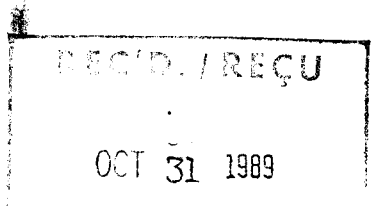
SMALL RUMINANT PRODUCTION IN THE ASIAN REGION

C DEVENDRA
Animal Production Systems
Division of Agriculture, Food and
Nutrition Sciences
International Development Research Centre
Tanglin P O Box 101
Singapore 9124



Paper presented at the National Meeting on Small Ruminants
16-20 October 1989, Beijing, China

SMALL RUMINANT PRODUCTION IN THE ASIAN REGION

C DEVENDRA
Animal Production Systems
Division of Agriculture, Food and
Nutrition Sciences
International Development Research Centre
Tanglin P O Box 101
Singapore 9124

ABSTRACT

Small ruminant production in Asia is discussed with reference to the size and trends in the populations of goats and sheep, available genetic resources, productivity, economic importance, significance of ownership, production systems, comparative feeding and nutrition and strategies for development. The importance of these aspects is reflected in the fact that goats and sheep in the region account for about 51.0% and 21.0% of the total world population, and include approximately 62 potentially important indigenous breeds useful for a variety of functions. Currently, the goat population is growing faster than that of sheep, but analysis of output and demand for meat suggests that the gap between the two is widening. Considerable opportunities exist for increasing productivity from both species, especially through improved and more efficient systems of feeding and management, and reduced mortality. The development strategies include clear production objectives, exploiting more fully the avenues of production, continuing research, improved research-extension linkages, on-farm validation of results and dissemination of appropriate results. The last two aspects merit participatory research with farmers.

INTRODUCTION

Small ruminants (goats and sheep) constitute important renewable resources in the Asian region. They are part and parcel of various types of farming systems and the socio-economic life of landless people and small farmers throughout the region. In this context, they are found, compared to other ruminant species, uniquely distributed in all types of agro-ecological conditions throughout Asia : from the high altitude Himalayas, arid and semi-arid areas of Pakistan, India and Mongolia, to the high rainfall, high humidity countries that are characteristic of most parts of South East Asia.

The various agro-ecological zones are also the locations of variable populations of a bewildering variety of goats and sheep that demonstrate ability to adapt, survive and reproduce within the climatic extremes. In these situations, they perform a number of primary and secondary functions which are extremely important to the small farmers and landless peasants. In many instances, this contribution forms a significant proportion of the total farm income and the stability of farming systems.

It is emphasised at the outset that despite the value and considerable extent of the contribution of both these species, the productivity for them is generally small. Considerable possibilities exist therefore of increasing this contribution further, which might be

of direct benefit to especially the poor livelihood and nutrition of rural people.

The intent in this paper is to examine various aspects concerning small ruminant production, draw attention to those issues that are worthy of increased research and development focus, stress important development strategies and allude to how some of these aspects may be relevant to situations in China.

I. GOAT AND SHEEP POPULATIONS

Table 1 indicates that goats and sheep in Asia and the South Pacific account for 51.0% and 20.5% of the total world population of these species. Of this, the corresponding figures for the goat and sheep populations in China were 13.4% and 8.6% respectively. The ratio of sheep to goats is about 1 : 1. The rates of growth of the individual species over the last 10 years from 1977 to 1987 were 1.8% and 1.3% indicating that the goat population is growing faster than the sheep population in Asia and the South Pacific.

II. BREEDS

Asia is very important reservoir of widely different and well adapted indigenous goat and sheep breeds. They are very diverse and classification is not easy especially since there has been considerable crossbreeding between the breeds. The goats are extremely varied, and are concentrated mainly in the north-east and the north-west in the Ganges and along the Himalayas, throughout the Sind and the Punjab and in the mountain valleys of Baluchistan and around Kashmir. Although there is a diversity of breeds and type of goats, there are certain external features which are prominent. Black is a dominant colour and horns, where present are usually scimitar-shaped. Scimitar horned goats have been found in vast fragments near Baghdad going back to about 3000 B.C., and ceramic art involving goats around 1000 B.C. are known to be associated with the Indus Civilisation and the Chalcolithic cultures of Central India.

