metabolic body weight ($kg^{0.75}$) of ewe lambing.

Table 1. Effect of body weight on survival rate of lambs to weaning and weight of lambs weaned per ewe and per unit metabolic weight of ewe.

Ewe body weight (kg)	Survival rate (%)			Weight of lambs at weaning (kg) per ewe			per metab wt	
	n	mean	SE	n	mean	SE	mean	SE
10-15	44	35.4[a]	6.7	27	8.8[a]	0.63	1.15[a]	0.063
15-20	144	57.4[b]	4.8	163	11.0[b]	0.43	1.22[a]	0.043
20-25	231	64.1[c]	5.0	214	12.7[c]	0.42	1.22[a]	0.042
25-30	71	69.3[cd]	5.9	67	14.3[d]	0.50	1.21[a]	0.050
>30	19	71.8[bc]	9.0	19	15.3[d]	0.72	1.12[a]	0.072
Significance		P<0.01			P<0.01		ns	

This is a summary of a paper prepared for the Journal of Research, SBPT Sei Putih.

STUDIES ON THE EPIDEMIOLOGY AND CONTROL OF IMPORTANT DISEASE CONSTRAINTS OF SHEEP AT SUNGAI PUTIH

Alan J Wilson[2], Ruth M Gatenby[1], Iskandar Mirza[1], Gatot Adiwinata[2], Aron Batubara[1] and Beriajaya[2]

This program is conducted through a contract with INI ANSREDEF in Bogor. Results from the first two years of this program are:

i) Nematode parasitism is a potentially serious constraint to sheep production under any management system developed at Sei Putih. The climate is conducive to parasite development with high attack rates all year round.

ii) The parasites are highly susceptible to benzimidazole anthelmintics over a period of two years. However, there is now some evidence that benzimidazole resistance is developing in the haemonchus population in the flock.

iii) *Haemonchus* is by far the most pathogenic species all year round. *Trichostrongylus* is also important at specific times of year.

iv) Maximum larval survival on pasture is around 3 months. This result is of great significance and is the basis of the grazing management system at Suka Damai where a 3-month rotational grazing system is now standard practice.

v) Some sheep show lower egg counts that others. This led to the initiation of Protocol 5, an in-depth study of the possibility of the development of genetic resistance in individual sheep at Suka Damai. It has also stimulated additional interest from the Prince Leopold Institute for Tropical Medicine in Belgium who will assist in the funding of this work.

vi) A further helminth problem has been identified, namely the trematode *Eurytrema pancreaticum* (pancreatic fluke). Post-mortem studies have shown that this trematode was common in sheep aged one year and older. Some infected sheep aged 2 or more years show ill thrift. A drug trial using nitroxynil, praziquantel and albendazole showed that none of these drugs is effective in the control of the parasite at the dose rates tested.

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1. Sub-Balai Penelitian Ternak Sei Putih, North Sumatra.

2. Indonesia International Animal Research and Development Foundation and Balai Penelitian Veteriner, Bogor, Java.

This year there are five protocols:

Protocol 4.1. <u>The effect of breed on the levels of helminth parasitism</u>

Six ewes in each of four breeds (Sumatra S, East Java Fat-tail E, Virgin Island H and Sumatra x Virgin Island H1-HC) were monitored for nematode faecal egg count every two weeks. The means for each group are shown in Figure 1.

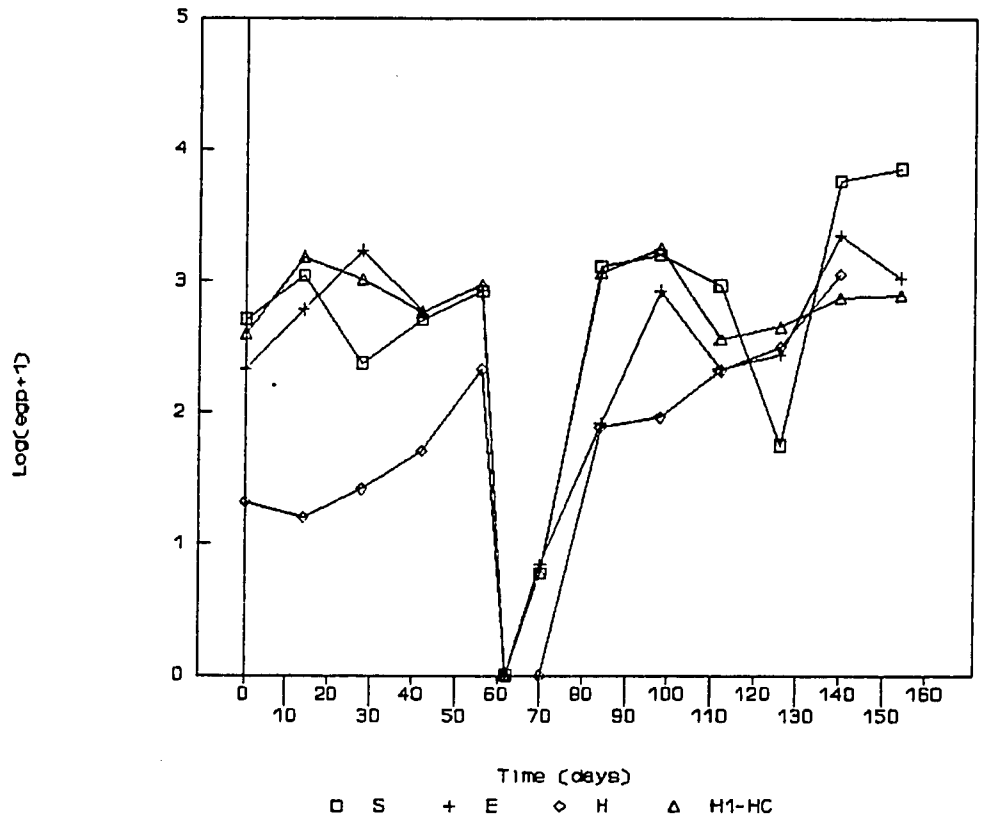

Figure 1. Average faecal egg counts of groups of ewes. The data were collected from August 3 (day 0) to January 1993. Anthelmintic was given on day 62.

The results show that

a) The drug used (Rintal) still remains effective in clearing gastro-intestinal nematodes from sheep in this experiment.

b) The rapid uptake of worms as judged by faecal egg counts was similar to that described in previous studies. High nematode egg counts were observed 21 days after treatment in some of the animals in groups S, E and H1-HC.

c) The nematode egg levels of the Virgin Island (H) group were consistently and significantly lower than the other groups. This characteristic seems to be present in some individuals in the H1-HC group indicating some possible heritability.

d) The uptake of worms after treatment was very rapid; some animals were back to pathogenic levels within 20 days. Uptake was slower in groups H and E.

e) There was great individual variation in nematode egg levels between animals within all the groups. Some animals had consistently low levels (12001 E, 01065 S, 10368 H, 10385 HC) and some had consistently high levels (12850 E, 7104 S, 00142 HC)

This protocol is being continued, and the most recent results are described by Batubara et al (page 45 of this report).

