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PHILIPPINE CARABAO CROSSBREEDING RESEARCH

Report on the FAO/UNDP/Philippine Government Project PHI/78/017

J. Hodges 1/

The Philippines has about 2.9 million carabaos, 99 percent of which are in the hands of smallholder farmers, with 1-2 heads or more integrated closely with their farming systems. These are mainly used as draught

animals. The size and weight of these animals have been gradually declining since the farmers have been castrating the best bulls as work animals and leaving the weaker small sized bulls for breeding. Unknowingly, natural selection for smaller size has been going on. They are poor in milk and meat production. During Phase I (1981-86) the objectives of the project were:

a. To develop a strain/type of carabao that will be superior for draught, milk and meat under the backyard production scheme of smallholder farmers and commercial ranch production systems.
b. To generate the appropriate technologies of mating, feeding, care and management, herd health programme and extension strategies best suited for various types of crops-livestock integrated farming systems within the context of small farmer environment and resources.
c. To meet the country's animal draught power requirement in the present energy crisis and nutritional demands for milk and meat of the increasing human population.
d. To develop manpower training programmes to enhance the technical capabilities of personnel in various governments and private agencies involved in carabao production.
e. To build-up the research and training facilities of the pilot institutions through the assistance of UNDP in order to accelerate the development and improvement of the carabao as an important component of Philippine agriculture.

During the first three years (1981-1983) the foundation breeding stock was purchased (518 heads) and bred with the exotic semen of Murrah, Nili-Ravi and Thai bulls imported from abroad. So far 125 crossbreds have been produced in the centre both by artificial breeding and natural mating at the institutional herd as well as with the farmer cooperators. During Phase I, 300 crossbreds are to be produced and their performance has to be tested for draught, meat and milk production. An artificially induced breeding scheme has been successfully developed for smallholder farmers to increase the calf crop from carabao kept in smaller units and showing silent heat. This technology is being tested in the field.

The results so far on the crossbreds raised have shown that F1 crosses of Phil-Ravi (Native Carabao x Nili-Ravi) and Phil-Murrah (Native Carabao x Murrah) grow 42 percent faster than native carabao up to 24 months of age both under smallholder and ranch management conditions. The draughtability is the same as that of native at the same body weight without any physiological stress in the F, crossbreds. Milk production is about 2 1/2 times (1300 litres/300 days) more than the natives (550 litres/300 days). However, the number of animals is still low and confirmation of these preliminary results is awaited from larger numbers of pipeline animals.

Based on the above work, the Philippine Government is planning a 10-year National Carabao Development Project to undertake an action programme on large-scale crossbreeding of the native carabao to produce about seven hundred thousand crossbreds. Induced artificial breeding technology, generated by the project would be used in mass crossbreeding. Carabaos having long generation interval would need more time to produce enough offspring to serve as foundation stock for a new strain or type of carabao/buffaloes that would be superior for draught, milk and meat. Production of sufficient F_1s of various breeds (Nili-Ravi, Murrah and Thai) may take another 2 years and the evaluation of these F_1s may take another 3 to 4 years, before inter se matings of F_2s may be achieved. Hence, a minimum of 15 years may be required to produce a significant number of F_2s with stabilized characteristics for superior draught, milk and meat qualities. Hence, the second phase has been planned in order to make an objective evaluation of the performance of F_1 .

The project indicates the type of approach which will involve the use of different genotypes from various countries in improving animal production in developing countries in the future.

1/ Animal Production Officer, Animal Production and Health Division, FAO, Rome.

PRINCIPLES OF INDIGENOUS SHEEP IMPROVEMENT IN NORTH AFRICA

A. Lahlou-Kassi 1/

1. INTRODUCTION

The North African region, which includes Morocco, Algeria, Tunisia, Libya and Egypt, raises some 42 million sheep, and is ranked among the top sheep production areas in the world (FAO, 1981).

These sheep are mainly raised for meat and leather production, and to a small extent for wool and milk. Only 6 to 10 percent of ewes are milked in Morocco (Livestock Survey-MARA, 1975). Mutton contributes 6 to 55 percent to the total meat consumption in each country (Egypt 6 percent, Morocco 18 percent, Tunisia 35 percent, Algeria 47 percent and Libya 55 percent - FAO, 1981). Some countries like Algeria, Libya and Egypt import 20 to 50 percent of their meat needs, and the other countries are just self-sufficient.

The meat shortage in the presence of a relatively important sheep flock can be explained by low productivity. It is estimated that the average meat production per ewe per year is around 5 to 8 kg, and carcass weight does not exceed 10 to 15 kg (OADA, 1984).

Improvement of productivity in sheep flocks is then a must, the general principles for improvement being well known (health, feeding and reproductive management, breeding and crossbreeding). However, improvement objectives and the methods to be used should be defined for each country and for each breed according to the environment and management system, as well as the type of production desired.

A better knowledge of the performance of different sheep breeds present in the region, and analysis of experiments on improvement conducted there, will allow us to elaborate some basic principles and recommendations for improving the productivity of sheep in North Africa.

2. CHARACTERISTICS AND PERFORMANCE OF INDIGENOUS SHEEP BREEDS

This is not intended to be an exhaustive study, the paper being limited to the following:

- Phenotypic traits that seem to be linked to adaptation to heat and the general environment as well as walking ability.

- Performance traits that will permit an evaluation of the ewes' productivity level.

- Sheep breeds that are already identified as relatively homogeneous populations.

Most of the data presented in this paper were obtained on experimental stations, where the level of management is medium or relatively good, and consequently the breeds are better able to express their genetic potential.

2.1 Adaptation Traits

Among the most important traits for adaptation to the environment are coat type, colour, legs and temperament, as well as the size and location of fat "reserves". These have been well studied and should be considered in any improvement scheme.

2.1.1 Fat-tailed breeds

Almost all breeds of sheep in Egypt (Rahmani, Ossimi and Barki), Tunisia and Libya (Barbary) are fat-tailed.

- Rahmani: Located in the north-west of the Nile delta, relatively long-legged with a long fleece of coarse, kemp wool, generally brown.

- Ossimi: Raised mainly in Middle Egypt, the southern part of the Delta and upper Egypt; long-legged and has a coarse fleece, with kemp.

- Barki: Raised in the western desert; long-legged with a coarse open fleece.

- Barbary: Present in the steppes along the northern coast of Libya, and from the Sahara to the Tunisian coast; very hardy, long-legged and good walker.

2.1.2 Thin-tailed breeds

- Rembi: Raised in the Saharan Atlas Mountains and Djebel Amour (Algeria); long-legged, fine fleece.

- Hamra: Raised in the Western Plateau of Algeria; medium-legged, fine fleece.

- Tadmit/Ouled Djellal: Raised in Biska, Tonggout and Ouled Dejellal regions (Algeria); long-legged, strong skeleton good walker, fine fleece.

- Timahdite: Raised in Middle Atlas Mountains; medium-legged, coarse wool, semi-open fleece (Mrocco).

- Sardi: Raised in the central plateau Tadla Morocco; long-legged, coarse wool, closed fleece.

- Beni Guil: Raised in the high plateaux of the North and part of the sandy Pre-Saharian Zone of Missour: short-legged, coarse wool, semi-open fleece.

- Beni Hsen: Raised in the lowlands along the Atlantic coast; long-legged, finest wool, closed fleece.

- D'Man: Raised in the Oases of the South of Morocco; short-legged, mixed hair-wool.

2.2 Reproductive Performance

2.2.1 Puberty and age at first lambing

All breeds in the region except the D'Man have a late first lambing, the average age being 22 months. Ewe lambs are not able to conceive during their first year of life because of a delayed puberty, the age at first oestrus being about 14 to 16 months. The D'Man is peculiar for its precocity, the age at first oestrus being 6 to 8 months, and the first lambing generally at 11 months (Table 1).

Table 1 PUBERTY AND AGE AT 1ST LAMBING OF INDIGENOUS SHEEP BREEDS

Breed	Age at 1st oestrus (Months)	Age at 1st lambing (Months)
Timahdite	16 - 18	21 - 23
Sardi	14 - 16	20 - 23
Beniguil	-	21 - 23
Benihsen	-	21 - 23
D'Man	6-8	11 - 17
Tadmit/Ouled Jellal	-	18 - 24
Rembi	-	24
Hamra	-	20
D'Man	-	12
Barbary	10 - 12	16 - 22
Ossimi	7-16	21 - 24
Rahmani	-	21 - 24
Barki	-	21 - 24

There is a large variation between animals in the age at puberty for the Timahdite, Ossimi and Barbary breeds, as reported by several authors (278 to 386 days for the Barbary, 240-400 days for the Timahdite).

2.2.2 Conception rate and prolificacy

Conception rates for different breeds raised in stations or experimental farms are very satisfactory. They average 95% for the thin-tailed breeds and 85% for the fat-tailed breeds. These rates are higher than those recorded in flocks raised only on pastures (60 to 70 percent), which means that principal causes of failure to conceive are feeding and health management rather than genetics.

The D'Man breeds is outstanding for its high prolificacy or litter size (1.8 to 2.7 lambs/ewe lambed). The frequency of twinning in thin-tailed breeds is 10 percent in Morocco and Algeria. Fat-tailed sheep have 15 to 20 percent twinning in Tunisia and Egypt, except for the Barki breed, which bears twins in only 5 percent of births.

This relatively low prolificacy, when compared to those of prolific breeds such as the D'Man, Romanov and Finn, is compensated by the fact that 10 to 30 percent of ewes can lamb twice in the year (Table 2).

2.2.3 Breeding season and post-partum anoestrus

The oestrous activity of different North African breeds in different months of the year and after lambing is reviewed in Table 3.

This table shows clearly that all breeds except D'Man and Rahmani have a prolonged breeding season, generally from May to January (240 to 300 days). The anoestrous season lasts from February to April. However, Lahlou-Kassi (1983) and Khaldi (1984) have noted in Moroccan and Barbary breeds respectively the existence of silent ovulations in 40 to 60 percent of ewes during this period.

Table 2 REPRODUCTIVE PERFORMANCE OF INDIGENOUS SHEEP BREEDS (ADULT EWES)

Breed	Conception rate %	Litter size	No. of lambings per year	Lambs weaned/ ewe joined/per lambing
Timahdite	77 - 95	1.02-1.07	1.10-1.30	0.08-1.10
Sardi	85 - 92	1.00-1.30	1.10-1.20	1.00-1.21
Beniguil	80 - 92	1.00-1.04	1.10-1.20	0.80-1.10
Benihsen	82 - 93	1.04-1.20	1.00-1.25	0.80-1.20
D'Man	80 - 100	1.76-2.65	1.50-1.97	1.50-2.20
Tadmit Ouled Jellal	75 - 90	1.00-1.12	-	0.97-1.16
Rembi	90	1.15	-	-
Hamra	93	1.13	-	-
D'Man	85	2.12	-	-
Barbary	86 - 96	1.07-1.25	-	-
Ossimi	82 - 83	1.14-1.17	1.10-1.40	0.83-0.87
Rahmani	82 - 86	1.21-1.23	1.10-1.13	0.82-0.93
Barki	85 - 88	1.05-1.07	1.07-1.15	0.83

Table 3 BREEDING SEASON AND POST-PARTUM ANOESTRUS OF INDIGENOUS SHEEP BREEDS

Breed	Breeding season	Post-partum 1/ anoestrus	Author
Timahdite	May to January (265 d)	160 d (60-250)	
Sardi	May to January (265 d)	110 d (40-230)	Lahlou-Kassi 1983, 1985
Beniguil	June to March (300 d)	100 d (40-250)	
D'Man	Over the year (365 d)	60 d (20-120)	Kerbaa 1985
Tadmit	May to January (275 d)	-	
Barbary	June to January (242 d)	104 d (80-130)	Khaldi 1984
Ossimi	June to January (240 d)	-	
Rahmani	Over the year (365 d)	-	Aboul-Naga 1985
Barki	April to January (300 d)		

1/ Post-partum anoestrus of ewes lambed during November-February. The minimum and maximum represent individual variation.

