

Small ruminants in Asia; Contribution to food security, poverty alleviation and opportunities for productivity enhancement

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Summary

Small ruminants (goats and sheep) form an important economic and ecological niche in agricultural systems throughout the developing countries. Their current contribution is not commensurate with the potential capacity for higher levels of production. The context for productivity enhancement and increased socio-economic contribution relates to large population size, wide distribution across various agro-ecological zones and production systems and diversity of breeds. The populations of goats and sheep in Asia are 390.4×10^6 and 250.3×10^6 , respectively, of which about 57% and 23% of the total world population of goats and sheep are found in Asia, including 55 % of all goats and 39 % of sheep breeds in China, India and Pakistan. There exist about 146 breeds of goats and 233 breeds of sheep in Asia out of a world total of 570 and 1314 breeds, respectively. The advantages and disadvantages of small ruminants are enumerated with reference to adaptation and environment, small size, production systems, products and interactions with the environment. The benefits and attributes of the foods from both species (meat and meat products and goat milk) are enumerated, emphasising also the contribution to nutritional and food security. At the national level, priority attention is essential to build up numbers in concerted breeding programmes, to include selection for reproduction and meat production, improvements to traditional markets and marketing systems. Post-production systems and improvements involve collection, handling, marketing, slaughter facilities and consumer requirements. To shift subsistence production to a more market-oriented opportunity, affirmative action is necessary, backed by official policy support, institutional commitment and increased resource use that can target poverty and directly improve the livelihoods of the poor. These efforts together constitute the challenges for both the owners and producers and national governments to accelerate increased contribution of small ruminants in the future.

Key words: goat and sheep genetic resources, production systems, meat, milk, skins, markets and marketing, post-production systems, food security, livelihoods.

Introduction

Throughout the developing countries, small ruminants make a very valuable contribution, especially to the poor in the rural areas. These contributions range from precious animal proteins (meat and milk) to fibre and skins, draught power in the highlands, food security and stable households. By and large, the importance and extent of the contributions are inadequately understood as a consequence of which these valuable genetic resources continue to be generally neglected. Research and development investments to improve the relatively low level of contribution do not match their potential importance, the contribution to nutritional insecurity and livelihoods of the poor in rural areas. There is a real need to increase the contribution to food production from components of the livestock sector in Asia in the future, in the face of several demand-led factors which *inter alia* include population growth, urbanisation, income growth, inability of current supplies to match requirements, and changing consumer preferences. This situation is further exacerbated by inefficiencies in individual animal production systems and natural resource management that can respond to increased supplies of foods of animal origin, and promote improved livelihoods.

In the search for efficiency in the use of the livestock resources, it is therefore important to examine the imperatives for improving the contribution from goats and sheep. While their socio-economic importance is widely recognized, potential contribution is constrained by inefficient use of potentially important breeds, inefficient and inappropriate production systems, poor strategies for

improved natural resource management, and inadequate official support and resource use. Their current contribution is not commensurate with their value, especially in small farm systems and resource-poor farmers.

The paper discusses the contribution of small ruminants to food security and poverty alleviation, the opportunities to improve productivity growth, imperatives that merit urgent attention, and can directly contribute to increased food production and improved livelihoods. The paper also provides suggestions on development strategies and necessary affirmative action that is required in the future.

Goat and Sheep Genetic Resources

Table 1 presents the size of the goat and sheep populations in developing countries. The sizes of individual populations are considerable, with goats and sheep accounting for 95.7% and 63.3% of the total world population, and 26.2% and 26.5% of the total number of grazing ruminants (buffaloes, cattle, goats and sheep) in the developing countries. About 60% of the goat breeds are found in the developing countries. Asia has the largest population of goats (55 % of world population), followed by Africa. Some specific features within- species are as follows:

Goats: The largest populations were found in India (35.2%), China (29.3%) and Pakistan (12.0%). These countries together accounted for about 84% of the population of goats in Asia. FAO data indicates that there exist 570 breeds, of which 146 are found in Asia.

Sheep: The largest populations are found in China (43.7%), India (17.8%) and Pakistan (11.0%). China, India and Pakistan together accounted for about 72% of the total population of sheep in Asia. There exists an estimated 920 breeds of sheep, 233 of which are found in Asia.