Table 2 identifies the more important indigenous goat breeds in Asia with reference to such specialised attributes as milk, meat, prolificacy, cashmere, pashmina and skin production. The breeds have potential "improver" capacity, and have above average productivity in one way or other, or because they are specially adapted to a particular environment. A total of 47 important indigenous breeds are identified which are worthy of more research and development.

Likewise, Table 3 lists the more important indigenous sheep breeds in Asia with reference to milk, mutton, fine wool, carpet wool and prolificacy. A total of 15 important indigenous breeds are identified.

Reference is made in this connection to a description of breeds of goats and sheep in China (Cheng Peilieu, 1984) and more recently, also of goats (Jian Ying, 1986).

Both Tables 2 and 3 are not exhaustive, simply because of a lack of more complete information. It is quite likely many more potentially

important goat and sheep breeds are present in Asia which are also worthy of more investigations and documentation.

III. **PRODUCTIVITY**

Table 4 summarises the extent of the different types of products from each species. Goats produced approximately 52.9% of the goat meat and sheep 16.7% of mutton and lamb as percentage of total world production. Corresponding contributions for milk were 32.3% and 11.2% for goats and sheep respectively as percentage of the total world contribution.

Turning to wool production sheep produced 9.4% of the total world production of greasy wool. Fresh skins are an important by-product of goat and sheep production and the extent of the contribution, as percentage of total world production was 57.8% and 18.5% respectively.

Between the two meats, both of which are inadequate to meet current demands, the situation is such that considerable opportunities exist for increasing the current level of supply. With specific reference to goat meat, an analysis of past and projected trends (Devendra, 1987a) suggest the following conclusions :

(1) Inadequate supplies of goat meat have resulted in a trend towards the increased price of per unit of goat meat relative to all other meats. This is reflected in many countries in . especially South East Asia (Devendra, 1979).

(2) There have been increased imports of feral goat meat notably from Australia and New Zealand to markets in the Near East and the West Indies.

(3) The high price of goat meat has encouraged unscrupulous substitution by imported mutton from poorer quality sheep.

(4) Inadequate goat meat supplies have also resulted in the increased price of live goats, including breeding animals.

(5) The demand for goat meat has encouraged increased slaughter of breeding animals with a consequent erosion of the base population in quantitative and qualitative terms.

(6) The reduced availability of improved breeding animals has also resulted in some countries to shift from goat to sheep production.

Self sufficiency ratios calculated on assumptions concerning population growth, trends in per capita income, income elasticity of demand and projected consumption of meat in 1990 and 2000, including detailed analyses of projected output and demand for all meats, suggests that the trend will be towards a widening gap between output and demand (Sarma and Yeung, 1985). Table 5 indicates that the self-sufficiency ratios for meat and milk are lowest in North Africa/Middle East and Sub-Saharan Africa, followed by Asia and Latin America.

IV. ECONOMIC IMPORTANCE OF GOATS AND SHEEP

The economic importance of rearing goats and sheep is reflected in a study on rural households in West Java, Indonesia, where up to 30% of the farmers reared sheep or goats (Knipscheer et al., 1983). The contribution to the total farming income is substantial, and was about 14, 17 and 26% for the three categories of lowland, upland and rubber plantation situations, respectively (Table 6); these increased as the farmer's resource base, especially land, decreased.

By comparison in China, similar limited data exist concerning intensively cultivated upland areas in the Sichuan province involving wheat-barley-rape-rice cropping systems where dairy goats and pigs are commonly reared by farmers. It has been estimated that in these situations, the income generated from these animals together was 29% of the total farm income, of which pigs contributed 19% and goats 10%. The goats in particular, was associated with the poorer farming families.

V. SIGNIFICANCE OF OWNERSHIP

Goats and sheep are raised with several objectives to serve the material, cultural and recreational needs of farmers with the following advantages (Devendra, 1980; Devendra and Burns, 1983).

(1) Income : important means of earning supplementary income.

(2) Food : provide animal proteins (milk and meat) that are important for the nutritional well-being of peasants.

(3) Security : sources of investment, security and stability.

(4) Employment : creation of employment including effective utilisation of unpaid family labour.

(5) Fertiliser : contribute to farm fertility by the return of dung and urine.