The D'Man and Rahmani breeds have sexual activity throughout the year. The time before resumption of oestrus after lambing is also very short for the D'Man, (x = 60 days) and medium in the other breeds (100 to 160 days). The combination of these characteristics (long breeding season and relatively short post-partum anoestrus) allows these breeds to conceive and lamb more than once a year.

2.3 Production

2.3.1 Birth and weaning weights

Birth weights for the indigenous breeds range from 2.0 to 4.5 kg with an average of 3.2 kg.

Weaning weight at 90 days ranges from 14 to 26 kg, indicating the large variation in milk production for ewes of different breeds.

Highest birth and weaning weights are observed in Sardi, Timahdite (Moroccan breeds), Tadmit, Rembi (Algerian), Barbary (Tunisian) and Ossimi (Egyptian). The lowest birth and weaning weights are observed in the D'Man, due to high litter size (Table 4).

Table 4 LAMB GROWTH RATE OF INDIGENOUS SHEEP BREEDS

Breed	Sex	Birth weight (kg)	Live weight gain (g/day)	Weaning weight at 90 days (kg)
Timahdite	M	3.3-4.2	204-243	18-21
	F	3.2-3.6	190-210	17-19
Sardi	M	2.6-4.3	129-195	16-21
	F	3.2-4.0	126-180	14-20
Beniguil	M	2.9-3.6	125-176	11-19
	F	3.0-3.4	117-164	10-15
Benihsen	M	3.4-4.0	100-190	9-17
	F	3.0-4.6	90-170	8-15
D'Man	M	2.1-3.2	100-239	13-17
	F	1.7-3.0	81-180	13-16
Tadmit	M	3.4-4.3	196-220	21-34
	F	3.3-4	174-184	19-19.6
Rembi	F	-	-	26
Hamra	F	3.0	-	17
D'Man	F	2.0	-	15
Barbary	M+F	3.0-5.0	200-250	22-26
Ossimi	M	2.5-4.0	-	21-23
	F	2.0-3.0	-	18/2-19.4
Rahmani	M+F	3.4	-	20-22
Barki	M+F	3.0	-	20-21

2.3.2 Lamb mortality

The average mortality rate varies from one flock to another according to management level. Under relatively good management, it is 5 to 10 percent from Moroccan breeds, except D'Man which has a high average rate (15 to 20 percent), due mainly to the higher losses in triplet and quadruplet lambs (Lahlou-Kassi 1983).

For the Barbary, lamb mortality averages 8 to 13 percent, with 15 to 25 percent for twins (Khaldi 1984) and for Egyptian breeds, 12 to 18 percent.

2.4 Summary

Analysis of adaptation traits and performance of the different North African sheep breeds leads to the following general conclusions.

2.4.1 Interesting traits for future improvement

- Variability of adaptation traits (coat, conformation, fat reserve) for various climates and land types existing in the region (semi-arid, arid, mountain and Sahara).

- Long breeding season and relatively short post-partum anoestrus in these breeds allow good reproductive efficiency even in years where there is a delay in rainfall and vegetation growth and a second lambing, at least for part of the flock, when the year is good.

- Existence of a well adapted prolific breed within the region (D'Man) which can be included in cross-breeding schemes for prolificacy improvement.

- Large individual variability within the same flock and between flocks for either reproductive or productive traits allows good opportunity for improvement through selection.

2.4.2 Actual limiting traits

- Late age of puberty and age at first lambing in the majority of indigenous breeds.

- Relatively slow lamb growth rate from birth to meaning in relation to milk potential of the mother.

- Low or medium fecundity of the majority of the breeds, for intensive sheep production systems.

- Large between-breed variability in quantity and quality of wool.

3. TRIALS IN THE REGION FOR IMPROVING LOCAL SHEEP

3.1 Selection Trials

3.1.1 Improvement of general conformation

National programmes of selection for the improvement of local breeds have been established in Egypt, Algeria, Tunisia and Morocco, the major purpose being:

- Initial phase: Homogenization of phenotype for each breed, based essentially on colour and body conformation.

- Second phase: Improvement of production performance in each breed.

The first phase of the programmes has been achieved with some success in some countries, after establishment of national breeding policies based on the following (Moroccan example):

- Production of selected rams in national selection farms, specific to each breed; these rams are sold to farmers.

- Mapping and delimitation of the area of origin for each breed, called the "zone berceau de race".

- Creation of the National Association for Sheep production, which includes professionals from different areas and breeders. This Association has as its role production of selected rams, and organization of livestock shows and competitions.

- Appointment of the Commision for Sheep Selection, composed of government officials and representatives of breeders. This Commission is in charge of the registration of selected animals in the "Flock book".

Unfortunately no data are yet available on the evluation of this kind of programme.

3.1.2 Improvement of fecundity

To our knowledge, none of these programmes have included fecundity parameters such as age at first lambing or prolificacy in the selection scheme.

The selection programme for prolificacy improvement in D'Man sheep, which started in 1973 at the ORMVA, Quarzazate, Morocco, shows that average litter size in the selected flock increased from 1.66 to 2.33 in 8 years. However the reported data do not make it clear whether this improvement is due to a genetic gain or to improvement of management and feeding.

Because of the tremendous variability existing between individuals at the age of first lambing and duration of breeding season and prolificacy in each breed reviewed here, it is of value to include these criteria in selection schemes.

3.2 Crossbreeding Trials

3.2.1 Crossbreeding for improving fecundity

Different trials have been conducted for improving the fecundity of local sheep through crossbreeding with imported prolific breeds (Finn, Romanov, Chios) or the indigenous prolific breed (D'Man). We review here briefly the two main trials conducted in Egypt and Morocco.

a. Moroccan trial:

With the financial help of the Small Ruminant Programme (CRSP) and the collaboration of Prof. Eric Bradford from the University of California, Davis, a crossbreeding scheme between Sardi and D'Man breeds was

conducted to evaluate the reproductive and growth performance of the two parental breeds and their crosses. Preliminary results are summarized in Table 5 and 6.

Performance of ewe lambs (Table 5): at 10-12 months of age, the conception rate of Fl (D'Man x Sardi) ewe lambs is higher than that of Sardi ewe lambs (64-78 percent vs. 0.27 percent) and similar to that of D'Man. The prolificacy of Fl ewe lambs is intermediate (1.3 vs 1.0 and 1.6).

Performance of adult ewes (Table 6): crsssbred (D'Man x Sardi) ewes are distinguished from the Sardi by:

i. a higher prolificacy (1.6-2.1 vs. 1.16-1.28);
ii. advanced breeding season: conception rate for the May-June mating is 9-100 percent vs 57-64 percent.

Table 5 REPRODUCTIVE PERFORMANCE OF SARDI, D'MAN AND Fl (D x S) EWE LAMBS (10 TO 12 MONTHS OLD)

Genotype	Mating period	No.	Conception rate	Litter size	No. lambs weaned/ewe lambing	Weaning rate %	Weight of lamb weaned/ewe lambing (kg)
Sardi	I	26	27	1.00	0.26	100	4.0
	II	28	0		0	0	0
D'Man	I	23	64	1.50	1.10	100	12.7
	II	21	61	1.75	1.25	86	13.5
F1	I	64	78	1.22	0.94	90	10.8
	II	45	64	1.34	0.80	92	10.5

Table 6 REPRODUCTIVE PERFORMANCE OF SARDI, D'MAN AND Fl (D x S) ADULT EWES: I - MATED DURING SEPT-NOV. 1984
II - MATED DURING MAY-JUNE 198 5

Genotype	Mating period	No.	Conception rate	Litter size	No. lambs weaned/ewe lambing	Weaning rate %	Weight of lamb weaned/ewe lambing (kg)
Sardi	I	136	94-96	1.25-1.28	1.13-1.21	92-100	17.5-19.6
	II	137	57-64	1.16-1.18	0.60-0.70	90-98	10.1-10.8
D'Man	I	43	92-100	2.11-2.65	1.55-1.89	64-90	16.0-20.5
	II	70	86-95	1.96-2.25	1.50-2.00	84-93	16.7-22.4
F1	I	42	92-100	1.61-2.00	1.50-1.81	94-95	19.6-19.8
	II	42	91-100	1.80-2.10	1.50-1.70	81-94	19.6-20.3

On the other hand, the weaning rate is similar for all three genotypes (D'Man, Sardi, D'Man x Sardi).

Average productivity expressed as weight weaned per ewe lambing is 20 to 22 in D'Man and Fl compared with 10 to 20 for Sardi.

The major disadvantage was a decrease in quality and quantity of wool in Fl, compared with Sardi.

b. Egyptian trial:

An ambitious programme for crossbreeding between Ossimi and Rahmani breeds and imported prolific breeds (Finn, Romanov and Chios) is in process in Egypt. Data of the resulting crossbreds, under an accelerated lambing system of a crop every 8 months, are presented in Table 7.

Prolificacy and lambing rate were increased respectively by 50 to 70 percent and 5 to 30 percent in the first crosses and by half this figure in the 1/4 Finn. Of importance, the different crossbred ewes showed a good ability for rebreeding every 8 months, which is important in a sutropical environment.

Table 7 IMPROVING FECUNDITY OF LOCAL OSSIMI (0) AND RAHMANI (R) BY CROSSING WITH FINN (F) SHEEP UNDER THE SYSTEM OF ONE CROP/8 MONTHS

Breed group	No.	Lambing	Lambs per ewe	Lambs per ewe lambing	Lambings per ewe per year	Lambs per ewe per year
R	775	0.715	1.01	1.37	1.07	1.47
F x R	151	0.880	1.73	2.06	1.32	2.72
F.R x R	160	0.826	1.14	1.54	1.24	1.91
R x F.R	284	0.781	1.20	1.50	1.17	1.76
(F.R=R) F2	104	0.707	1.15	1.54	1.06	1.63
0	411	0.743	0.98	1.28	1.11	1.42
F x 0	77	0.768	1.48	1.93	1.15	2.22
F.O x 0	108	0.824	1.13	1.42	1.24	1.76
0 x F.O	40	0.847	1.31	1.55	1.27	1.97

The evaluation of this crossbreeding scheme, however, should include the incidence of lamb mortality and growth rate to test the adaptability of Finn sheep to a hot humid climate.

3.2.2 Crossbreeding for improving lamb production

Most of the crossbreeding schemes for improvement of lamb production are based on crosses between local breeds and European meat breeds. In Morocco, the breeds used are: Merino, Berrichon du Cher, Ile-de-France and Suffolk. These crosses are exlcusively for the production of lamb, and are conducted under intensive management, on private farms. As data are lacking, it is impossible to evaluate the results.

In Egypt crosses between Ossimi and Suffolk and Hampshire are reported by Aboul-Naga and Afiji (1980) and Aboul-Nagaga et al. (1980). Tables 8 and 9 summarize results from Hampshire x Ossimi crosses.

Table 8 LAMB PERFORMANCE TRAITS OF OSSIMI (0) AND HAMPSHIRE (H) X OSSIMI(O) CROSSES
(Aboul-Naga and Afifi, 1980)

Breed group	No.	Birth wt. (kg) mean ± S.E		Weaning wt (kg) mean ± S.E.		Survival to Weaning mean	Yearling wt. (kg) mean ± S.E.	
0	136	2.98±0.08	ad	18.89±0.54	a	0.86	33.35±1.06	a
1/2 H	91	2.74±0.11	ac	20.37±0.72	ab	0.83	33.58±1.32	a
9/16 H	53	2.52±0.14	c	22.09±1.10	b	0.76	39.23±2.09	ab
5/8 H	88	2.53±0.12	c	20.73±0.8	b	0.72	34.71±1.47	ab
3/4 H	17	2.79±0.23	cd	18.70±1.4	ab	0.52	37.82±4.86	ab
7/8 H	19	3.33±0.22	bd	18.70±1.4	ab	0.63	36.73±2.08	ab

The different H x 0 crossbred groups were generally inferior to the Ossimi breed for all traits, the only lamb performance trait improved by upgrading the Ossimi sheep with Hampshire being the first greasy-fleece weight. Lamb survival and weaning weight decreased as the percent of Hampshire increased.