Protocol 5.1. Monitoring for possible traits of helminth resistance in lambs

All lambs in the SR-CRSP flock at Suka Damai are being monitored (at 3, 9 and 12 months of age) prior to the flock being treated with anthelmintic. The following are being recorded.

1. faecal egg count
2. packed cell volume, starting May 1993
3. body weight
4. breed and birth date of each animal

All data are being collected and entered into the computer. These will be analysed by Endang Romjali for his MSc dissertation, starting July 1993.

Protocol 6.1. Monitoring of disease through gross pathology and histopathology of all sheep which are post-mortemed at Sungai Putih

Reports of the histopathological examination of sheep are shown in the Mid-term report. Lesions consistent with the established causes of death were confirmed in 11 cases considered to be acute *Pasteurella* pneumonia (1) acute parasitic gastroenteritis (2) nutritional disorder associated with Ca/P imbalance (3) and pancreatic fluke (5).

Protocol 7.1. Further studies on the chemotherapy of pancreatic fluke in sheep

The results of a drug trial have been reported in detail by Gatenby et al (1992). None of the three drugs tested (nitroxynil, praziquantel and albendazole) were effective in the control of *Eurytrema pancreaticum*.

The following is planned. (i) Further flukicides will be procured, namely Chlorsulon, Rafoxanide and Fasinex. Some of these will have to be purchased outside Indonesia. (ii) The development of simpler and cheaper experimental techniques to test the efficicacy of drugs against the pancreatic fluke.

Protocol 8. Examination of the effect of breed on levels of gastro-intestinal nematodes and pancreatic trematodes in sheep

This protocol is described by Gatenby et al on page 49 of this report.

REFERENCES

Gatenby, R.M., Romjali, E., Wilson, A.J., Hutauruk, M., Glenn, J. and Pitono, A.D. 1992 Comparison of three drugs to control pancreatic fluke (*Eurytrema pancreaticum*) in sheep. Working paper 137. SR-CRSP Sei Putih, P O Box 1, Galang 20585, North Sumatra.

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EFFECT OF BREED OF SHEEP ON LEVELS OF GASTRO-INTESTINAL NEMATODES AT SUNGAI PUTIH

Aron Batubara, Iskandar Mirza, Melinda Hutauruk,
Ruth M.Gatenby and Alan J. Wilson

INTRODUCTION

In the humid tropics gastro-intestinal nematodes are one of the most serious health problems of sheep. Control of nematodes by pasture spelling and the use of anthelmintics is difficult for farmers in Sumatra because grazing land is communal and anthelmintics are not yet available in rural areas.

An alternative method of controlling nematodes is to develop genotypes which are resistant to nematodes. Our studies so far have suggested that there may be (i) differences between breeds, and (ii) differences between individuals within breeds in susceptibility to nematode infection.

The objective of this experiment was to monitor the levels of parasitism in all breeds of sheep at Sungai Putih.

MATERIALS AND METHOD

The study is being conducted at Sungai Putih, North Sumatra, Indonesia in the sheep flock of the SR-CRSP at Suka Damai and laboratory work is being done at the Animal Research Institute (SBPT). The sheep are maintained under a management system of pasture spelling, moving every 3 months to clean pasture, with anthelmintic being administered 2 days prior to movement, and the sheep graze from 08.00 am to 16.00 pm each day.

Three young ewes from each of 6 breeds and two older ewes where available are being studied. There are six breed types: H (Virgin Island and 90% Virgin Island), S (Sumatra Thin-Tail), H1 (Virgin Island x Sumatra Thin-Tail F1 generation), B1 (Barbados x Sumatra Thin-Tail F1 generation), E1 (Virgin Island x East Java Fat-Tail F1 generation) and HC (Virgin Island x Sumatra Thin-Tail F2 and subsequent generations).

The first samples for this study were obtained on February 15 1993 and subsequent samples were taken every two weeks. EPG was measured in all samples and PCV was measured in samples from April onwards.

RESULTS AND DISCUSSION

Average values of faecal egg counts for each genotype are shown in Figure 1. Anthelmintic was given at the beginning of January 1993 and again on 4 April. Egg counts were reduced to zero following administration of anthelmintic, but increased rapidly afterwards.

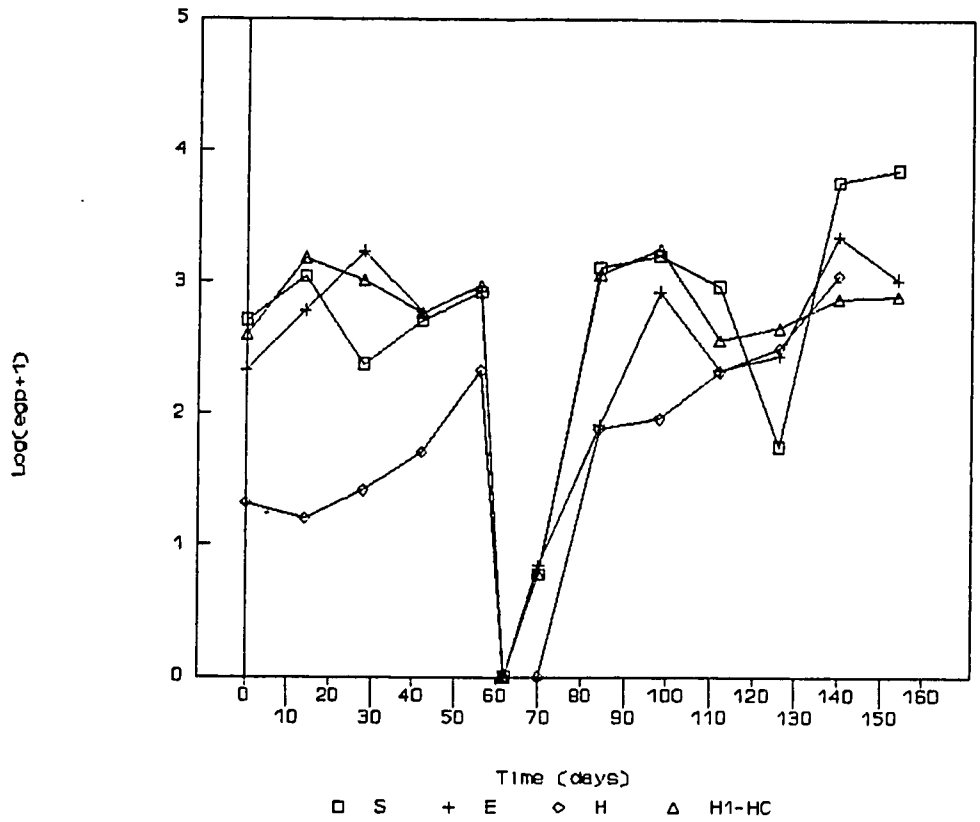

Figure 2. Average faecal egg counts of groups of ewes. The data were collected from August 3 (day 0) to January 1993. Anthelmintic was given on day 62.