(6) By-product utilisation : they enable economic utilisation of non-marketable crop residues.

(7) Social values : the ownership of animals has been shown to increase cohesiveness in village activities.

(8) Recreation : socio-economic impact of animal ownership also includes a recreational contribution to small farmers.

VI. PRODUCTION SYSTEMS

Small ruminant production systems in Asia have endured in relation to the overall pattern of crop production and farming systems. They are especially dependent on the agro-ecological environment and as ruminants, must always depend on vegetation or crops for their feed base.

Table 7 attempts to bring together types and characteristics of predominant farming systems involving ruminants, including goats and sheep in Asia. The table identifies the cropping pattern (wheat, rice, maize or combination of these, coconuts, oil palm and rubber), including mixed cropping, type of ruminants reared, production objective and also gives approximate sizes of goat and sheep flocks. The latter are variable and partly dependent on the nature and extent of the crop residues produced. The last column in Table 7 gives an indication of the current importance of goats and sheep in each of the main systems, based on average ownership by small farms, landless labourers and peasants.

Small ruminant production systems have recently been discussed (Devendra, 1986) and are of three categories :

1) Extensive Systems

2) Systems Combining Arable Cropping
   i) Roadside, communal and arable grazing systems
   ii) Tethering
   iii) Cut-and-carry feeding

3) Systems Integrated with Tree Cropping

Extensive Systems

This system is the most common system and applies to all types of ruminants in the Asian region. It is characterised by small ruminants, usually owned by small farmers, grazing on all available grazing areas, largely uncultivated, including marginal land, for varying periods during the day. The length of the grazing period is dictated primarily by the type of ruminant and the objectives of production, i.e. meat or milk.

The system has certain very definite features. Rearing ruminants is secondary to crop production, consistent with the pattern of agriculture. Usually, more animals tend to be carried than in the intensive system, probably because these animals have access to plenty of grazing land. Buffalo and cattle tend to be grazed separately, but where goats and sheep are reared, these small ruminants are grazed together, probably because goats tend to lead the herd. Additionally, the small ruminants tend to be herded over longer distances compared to buffalo and cattle, which are relatively more sedentary.

The flock sizes are larger (1-15 herd), and animals, often goats and sheep belonging to several owners, are run together and brought back in the evening. Stocking rates are usually in the range of 1-4 head/ha. Very extensive systems are rare, as with other parts of the humid tropics, presumably because of the availability of more forage and crop residues.

An additional feature about this system, is the use of a low level of unpaid family labour, in which usually women and children are involved. The involvement of women and children in rearing small ruminants is very common throughout the Asian region and the extent of

Othis is often underestimated. In Indonesia, women are very much involved in decision making concerning small ruminants in mixed farms (Wahyuni, Gaylord and Knipscheer, 1985). The contribution by women and children represents an aspect of effective labour use whereby both cropping and rearing of ruminants represent important components of farm income. Except for the use of this low labour input, the system is principally one of low resource use, and a generally low level of productivity emerges from substandard nutritional management where very little or no concentrates, salt, or mineral licks are provided.

Systems Combining Arable Cropping

Ruminant production systems combining arable cropping have evolved in situations where crop production is important to contribute to the stability of the system. Animals do not compete for the same land and play a supplementary role to arable cropping. Three types of systems are common : roadside, communal and stubble grazing; tethering; and cut-and-carry feeding.

The three systems are not mutually exclusive. Grazing on roadsides and on communal (waste) land may be practiced by landless stock owners as well as others when their privately owned lands are under arable crop cultivation. Grazing in rice fields is restricted to periods immediately after harvest when the feeds available consist of the aftermath of the rice crop (i.e. rice stubble and some regrowth from the stubble), any weeds that grow in the paddies, the grasses that are found on paddy bunds, and browse from shrubs and trees that grow in it. Where multiple cropping is practiced, the crop aftermath may be burnt after the harvest and stubble grazing may be severely restricted or non-existent.

Tethering is adopted when there is a need to prevent animals wandering into areas being cropped and to ensure that they graze down the available feed in a given area before they are moved. This type of confinement feeding is most popular in Southeast Asia because multiple cropping is widespread in this region. The animals may be tethered on waste grazing areas close to the farm or on rice fields after harvest to regulate stubble grazing or close to stacks of rice straw to allow self-feeding.