Corresponding to the relative populations of goats and sheep, the volume of goat meat produced is higher than that of sheep. Current levels of goat meat and mutton and lamb production are 94.6% and 57.9% of the total world output respectively. These data reflects the relative importance of the species, but is also associated with species differences in fertility, income elasticity of demand for goat meat, and value to poor people throughout the developing countries.

Between goats and sheep, the annual growth rates between 1998-2003 were 1.3 and 0.6 % per year. With respect to breeds, the Asia and Pacific region has 26% of all goat breeds and 18 % of all sheep breeds. However, the major proportion of breed diversity is found in only a few countries, notably China, India and Pakistan. Thus with goats, 66% of all breeds and 57% of the sheep breeds are found in these three countries (Table 1).

Distribution Across Agro-Ecological Zones

It is useful to know the distribution of goats across agro-ecological zones in regional terms. Existing statistics on small ruminant populations do not, unfortunately, indicate their relative concentrations and distribution across agro-ecological zones (AEZs). The analysis for Asia indicates that both species were largely concentrated in the semi-arid and arid, and humid and sub-humid AEZs in the rainfed lowlands, and the upland areas in mainly mixed farming situations. This is seen in Indonesia for example, where 1 in 8 households keep goats and surveys across lowland and upland sites indicated wide ownership by farm households.

Advantages and Disadvantages of Small Ruminants

Given the wide distribution across AEZs, it is appropriate to keep in perspective the advantages and disadvantages of small ruminants (Devendra, 1987; Devendra, 1999). Small

Table 1. Statistical data on small ruminants in Asia (FAOSTAT, 2003).

Characteristic	Goats	Sheep
Population (10 ⁶)	428.3	250.3
Percent of world population (%)	55.0	39.0
Annual growth rate (%) ⁺⁺	1.3	0.6
Number of breeds ⁺	146	233
Percent of all breeds (%)	26	18
As % of all grazing ruminants (%)	36.1	22.3
Carcass weight (kg/head)	12-13	14-16

+66% of the goat breeds and 57% of the sheep breeds are found in China, India and Pakistan;

++for 1998-2003

ruminants are of considerable importance, and there is a whole range of advantages over large ruminants. Some of the features are characteristic of goats or sheep, e.g. feeding habits, but the groupings present more general features that are especially relevant to both species. Additionally, small ruminants in these marginal areas provide the main, if not the only, means of livelihood, combining economic and food security, nutrition and means of survival. In these circumstances the importance of both species especially to the very poor and landless peasants increases with decreasing quality of grazing and feed availability in harsh environments. Of course, there are also disadvantages and these are indicated.

The sections below have grouped the more distinctive features in relation to adaptation and the environment, small size, production and products:

Adaptation and environment

Advantages

- Generally wide adaptation to most environments
- Suitability to small farm systems
- Less affected by drought, with no after effects on reproduction
- Use browse and feeds more effectively
- Use marginal land effectively
- Are well suited for integration into perennial tree crop systems
- Major source of survival and assets for the landless and very poor
- Food and nutritional security
- Promote social values (village cohesiveness and recreation)
- Trypanotolerance and helminth disease resistance.

Disadvantages

- Need for controlled management to prevent environmental damage
- More numbers needed to meet household/community/national needs.

Small size

Advantages

- Easy management
- Low production inputs and capital investment
- Low risk
- With meat, high proportion of total edible and saleable products.
- No storage requirements for meat and milk.

Disadvantages

- More easily stolen
- Susceptible to predators

Production and products

Advantages

- Produce meat, milk, fibre and skins, and also provide draught power in mountain areas
- Utilise non-marketable crop residues and available grazing to generate value-added products such as meat, milk, fibre and skins
- Dung and urine promote soil fertility, especially in the semi-arid and arid areas
- Promote effective use of unpaid family labour, with concurrent low labour requirements
- Provide ready means to consume meat and milk, without need for storage
- Skins are a growing source of value-added income
- Production systems provide considerable opportunities to accelerate research and development efforts.

Disadvantages

- Breeding programmes are difficult to control in more extensive systems
- Susceptibility to disease, with poor access to services
- Poor overall resource allocation for research and development.