Egg counts were higher in the period of February and March than in April to June. This difference can be attributed to the better quality of forage available in the area grazed from April to June.

Mean egg counts for each breed

The final four samples before anthelmintic was given at the beginning of April and the beginning of July were subjected to further analysis. Analysis was performed using the GLM procedure of SAS. The data were transformed using the transformation log(epg+1).

The overall transformed mean was 2.05 which corresponds to 110 epg. Time of sample, breed of animal and individual animal within breed all had highly statistically significant effects on faecal egg count. The means for each breed are shown in Table 1.

Table 1. Mean transformed values of faecal egg counts.

Breed	Mean±SE
B1	2.27±0.19[b]
E1	2.03±0.19[b]
H	1.41±0.14[a]
H1	2.22±0.14[b]
HC	2.30±0.16[b]
S	2.26±0.15[b]

The average egg counts of all breeds were similar, except that the Virgin Island hair sheep (H and H3) had considerably lower worm burdens than the other breeds. All ewes were subjected to the same grazing environment. There are two possible reasons for this breed difference (i) sample size was small with only five hair sheep monitored and, as there is much between-animal variation in epg, this may just be a chance effect; and (ii) H ewes are less susceptible than the other breeds to worm infection. Virgin Island sheep developed in a hot humid climate in the Caribbean where there is much selection pressure for worm resistance.

CONCLUSION

The faecal egg counts of all breeds were similar, except that the Virgin Island purebred and third-generation backcross sheep had lower worm burdens than the other genotypes.

This result is encouraging, as it shows that introducing Virgin Island hair sheep into North Sumatra does not increase susceptibility to internal parasites.

EFFECT OF GENOTYPE OF SHEEP ON LEVELS OF WORMS AND FLUKE

Ruth M. Gatenby, Gatot Adiwinata, Alan J. Wilson, Iskandar Mirza, Aron Batubara, Melinda Hutauruk and Immanyanto

INTRODUCTION

As part of the programme to improve sheep productivity in North Sumatra, local Sumatra sheep are being crossed with Virgin Island, Barbados Blackbelly and Java Fat-tail breeds. One critical characteristic in a hot-humid climate is susceptibility to internal parasites. Are the introduced genotypes more suscpetible to worms and fluke?

Three batches of 20 ram lambs were subjected to well-defined grazing management then slaughtered to study levels of nematode and trematode infection. The data presented here are those of nematode levels and growth rate, and worm counts at slaughter.

MATERIALS AND METHOD

Groups of five ram lambs of four genotypes aged about 4 months and weighing 8-16 kg were subjected to one month grazing on contaminated pasture followed by one month stall-feeding then were slaughtered. The trial was repeated in three seasons starting August 1992, November 1992 and February 1993. At the start of each trial all the lambs had been weaned for at least two weeks and they were treated with anthelmintic.

The genotypes used in this experiment were:

S Sumatra;
B1 Barbados Blackbelly x S, first generation;
E1 Java Fat-tail x S, first generation;
H1 Virgin Island (St Croix) x S, first generation; and
HC Virgin Island (St Croix) x S, second generation.

B1 lambs were available only in the first season, when they were compared with E1, H1 and S lambs. In the second and third seasons the breeds compared were E1, H1, HC and S.

RESULTS AND DISCUSSION

Faecal egg counts

Faecal egg counts (epg) were converted for statistical analysis using the transformation log(epg+1). The final five values of epg in each trial were analysed using analysis of variance on the statistical package SAS. The factors included

in the analysis were breed, animal within breed and time. In all cases time had a significant effect on worm burden; epg increased with duration of infection.

Table 1 shows the mean values of log(epg+1) for the five genotypes. The overall geometric mean was 3.64, corresponding to a faecal count of about 4400 eggs per gram.

Table 1. Mean transformed faecal egg counts (eggs per gram faeces). Mean±SE.

	n	Season 1	Season 2	Season 3
B1	5	3.40 ± 0.05^{a}		
E1	5	3.60 ± 0.05^{b}	3.75 ± 0.11^{bc}	3.90 ± 0.06^{a}
H1	5	3.58 ± 0.05^{b}	3.79 ± 0.11^{c}	3.76 ± 0.06^{a}
HC	5		3.30 ± 0.11^{a}	3.80 ± 0.06^{a}
S	5	3.56 ± 0.05^{b}	3.46 ± 0.11^{ab}	3.83 ± 0.06^{a}

Values in each column with the same superscipt are not significantly different.

B1, H1 and HC animals had geometric means similar to or slightly lower than the S animals, showing that crossbreeding with Barbados Blackbelly or Virgin Island genotypes does not increase susceptibility to worm infection. The second generation HC lambs had similar worm burdens to the first generation H1 lambs. E1 ranked highest or second highest each season, suggesting that this genotype is the most susceptible to worm infection.

In all seasons animal within breed had a highly significant ($P<0.01$) effect on log(epg+1) showing that there is considerable variation between individual lambs in susceptibility to worms.

Growth rates

Table 2 shows that there were no statisitically significant differences between breeds in growth rate during the two-month period of the experiment.

Table 2. Growth rates of lambs (g/d). Mean±SE.

	n	Season 1	Season 2	Season 3
B1	5	84.2±53.7[a]		
E1	5	77.0±11.5[a]	61.5±21.7[a]	52.0±20.2[a]
H1	5	93.0±25.5[a]	66.8±26.9[a]	72.2±15.8[a]
HC	5		60.8±24.8[a]	58.2±10.2[a]
S	5	77.5±21.1[a]	73.5±29.7[a]	51.2±31.1[a]

Number of worms and flukes at slaughter

Table 3 summarises the data obtained at slaughter. *Haemonchus contortus* is the worm of most serious economic consequence. Even though the lambs were only six months old at slaughter, many were already infected with pancreatic fluke, *Eurytrema pancreaticum*.

Table 3. Mean values of parasite counts and weight of pancreas. Only means marked * were affected by genotype.

	Transformed values			Overall actual mean
	Season			
	1	2	3	
Abomasum: *Haemonchus contortus*	2.88	2.61	2.65	520
Abomasum: *Trichostrongylus*	0.38	0.10	0.34	2
Small intestine: *Cooperia*	2.01	2.40	2.90	270
Small intestine: *Trichostrongylus*	1.74	1.27	2.25	57
Small intestine: *Strongyloides*	0.41*	0.70	0.23	3
Large intestine: *Oesophagostomum*	0.11	0.25	1.52	4
Pancreas: *Eurytrema pancreaticum*	0.87	1.69*	1.03	16
Weight of pancreas (g)	23.5	24.3	19.8	23

The only means affected by breed were numbers of (i) Stronglyes in the small intestine in Season 1 (B1 0.45±0.54; E1 0.19±0.39; H1 1.00±0.30; S 0.00±0.00), and (ii) E pancreaticum in the pancreas in Season 2 (E1 0.78±0.75; H1 1.26±1.45; HC 2.62±0.18; S 2.11±0.36). However, comparison with means from the other seasons showed that there were no consistent effects of breed.