In the cut-and-carry system, a large proportion of the feed is usually brought in from outside the holding area because of the small size of holdings in relation to the number of animals kept. The system is subject to the vagaries of seasonal abundance and shortage of forage that characterise it. Because the livestock is housed most of the time, their growing dependence on high-priced concentrate feeds during lean periods increases. .

The system together has had limited success because of the value of arable land for food production. This also presents a constraint to forage production for animals. The emphasis on crop production, however, makes large quantities of crop residues available, which are valuable as feeds, especially to ruminants.

The cut-and-carry or stall-feeding system requires high labour and capital investment. It is a system that favours situations where there is no land or, more particularly, the availability of abundant supplies

of crop residues and agro-industrial by-products. Probably because of the higher capital investment, it has not been adequately used as a system.

Systems Integrated With Tree Cropping

Systems integrated with tree cropping are especially common in the humid and subhumid regions where there is intensive crop production. Although the system is not new, integration with these tree crops to ensure more complete utilisation of the land has not been given adequate attention. The advantages of the system are :

- Increased fertility of the land via the return of dung urine,
- Control of waste herbage growth,
- Reduced use of weedicides,
- Reduced fertiliser wastage,
- Easier management of the crop, and
- Distinct possibilities of increases in crop yields, consistent with greater economic including sale of animals and their products.

An additional advantage inherent in the system is the presence of abundant shade offered by the trees. This creates an environment that reduces heat stress on the grazing animals.

The potential for this kind of activity is reflected in an estimated area of 20.3 X 10^6 ha under tree crops in South and Southeast Asia (FAO, 1986). Many of the Pacific island territories, notably Papua New Guinea, New Hebridges, Fiji, the Soloman Islands, and Western Samoa, have large land areas under coconuts, implying that there is much potential for integrating goats or sheep into them.

It is suggested that the prevailing ruminant production systems are unlikely to change. Major shifts in resource use would be difficult unless returns from the new proposed systems are demonstrably superior. Changes must, therefore, be introduced gradually and must ensure income stability and low risk. The principal aim should be to make maximum use of the basic feed resources available, which is essentially crop residues or low-quality roughages or both. In addition, delivery systems should be developed for the essentially supplementary feeds (leguminous forages, agro-industrial by-products, or other feed concentrates).

VII. FEEDING AND NUTRITION

Of the factors affecting productivity in both species, feeding and nutrition represents the principal constraint. Efficient feeding and nutrition, more than any other factor, is the most important means of achieving this objective. Efficiency in this case implies not only achieving the biological limits of production for a particular purpose (meat, fibre or skin), but also the use of different inputs within a

system to derive the product output is compatible with economic production.

The efficiency of goat and sheep production depends to a large extent on the type of feeding system, the level of feeding management and the availability of nutrients for high production. The importance of all three aspects in controlled management for high production cannot be over-emphasised. The components of quality, quantity and appropriate systems of management are involved together, and the application of these concepts in recent years has demonstrated quite forcefully, the impact of nutrition in stimulating high productivity.

There are two related issues concerning feeding systems and productivity. One is the need for accelerated development in the prevailing challenging situation in which the demand for goat meat far outweighs supplies, partly because of the tremendous export potential of the Near Eastern markets. The second issue which needs to be kept in perspective is the fact that small farm systems constitute the pivot of traditional agriculture, and the key elements in this type of farming are production for subsistence rather than for sale, low income and illiteracy. Within the small farm scenario involving mixed cropping and animal-based systems, goats play an important role, and their socio-economic contribution is more significant than is commonly realised. The fact remains however, that inadequate nutrition, consistent with a low level of production, remains a conspicuous feature of production in the Asian region (Devendra, 1980).

It is especially important in addressing efficient utilisation of the available breeds with a view to increasing productivity from them, to recognise that goats and sheep do have differences that are characteristic of the species. The differences relate to feeding behaviour, aspects of digestive function and utilisation of nutrients. Many of these features, and especially the aspects related to digestive physiology are not well understood. The differences are nevertheless sufficient to warrant a different standard on nutrient requirements for goats (N.R.C., 1981) compared to sheep. Similarly, the differences in feeding behaviour and utilisation of nutrients suggest that although they may be herded together for grazing, management and feeding strategies need to take cognisance of the apparent and real differences in order to ensure high performance in both species.