Table 9 REPRODUCTION TRAITS OF OSSIMI (0), HAMPSHIRE (H) AND THEIR CROSSBRED GROUPS OF EWES
(Aboul-Naga and Afifi, 1980)

Breed group	No. of ewes	Conception rate %	No. of lambs born/ewe lambed	No. of lambs weaned/ewe lambed	No. of lambs weaned/ewe joined
Ossimi (0) x H	115	76	1.20	1.12	0.93
1/2 H x H	145	72	1.22	0.94	0.90
1/2 H x 1/2 H	70	62	1.10	0.85	0.68
3/4 H x H	16	52	1.34	0.89	0.73
5/8 H x H	66	68	1.15	0.74	0.78
Hampshire (H) x H	45	32	1.11	0.77	0.43

4. CONCLUSIONS

This review points out some important principles that should be taken into consideration in any programme for improving sheep productivity in North Africa. These can be summarized as follows:

- Precise knowledge of reproductive and production performance, as well as adaptation of local breeds, as needed.

- Objectives of the improvement programme should be well defined namely, improvement of growth, reproduction of wool.

- The environment and type of management in which the programme is to be conducted (pasture only, or with supplementation, intensive) should be defined.

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1/ Department of Animal Reproduction and A.I., I.A.V. Hassan II, B.P. 6202 Rabat-Instituts, Morocco.

PRINCIPLES FOR ANIMAL IMPROVEMENT IN THE TROPICS SHEEP AND GOATS: ASIAN EXPERIENCES

P.N. Bhat 1/

1. INTRODUCTION

Sheep and goats constitute a sizable population of livestock in Asia, with 322 million sheep (22% of the world total) and 255 million goats (49%). The land area is 2679 million hectares, of which only 426 million are arable (Table 1). The small ruminants are raised in a complexity of farming systems, primarily on small farms where the emphasis is on intensive crop production, but also on extensive systems in large flocks, in groups of 500-1000, which may consist of a collection of small units. These large flocks are nomadic or transhumant, moving to high pastures in summer and plains in winter.

In Asia, sheep and goats are raised in four distinct geographic areas, which have given rise to different management systems, and different breeds/strains. The regions are:

i. arid and semi-arid, where the majority of the sheep and goats are;
ii. temperate and subtropical, where most apparel wool sheep are;
iii. cold deserts, where sheep and goats form the main livestock species;
iv. humid tropics, where goats are the main species.

Sheep and goats contribute meat, milk, skin, fibre and manure to the agricultural system (Table 2), and help to meet the world's demand for carpet wool, ropes, bags, skins and meat. They are an important source of earnings to livestock owners, and are the sole, or a subsidiary, occupation for many small, marginal farmers and landless labourers, most of whom are poor and engaged in subsistence agriculture.

Many Asian farmers prefer to invest their labour in plant food production; usually sheep and "goats are raised as an extra investment, without major labour input, and as an adjunct to a cropping system. The animals make use of natural vegetation, crop residues, roadside plants and tree leaves, which provide a sizable portion of the energy they consume.

Due to intensification of cropping, with irrigation and cultivation of large areas, there has been a progressive reduction in grazing land, resulting in high density of livestock. The grazing lands are thus over-utilized, and investment in their improvement is nil.

Population trends for sheep and goats have varied in the different Asian countries. China now has the largest sheep population (Table 1), followed by Turkey, India and Iran, while India has the largest goat population, followed by China, Pakistan and Turkey. Pakistan and China have shown the greatest recent increases in sheep numbers, while in Iran the numbers of both sheep and goats have declined. Trends in sheep numbers in India have varied from increases in the arid and north-western regions to a decline in the semi-arid southern, central and peninsular areas. Goat numbers in India have increased.

Table 1 LAND USE, TOTAL LIVESTOCK (EXCLUDING POULTRY) AND SHEEP AND GOAT POPULATIONS IN ASIA
(FAO, 1984)

Countries	Land area (m ha)	Arable land (m ha)	Total livestock (m)	Total sheep (m)	% of the total livestock	Total goats (m)	% of the total livestock
1.	2.	3.	4.	5.	6.	7.	8.
Afghanistan	64.750	7.910	28.71	20.00	69.66	3.00	10.45
Bahrain	0.062	0.001	0.03	0.01	33.33	0.02	66.67
Bangladesh	13.391	8.917	52.14	2.00	3.84	12.05	22.89
Bhutan	4.700	0.092	0.55	0.04	7.27	0.05	9.09
Brunei	0.577	0.003	0.04	-	-	0.00	-
Burma	67.655	9.613	15.92	0.40	2.51	1.00	6.28
China	932.641	97.482	574.82	98.92	17.21	68.23	11.87
Cyprus	0.924	0.365	1.20	0.50	41.67	0.36	30.00
East Timor	1.487	0.070	0.26	0.01	3.85	0.06	23.08
Gaza Strip	0.038	0.005	0.05	0.02	40.00	0.03	60.00
Hongkong	0.099	0.007	0.51	-	-	0.00	0.00
India	297.319	164.850	379.58	40.89	10.77	80.80	21.29
Indonesia	190.457	15.000	26.04	4.79	18.39	7.91	30.38
Iran	163.600	13.100	58.65	34.30	58.48	13.60	23.19
Iraq	43.397	5.250	12.92	8.30	64.24	2.30	17.80

Israel	2.033	0.344	0.08	0.24	30.00	0.11	13.75
Japan	37.108	4.238	15.21	0.02	0.13	0.06	0.39
Jordan	9.718	0.378	1.61	1.00	61.11	0.53	32.92
Kampuchea (DM)	17.652	2.900	3.09	0.00	0.00	0.00	0.00
Korea (DPR)	12.041	2.200	4.37	0.34	7.78	0.26	5.95
Korea (REP)	9.819	2.032	6.22	0.01	0.16	0.35	5.63
Kuwait	1.782	0.002	1.00	0.60	60.00	0.31	31.00
Laos	23.080	0.870	2.86	-	-	0.06	2.10
Lebanon	1.028	0.210	0.65	0.13	20.00	0.44	67.69
Macau	0.002	-	0.01	-	-	-	-
Malaysia	32.855	1.020	3.29	0.07	2.13	0.34	10.33
Maldives	0.030	0.003	-	-	-	-	-
Mongolia	156.500	1.313	23.62	14.11	59.74	4.55	19.26
Nepal	13.680	2.318	16.91	2.52	14.90	2.60	15.37
Oman	21.246	0.015	1.23	0.30	24.39	0.70	56.91
Pakistan	77.872	20.150	86.21	24.27	28.15	28.70	33.29
Philippines	29.817	7.850	14.78	0.03	0.20	1.85	12.52
Qtar	1.100	0.003	0.13	0.05	38.46	0.06	46.15
Saudi Arabia	214.969	1.060	6.78	3.60	53.10	2.35	34.66
Singapore	0.058	0.002	1.32	-	-	0.00	00.00
Sri Lanka	6.474	1.064	3.34	0.03	0.90	0.53	15.87

Syria	18.405	5.087	16.09	14.00	87.01	1.00	6.22
Thailand	51.177	17.400	14.99	0.02	0.89	0.03	0.20
Turkey	77.076	23.468	85.59	48.70	56.90	16.73	19.55
UA Emirates	8.360	0.007	0.70	0.15	21.42	0.45	64.28
Vietnam	32.536	7.000	16.27	0.02	0.12	0.26	1.59
Yemen (AR)	19.500	2.740	5.58	1.82	32.62	2.23	91.96
Yemen (DEM)	33.297	0.192	2.78	1.00	35.97	1.38	49.64
Total	2 679.070	426.531	1 486.28	322.90	21.72	255.22	17.17

Table 2 MEAT, MILK AND WOOL PRODUCTION FROM SHEEP AND GOATS IN THE ASIAN COUNTRIES (FAO, 1984)

	Total Meat production (m kg)	Mutton production (m kg)	% of total meat	Chevon production (m kg)	% of total meat	Total milk production (m kg)	Milk from sheep (m kg)	% of total milk c	Milk from goats (m kg)	% of total milk	Total greasy wool (m kg)
1	2	3	4	5	6	7	8	9	10	11	12
Afghanistan	252	133	52.77	26	10.31	900	5	0.55	5	0.55	23.50
Bahrain	10	4	40.00	1	10.00	6	-	-	-	-	-
Bangladesh	353	2	0.56	48	13.59	1 632	17	1.04	517	31.69	1.32
Bhutan	3	-	-	-	-	13	-	-	-	-	0.04
Burma	287	2	0.69	5	1.74	507	5	0.98	6	1.18	0.40
China	18 335	322	1.75	306	1.67	4 498	525	11.67	150	3.33	187.00
Cyprus	51	6	11.76	4	7.84	119	26	21.84	40	33.61	1.20
India	1 006	133	13.22	305	30.31	35 855	-	-	955	2.66	38.00
Indonesia	537	24	4.47	38	7.07	153	-	-	-	-	-
Iran	703	230	32.71	45	6.40	2 617	705	26.93	223	8.52	16.20

Iraq	220	48	21.82	11	5.00	543	165	30.38	69	12.70	17.00
Israel	234	4	1.71	1	0.43	846	22	2.60	25	2.95	0.60
Jordan	53	6	11.32	7	13.20	45	26	57.77	170	37.77	2.50
Korea (DPR)	216	2	0.92	1	0.46	70	-	-	—	-	—
Korea (REP)	679	-	-	2	0.29	650	-	-	1	0.15	—
Kuwait	76	43	56.58	2	2.63	157	6	3.82	20	12.73	0.75
Lebanon	79	9	11.39	4	5.06	138	14	10.14	39	28.26	1.00
Malaysia	245	-	-	1	0.04	35	-	-	-	-	0.07
Mongolia	229	103	44.98	20	8.73	310	55	17.74	39	12.58	19.80
Nepal	80	12	15.00	13	16.25	793	-	-	33	4.16	4.50
Oman	14	2	14.28	4	28.57	29	-	-	9	31.03	-
Pakistan	973	180	18.49	240	24.66	9 805	35	0.35	390	3.97	45.13
Philippines	761	-	-	8	1.05	28	-	-	-	-	-
Qatar	5	3	60.00	-	-	18	2	11.11	9	50.00	-
Saudi Arabia	345	88	25.50	12	3.48	513	90	17.54	83	16.18	3.60
Singapore	105	2	1.90	-	-	1	-	-	-	-	-
Sri Lanka	35	-	-	1	2.85	270	-	-	6	2.22	-
Syria	201	80	39.80	7	3.48	1 133	525	46.33	79	6.97	25.00

Turkey	900	312	34.66	71	7.88	5 805	1 300	22.39	625	10.76	63.00
UA Emirates	20	5	25.00	4	20.00	17	4	23.52	8	47.05	-
Vietnam	835	-	-	2	0.24	87	-	-	-	-	-
Yemen AR	75	2	28.00	26	34.66	223	38	17.04	125	56.05	3.68
Yemen DEM	16	6	37.50	5	31.25	45	12	26.66	25	55.55	-

[1/]Director, Indian Veterinary Research Institute, U.P., India. 243122.

2. GENETIC RESOURCES

2.1 Sheep

Almost all the reported data are from experiment stations and government farms; very few have been collected on producers' farms or in villages, and comparative data on crossbred and native contemporaries within the same flock or herd, run together in the villages, are rare. Such data should be collected in a planned manner, to encompass lifetime performance in relation to production, reproduction, survival and resistance to disease, so that valid comparisons can be made between native breeds, or between natives and crossbreds, run under the same field conditions.

Even the recorded information available from experiment stations is far from complete; there are few records of lifetime performance.

Table 3 gives a summary of general information on sheep breeds in various countries, while Tables 4-6 present production data, Table 4 for India and Tables 5-6 for some other Asian countries.