CONCLUSIONS

1. Levels of infection with worms and pancreatic fluke in the rubber plantation environment in North Sumatra are high.

2. Differences between individual animals in susceptibility to worms and fluke are much larger than differences between genotypes.

EFFECT OF TIME OF GRAZING ON WORM UPTAKE BY SHEEP

Iskandar Mirza and Ruth M Gatenby

Internal parasites are one of the most serious health problems of sheep in plantations in the humid tropics. Sheep excrete worm eggs in the faeces; the eggs hatch into larvae which move up the leaves of grass and are eaten by sheep.

It has been suggested that the infection of grazing sheep by worms is most severe in the morning when the grass is damp, and least severe in the afternoon when the grass is drier and provides a less favourable environment for the larvae. Many farmers allow their sheep to graze only in the afternoon. The primary reason for this is usually that the children who herd the sheep are at school in the morning, but it has also been speculated that the tradition of afternoon grazing has arisen in response to a reduced worm burden.

The objective of this research was to see if the time of grazing affects the level of infection of sheep with worms.

METHOD

Sixteen ram lambs aged approximately 4 months and weighing 9.7 - 20.3 kg were divided into four blocks on the basis of breed and body weight. The four blocks were

1 Virgin Island hair sheep - H, H4 and H3.
2 East Java Fat-tail x Sumatra - E1.
3 Larger Virgin Island x Sumatra - HC and H1.
4 Smaller Virgin Island x Sumatra - HC.

One lamb from each block was randomly allocated to each of the four treatment groups:

I Grazed 0800-1200h. "Morning".
II Grazed 1100-1500h. "Midday".
III Grazed 1400-1800h. "Afternoon".
IV Lambs stayed in the sheep house. "Control".

The duration of grazing for groups I, II and III was 4 hours, but the time of the grazing periods was staggered, starting at 0800h, 1100h and 1400h. The lambs were grazed in the same area as a large flock of sheep on natural vegetation in an old rubber plantation.

The Control group of lambs and Treatments I, II and III when not grazing were kept in a group pen in a sheep house which had a raised slatted floor. They were given grass cut from an ungrazed area. A small amount of concentrate was also fed daily.

Before the experiment started, each animal was inspected to establish that its general health was good. Samples of faeces, blood and urine were inspected in the laboratory.

The duration of the experiment was six weeks, from 29 November 1992 to 11 January 1993. Initially all the lambs were given Febantel anthelmintic (Rintal, Bayer) orally at a rate of 1 g per 20 kg body weight. One day later the experiment began. The animals were weighed and faeces samples collected from the anus twice each week.

The worm eggs in 2 g samples of faeces were extracted using saline solution following the McMaster technique and counted to give the numbers of eggs per gram of faeces (EPG). The body weight and EPG data were entered onto the computer using Lotus 1-2-3 and analysed using SAS.

RESULTS AND DISCUSSION

At the beginning of the experiment, levels of worm eggs in the faeces (EPG) were very low because all worms in the animals had been killed by the anthelmintic. About three weeks after the start of the experiment eggs began to appear in the faeces of the grazed animals (Figure 1).

the start of the experiment eggs began to appear in the faeces of the grazed animals (Figure 1).

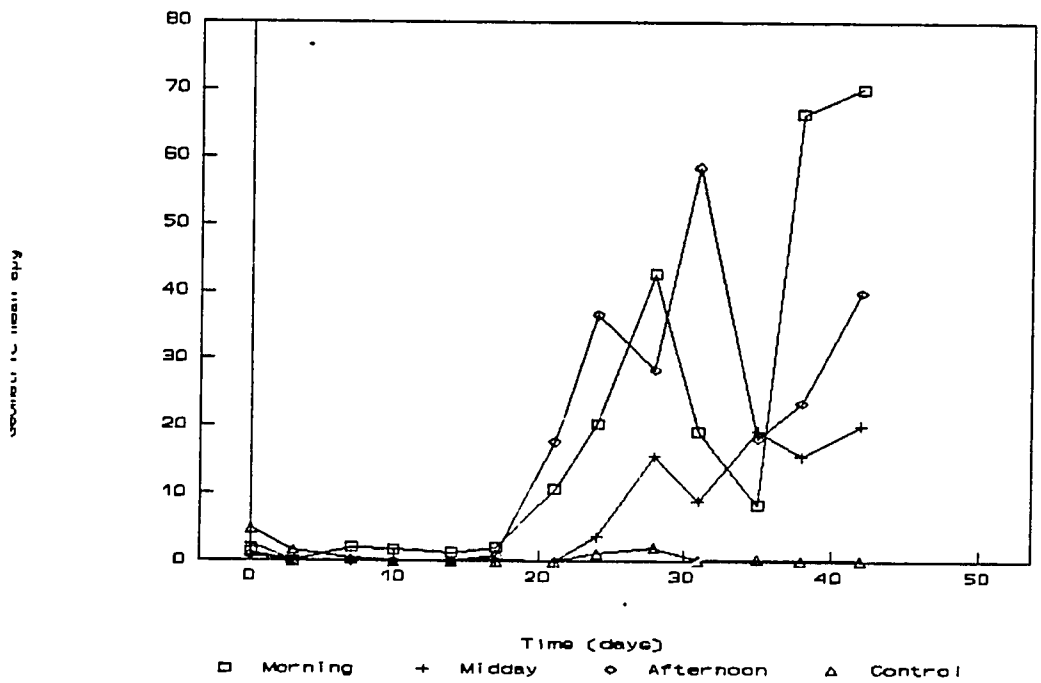

Figure 1. EPG values of lambs during the experiment. (Average values for each treatment).

In the grazed animals the numbers of worm eggs per gram of faeces (EPG) began to rise after about 3 weeks. Analysis of ln(EPG+1) from the final 5 samples showed that treatment had a significant effect ($P<0.01$). The stall-fed control group

maintained a very low EPG (geometric mean 0.5). For the lambs grazed in the morning, midday and afternoon, geometric mean values were 48, 15 and 31, respectively. The lower worm burden of the midday group is attributed to the dryness of the pasture at midday. Delaying grazing until midday reduces the worm burden of lambs, but uptake of worms is high if they are grazed in the late afternoon.

Overall mean growth rate (LWG) was 88 g/d. The growth rates of the four treatment groups were not significantly different. Animals with high EPG tended to have low LWG, and vice versa. Although the stall-fed group had the lowest EPG, LWG was not as high as the midday grazed group, presumably because the nutrition of the grazed lambs was superior.

CONCLUSION

Delaying the start of grazing until late morning reduces but does not eliminate worm infection by sheep. Uptake of worms in the late afternoon appears to be almost as great as uptake in the early morning.

Level of worm burden in sheep can be maintained at a negligible level by stall feeding with grass cut from an area which is not grazed.