Table 8 brings together comparative differences in feeding behaviour and nutrition, based on the available knowledge. Some 16 main differences are identifiable, but these are by no means exhaustive or meant to be complete. The list does provide however, the main differences, inherent, and in response to the environmental factors.

A number of differences are worth emphasising. These include in the goat, the bi-pedal stance (Malachek and Provenza, 1981), relatively higher activity, distinctly greater preference for more variety of herbage, but is reduced with increasing intensification. Under stall-feeding conditions, goats and sheep are also selective, but the former had a greater intake of roughages (Wahed and Owen, 1987). Other differences are related to taste, water economy, dehydration, salivary secretion, recycling of urea and digestive efficiency.

Goats are essentially browsing animals, and by comparison, sheep

are grazing animals. Goats have a competitive advantage over sheep in woodland and shrubland, are generally more active, selective, walk longer distances in search of feed and relish variety in feeds (Devendra, 1987b). Thus they are natural leaders of mixed goat and sheep flocks in many developing countries. Sheep are less selective and utilise pasture more effectively. Another feature of the feeding behaviour of goats is their discerning ability to taste.

VIII. **HEALTH AND DISEASES**

Both goats and sheep are affected by a variety of diseases, the extent of which is dictated by the level of efficient management as well as the agro-ecological environment.

In Indonesia, for example, Purnomo and Wilson (1987) classified diseases of small ruminants into three categories as follows :

1) Diseases of significance in suggested order of economic importance,

2) Diseases known to occur, and

3) Diseases of other livestock involving small ruminants as carriers.

Such a classification applies equally to most other countries in the Asian region. In terms of losses of economic significance, these are of two main categories. The first involves the combined losses at birth and up to weaning which can account for as much as 30-35% losses. Kids are particularly susceptible to respiratory disorders of which pneumonia is very common.

The second major source of loss os gastrointestinal parasitism in both species, of which infection due to a complex of nematode parasites of which Haemonchus is very common. The annual cost of Haemonchosis to the small ruminant industry in Indonesia is estimated at around US $16 million (Parsons and Vere, 1984). Regular drenching is therefore most important to reduce the effects of, and incidence of losses, due to gastrointestinal parasites. This preventive measure also necessitates the use of alternative arthelmentics to offset any development of resistance to the active ingredient.

Associated with the need for good management is to ensure that these animals are adequately fed in manner that the daily intake of nutrients does match the maintenance and production requirements. Failure to do so reduces the condition and constitution of the animals, therefore increasing the susceptibility due to diseases.

XI. **DEVELOPMENT STRATEGIES**

There are a number of important development strategies that are worthy of production. These include inter alia :

(1) Clear Production Objectives

The following aspects are imperative :

i) **Meat** : (Goat meat and mutton)
Quantity - Total amount of lean meat in the carcass (measured by live weight before slaughter).

Growth rate, is related to efficiency of production in both kids and lambs. Total number of animals available for slaughter; and the amount of meat yield per animal are equally important.

Quality - Quantity and distribution of fat (excess undesirable).

ii) **Milk** :
Quantity - Total yield, lactation length, persistency and number of lactations.

Quality - Milk composition (butter fat and solids not-fat).

iii) **Carpet wool** :
Quantity - Clean wool per head.

Quality - Average fibre diameter (coarse fibre desirable).
Presence of a proportion of medullated fibres (hair)
Absence (or a very small proportion) of kemp (shed fibres, or ones with the medulla occupying 90% of the diameter).
Staple length.
Percentage of clean scoured yield.

Although no reference is made to fine wool production which is very important in China, the parameters identified for carpet wool would also apply.

(2) Developing the avenues of production

All the avenues of production must be examined critically and exhaustively. Priority should be given to the development of production systems that integrate goats or sheep with mixed cropping especially in small farm systems. This will also alleviate the level of poverty and health of subsistence farmers and the landless. It is essential in this task to use the appropriate breed to relate this to production objectives.

(3) Continuing research

This is vital to sustain and stimulate increased contribution from goats. There should be focus on breed characteristics, genetic potential, feed resources, feeding and nutrition, physiology, breeding and genetics, improved management practices, prevention and control of disease, carcass quality and processing.