2.1.1 India

Several authors have published extensive reviews of available data on Indian sheep breeds, including Bhat et al., (1980 and 1981), Acharya (1982), Acharya and Bhat (1984), and full details can be obtained from these. India is divided into four ecological zones, each with its own main product and different breeds - carpet wool in the Northwestern, meat in the Southern Peninsula and Eastern, apparel wool in the Northern Temperate.

One apparel wool breed not in Table 3, the Hissardale, occurs in the Northwestern Region, but it consists now of only one flock at Haryana University.

2.1.2 Afghanistan

Yalçin (1979) defines 8 breeds in Afghanistan, the Karakul, bred for lamb pelts, being predominant. In general, white breeds occur in the eastern, southern and western parts of the country, and pigmented breeds in the central and northern regions.

2.1.3 Iraq

There is large diversity in the available sheep genetic resources, but the Awassi is the predominant breed. All grow carpet wool and meat, some also producing milk.

2.1.4 Iran

Various authors have identified different numbers of Iranian sheep breeds; Sohraby (1937) named 14, Ardelan (1938), 12, Jones (1964), 16 and Yalçin (1979), 16. Data in Table 3 are based mainly on Yalçin (1979).

2.1.5 Turkey

Turkey has 11 sheep breeds, 5 with fat tails, 1 with semi-fat, 1 with fat rump, and 4 with thin tails. The most numerous breed is the White Karaman. Two distinct strains of Turkish Merino have been developed over the last 5 decades, the Anatolian and the Karacabey, accounting now for 3 percent of the total sheep population.

Table 3 SHEEP GENETIC RESOURCES IN VARIOUS COUNTRIES

Country	Region	No. of breeds	Main products	Coat types	Colour range	Tail types	Range between breeds			Authors
							Field populations (m)	Flock sizes (heed)	Adult body wt. (ewes) (kg)	
India	North western	11	Carpet wool Meat	Coarse wool, with varying degrees of medullation	Mostly white Some breeds hare pigmented heads or faces	All thin	0.2-5.7	30-500	21-30	Bhat. et al., 1980 Acharya, 1982 Adhary a and Bhat, 1984 Acharya, 1985
	Southern Peninsula	14	Meat	Hair (no usable wool) to coarse highly medullated wool	Mostly pigmented; (a few white)	All thin	0.2-5.1(2 unknown)	25-330	20-30	

	Eastern	6	Tibetan-Wool Rea at meat	Tibetan relatively fine wool; rest not used	Tibetan white; others mixed	All thin	0.3-0.6 (2 unknown)	3-250 (1 uknown)	19-41 (pooled sexes)	
	Northern Temperate	7	Apparel wool Carpet wool	Relatively fine and dense to coarse and highly medullated wool	Mostly white	All thin	Unknown	Unknown	25-35	
Afghanistan		8	Karakul (predominant) lamb pelts Turki - Meat, Rest - Meat, milk, carpet wool of varying quality	Coarse wool with varying degrees of medullation	Some breeds white; others mainly pigmented	6 fat-tail 2 fat-rump	0.2-6.6	not given	26-52	Yalçin, 1979
Iraq.	Central and North Western	1	Awassi - Carpet wool, meat and milk	Coarse wool With some medullation	white; pigmented head - may extend to fleeoe	Fat	5.0	Not given	40-65	Karam et al., 1971 Bhat, 1985
	Southern	1	Arabi - Carpet wool and meat	Coarse wool with some medullation	White pigmented head - may extend to fleece	Fat	5.0	Not given		
	Northern	1	Karradi (or Kurdi) - Carpet wool, meat and milk	Coarse wool with some medullation	White pigmented head - may extend to fleece	Fat	not given	not given		

	General	3	Strains developed from main 3 breeds		Many animals pigmented	Fat	Small numbers	not given	not given	
Iran	North and North-easter	6	Meat, milk, carpet wool Karakul - Sate lamb pelts also (black)	Coarse wool with varying degrees of medullation	Pigmented except one mainly white (Zel)	5 fat-tail 1 thin tail (Zel)	0.2-2.3	not given	30-50	Sohraby, 1937 Ardelan, 1938 Johns, 1964 Yalçin, 1979
	North-western	2	Meat, milk, carpet wool	Coarse wool with varying degrees of medullation	White; pigmented face and feet	Fat	1.2-3.4	not given	40-45	
	Eastern	1 (Baluchi)	Carpet wool, meat and milk	Coarse wool with medullation	White, pigmented head and legs	Fat	10.3 (includes Baluchi and Kallakui from NE)	not given	35-40	
	Western	5	Meat, milk and carpet wool	Coarse wool with medullation	Some white with pigmented head and legs, some pigmented	Fat	0.04-3.5	not given	40-50	
	South-western	1 (Bakhtiari)	Meat, coarse carpet wool and milk	Coarse wool with medullation	Mainly white - pigmented head and feet	Fat	1.5	not given	45-50	
	Southern	1 (Grey Shiragi)	Lamb pelts, Meat and carpet wool	Coarse wool with medullation	Grey	Fat	3.2	not given	42-45	

Turkey	West and Northwest	3	Garpet wool, Me at and milk	Coarse wool with medullation	Mostly white - pigmented face and legs	1 Fat 2 Thin	0.06-0.32	50-300(2 unknown)	35-40	Yalçin, 1979
	Center and Northwest	1 (Merino)	Wool	Apparel wool.	White	Thin	1.2	not given	50-55	
	Central West	1 (sekis)	Meat and Milk	Course Wool with medullation	white some pigment	Semi-fat	0.01	2-4	40-45	
	Central North	1(karakul)	Lamb pelts, meat and carpet wool	Course wool with medullation	Pigmented (lamb black)	Fat	0.1	not given	35-45	
	Centre and east	1 (white and Karaman)	Carpet wool and meat	Course wool with medullation	White black nose	Fat	17.9	not given	35-50	
	Northeast	3	Meat milk and carpet wool	Course wool with medullation	2 white 1 pigmented	1 thin-tailed 1 fat-tailed 1 fat-rump	0.1-8.1	5-200(2 unknown)	35-55	
	Southeast	1 (Awassi)	Carpet wool, neat and milk	Coarse wool With medullation	White-pig-mented head	Fat	0.8	not given	40-45	
Pakistan	Baluchistan	4	Carpet wool, neat and milk	Coarse wool with medullation	Mostly white pigmented heeds and feet	Fat	not given	40-1000	30-33	Hasnain, 1985
	Northwest Frontier Province	7	Meat, milk and carpet wool	Coarse wool I with medullation	4 white, - pigmented head 3 pigmented	5 fat 2 thin	not given	22-150	22-70	

	Punjab	7	Carpet wool an d meat, one milk also (Thalli)	Coarse wool with medullati on	Mostly Write pigmente d head and legs	Thin	not given	20-300	23-45	
	Sind	3	Meat and carpel Wool - 2 milk also	Coarse wool with medullati on	Mostly white, pigmente d head	1 fat 2 thin	not given	15-500	23-30	
	Northem Areas	3	Meat and menure 1 also carpet wool and milk 1 also milk	1 no wool 2 coarse wool with medullati on	Mixed	2 Small fat 1 thin	not given	5-90	25-33	
	Azad Kashmir	4	Meat and carpet ore (Kail) apparel wool one (Pahari) milk	3 coarse with medullati on 1 finer with less medullati on	Mixed	Mostl y thin	not given	10-250 (2 unknow n)	29-35	

China	Pastoral	7 (native)	Carpet wool and neat	Coarse wool with varying medullation	Mostly white; pigmented heeds and necks	3 fat-tail 1 fat-rump 3 thin-tail	not given	not given	33-69	Cheng, 1985
		3 (developed)	Apparel wool and neat	Apparel wool	White	Thin	not given	not given	44-52	
	Mixed agricultural - pastoral	1 (Tan)	Lamb pelts carpet wool and meat	Coarse wool withn medullation	White pigmented head	Fat	not given	not given	35	
	Agricultural	4	Lamb pelts and carpet wool	Coarse wool with medullation	Mostly white same pigmented heads and necks	Fat	not given	not given	31-41	

General reference - Ponting (1980).

Table 4 BETWEEN-BREED RANGES OF IMPORTANT ECONOMIC TRAITS FOR INDIAN SHEEP BREEDS
(Acharya and Bhat, 1984)

Region	Body weight at: Greasy fleece weight								Survivability		
	No. of breeds recorded	3 mths kg	12 mths kg	6 mths kg	Adult kg	Medul-lation %	Staple length cm	Average fibre dia-meter µm	0-3 mths %	3-12 mths %	Adult %
Northwestern	9	8-13	18-33	0.5-1.4	0.9-2.9	24-83	5-9	28-115	71-99	80-99	73-94
Southern Peninsula	11	7-14	14-24	0.3-0.9 (2 breeds only)	0.7-1.2 (3 breeds only)	24-43 (2 breeds only)	6-7 (2 breeds only)	27-59 (3 breeds only)	81-98 (6 breeds only)	95-97 (3 breeds only)	89-97 (3 breeds only)
Northern	3	8-22	16-18 (2 breeds only)	0.4 (1 breed only)	0.8-2.8	0-26	6-16	20-34	89 (1 breed only)	89 (1 breed only)	80-91 (2 breeds only)

Table 5 PRODUCTION PERFORMANCE OF SHEEP OF THE ASIAN COUNTRIES
(Acharya, 1985)

Breed	Fleece Production			Lactation			
	Annual greasy fleece weight (kg)	Average fibre diameter (µm)	Percent medul-ation	Yield (kg)	Length (days)	Birth (%)	Twinning (%)
1	2	3	4	5	6	7	8
AFGHANISTAN							
Arabi	1.2-1.7	36	52	45-55	130-140	65-80	0-2
Baluchi	1.3-1.8	30	28	35-40	120-130	60-75	0-1
Gadik	0.6-0.9	24	19	30-35	120-130	65-75	0-1
Ghiljai or Ghilzai	1.5-2.0	34	45	35-45	120-130	70-75	0-2

Khandhari	1.2-1.6	35	42	35-40	120-130	65-75	0-2
Karakul	2.0-2.6	38	57	40-45	120-130	70-85	5-8
Turki	0.8-1.0	-	51	55-65	130-140	75-80	8-10
IRAQ							
Awassi	2.0-2.5	32	2.4	156	-	-	-
Arabi	1.5-2.0	31	2.5	-	-	-	-
Karradi	2.3-3.0	47	3.9	-	-	-	-
Hamdani	2.5-4.0	40	5.5	-	-	-	-
Neimi	1.5-2.0	40	7.2	-	-	-	-
IRAN							
Bakhtiari	1.5-1.8	-	-	35-40	130-140	70-85	2-7
Baluchi	1.3-1.8	-	-	40-50	120-130	60-75	1-5
Grey Dhirazi	1.5-1.8	-	-	45-55	140-150	90-95	1-2
Karakul	1.6-2.5	-	-	40-50	120-150	90-95	2-10
Kurdi	1.8-2.0	-	-	60-65	-	-	-
Makui	1.5	-	-	60-65	-	-	-
Mehraban	0.8-1.2	-	-	60-65	150-180	70-80	0.8
Sangasari	1.0	-	-	35-40	-	-	-

Sanjabi	1.5-2.0	-	-	54	180	80	3.0
Zol	1.0-2.2	-	-	35-40	130-140	70-80	3-5
TURKEY							
Awassi	1.8-2.2	32-35	-	100-155	200-210	-	12
Deglic	1.8-2.2	28-32	-	35-45	130-140	-	1-2
Imroz	1.6-2.0	32-40	-	70-100	150-170	-	10-20
Karakul	2.3-2.5	33-35	-	55-60	130-140	-	10-15
Kivirdik	1.3-1.7	27-30	-	60-90	150-160	-	10-20
Red Karman	1.2-1.5	30-34	-	45-55	140-150	75-80	0-5
Turkish Merino							
a) Karacabey Merino	3.0-3.4	22-33	-	50-70	130-140	85-95	10-20
b) Central Anatolian Merino	3.7	22	-	40-50	140-150	88-90	45
Knise Karaman	1.5-2.0	30-35	-	40-50	140-150	-	4-5