REFERENCE

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EVALUATION OF EXISTING FEED RESOURCES FOR SHEEP REARING IN VILLAGES OF THE OPMM AND ORP PROJECTS

Artaria Misniwaty, Juniar Sirait,
Jos van Oostrum and Peter Horne

The botanical composition, chemical composition and feeding value of forages in plantations are well understood (Sanchez, 1989 and Sivaraj et. al., 1992). In general, forages in young rubber plantations have adequate protein and energy contents but these decline rapidly as the plantation ages. Adequate levels of dry matter, energy and protein intake by sheep can be maintained in young plantations, but supplements are necessary for sheep grazing older plantations. Previous research by the SR-CRSP and SBPT has identified various forms of supplementation for sheep (including tree legumes and agricultural/industrial by-products) on diets of plantation grass. The next stage of the research is to characterise the existing feed resource in villages associated with rubber plantations and recommend which supplements can be used to improve sheep productivity.

One way to overcome shortages of forage on plantations is to plant large areas with higher yielding, shade tolerant species. This solution is not, however, appropriate for farmers on the fringes of plantations or smallholder rubber producers. Not only do improved forages require large amounts of valuable land but they also require careful management to maintain legume persistence. There is also no tradition of forage production among livestock rearers in Indonesia. For smallholders, supplements of shrub and tree legumes and cheap, locally available feedstuffs (such as rice bran and oil palm by products) offer the best prospects for improving the base feed resource of plantation forages, crop residues and tree leaves. The more common tree legume species (such as *Calliandra, Albizia, Leucaena* and *Gliricidia*) are persistent, easy to grow and can be harvested to provide a high-protein supplement at strategic times. Also, there is a tradition in Indonesia of feeding tree leaves to ruminants.
To estimate the potential feed resource of plantations in North Sumatra, Juniar Sirait is collecting data on the area and age structure of all plantation from the major plantation companies of North Sumatra.

A survey of farmers associated with the outreach projects (ORP and OPMM) and farmers who rear sheep in the vicinity of those projects, is being prepared. The survey will provide information on current and preferred feeding systems (grazing vs. cut-and-carry or a combination of both), limitations of the feed resource (quantity, quality, distance, labour, seasonal shortages, access to land) and opportunities for

improving the feed resource (availability of unused land and agricultural by-products). The survey will be conducted for three months during each of the wet and dry seasons, starting in August 1993.

A small group of farmers will be chosen for specific monitoring of their sheep by Jos van Oostrum to measure feed composition, dry matter intake, feed quality and diet selection.

At the same time, an evaluation will be made of each ORP and OPMM farmer's land resources to provide advice on where tree legumes could best be planted and which species would be most appropriate. Seedlings will be raised in polybags and distributed. Guidelines on when to harvest and how to feed the leaves will be given (based on the results of the previous survey) and yields will be measured, in terms of quantity of leaves fed per month for a period of one year.

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EVALUATION OF PROMISING NEW FORAGES FOR SHADED ENVIRONMENT

Peter Horne and Misro Aliandi

In the first stage of evaluation of forages for shaded environments, the SR-CRSP investigated over four years the yields and persistence of 21 promising species and 12 mixtures sown in plots under young rubber trees. The best of these species are being carried forward into large-scale evaluations under grazed and cut conditions. Since the first evaluation experiment commenced, new promising planting material has become available. Twenty accessions of *Arachis* spp. (grazing peanut from Florida), one commercial release of *Arachis pintoi* from Australia, two accessions of *Stenotaphrum secundatum* (buffalo grass from Vanuatu) and one accession of *Clitoria ternatea* (tropical legume from North Carolina) are being propagated in polybags for later evaluation in shade under rubber trees.

In Malaysia, *Arachis* spp. have produced substantially higher yields under 50% shade than in full sunlight, although the results are variable. In Sulawesi, *Arachis pintoi* has shown great promise for the light shade under coconuts. Additional lines of *Arachis* spp. will be sent from North Carolina, where they are currently being screened in glasshouses for shade tolerance and insect resistance. The most shade tolerant lines are being examined to determine the mechanisms of tolerance as well as the physiological and production consequences of the trait.

Stenotaphrum secundatum is well adapted to the shade conditions of coconut plantations and is widely used for cattle production in plantations on the islands of the South Pacific. It is not clear how well it will grow under the harsher conditions under rubber trees. It has only a moderate nutritive value but it does have the potential to survive longer than any of the other sown species and may thus overcome the concern of plantation managers that as sown forages die out, the worst weeds will return. *Clitoria ternatea* is a tropical legume adapted to humid wet climates but does not normally persist well under grazing. The line used here has been selected in the US for its better performance in shade.

The *Arachis* and *Stenotaphrum* accessions were available only as stem cuttings and the *Clitoria* in a small seed batch. It is expected that sufficient planting material will be available for a field evaluation in January 1994.

ERADICATION OF *ASYSTASIA INTRUSA* FROM THE RUBBER PLANTATIONS SURROUDING SUNGAI PUTIH

Miro Aliandi, Tuti Kustyanti and Peter Horne

Asystasia intrusa is an herbaceous species of the family Acanthaceae. It is remarkable for its wide adaptability, being able to grow well in full sun as well as deep shade. It has a high nutritive value with dry matter, crude protein and energy digestibilities of ~62%, 68 g/kg DM and 2.1 Mcal/kg respectively (Mokhtar and Wong, 1988). However, it is now regarded as the most serious weed of rubber and oil palm plantations in Malaysia, because of its high demand for nutrients, and it has been shown to significantly reduce plantation yields (Abdullah, 1985). One of the main reasons for sheep research in Malaysia is to control *Asystasia intrusa* in plantations. Although *Asystasia intrusa* has been reported in North Sumatra since 1940, there have been no reports of it becoming a serious weed in plantations.

Asystasia intrusa was introduced to Sungei Putih, North Sumatra from Malaysia in 1988 for field studies on its value as a forage for sheep. Since that time it has gradually spread to the immediate surrounding areas. The main mechanisms of spread are thought to be transport by people (seeds in cut forage or soil used to fill polybags), seed on car tyres and seed dispersed through explosion of its pods (Abdullah, 1988). It is unlikely that it is spread by birds or wind. Until the full benefits and adverse effects of this species are better understood, its natural spread should be controlled.

A survey has been conducted to identify how far the species has spread and it appears the area of infestation is relatively small (5km radius of the old forage experiment). Several experiments have been conducted to determine the longevity of the seed in the soil, when stored, when eaten by sheep and when incubated in the rumen. Seed stored for seven months in a desiccator had extremely low germination (<5%). Seed sown on the surface and at depth (>5cm) did not germinate because of fungal attack (the former) and too great a depth for radicle emergence (the latter). It appears that the seed will not remain viable in the moist soil for more than three months. The ability of the seed to pass through the gut of sheep and remain viable is still unknown.

A small trial was conducted to compare the performance of six herbicides and all proved effective. *Tordon* (a 2-4D base) is now being used to eradicate the *Asystasia intrusa* in all the known areas of infestation. As *Asystasia intrusa* does not appear to maintain a large and persistent pool of seed in the soil, it is likely that the weed can be eradicated after each infestation has been sprayed 3-4 times. All infested areas will be checked regularly for new outbreaks.