(4) On-farm validation of results

The value of research results lie in their extension and validation in real farm situations. This is best done through particular research with farmers. Practical procedures for conducting on-farm animal research have recently been published (Amir and Knipscheer, 1989).

In addition to these, attention is drawn to a number of other recommendations for research and development in goats in sheep in three recent proceedings of useful meetings (Devendra, 1987c; Devendra, 1988 and Devendra and Faylon, 1989).

X. CONCLUSIONS

Small ruminant production in the Asian region is currently constrained by inadequate and inefficient utilisation of the available breeds and improved systems of management. The prevailing production systems are unlikely to change in the foreseeable feature, and in view of this, more concerted efforts are necessary to improve current feeding patterns and methods, as well as apply more innovative systems of feedings. The opportunities for achieving this are enormous, and is associated with potential improvements in productivity. These and other approaches need to be considered in the broader context of the role and contribution of small ruminants in traditional and mixed small farm systems in Asia.

REFERENCES

Amir, P. and Knipscheer, H.C. (1989). Conducting On-farm Animal Research : Procedures and Economic analysis, Winrock International and International Development Research Centre, Singapore, xiv + 244 pp.

Cheng, Peilieu (1984). Livestock breeds of China. FAO Anim. Prod and Hlth. Paper, No. 46, 215 pp.

Devendra, C. 1979. Goat and sheep production potential in the ASEAN region. Wrld. Anim. Rev. (F.A.O.), 32 : 33-41.

Devendra, C. 1980. The potential of sheep and goats in less developed countries. J. Anim. Sci., 51 : 461-473.

Devendra, C. 1986. Small ruminant production systems. Proc. IDRC/SR-CRSP Workshop on Small Ruminant Production Systems in South and South East Asia, (Ed. Devendra, C.), Bogor, Indonesia, p. 29-51.

Devendra, C. 1987a. The role of goats in food production systems in industrialised and developing countries. Proc. IV Wrld. Conf. on Goat Production, Brasilia, Brazil, Vol. 1 : 3-27.

Devendra, C. 1987b. Herbivores in the arid and wet tropics. In The Nutrition of Herbivores, Academic Press, Sydney, Australia, p. 23-46.

Devendra, C. (Editor) 1987c. Proceedings of the Workshop on Small Ruminant Production Systems in South and South East, International Development Research Centre, Ottawa, Canada, xii + 414 pp.

Devendra, C. (Editor) 1988. Proceedings of the Workshop on Goat Meat Production in Asia. International Development Research Centre, Ottawa, Canada, xi + 262 pp.

Devendra, C. 1989. Comparative aspects of digestive physiology and nutrition in goats and sheep. Satellite Symposium on Ruminant Physiology and Nutrition in Asia, VII Symp. on Ruminant Physiology, 28 Aug. - 1 Sept. 1989 (In press).

Devendra, C. and Burns, M. 1983. Goat Production in the Tropics, (Revised Edn.), Tech. Commun. Common. Bur. Anim. Breed. Genet., Commonwealth Agricultural Bureaux, England, xiii + 183 pp.

Devendra, C. and Faylon, P.S. (Editors) 1989. Sheep Production in Asia. Book Series No. 80/1989, Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Los Banos, Philippines, xi + 215 pp.

F.A.O. (1986). Production Yearbook. Vol. 40, Food and Agriculture Organisation, Rome, Italy, xlix + 306 pp.

Jiang Ying (1986). Some goat breeds in China. Wrld. Anim. Rev. (FAO), 58 : 31-41.

Knipscheer, H.C., De Boer, J., Sabrani, M. and Soedjana, T. 1983. The economic role of sheep and goats in Indonesia : A case study in West Java. Bull. Economic Studies, 19 : 74-93.

Malachek, J.C. and Provenza, F.D. 1981. Feeding behaviour and nutrition of goats on rangelands. Proc. of the Int. Symp. on Nutrition and Systems of Goat Feeding, Tours, France, Vol. 1 : 411-428.

National Research Council, 1981. Nutrient requirements of goats. No. 15, National Academy of Sciences, Washington, D.C., U.S.A., vii + 91 pp.

Parsons, S.A. and Vere, D.T. (1984). Benefit-cost analysis of the Bakitwan Project, Bogor, Indonesia. Australian Development Assistance Bureau, Canberra, Australia (Mimeograph).