Table 6a BODY AND FLEECE WEIGHTS (KG), MILK PRODUCTION (KG), FERTILITY AND LAMBING PERCENTAGE IN VARIOUS IRAQI BREEDS OF SHEEP
(Bhat, 1985)

	Awassi		Arabi		Karradi		Hamdani		Neimi	
	M	F	M	F	M	F	M	F	M	F
Weight kg at/c										
1. Birth	4.5	4.3	3.5	3.0	4.0	3.5	5.0	4.5	4.0	3.8

2. Weaning	28.0	25.0	20.0	18.0	24.0	22.0	30.0	27.0	25.0	23.0
3. Yearling	50.0	45.0	38.0	30.0	40.0	34.0	55.0	50.0	40.0	35.0
4. Maturity	65.0	55.0	50.0	40.0	50.0	42.0	80.0	65.0	55.0	45.0
5. Fleece	2.5	2.0	2.0	1.5	3.0	2.3	4.0	2.5	2.0	1.5
Milk Production (kg)		106		40		60		80		100
Lactation Period (days)		142		140		130		145		146
Staple Length (cms)		4-6		2-4		6-8		7-9		3-6
% ewes lambing		75		55		80		89		60
Lambing Percentage		120		104		104		124		105

Table 6b FIBRE DIAMETER (MICRONS), MEDULLATION PERCENTAGE AND KEMP PERCENTAGE IN WOOL SAMPLES

	Rams				Ewes			
	(n)	F.D.	Med.	Kemp	(n)	F.D.	Med	Kemp
Awassi	16	32.5	1.9	0.5	-	-	-	-
Arabi	10	31.2	2.4	0.1	3	29.1	1.2	0.6
Karradi	13	47.4	3.4	0.5	-		-	-
Hamdani	19	40.1	4.3	1.2	100	43.0	8.2	1.3
Ne'imi	9	40.1	4.6	2.6	22	38.4	6.4	2.7

2.1.6 Pakistan

Hasnain (1985) described altogether 28 sheep breeds in Pakistan, grown mainly for carpet wool and meat; some are also milked, and one (Kail) produces apparel wool. About half have fat tails.

2.1.7 China

Cheng (1985) described 12 native breeds, grown for carpet wool, lamb pelts and meat. Three new Merino types have been developed.

2.1.8 Indonesia

Sheep breeds found in Java are of two main types, the Thin-tailed sheep (JTT) prevalent in the West and the Fat-tailed wool sheep (FTJ) found mostly in East Java (Hardjosubroto, 1980). Both types grow coarse, highly medullated fleeces which are not used; in fact, the FTJ are kept closely clipped. The JTT are pigmented and FTJ mostly white. Both are known to be highly fecund, but of low mature liveweight. Lamb mortality tends to be high, partly on account to low birth weights and partly because of unpredictable multiple births.

These sheep are known to be very prolific, with litters of 3 and 4 occurring with relatively high frequency, and litters of 5 and 6 on rare occasions (Sitorus and Subandriyo, 1982). However, they also show a much higher incidence of single births than expected for sheep which have 3 or more lambs at the frequencies observed, and are unusually variable in litter size. Mortality is very high in the larger litters. The overall mean number of lambs born in 131 lambings was 1.98, identifying the breed as above average but not of exceptional prolificacy. However, 11% of parturitions contained 4 or more lambs, a most unusual result for a group with a mean of 2 or less.

Documentation of the extreme variability in litter size indicates potential for very high production from the Javanese Thin-tail ewes, but also major management problems. Mortality rates of 16.7, 18.4, 35.5, 42.9 and 60.0% for lambs born in litters of 1, 2, 3, 4 and 5 respectively have been recorded. Applying these to the proportions of ewes producing the different litter sizes reported for JTT gives a mean of 133 lambs weaned per 100 ewes lambing, not a very outstanding record compared to other breeds of the region.

2.1.9 Sri Lanka

According to Goonewardena et al. (1984) the native sheep are mostly concentrated in the northern and eastern regions of the island. The climate in these regions is hot and humid throughout the year. The native sheep are hairy and small in size. The mean heights at withers of adult rams and ewes are 52 and 49 cm respectively, and the mean adult body weights 24 and 19 kg. Ewes are capable of breeding all the year round, but management aims at a peak between the months of November and January.

It is believed the sheep were brought from South India several hundred years ago. The native flocks are generally closed, with some between-flock movement of rams.

The native sheep of Sri Lanka are a product of natural selection in a semi-arid environment, resulting in poor growth rate, later maturity and poor reproduction rate. They are impressive, however, in their ability to survive and reproduce in the harsh environment.

2.1.10 Malaysia

There is only one breed of sheep in Malaysia. Lee et al. (1978), Vanselow (1978) and Mukherjee (1980), have described some production figures of this breed, which is only available in small numbers. The wool is not used. Current interest in these sheep has grown due to their capacity for harvesting weeds from the plantations.

2.2 Goats

2.2.1 India

The origin of the Indian goat breeds is not clearly known. They are believed to have been derived from wild goats which inhabited the Asian mountains in antiquity, and to have been domesticated around the 7th century BC, much earlier than cattle (Allchin, 1969). There are at present 20 distinct goat breeds in India, of which several are economically useful, with distinct characteristics of productivity and adapted to the various agro-climatic regions. Eleven are in the Northwestern Region, 4 in the Southern Peninsular, 2 in the Eastern and 3 in the Northern Temperate.

The Jamnapari breed of the Chambal Ravines in Etah district (UP) has been extensively used for improvement of native breeds in several countries. The famous Anglo-Nubian breed is based on a cross of the Jamnapari. The dwarf goat breeds,such as Black Bengal, Barbari, Malabari and Assam Hill, are famous for high prolificacy (multiple births), early sexual maturity and generally give two kid crops in a period of 14 months. The Pashmina goats of Ladakh produce the finest quality of pashmina fibre (cashmere) in the world.

Many excellent reviews are available on the genetic resources of goats in India (Bhat et al., 1980; Acharya, 1982; Acharya and Bhat, 1984). Large inter- and intra-breed variability is indicated (Table 7) but most of the data reported are from experimental stations and Government farms. Very few reports are available from producers' flocks under village conditions. Comparative data on crossbreds and native contemporaries within the same flocks under village conditions are not available.

2.2.2 Afghanistan

There are four goat breeds in Afghanistan. The Vatani and Asmari produce pashmina fibre from their undercoats. Generally information on them is scanty and evaluations are not available. The Asmari is generally used as a pack animal and for meat. Its long hair is used for making ropes and tents.

2.2.3 Iraq

Iraq has a number of goat breeds. These are small triple-purpose animals. The Khurdi, found in the northern provinces, is similar to the Central Asiatic Pashmina. In the Dohak region Angora goats are found, which produce mohair in common with the Angoras of Turkey. Many colours are found in Angoras. The Iraqi is another important breed, which is' generally black, but other colour types are known. This breed is the most numerous, and is found in all three agro-climatic zones; it is used generally for meat.

2.2.4 Iran

Iran has a numer of breeds, the most common being the Khurdi of northern Iran. The Nejdi is dual-purpose (milk and fleece), and the Lori is an Iranian milk goat. Morghose, Raini and Khurdi are pashmina-producing.

2.2.5 Turkey

There are 6 breeds of goats. One fourth of the entire goat population, however, consists of Angoras and other fibre-producing breeds.

2.2.6 Pakistan

Hasnain (1985) lists 25 breeds of goats, which are maintained for meat, milk, fibre and skins. Some of these are also used as pet animals. Four are able to produce fibre like pashmina. There are 3 breeds in Baluchistan, 3 in N.W. Frontier Province, 4 in Punjab, 4 in Sind, 4 in the Northern Areas and 7 in Azad Kashmir.

Table 7 BETWEEN BREED RANGES OF IMPORTANT ECONOMIC TRAITS FOR INDIAN GOAT BREEDS
(Acharrya, 1982; Acharya and Bhat, 1984; Acharya, 1985)

Region	No. of breeds	Body weight at:		Total yield kg	Lactation		Dry period days	Age at first kidding days	Kidding interval days	Service period days	Kidding %	litter size (% total kiddings)			
		3 mths kg	12 mths kg		Daily yield kg	Length days						1 %	2 %	3 %	4 %
North-Western	6	6-10	15-22	71-173	0.7-1.3	106-188	115-155 (3 breeds only)	525-776 (4 breeds only)	329-365 (3 breeds only)	124-170 (2 breeds only)	30-154 (4 breeds only)	41-100	7-52	0-7	0-0.2
Southern Peninsula	3	6-7	14-17 (2 breeds only)	54-83 (2 breeds only)	0.4 (1 breed only)	168-172 (2 breeds only)	145 (1 breed only)	491-610	290-357 (2 breeds only)	143-155 (2 breeds only)	187 (1 breed only)	44-62 (2 breeds only)	36-44 (2 breeds only)	0.6-6 (2 breeds only)	0-0.3 (2 breeds only)
Eastern	2	5 (1 breed only)	11-12	52 (1 breed only)	-	119 (1 breed only)	-	522-1067	282-376	90 (1 breed only)	85 (1 breed only)	22 (1 breed only)	54 (1 breed only)	20 (1 breed only)	3 (1 breed only)
Northern Temperate	2	7-9	17 (1 breed only)	69 (1 breed only)	-	187 (1 breed only)	-	628 (1 breed only)	280 (1 breed only)	-	-	-	-	-	-

2.2.7 China

Several authors have described Chinese goat breeds (Epstein, 1969, Devendra and Burns, 1970; Cheng 1985). Cheng lists 16, with 3 in the pastoral, 1 in the mixed agricultural-pastoral and 12 in the agricultural areas. They are ued for meat, skins and pelts, with 8 producing cashmere; of these, the Liaoning Cashmere, in the agricultural areas, has the highest production.

2.2.8 Indonesia

The Katjant goat is the indigenous type and Katjan Etawah crosses are also common. The Etawah is actually a cross between the Jamnapari imported from India and better local Javanese goat varieties. Though essentially a milking goat, the Etawah is rarely used for milk in Indonesia. Both the Etawah and the Katjang types are valued almost exclusively for their meat. The Gambrong breed of East Bali is larger than the Indonesian Katjang, and has a special purpose in that the long coarse hair of the male is used to make fishing lures.

2.2.9 Malaysia

The Katjan breed has been described in a number of reviews (Devendra and Burns, 1970; Devendra and Nozawa, 1976; Mukherjee, 1980). This breed is supposed to have given rise to a large number of sub-types which are available throughout the South-Asian region, particularly in Malaysia, Indonesia and the Philippines. Mason (1969) considers the Sarawak breed of Malaysia and the Metiga of Indonesia small varieties of Katjan. The Philippines native goats are also of the same type, but with coarse hair. In both Malaysia and Indonesia these breeds have been crossed with the Jamnapari of India and crossbreeding has resulted in a breed called Peranankan Etawah in Indonesia.

2.2.10 Korea

Korea has a medium-sized black goat which is not generally described as a breed type. It has been suggested that these goats are related to Chekiang and Kiangsu goats of Eastern China.

2.2.11 Japan

The native Japanese goat, called Tokara, is generally found in Southern Tynkyu Island. It is believed to be an introduction from Taiwan around the 15th century AD. The Okinawa meat goat has been described by Shinjo et al., (1978). Nozawa et al., (1978) have suggested that 13% of the genes in this breed have been derived from the Saanen breed; their suggestion is based on blood protein polymorphism.

3. HUSBANDRY

3.1 Management Practices

3.1.1 India

In arid and semi-arid regions sheep and goats are raised on permanent migration and the flocks follow well-established migratory routes according to the season. They are not brought to a homestead at any time of the year. Another group, generally from the western district of Rajasthan, migrate for 6-9 months and are brought to the homestead for the rest of the year. Goat flocks are normally non-migratory, except where they form part of mixed sheep and goat flocks. The animals are grazed on crop residues in harvested fields, in forests and in lean seasons on tree loppings. Only lactating animals get supplementary feeds, which may vary from concentrate mixture to hay or dry tree leaves. About 60% of flocks are penned in open fields away from the house and the rest are penned in temporary yards. Although the animals breed around the year, most breeding is linked with seasonal availability of grazing resources. The males stay with the flocks throughout the year, with copulation prevented as required.