The help of rubber tappers and farmers who cut grass for their livestock in the known infested area is to be sought to ensure that there are no new or undetected infestations. The eradication program will continue for at least one year, possibly two.

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THE NUTRITIVE VALUE OF THREE TREE LEGUME SPECIES AND THEIR EFFECT ON GROWTH AND INTAKE OF GROWING LAMBS

Roger Merkel and Kevin Pond

The overall objective of this PhD research was to evaluate three species of tree legumes as supplementary feed for sheep. Included in this evaluation are the effects of tannins on digestibility of both total diet and dietary protein. Three separate experiments were conducted to look at these effects with objectives and methodology summarised below.

The first experiment, consisting of three trials, examined the effect of tannins found in three tree legume species (*Paraserianthes (Albizia) falcataria, Gliricidia sepium* and *Calliandra calothyrsus*) on growth rates and dietary protein utilisation in growing lambs. The first of these trials investigated the long term effects feeding these three species have on growth and intake of growing lambs. Concentrate based diets containing 14% crude protein were fed to 42 ram lambs divided into seven groups. Each tree species was fed to two groups at different levels of protein substitution, 25 and 50% of total dietary crude protein. A control group received *Paspalum dilitatum* along with a concentrate. Concentrates were composed of available by-products from local oil palm, sugar cane, cassava and rice industries. The trial lasted 90 days.

Following the growth study, three lambs from each group were housed in metabolism crates for dietary digestibility and nitrogen balance determination through total fecal and urinary collection. This trial was conducted to determine the effect tree legume supplementation has on total dietary and protein digestibility. The final trial tracked the disappearance of protein from the digestive tract. To accomplish this, lambs from the digestibility trial were dosed with chromic oxide and slaughtered for digesta sampling throughout the digestive tract which will be analysed for nitrogen content. Relative concentrations of nitrogen found in different parts of the system will indicate where protein is being digested and absorbed. If tannins are binding protein irreversibly a higher proportion of nitrogen will be expected further along the tract.

Results from this series of trials will reveal the effect these tree legume species have on growth, intake, dietary digestibility and protein utilisation. These results will affect the decision on which tree species to extend to farmers and the amount that can be fed to lambs with no adverse effects upon growth rate. The potential relative capacities of these species to reversibly bind protein creates the possibility of diet formulation including tree legumes as a source of by-pass protein.

The second experiment concerned the feeding value of tree legumes to sheep. Of concern when using tree legumes in diet formulation is having correct chemical composition data. Components such as nitrogen, fiber and minerals can be easily determined from laboratory analyses. The energy derived by an animal from these

feeds is an area where little data exists. True digestibilities of these tree legumes also need further estimation. In order to estimate the true digestibility and digestible energy obtained by sheep from *Paraserianthes (Albizia) falcataria, Gliricidia sepium* and *Calliandra calothyrsus* an experiment was designed using these tree legumes as sole feeds. Also included as feeds were *Paspalum dilitatum* and *Asystasia intrusa*. Twenty ram lambs were housed in metabolism crates, four per group, for total fecal and urinary collection. Fed material and refusals were sampled for chemical composition. From this experiment the digestibility of the total feed as well as components, i.e. fiber and protein, can be established plus digestible energy and nitrogen balance.

The last experiment conducted using tree legumes evaluated two different methods of sample preparation upon digestibility as measured by the nylon bag technique. The three tree legume species previously used were harvested with each sample being divided into two parts. One part was frozen and oven dried at 60C while the other half was frozen and freeze dried. Each sample was then ground through a 1mm screen. Nylon bags were filled with three grams of ground material and incubated in the rumen fistulated bulls for 96, 48, 24, and 12 hours. These times were chosen to evaluate the rate and extent of digestion. Literature reports that tannins are destroyed by oven drying while are preserved when samples are freeze dried. Differences may appear between the digestibilities of the differently prepared samples.

A further study investigated the effect forage supplementation has on sheep grazing for only half a day. Four groups of grazing ewes were used: four hours in the morning, four hours in the afternoon, full day grazing and barn fed. Sheep grazing for four hours in either the morning or afternoon received 5 kg supplemental forage per group while the full day group received no supplemental forage. Intake was measured by twice daily chromic oxide dosing for twelve days with grab fecal samples taken the last five days. Samples of available forage were taken for digestibility determination. Four different breed crosses were utilised to obtain indications of possible breed differences. Different breed crosses may respond differently to the heat and humidity often found in North Sumatra.

A final experiment concerned the palatability of *Gliricidia sepium*. Conflicting literature reports that animals may not consume fresh *Gliricidia* leaves due to the aroma given off caused by coumarins contained in the tissue. Several authors recommend that leaves be wilted before feeding to increase intake. At Sungai Putih fresh *Gliricidia* has been fed and found to be relished by sheep. In order to evaluate any differences in preference by sheep between fresh and wilted material a simple preference trial was conducted. *Gliricidia* was harvested to provide wilted material of 6 and 24 hours. These two wilting levels were then offered to sheep along with fresh Gliricidia for 15 minutes. Samples were weighed to determine intake. Samples were also taken for coumarin analysis to evaluate differences in the amount of coumarin that is lost by wilting.

GROWTH POTENTIAL AND DRY MATTER INTAKE OF SIX BREED OF SHEEP WHEN FED PLANTATION GRASS AND CONCENTRATE

Peter Horne and Kevin Pond

A major aim of the SR-CRSP is to produce a breed of hair sheep that is well adapted to the climate and feed resources of the tropics. Two main parameters contributing to the relative productivity of lambs post-weaning. Results from the experimental flock in North Sumatra indicate that Virgin Island x Sumatra crossbred (H1) ewes are significantly heavier than local ewes and reproductive performance (as measured by kg lamb weaned per kg of ewe metabolic weight per year) is 20% higher for the H1 ewes (Gatenby et al., 1993). The aim of this research was to study the relative productivity of crossbred lambs post-weaning.

In the experimental flock, lambs are fed cut plantation grass with a concentrate supplement for three months after weaning. In the outreach projects of the SR-CRSP, few farmers feed anything but grass and it is thought that dry matter intake of their sheep is also limited. However, supplementation with shrub and tree legume leaf is realistic prospects for improving the basal feed resource in villages. The more common tree legume species (such as *Calliandra, Albizia, Leucaena* and *Gliricidia*) are persistent, easy to grow and can be harvested to provide a high-protein supplement at strategic times. There is also a tradition in Indonesia of feeding tree leaves to ruminants.

Two experiments were conducted to compare the growth and dry matter intake of six breed types of lambs when fed three diets, representing low, moderate and high nutritive value. The six breed types used were Sumatra Thin Tail (S), Virgin Islandx Sumatra (H1), Barbados BlackbellyxSumatra (B1), East Java fat tailx Sumatra (E1), H1xH1 (HC) and East Java fat-tail (E). Lambs were chosen such that the average weight for the treatments within each breed group were similar. The lambs were pen fed in groups of four (first experiment) or five (second experiment). Refusals were measured daily and lamb weights measured weekly. The first experiment ran for 84 days and the second for 119 days. The aim of the experiments was to examine the extent to which crossbred lambs require a higher quality diet to express their higher genetic potential compared with local lambs.