Purnomo, R. and Wilson, A.J. (1987). Disease problems of Small Ruminants in Indonesia. Proc. IDRC/SR-CRSP Workshop on Small Ruminant Production Systems in South and South East Asia, (Ed. Devendra, C.), Bogor, Indonesia, p. 280-288.

R.A.P.A./F.A.O. 1988. Selected indicators of food and agriculture development in Asia-Pacific region, 1977-1987. Regional Office for Asia and the Pacific, F.A.O., Bangkok, Thailand, 199 pp.

Sarma, J.S. and Yeung, P. 1985. Livestock products in the third World: past trends and projections to 1990 and 2000. Res. Rpt. 49, Int. Food Policy Res. Institute (IFPRI), Washington, D.C., USA, 87 pp.

Wahed, R.A. and Owen, E 1987. Goats versus sheep : roughage intake and selection in stall-feeding. Proc. IV. Int. Conf. on Goats, Brasilia, Brazil, Vol. II : 1377 (Abstract).

Wahyuni, S., Gaylord, M. and Knipscheer, H.C. (1985). Women's decision making role in small ruminant production the conflicting view of husbands and wives. Working Paper, No., 43, SR-CRSP, Bogor, Indonesia (Mimeograph, 8 pp.)

TABLE 1

THE GOAT AND SHEEP RESOURCES OF ASIA AND THE SOUTH PACIFIC REGION

Species	Population (millions)	As % of total world population*	Rate of growth/yr (%) (1977-1987)	As % of total grazing ruminants in Asia
Goats	256.1	51.0	1.8	24.1
Sheep	237.0	20.5	1.3	22.3

* Goats : 501.8 millions and Sheep : 1157.6 millions

Source : R.A.P.A./F.A.O. (1988)

TABLE 2

IMPORTANT INDIGENOUS GOAT BREEDS IN ASIA

	Speciality	Country	Breed
I)	Medium milk yield	India	Beetal and Jamnapari
		Pakistan	Damani, Dera Din Panah, Kamori
II)	Meat'	Bangladesh	Black Bengal
		China	Banjiao, Chengdu Ma, Du An, Fuquing, Guizbou White, Haimen, Huai, Leizhou, Longlin, Ma'Tou, Shanxi White
		India	Barbari, Black Bengal, Cutchi, Ganjam, Khasi (Assam Hill goat), Malabari, Marwari, Osmanabadi, Sangamaneri, Sirohi (DP)
		Nepal	Changra, Khari, Sinhal, Terai
		Pakistan	Barbari (DP, "Barri"), Bangal (Teddy), Bugri, Chappar (DP), Damani, Jattan (DP), Kacchan (DP), Kaghani, Kail, Lehri, Patteri, Topri
		Sri Lanka	Kotukachchiya
		Thailand, Malaysia, Indonesia and Philippines	Katjang
III)	Prolificacy	Bangladesh } Pakistan }	Black Bengal
		China	Ma'Tou
		India	Barbari, Black Bengal
		Malaysia	Katjang
IV)	Pashmina (Cashmere)	China	Liaoning
		India	Kashmiri
V)	Skins	Bangladesh,} India and } Pakistan }	Black Bengal

' The reference to DP means dual-purpose (meat and milk)

TABLE 3

IMPORTANT INDIGENOUS SHEEP BREEDS IN ASIA

	Speciality	Country	Breed
I)	Milk	Pakistan	Damani
II)	Mutton	India	Mandya, Muzzafarnagri, Balkhi, Rakshani, Kaghani, Dumbi
III)	Fine wool	India	Chokla
IV)	Carpet wool	India	Magra, Marwari
		Pakistan	Baluchi, Buchi
V)	Prolificacy	China	Hu
		Bangladesh	Bangladeshi
		Indonesia	Javanese thin-tail

TABLE 4

PRODUCTIVITY OF GOATS AND SHEEP IN ASIA AND THE SOUTH PACIFIC

Species	Meat (10^3 tonnes)	Milk[1]	Wool greasy[1] (tonnes)	Skins[1], fresh
Goats	1168	2488	-	234,265
Sheep	1075	973	319,040	223,890