In sub-tropical and temperate regions most flocks start migration in April, when they move to alpine pastures at high altitude, and start migration down in the month of October. During April-October they graze the alpine pastures, and during winter are fed dry fodder, tree leaves and concentrates. They are penned in closed houses as a protection against cold.

3.1.2 Afghanistan

Eighty percent of the sheep population are kept in transhumant flocks and the remaining 20% are stationary. Grain feeding is practised on an extremely limited scale. Breeding begins about the middle of September. Most surplus lambs and kids are marketed at about 7-10 months of age. In the Karakul breed 95% of male lambs are killed for pelt within 24 hours of birth.

3.1.3 Iran

Seventy percent of the sheep population is transhumant. Flocks migrate long distances following seasonal grass growth. The other 30% are stationary and are maintained on grazing lands around villages. During the cold and snowy winters sheep are often subjected to critical feed shortages, with high death rates and poor lamb crops.

3.1.4 Iraq, Syria, South Arabia and Yemen

In most Middle East countries, sheep are kept in communal flocks. The flocks are either stationary, transhumant or fully nomadic. Transhumance is generally observed in mountainous areas.

3.1.5 South Asia

Most flocks are with smallholders, 2-3 goats being tethered together and raised as part of the household. Very rarely is there special housing for either sheep or goats, except in Malaysia (goats) and Java (sheep).

4. IMPROVEMENT PROGRAMMES

4.1 Sheep

4.1.1 India

i. Selection within indigenous breeds

Bhat et al. (1980), Acharya (1982) and Acharya and Bhat (1984) • have reviewed a large number of Indian experiments aimed at increasing either body weight or fleece quality in indigenous breeds. Most of these have had neither continuity in time nor consistency in purpose, and the main gains from the studies have been estimates of phenotypic and genetic parameters for the breeds used. From these estimates it has been concluded that selection on body weight at 6 months improves market weight, yearling body weight and ewe productivity, while an index based on body weight at 6 months and greasy fleece weight would improve fleece quality. Selection against medullation percentage would show a significant reduction, with a correlated decrease in average fibre diameter, body weight and fertility.

Improvement programmes through selection of indigenous breeds, using better pedigreed rams, have been undertaken in a number of Indian States: in Rajasthan with the Bikaneri and its derivatives, in Andra Pradesh with the Nellore Mandya, in Uttar Pradesh with the Muzzafarnagri (in the western districts where sheep have been adapted to irrigated agriculture), and in Punjab and Haryana with the Nali and Lohi.

Although many programmes have been launched by various State Governments to improve the productivity of native village sheep flocks by the use of improved breeds, the results by and large have not been satisfactory.

ii. Use of tropical improver breeds

Crosses produced by grading up the Bellary and other coarse-wooled hairy breeds with the Bikaneri have shown improvement in greasy wool weight and wool quality, as indicated by a decline in medullation percentage and fibre diameter. Superior Indian carpet wool and mutton breeds have been extensively used for upgrading; for example, the Nali and Lohi of Punjab and Haryana have

been widely used on local populations in the Indo-Gangetic Plains, with some rewarding results, though not in the case of the cross between the Nali and the Muzzafarnagri in irrigated areas.

North Indian carpet wool breeds have also been used on South Indian woolless mutton breeds to introduce fleece cover; in most crossbreds there was an improvement in fleece quality and quantity, but none in body weight gain, dressing percentage or efficiency of feed conversion.

By and large these experiments have shown a marginal improvement in wool characteristics, but in the absence of any field recording system it is difficult to evaluate the impact of the improvement programmes on populations adapted to various ecological niches. The programmes have shown, however, that within breed selection is superior to the use of improver breeds.

iii. Use of temperate breeds

Crossbreeding with superior temperate breeds to improve wool quality and mutton production has been extensively used, and the results have recently been reported by Acharya (1982) and Acharya and Bhat (1984). Most of these experiments were done to improve wool weight and quality; breeds of three fleece types (fine carpet wool, Chokla; medium carpet wool, Jaisalmeri and coarse carpet wool, Malpura) were crossed with Rambouillet and interbred at various levels of exotic genes (Acharya and Mohan, 1979). Fine wool (Avastara) and superior carpet wool strains (Avakalin) have been produced from these experiments (Tables 8, 9 and 10).

A classic example of success in introducing superior temperate inheritance into indigenous sheep with the objective of developing a fine wool breed is the Kashmir Merino, which is now a well recognized Indian breed, used for apparel wool. This breed is a result of crossing 4 breeds of sheep in the valley of Kashmir, initially with Australian Merino, then with Rambouillet and Russian Merino. About 75-82% of genes in the breed are now from the three exotics, the majority coming from Russian Merino. The present population of the Kashmir Merino exceeds 1 million.

Table 8 AVERAGES AND STANDARD ERRORS OF GREASY FLEECE WEIGHT AND WOOL QUALITY ATTRIBUTES OF INDIAN SHEEP BREEDS CHOKLA, NALI AND PATTANWADI AND THEIR CROSSES WITH RAMBOUILLET AND MERINO (Arora et al. , 1983; Acharya and Bhat, 1984)

Breed or cross		Average fibre diametre µm	Medullation %	First 6 monthly greasy fleece weight kg	Body weight at 6 months kg
Chokla		23.1 ± 0.35 (79)	25.1 ± 0.05 (79)	0.9 ±0.02 (439)	13.3 ± 0.15 (315)
	Fl	20.6 ± 0.19 (196)	19.0 ± 0.04 (196)	1.0 ± 0.03 (795)	15.2 ± 0.11 (749)
	F2	21.2 ± 0.38 (81)	19.0 ± 0.04 (80)	1.0 ± 0.03 (115)	16.2 ± 0.29 (124)
	5/8	20.8 ± 0.57 (33)	15.2 ± 0.06 (30)	1.1 ± 0.04 (39)	14.8 ± 0.45 (41)
	3/4	20.0 ± 0.42 (63)	11.9 ± 0.04 (62)	0.9 ± 0.07 (62)	15.8 ± 0.03 (104)
Nali		28.0 ± 0.45 (81)	62.8 ± 0.85 (81)	1.0 ± 0.37 (341)	13.8 ± 0.15 (314)
	Fl	26.6 ± 0.18 (308)	28.1 ± 0.02 (308)	1.0 ± 0.03 (1028)	14.8 ± 0.09 (954)
	F2	21.8 ± 0.28 (159)	27.7 ± 0.03 (155)	1.1 ± 0.03 (191)	16.2 ± 1.9 (206)
	5/8	22.0 ± 0.51 (44)	23.8 ± 0.07 (43)	1.1 ± 0.03 (66)	16.6 ± 0.3 4 (67)
	3/4	19.3 ± 0.48 (61)	11.4 ± 0.05 (50)	1.0 ± 0.08 (125)	16.2 ± 0.26 (132)
Pattanwadi (P)		28.0 ± 0.46 (85)	35.0 ± 1.8 (85)	0.5 ± 0.61 (86)	16.8 ± 0 .18 (144)
Rambouillet x P		21.9 ± 0.24 (191)	16.0 ± 0.76 (191)	0.6 ± 0.01 (191)	19.4 ± 0.23 (306)

Merino x P	22.4 ± 0.44 (54)	18.2 ± 1.6 (54)	0.7 ± 0.02 (55)	18.8 ± 0.21 (172)

Numbers of observations in parentheses

The results of crossbreeding utilizing Dorset and Suffolk are given in Tables 11 and 12. Suffolk crosses were generally superior to Dorset crosses, but in many cases there was not much improvement in either cross. However, inter-breeding of Dorset and Suffolk crossbreds showed better results.

Similarly, Suffolk, Dorset and Corriedale have been used on large field populations to develop mutton type strains. In a number of cases this experience has not been rewarding. A number of crossbreds so produced have not survived when run together with the natives, particularly when the advantage of special care and management of the experimental farms was withdrawn. With most of the crossbreeding experiments, except where sustained efforts have been made as in the case of the Kashmir Merino, the results have not been successful. The general situation is that under the prevailing realities of sheep husbandry, it may not be possible for crossbreds run under village conditions of management and survival to outdo the native well adapted breed types on the basis of lifetime production. Since no data are available on such comparative lifetime production records it is difficult to make any positive recommendations, but by and large the results have not been satisfactory (Bhadula and Bhat, 1981; Bhat, Pran P. et al. 1978 and 1981.

Table 9 AVERAGES AND STANDARD ERRORS OF GREASY FLEECE WEIGHT, WOOL QUALITY ATTRIBUTES AND SURVIVABILITY OF INDIGENOUS AND SYNTHETICS (Arora et al., 1983)

Breed	Annual greasy wool production (kg)	Average fibre diameter (µm)	Medullation (%)	Six monthly body weight (kg)	Survivability (0-90 days) (%)	Lambing on the basis of ewes available (%)
Nali	2.9±0.02 (879)	28.6±0.71 (20)	42.8±4.0 (20)	14.4±0.14 (397)	84 (1072)	86.5 (104)
Chokla	2.5±0.01 (879)	23.2±0.79 (23)	18.4±3.2 (23)	13.7±0.13 (363)	83 (1235)	78.8 (85)
Nali synthetic	2.8±0.02 (760)	22.9±0.23 (132)	16.3±3.4 (127)	16.4±0.07 (1603)	92 (3502)	74.9 (315)
Chokla synthetic	2.7±0.03 (543)	21.1±0.26 (64)	8.8±1.1 (54)	16.3±0.09 (1157)	87 (3021)	82.3 (215)
Superiority percentage of new synthetics over indigenous						
Nali synthetic	(-) 0.8	18.3**	52.4	13.9**	9.4	(-)13.4
Chokla synthetic	7.9**	6.8**	21.8	19.2**	5.66	4.4

** P <0.01
Number of observations in parentheses

Russian Karakul sheep have been imported into India and crossed with Indian coarse carpet wool breeds for lamb pelt production under both hot and cold arid climates. The performance of Karakuls in both cases with respect to growth, survivability, greasy fleece production, productive performance and pelt quality were highly satisfactory. The crosses of Karakul with coarse carpet wool breeds showed significant improvement in pelt quality over the natives. There was, however, a large variation in pelt quality, and if selection within the crossbred population is resorted to, it is bound to lead to significant improvement in Indian pelt sheep (Acharya et al., 1980).

4.1.2 Afghanistan

Very little information is available concerning sheep production in Afghanistan. Studies were conducted for improving the productivity of Ghiljai, Hazargie and Gadik breeds through crossbreeding with Turkish

Table 10 AVERAGES AND STANDARD ERRORS OF GREASY FLEECE WEIGHT AND WOOL QUALITY ATTRIBUTES OF INDIAN SHEEP BREEDS MALPURA AND DECCANI AND THEIR CROSSES WITH RAMBOUILLET AND DECCANI (Arora et al., 1983; Acharya and Bhat, 1984)

Breed or cross		Average fibre diametre μm	Medullation %	First 6 monthly greasy fleece weight kg	Body weight at 6 months kg
Malpura		40.9 ± 0.54 (145)	82.9 ± 0.05 (145)	0.5 ± 0.03 (211)	14.0 ± 0.44 (190)
	Fl	27.8 ± 0.55 (117)	41.3 ± 0.05 (117)	1.0 ± 0.04 (113)	19.9 ± 0.44 (113)
	F2	24.6 ± 0.64 (85)	24.2 ± 0.06 (85)	0.9 ± 0.03 (114)	20.5 ± 0.39 (114)
	5/8	21.2 ± 0.08 (53)	17.0 ± 0.11 (50)	0.9 ± 0.04 (84)	20.6 ± 0.42 (84)
	3/4	19.7 ± 0.78 (58)	14.3 ± 0.09 (58)	0.8 ± 0.04 (103)	19.3 ± 0.42 (103)
Deccani (D)		52.4	68.2	0.5 ± 0.02 (55)	17.4 ± 0.74 (58)
Merino x D		23.9	32.8	0.6 ± 0.03 (26)	17.5 ± 0.69 (27)

Numbers of observations in parentheses.