The three diets consisted of:

Low Nutritive Value: *ad lib* plantation grass plus 400 g per head of concentrate (composition of concentrate:CP 11.8%; 2.77 MJ ME/kg; major constituent: palm kernel cake),

Moderate Nutritive Valeu: Concentrate plus *Albizia* leaf (to provide 50% of dietary CP in a diet containing CP 14% and ME of 2.5 MJ ME/kg). Total DM offered was 3.3 % BW

High Nutritive Value: *Paspalum dilatatum* plus a high energy/high protein concentrate given at 70% of dry matter intake (main constituents: corn and soybean meals; CP 15.3%; 3.22 MJ ME/kg). Total DM offered was 3.3% of BW.

Average daily gains (ADG) over the duration of the experiments are presented in Table 1. For all breeds for which comparisons could be made, ADG from the Low diet were similar to those from the Medium diet. ADG of B1 on the Low diet tended to be lower than from the other breeds. The highest ADG were produced by B1, E1 and H1 on the High diet, with ADG of some individual weeks greater than 250g/d.

Table 1. Average Daily Gain of breed groups on three diets

	Diet for First Experiment		Diet for Second Experiment	
Breed	Low	High	Low	High
B1	60.7	174.0	x	x
H1	84.8	166.4	77.9	141.4
E1	81.4	167.6	94.3	135.7
HC	x	x	88.2	131.6
E	x	x	85.9	120.2
S	90.8	127.6	98.1	149.8

x-treatment combination not included

The trend for lower ADG from B1 on the Low diet compared with S has to be qualified by the fact that the concentrate was goven on per head basis rather than per kg body weight and the S lambs were smaller than B1 at the start of the experiment (mean weights of 15.4 and 26.8kg respectively). However, as plantation grass was provided *ad lib* these results are no worse than might be expected from a typical smallholder sheep raiser. Total weight gains over the duration of the experiment from B1, H1, and S averaged 14.6 14.2 and 10.8 kg/head for the High diet and 5.1, 8.7 and 8.0 kg/head for the Low diet. These results have yet to be statistically analysed and compared with dry matter intake. The use of various tree legume species as a sole supplement for plantation grasses and improve forages will be part of the large scale trials on improved forages.

NUTRITIVE VALUE OF EX-DECANTER OIL PALM SOLID WASTE

Agus Salim, Bustanil Arifin, Nurul Najmah, Nurul Aswalainy, Leo Batubara, Junjungan Sianipar, Artaria Misniwaty and Peter Horne

Palm kernel cake (PKC), a by-product of palm oil production, has been used as a feed supplement in numerous SR-CRSP experiments. It has adequate levels of both energy (2.4 MJ ME/kg) and protein (15% CP) but is expensive as it is exported for animal feed in Europe. More recently, the waste produced by the washing of extraction equipment (Palm Oil Mill Effluent; POME) has been examined as a feed for livestock. POME has a lower nutritive value than PKC but is much cheaper than PKC and can sustain adequate growth of animals when fed as a supplement. Another by-product of the centrifuge palm oil extraction process is ex-decanter solid waste. This waste has potential as a feed supplement, having a crude protein content of ~15% and an estimated energy concentration of 2.4 MJ/kg. Whilst it has the advantage of being cheap, the largest drawback is that it is 75% water, limiting its use to areas surrounding the factories. A factory that processes 800 tons of fresh fruit per day, yields 12 tons of solid waste. Of the current 150 oil palm factories in Indonesia and 150 under construction, most of the factories are based on this process.

Four experiments have been planned to examine the feeding value of ex-decanter solid waste

1. Growth of lambs fed a supplement containing wet ex-decanter solid with and without a high-energy additive (cassava meal or molasses)

   Four feed treatments will be used, at a fixed percentage of body weight:
   - 100% Paspalum
   - 70% Paspalum and 30% concentrate (67% solid, 33% cassava meal on DM basis)
   - 70% Paspalum and 30% concentrate (67% solid, 33% molasses on DM basis)
   - 70% Paspalum and 30% concentrate (100% solid)

2. *In vivo* dry matter digestibility and fibre-fractions of diets containing wet ex-decanter solid

   The same feed treatments as in experiment 1 will be used. Twelve sheep will be fed these diets in metabolism crates for a total of twenty days. Feed offerred, dry matter intake and faecal output wil be measured and samples of feed and faeces collected.

3. Growth of lambs fed a supplement containing three levels of dried ex-decanter solid

The treatments to be imposed are:

100% Paspalum
30% Paspalum and 70% concentrate (containing 15% solid)
30% Paspalum and 70% concentrate (containing 30% solid)
30% Paspalum and 70% concentrate (containing 45% solid)

The composition of the concentrates will be adjusted to maintain a crude protein composition of 16%. Five three month old lambs will be used per treatment in individual pen feeding.

4. *In sacco* dry matter and crude protein digestibility of dried ex-decanter solid

This experiment will examine the dry matter and crude protein digestibility of the following concentrate compositions:

67% solid, 33% cassava meal
100% cassava meal
100% solid

Dried, ground samples will be placed in the rumens of three fistulated bulls for periods of 6, 12, 24, 48 and 96 hours. Measurements of the disappearance of dry matter and crude protein will be calculated from dried samples.

These experiments will be conducted by students in ruminant nutrition fom Andalas University in Padang, West Sumatra, under the supervision of SR-CRSP and SBPT scientists. The experiments wioll commence at the end of July and will continue for a period of 3-5 months.

EVALUATION OF FORAGES FOR RUBBER PLANTATIONS

Peter Horne, Joe Burns, Kevin Pond, Dwight Fisher,
Junjungan Sianipar, Tuti Kustyanti, Sumarmadji,
Tatang Ibrahim, Simon Ginting and Misro Aliandi

The most likely method of integrating forages and conventional rubber plantations involves establishing a mixture of the improved forages in strips between the rows of newly-planted rubber. The forage can then be cut for feed until the rubber trees are two years old and then grazed until the rubber canopy closes and the forages disappear under the heavy shade.

Testing of new forages for these conditions requires a number of equally important stages of research (see Figure 1). In particular, long-term persistence of shaded forages are strongly related to grazing frequency and intensity. Shaded forages tend to divert larger amounts of energy into shoot production than root production than those grown in full sun. Regrowth and persistence of shaded forages are therefore more dependent on the amount of green leaf left on a plant after it has been grazed than on root energy reserves. Therefore evaluation of new forages under grazing and cutting is essential.