Source : R.A.P.A./F.A.O. (1988)
[1] Refer to F.A.O. (1986) data

TABLE 5

SELF-SUFFICIENCY RATIOS FOR LIVESTOCK PRODUCTS BY REGION, 1961-65 AND 1973-77 AVERAGES AND PROJECTIONS TO 1990 AND 2000

Product/Period	Asia	North Africa/ Middle East	Sub-Saharan Africa	Latin America
Meat[+]				
1961-65	97	95	103	112
1973-77	94	89	103	108
1990	73	62	77	96
2000	61	52	57	91
Milk[++]				
1961-65	94	94	91	92
1973-77	93	87	82	92
1990	79	67	53	91
2000	71	57	38	96

[+] Includes beef, veal, buffalo meat, mutton and goat, pig and poultry meat

[++] Includes cow, buffalo, goat, sheep, camel and milk products (express as whole milk equivalents)

Source : Adapted from Sarma and Yeung (1985).

TABLE 6

ESTIMATED SHARE OF SMALL RUMINANT INCOME OF TOTAL INCOME IN WEST JAVA

Location	No. of Farms Surveyed	Annual Income Per Farm (1980)	Small Ruminant Income (1980)	Small Ruminants Income as % of Total Income
Cerebon (Lowland)	79	220,000	37,593	17.1
Ciburuy (Rubber Plantations)	66	180,000	46,671	25.9
Garut (Upland)	135	300,000	41,466	13.8

Source : Knipscheer et al. (1983)

TABLE 7

TYPES AND CHARACTERISTICS OF FARMING SYSTEMS INVOLVING SMALL RUMINANTS IN ASIA

Type of farming systems	Cropping pattern	Type of ruminants'	Small Ruminant Production	Average size of goat and sheep	Current Importance''
Crops	Rice	B, C	Goat meat/mutton	1 - 5	Low
Crops	Mixed Rice-maize*	C, B, G, S	Goat meat/mutton	1 - 5	Low
Crops	Mixed Rice-wheat	C, B, G, S	Goat meat/mutton/milk	10 - 30	Medium/low
Crops	Mixed Rice	B, C, G, S	Goat meat/mutton	1 - 5	Low
Crops	Wheat	C, B	Goat meat/mutton/milk	10 - 30	Medium/low
Crops	Wheat-rice	C, B	Goat meat/mutton	10 - 30	Medium/low
Crops	Coconuts	G, S	Goat meat/mutton	10 - 40	Medium/low
Crops	Oil Palm	B, G, S	Goat meat/mutton	8 - 30	Medium/low
Crops	Rubber	C, G, S	Goat meat/mutton	8 - 30	Medium/low

' B = Buffaloes, C = Cattle, G = Goats, S = Sheep

'' Based on average ownership by small farmers, landless labourers and peasants

* Mixed crops refer to root crops, oil seeds, cash crops, vegetables and also fodders

Source : Devendra (1986)

TABLE 8

COMPARATIVE FEEDING BEHAVIOUR AND DIGESTIVE PHYSIOLOGY IN GOATS AND SHEEP
(Devendra, 1989)

	Characteristics	Goats	Sheep
1.	Activity	Bipedal stance and walk longer distances	Walk shorter distances
2.	Feeding pattern	Browser, more selective	Grazer, less selective
3.	Browse and tree leaves	Relished	Less relished
4.	Variety in feeds	Preference greater	Preference lesser
5.	Taste sensation	More discerning	Less discerning
6.	Salivary secretion rate	Greater	Moderate
7.	Recycling of urea in saliva	Greater	Lesser
8.	Dry matter intake :		
	- for meat	3% of B.W.	3% of B.W.
	- for lactation	4-6% of B.W.	3% of B.W.
9.	Digestive efficiency	With coarse roughages higher	Less efficient
10.	Retention time	Longer	Shorter
11.	Water intake/unit DMI	Lower	Higher
12.	Rumen NH_3 concentration	Higher	Lower
13.	Water economy	More efficient	Less efficient
	- Turnover rate	- Lower	- Higher
14.	Fat mobilisation	Increased during periods of feed shortages	Less evident
15.	Dehydration		
	- Faeces	Less water loss	Relatively higher water loss
	- Urine	More concentrated	Less concentrated
16.	Tannins	More tolerance	Less tolerance