Table 11 AVERAGES AND STANDARD ERRORS FOR CHARACTERS RELATED TO FEEDLOT PERFORMANCE OF INDIGENOUS AND CROSSBRED SHEEP BRED FOR MUTTON (Arora et al., 1983)

Breed	Weaning weight (kg)	Feedlot gains (kg)	Efficiency of feed conversion (%)	Dressing percent on live weight (%)
Mandya	9.6±0.14 (885)	8.2 (45)	13.3 (81)	48.9 (42)
Dorset x Mandya	11.6±0.29 (463)	12.2 (91)	17.4 (84)	49.0 (49)
Suffolk x Mandya	11.9±0.49 (302)	11.4 (44)	17.8 (52)	48.8 (37)
Nellore	11.9±0.28 (562)	8.3 (44)	14.0 (79)	47.8 (38)
Dorset x Nellore	14.0±0.57 (395)	12.5 (60)	17.4 (59)	50.5 (9)
Suffolk x Nellore	13.9±0.40 (303)	10.9 (29)	15.6 (36)	49.5 (21)
Deccani	13.4±0.49 (47)	9.0	11.7	41.8 (10)
Dorset x Deccani	14.2±0.80 (12)	12.0	14.1	44.9 (15)

Number of observations in parentheses.

Merino, Russian Merino and Columbia. There was an improvement in crossbreds over indigenous breeds in wool weight and quality and in body weights at State farms. However, exotic breeds or their crosses could not survive under the conditions of nutrition existing in the villages. No trace of these crossbreds can be found today.

Table 12 AVERAGES AND STANDARD ERRORS FOR CHARACTERS RELATED TO FEEDLOT PERFORMANCE OF INDIGENOUS AND CROSSBRED SHEEP GROWN FOR MUTTON (Bohra, 1984)

Genetic group	Weaning weight (kg)	Feedlot gain (kg)	Total feed intake 1/ (kg)	Efficiency of feed conversion (%)	Dressing percentage live weight basis (%)
Malpura	11.4±0.20 (326)	9.1±0.45 (99)	69.9±2.22 (80)	13.1±0.38 (71)	47.4±0.40 (72)
Sonadi	11.3±0.19 (364)	8.6±0.45 (107)	67.1±2.30 (79)	12.4±0.40 (68)	46.0±0.38 (93)
Dorset x Malpura	12.8±0.17 (471)	11.7±0.41 (139)	75.1±1.89 (121)	15.7±0.32 (119)	48.4±0.36 (96)
Dorset x Sonadi	12.5±0.17 (486)	12.0±0.39 (147)	76.6±1.84 (118)	15.9±0.32 (lT7)	48.2±0.35 (102)
Suffolk x Malpura	13.1±0.20 (277)	12.6±0.44 (104)	73.7±2.10 (88)	16.2±0.36 (77)	47.5±0.38 (77)
Suffolk x Sonadi	13.3±0.19 (311)	12.9±0.44 (108)	75.9±2.12 (85)	16.0±0.36 (80)	47.2±0.38 (82)

1/ Feed composition: Zizyphus numularia or cowpea hay 30 parts, maize 40 parts, groundnut cake 20 parts, molasses 7 parts, mineral mixture 2 parts and common salt 1 part.

Number of observation in parentheses.

The Karakul Institute in Afghanistan is providing facilities for grading and marketing of pelts. The efforts made by the Institute have increased the proportion of grey pelts from 30 to 70%, and the proportion of top grade pelts from 30 to 80%.

4.1.3 Iraq

i. Body weights and growth rate

Hamdani sheep are the largest of all Iraqi breeds at all ages, followed by the Awassi and Ne'oimi. The smallest are Arabi and Karradi. Most sheep reach their mature weight between three and five years of age, the relatively fast growers such as Hamdani reaching it earlier. Some of them have reached a weight of 100 and 115 kg at Aski-Kalak Station at 18 months; males are always heavier than females and singles tend to be heavier than twins, differences decreasing after weaning (Table 6a).

ii. Fleece weight

Fleece weights are heaviest in Hamdani, followed by Karradi and lowest in Arabi. It is the other way around with respect to fineness and length, where Arabi wool is finest and shortest and Hamdani and Karradi coarse and long (Table 6). Weight at the first shearing is always lower, since many farmers shear their sheep for the first time at 9 months of age (September); otherwise sheep are shorn in April or early May depending on the locality. The heaviest fleeces are produced when sheep are three to four years old. Most fleeces yield between 70 to 80% clean wool, depending on the breed.

iii. Milk production

Ne'oimi and Awassi ewes are the best milk producers, followed by Hamdani. With better nutrition, several ewes have given up to one kilogramme of milk per day; individual records of 200 kg to 300 kg in a lactation period of 150 days are also known. The milking season usually lasts four to five months, while the fat percentage is between 5.5 and 7.5 and increases with age.

iv. Fertility and lambing percentage

These traits are mostly dependent on environmental conditions, particularly feeding and health. Percent of ewes lambing ranged from 50 to 90, Hamdani and Karradi being the most fertile followed by Awassi and Ne'oimi. Lambing percentages (twinning) were highest among Hamdani and Awassi. The flock of the State Board of Agricultural Research at Sho'la has a twinning percent of 25, but in other breeds twinning is of little significance.

v. Lamb mortality

Nothing is known about embryo losses in Iraqi breeds, and still births are quite rare. Lamb mortalities from birth to weaning are not very high in most experimental flocks, being less than 5-10%. The sheep are hardy and can withstand scarcity of feed and weather fluctuations except for the Hamdani and Karradi, which suffer from high summer temperatures.

vi. Lamb fattening

Lamb fattening is an important traditional enterprise in Iraq and consumers show a marked preference for mutton. About one third of the 11.7 million sheep are fattened in the five Northern Mohafadas each year, with 2.3 million in Nineveh alone, more than 60% of the latter being raised in the village Kikjally near Mosul city. Most of the sheep fattened are shipped southward to Baghdad, the main consuming centre of Iraq, utilizing about 50 percent of all meat produced in the country. Almost all fattening yards use barley alone with some straw, salt being given occasionally, and green roughage by some farmers. Sometimes the sheep are allowed to graze during the day. Feed is offered twice daily.

vii. Selection within Iraqi breeds

The development of the Hamadi breed has been one of the major results of selection within the Karradi. Experiments using body weight as a selection criterion have been conducted at the Abu-Ghraib Experimental Station and also under the UNDP sponsored project at Akisi Kalak, with varying degrees of success; by and large the experiments were successful in increasing body

weights both in Awassi and Hamdani breeds, with an increase of about 6 kg in one generation. Unfortunately no sustained efforts in this direction have been made.

viii. Crossing among Iraqi breeds

No sustained long range experiment has been done involving crossing among various Iraqi breeds. A small study on the preweaning weights of crosses of Awassi, Karradi and Arabi showed no significant difference among the purebreds in body weights at four months of age. There was some marginal increase in the crosses, particularly (A x K), which was also superior to all other genetic groups for ewe traits, but no definite recommendation could be made on the basis of these results since they were based on very few numbers, and the design of the experiment was not optimal.

ix. Crossing with temperate breeds for increased meat production

An experiment was conducted to increase prolificacy in the Hamdani breed, using purebred Hamdani and Finnish Landrace and their reciprocal crosses. The ewe progeny of Finn rams and Hamdani ewes showed a drastic reduction in body weights at weaning and first oestrus, compared with pure Hamdani, with no significant decrease in age at first oestrus. There was, however, a marked increase in prolificacy in the halfbreds, which produced 70% multiple births.

x. Crossing with temperate breeds for wool production

A number of attempts have been made to introduce temperate breeds either as possible replacer breeds or to produce crossbreds with fast growth rate and finer wool. Most of these attempts have not yielded the desired result. The introduction of Merino sheep in a breed replacement strategy has failed due to their non-adaptation to the harsh environment of North and Central Iraq. Crossbreds have generally done well both in introducing finer fleeces and faster growth, but in the absence of any national strategy to introduce crossbreds these investigations have not made any impact.

4.1.4 Iran

i. Crossing among Iranian breeds

A considerable body of information has become available on the performance of indigenous breeds under semi-intensive and intensive conditions of husbandry, but within breed selection has not been attempted. Crossbreeding among Karakul, Mehraban, Neini, Kizil and Bakhtiari breeds did not express any significant positive heterosis in terms of lamb production.

ii. Crossing with temperate breeds

Crosses of Karakul, Mehraban and Neini with Corriedale and Targhee have shown marginal improvement in pre-weaning and feelot gains and weights (Farid et al., 1977). Results of crossbreeding with Ile-de-France and various types of Merino rams on the ewes of indigenous breeds have given encouraging results (Yalcin, 1979) and a new fine wool sheep, Magbuillet, has been evolved through crossing Moghani ewes with Rambouillet rams. Introduction of Israeli Awassi genes into local Baluchi and Shal breeds has improved fleece weight and milk yield of the crosses.

Crossbreeding involving Suffolk and Targhee sheep from USA, and Chios from Greece with indigenous sheep of Iran has not yielded any satisfactory results because of prevailing nutritional

and management conditions. The situation was further aggravated by difficulty in natural mating between thin-tailed exotic rams and fat-tailed indigenous ewes.

iii. Feedlot performance

Studies on the feedlot performance and carcass yield of mature Bakhtiari, Baluchi, Kallakui and Kizil rams and ewes on different levels of nutrition for 120 days have indicated the consistent superiority of Kizil animals followed by Bakhtiari, Baluchi and Kallakui in descending order (Saleh et al. , 1972). The Baluchi and Kallakui differed little from each other. In carcass composition the breed differences were small and not consistent in various sex and treatment groups. Studies on the effects of castration and nutrition on fattening performance have shown highest daily gains for Kizil followed by Baluchi and Kallakui.

iv. Reproductive performance

Studies on reproductive performance, breeding season, oestrus synchronization etc. for increasing lamb production (Demiruren et al., 1971 and International Sheep and Goat Institute Report, 1977) Have shown 25-27% twinning percentage in most breeds, and breeding season lengths of about 7 months. The effect of docking and castration on the weight and carcass growth of lambs has shown (Demiruren et al., 1971 and Saleh, 1976) that the tail fat was deposited as suEcutaneous/intramuscular/internal fat with no change in lean to fat ratio.

v. Future trends

The present sheep production and improvement will of necessity have to come from native breeds. There are no large within-breed selection programmes combined with field recording of performance in any of these breeds. There is, however, a tradition of ram rotation and the breeders themselves exercise a certain amount of selection on the basis of body weights and prolificacy. The action programmes are primarily directed to this end. From the results of experimental crossbreeding, it is not possible to extend to any large tracts in the country the few pockets available for crossbreeding.

4.1.5 Turkey

i. Problems relating to selection

Of the 41.9 million sheep in Turkey, approximately 40.5 million are of native breeds. These sheep are not being subject to vithin-breed selection except at Government Experiment Stations and in organized flocks. Estimates of genetic and phenotypic parameters for different production characteristics are available for some breeds. Main limiting factors in initiating a programme of selection are the lack of stratification within the breeds, lack of recording in the field and the number of characteristics to be considered in selection. It would be desirable to establish nucleus flocks in the field, in addition to those at the State farms; this would be useful in creating stratification in the breeds, and in disseminating genetic improvement gained in the nucleus flocks tc other flocks by the sale of rams. Such an arrangement is particularly important for Awassi, Kivircik and Merino breeds.

ii. Crossing with temperate breeds for wool production

Crossbreeding of Kivircik and White Karaman sheep with mutton Merino rams since the 1930s has led to the formation of two Turkish-type Merinos, viz. Karacabey Merino and Central Anatolian Merino respectively (Yalcin, 1979).

iii. Crossing with temperate breeds for meat and wool production

When White Karaman were crossed with Ile-de-France rams, the F,s and F_2s showed significant improvement in body and fleece weights, milk yield and conception rate, while sheep with 60-70% Ile-de-France genes were considered adaptable.

iv. Crossing for meat production

Crossbreds involving Rambouillet and Daglic have shown significant improvement in growth rate in F_1 and F_2 lambs over either of the parent breeds. Results of crossbreeding Daglie, Merino and Ile-de-France sheep have shown that the Ile-de-France as terminal rams gave considerable advantage in growth rate and carcass quality.

v. Crossing for milk production

Introduction of Awassi genes into White Karaman has significantly improved milk production.