For rubber plantations, the first three stages of selection have been adequately covered through work over the last four years by the SR-CRSP and other research organisations from Indonesia, Malaysia and Australia. As a result, many shade tolerant tropical forages have been identified, including accessions of the grasses *Panicum maximum, Stenotaphrum secundatum* and *Brachiaria humidicola* and the legumes *Arachis pintoi, Desmodium heterophyllum, Stylosanthes humilis* and *Stylosanthes guianensis*. These species must now be carried through to the fifth and sixth stages of evaluation in which their performance in grazed or cut swards under shaded conditions is evaluated.

forages for the four experiments listed below will be sown in August 1993 to complete these fifth and sixth stages of evaluation. Cultivation of the field site commenced in June 1993.

1. Growth and residual biomass of four grazed tropical pastures under rubber trees

In this experiment, four forage mixtures will be planted under young rubber to determine:

a. residual biomass after defoliation that favours regrowth and persistence
b. tillering characteristics of the forage species
c. diet selection of grazing animals

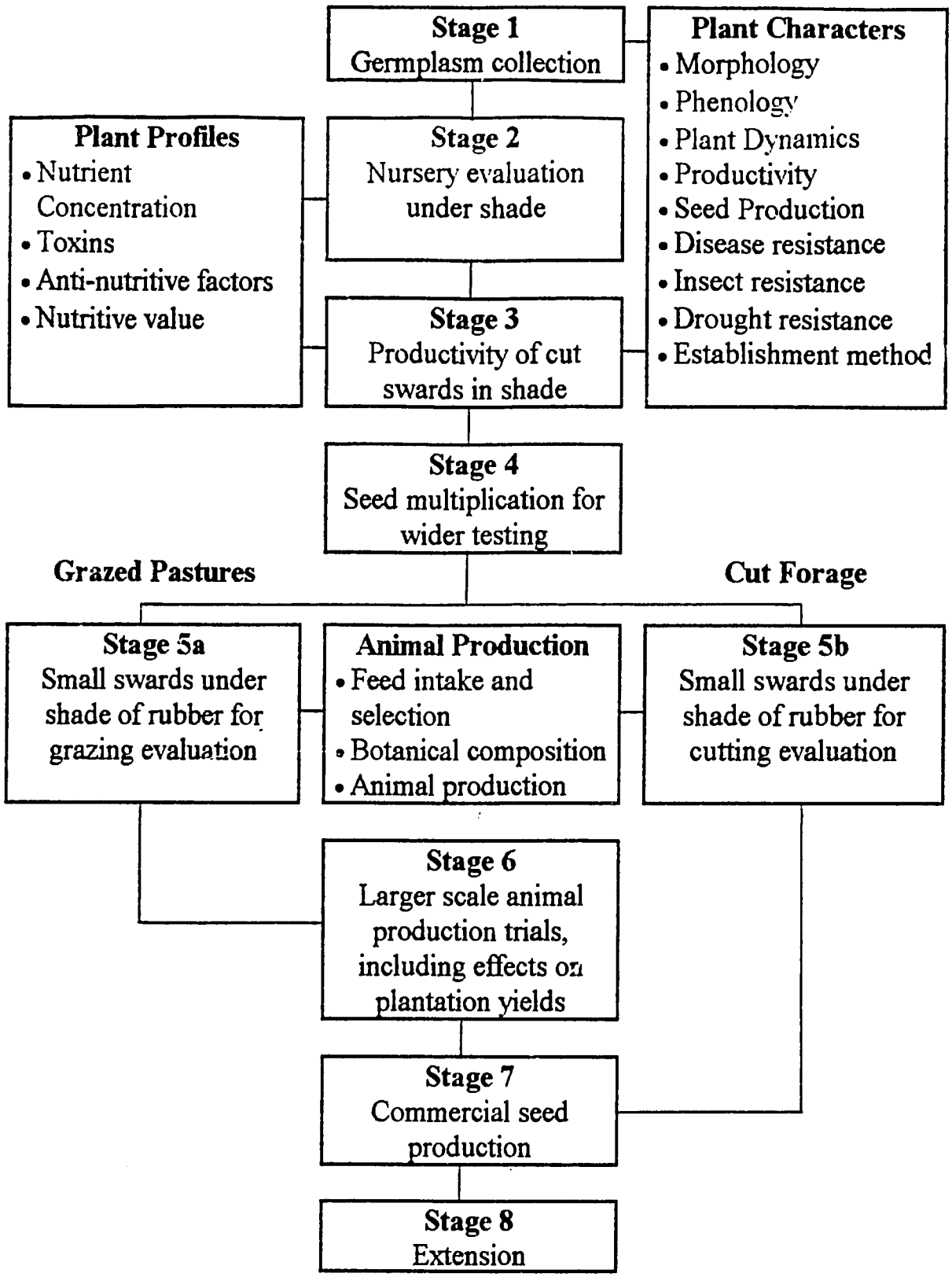

Figure 1. Scheme for evaluation of forages for rubber plantations (after Blair 1990)

The four mixtures are:

Pueraria javanica and *Centrosema pubescens*

Panicum maximum, Stylosanthes guianensis, Stylosanthes hamata and *Arachis pintoi*

Paspalum notatum, Panicum maximum, Stylosanthes guianensis and *Arachis pintoi*

Brachiaria humidicola, Centrosema pubescens, Stenotaphrum secundatum and *Arachis pintoi*

Each of the four mixtures will be established between rows of existing trees that were transplanted in December 1992, giving plots 5m wide by 8m long. The total land area to be planted is 0.05 hectares.

The plots will be grazed when the rubber trees are old enough to not be disturbed by the sheep. Measurements will include weeding and establishment costs, herbage mass, botanical composition, tillering response to defoliation, diet estimation, chemical composition of diet and light (PAR) penetration to the ground.

2. Growth of lambs when grazing three tropical pastures under rubber trees

The main aim of this experiment is to determine lamb performance per day and per hectare from a pasture consisting of a mix of well-adapted grasses and legumes

Three treatments will be imposed:

forage only

forage plus tree legume supplement

forage plus by-product supplementation

The forage used will be common to all treatments and will consist of *Panicum maximum, Stylosanthes guianensis, Stylosanthes hamata* and *Arachis pintoi*. The forages will be planted in rows under the young rubber trees giving strips 5m wide. Grazing will commence once the rubber trees are old enough to not be disturbed by the sheep. The area being prepared for this experiment is approximately 2 hectares.

Measurements will include herbage mass, canopy architecture, lamb growth, diet estimation, grazing behaviour, dry matter intake and chemical composition of forage.

3. Tree legumes as a source of dietary nitrogen for ewes during the reproduction phase when grazing tropical grass pastures

Traditional cover crops in rubber plantations (commonly *Pueraria, Centrosema* and *Calopogonium*) are not ideal forages for sheep as they are characterised by either low productivity, low digestible

The lambs will be kept in a kandang and fed cut grass (*Panicum maximum, Paspalum notatum* and *Brachiaria humidicola*) from the field. Measurements will include herbage mass, canopy architecture, lamb weight, diet selection, dry matter digestibility and chemical composition. The area being prepared for this experiment is 0.5 hectares.

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