4.1.6 China

Improvement of sheep by crossing indigenous breeds with exotic fine wool breeds has made rapid progress, with reasonably good results. Three new fine wool strains viz., Xinjiang fine wool (now renamed Chinese Merino), Northeast fine wool and Gansu Alpine fine wool have been evolved. The average fleece of improved (crossbred) fine wool and medium wool sheep is two to three times heavier than that of indigenous coarse wool sheep. There is also improvement in wool quality (Cheng, 1984).

4.1 Goats

4.2.1 General

In the Asian region goat improvement programmes are organized only in the Indo-Pakistan sub-continent, Malaysia and the Philippines. In the Middle East, improvement programmes are concentrated on the Angora breed. Other breeds have been left alone by the developement agencies and government initiatives, and are mostly looked after by the breeders themselves, who use traditional methods of improvement. These involve selection based on phenotype and the needs of the region, with some exchange of bucks. The major selection traits are body weight gains and prolificacy, with the aim of increasing meat production.

In the Indo-Pakistan sub-continent the development agencies have introduced exotic temperate breeds, mainly Saanen, Alpine, Toggenburg and German, to increase milk production in indigenous goats. Similar programmes are available in Thailand, the Philippines and Korea.

On Government farms and field stations and in research projects, the crossbreds have shown improvement in milk yield, age at first kidding and body weights. In some cases they have been produced in villages, where they have been given better nutrition; no data are available on their performance when run together with native breeds. So far, large crossbred field populations are not available on the basis of which conclusions could be drawn. Wherever attempts have been made to introduce exotic genes under village conditions the level has not exceeded 50%, and crossbreds have generally not survived as well as the natives. It is unlikely that crossbreds will successfully replace native goats except in small urban pockets. Improvement programmes should

concentrate on the native breeds; within-breed selection combined with field recording programmes should yield results.

4.2.2 Selection within indigenous breeds

Selection for milk production in goats has been largely restricted to experimental flocks. Studies in India have shown selection in Beetal goats to be effective.

4.2.3 Crossing among indigenous breeds

The Jamnapari and Beetal have been used extensively in the Asian region for upgrading local goat populations for meat and milk. While in the Indian sub-continent they have been used primarily as improver breeds for increasing size and milk production, in Indonesian villages and in other countries they have been used primarily for meat. Crossbreeding among indigenous breeds, especially Jamnapari, Beetal, Barbari, Black Bengal and Sirohi, reflected the usefulness of Jamnapari and Beetal as improver breeds for body size, body weight and milk production in smaller breeds.

4.2.4 Crossing among indigenous breeds for chevon production

The wide range of variability in body weights and reproduction rates can be effectively utilized for improving meat production through crossbreeding/grading. The primary results of such experiments in India involving Jamnapari, Beetal, Barbari and Black Bengal showed that the crosses of Beetal x Jamnapari and Barbari x Jamnapari were inferior to purebred Jamnapari. The Barbari x Beetal crosses were, however, superior to Jamnapari x Beetal. The magnitude of improvement was 18% in carcass weight, 8% in dressing percentage and 18% in bone percentage over purebred Beetal.

The Beetal x Barbari crosses were superior to Jamnapari x Beetal and Barbari x Beetal. The magnitude of improvement in Beetal x Barbari was 33% in carcass weight, 2.5% in dressing percentage and 16% in bone percentage over purebred Barbari. The Beetal x Sirohi crossbreds were superior to Sirohi, the magnitude of improvement in carcass weight and dressing percentage being 13% and 1.4% respectively over purebred Sirohi. The results of indigenous crosses revealed specific combining ability for various indigenous breeds, but Jamnapari, the largest Indian breed, did not "nick" well with any other indigenous breeds.

4.2.5 Crossing with exotic breeds for milk production

Crosses of indigenous breeds with exotic dairy breeds (viz. Alpine and Saanen) in India showed substantial improvement in Beetal and Malabari halfbreds. Milk production and lactation length improved greatly in both Alpine and Saanen halfbreds, Saanen halfbreds being superior to Alpine. Three-quarters Saanen with Beetal were superior to 1/2 Saanen x 1/2 Beetal. The crosses of Beetal with Alpine and Saanen showed marginal differences from the Beetal in age at first kidding, kidding interval and service period. The most commonly used exotic breeds are Alpine, Saanen and Anglo-Nubian. Results of Alpine and Saanen have shown that there was an improvement in milk yield of almost 100%. Anglo-Nubian crosses with Beetal showed maximum improvement in slaughter weight.

4.2.6 Crossing with exotic breeds for fibre production

Chegu and Changthangi pashmina goats in India have an annual . Production of 132 g and 214 g of pashmina (cashmere) respectively, with an average fibre diameter of 12.4 + 0.7 μm. There are no Angora goats in India, but crossing exotic Angoras onto indigenous Gaddi and Sangamneri Produced lower quantities of finer and shorter mohair.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 General Conclusions

i. Among Asian countries, China, India and Iran have the largest populations of sheep and goats, and have the highest production levels. Information on the performance of Asian breeds is highly inadequate and largely unsatisfactory. While some of the breeds have not even been fully described, others are being indiscriminately crossed. Their improvement, even today, is entirely based on ram/buck exchange between breeders and distribution of rams/bucks from Government farms, with no provision for monitoring their performance and impact. Wherever improvement programmes are underway, the participation of farmers is virtually non-existent.
ii. Most breeds of sheep are available in adequate numbers and there is no danger of extinction for any breed population. In goats, except for two breeds (Jamnapari and Barbari of India), whose numbers have declined to 5000 and 30 000, numbers are fairly adequate.
iii. Most countries have been crossbreeding indigenous breeds with imported exotic rams/bucks/semen, in order to introduce gains in body weight and wool quality. Except for two cases (Turkey and India), these programmes have not been able to create any impact.
iv. No system of recording performance in producers' flocks exists in the entire region except in Turkey. Crossbreeding is being extensively used under the impression that dramatic changes in the performance of these breeds will be obtained, without considering the realities of the environments in which these crossbreds are to survive and produce. It can be safely concluded that all these goals can be achieved if indigenous breeds are given proper nutrition and adequate health cover, combined with within-breed selection based on performance recording in farmers' flocks.

5.2 Gaps in Information

The information available from these countries on various aspects is scanty, and data need to be collected. Some aspects are detailed below:

5.2.1 Reproductive cycle

It has been observed that most breeds in the region breed round the year, while some breeds show considerable variations in breeding season and frequency of lambing. This inconsistency needs to be examined.

5.2.2 Lifetime performance

Data on sheep maintained in the experimental stations which have been reported in the literature refer to performance early in life. There are no data on lifetime performance. This vital aspect is not realized when comparing native breeds with crossbreds or new introductions. While some figures are available on lamb survival, the mortality figures over the years are not available. Changes in lambing percentage and wool production for native breeds with age are also not available.

5.2.3 Performance under village conditions

Lifetime performance needs to be compared in villages as well as on experimental farms. This information is not available.

5.2.4 Artificial management of crossbred and native

In most village conditions in Asia, whenever a crossbred is produced it is given special care, consequently the cost of production increases. The question which needs to be examined is whether a cost/benefit ratio on management would give this new crossbred introduction an advantage over the native if the special care did not

exist. This information is vital for making any general recommendation on crossbreeding as a method of improvement.

5.2.5 Comparisons from available information

From the presently reported information, it is not always possible to decide whether the comparisons are contemporary or not. This is a basic defect with most of the data presented. Efforts need to be made to rectify this.

In most experiments native and crossbred have to be run concurrently, in the initial years of experiments. This comparison is available when crossbreds are being generated. Data on the natives are reduced as the crossbred groups are increased and the natives are eliminated, whatever the reasons, with the result that concurrent information on the natives is lost. This kind of design needs to be avoided if meaningful comparisons are to be made from which recommendations can be made to farmers.

5.2.6 Valuable traits of native breeds

Lists of genetic traits which are available from the point of view of conservation are difficult to make, but a few can be identified:

Adaptation: Most native breeds are adapted to harsh environments. When purebred exotics are introduced into these environments they generally do not survive. Halfbreds with exotics have shown increased production, but when concurrently left under village conditions the marginal increase is not large enough to justify the costs under the harsh environment. The crossbred survival is also difficult without proportionate input, which is generally not forthcoming.

High ovulation rate: A number of breeds from the Asian regions show high ovulation rate; particularly Javanese thin tailed sheep (JTT) and Bengal goats.

5.3 Recommendations

i. Evaluation of indigenous breeds needs to be undertaken, starting with those that are numerically more important and in keeping with local product needs, such as meat, milk and wool.
ii. Evaluation of breeds for crossing with local breeds for increased meat, milk or wool production (quality and quantity) should be undertaken. This should include breeds from within and outside the region.
iii. Most of the sheep and goat breeds in the region have long breeding seasons. In fact, some of the ewes continue to cycle even during the "non-breeding season". In some breeds, two peaks of breeding activity have been reported. This trait of sheep is not being fully exploited. There is now sufficient evidence under experiment station conditions that it is technically feasible to breed every eight months or three times in two years, but this concept has yet to be field-tested to identify practical problems under nomadic and transhumant situations.
iv. There is interest in the use of hormones for synchronization of oestrus, superovulation and induction of early maturity. The physiology of reproduction and its modification through hormonal intervention is not sufficiently understood, however, to warrant immediate studies in the region. Instead, efforts are needed to understand the reproductive behaviour of the indigenous breeds in the regional environment. Hormonal interventions may be called for after the seasonal and lactational anoestrus are well understood.
v. It is necessary to develop JTT strains homozygous for the "prolificacy" gene. These sheep show considerable variability in litter size, but on an average, to have a high litter size it is necessary to develop strains which have a uniform litter size.

vi. It is also desirable to develop strains of JTT sheep which do not carry the "prolificacy" gene. Such ewes will have mostly singles and twins. This will be an adequate level of prolificacy for most currently existing management situations.
vii. Most of the indigenous breeds have poor body weight gains and efficiency of feed conversion. Improvement through selection in body weight gain, which is highly heritable, is possible.
viii. A critical evaluation of the current crossbreeding programmes must precede any recommendation for the future.
ix. Most of the breeds in the region produce fleeces which have high average fibre diameter and medullation percentage. These are suitable for various grades of carpets. Some of the breeds have coarser and more hairy fleeces which are not usable even for low quality carpets. Selection against medulallation results in improvement in fleece quality.
x. Selection for the first six-monthly fleece weight and against medullation percentage in extremely coarse and hairy breeds improves greasy wool production and quality towards better carpet wool. Such a selection needs also to be undertaken in better carpet wool breeds.
xi. It is recommended that for improving apparel wool production, crossing of better carpet wool breeds with exotic fine wool breeds can be attempted, stabilizing exotic inheritance at 50%. Further improvement may be brought about through selection in crossbred populations for greasy fleece weight and against medullation percentage.
xii. It is recommended that for improving mutton production, especially under intensive feed management, crossbreeding of extremely coarse and hairy wool breeds with exotic mutton breeds be undertaken.
xiii. Improvement of milk production in goats can be brought about through selection for first lactation milk yield and age at first kidding.
xiv. The important goat breeds of India whose number have declined seriously are the Barbari and Jamnapari. It is reported that only 5000 animals of Jamnapari and 30 000 heads of Barbari exist at present. They need to be conserved.

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