Interactions with the environment

Goats are more concentrated in the drier and harsh environments, notably the semi-arid and arid agro-ecological zones (AEZs). Together with wide adaptation across various AEZs, and several unique attributes (e.g. high digestive efficiency for coarse roughages, water metabolism, more tolerance to tannins, and disease resistance), they also provide for food security and survival, thus making a significant socio-economic contribution that is underestimated. Increased digestive efficiency of coarse roughages as well as tolerance for deleterious substances in feeds, for example, are higher in goats compared to sheep. There is evidence that there is genetic variation in resistance to helminths in both goats and sheep (Mandonnet et al., 1997; Pralomkarn et al., 1997).

On the positive side, goats have been used to clear bush in many parts of Africa inclusive of trypanotolerance, and are potentially important likewise in the use of tree and shrub savannahs regions in the world (O'Reagan and Turner, 1993). An even more significant example of a beneficial crops-goats and sheep interaction concerns the practice of folding. The migrating flocks of goats and sheep are often used overnight to fertilise crop land, and crop farmers pay relatively high prices or give cereals in return for their service. In northern India for example, 2000-3000 goats and sheep are folded on 0.2 ha of land costing 1 US\$ per 100 animals per night or 60-80 kg of grain in return.

In many parts of South East Asia, integration with perennial tree crops like coconuts and oil palm have been associated with reduced cost of weeding, improved soil fertility, increased crop yields, increased productivity per hectare and socio-economic benefits to small farmers. In the Philippines for example, the integration of goats and sheep with coconuts over three years increased the income of farmers by between US\$127-229 (PCARRD, 1994). Likewise, the integration of leguminous hedgerows to reduce soil erosion in upland areas improve soil fertility and nutrients for crops e.g. maize and black pepper, as well as produce forage for goats in a zero grazing system indicated a mean annual income of US\$1354 per 0.5 ha, equivalent to a mean internal rate of return of 38.7% (Laquihon *et al.*, 1997). In Malaysia, the integration of goats and cattle with oil palm increased the yield of fresh fruit bunches and palm oil (Devendra, 2004).

Damage to the environment is inevitable so long as there is no control over numbers and also grazing, especially in situations where feeds are very scarce. In these circumstances, goats and sheep have to search for feeds over long distances in very extensive systems. In most situations, available feeds, feed production and use are not identified with goat numbers, with resultant environmental damage, also to forests.

Benefits of food products from small ruminants

Small ruminants produce a variety of foods, which are very useful for both urban and rural markets. With the exception of processed milk products, these food products are especially important for rural households. Two generalisations can be made about the food products from small ruminants. Firstly, the meats from goats and sheep and also goat milk are very valuable for household nutrition and food security in the rural areas. Goat milk is valuable for the children, the malnourished, pregnant mothers and the elderly in areas where cow or buffalo milk is not available, mainly due to sales to urban areas. Secondly, there are no religious taboos against meats, goat milk and their products. These considerations together underline the fact that both species currently make a most important contribution to nutritional and food security to rural communities not only in those countries where there are sizeable small ruminant populations, such as India, Pakistan and China, but also elsewhere, such as Indonesia and the Philippines.

The following meat and milk products are the more important foods produced from small ruminants that are used widely:

Meat

- Meat, fresh goat meat and mutton.
- Meat products – blood, offals e.g. feet, head, testicles.
- Processed meat products - cooked meat, sausages, goat meat extract.
- “Zeungtang “ in Korea), frozen carcasses, chilled meat, bone-in cuts, boneless cuts and salted meat.

Milk

- Milk, fresh milk.
- Processed milk products - pasteurised milk, milk powder, condensed milk.
- (Vietnam), yoghurt, goat butter, ice cream, various cheeses and sweets.

Attention is drawn to the useful recent publication of an atlas of goat products (Rubino, Morand-Fehr and Sepe, 2004). Goat meat generally has a higher lean content than mutton or beef on account of the fact that the fat content in the former tends to be concentrated in the viscera rather than sub-cutaneously. Two parameters are relevant in identifying the relative importance of the meats as well as the economic value of the species. These are total edible and total saleable proportions. These proportions will vary according to species, location and also country. In Malaysia for example, the total edible and total saleable proportions in Kambing Katjang goats reared in intensive systems and slaughtered at 25 kg live weight have been reported to be 61.2 and 81.5 % respectively (Devendra and Owen, 1979).

Concerning milk, Haenlein (2004) has recently reviewed the importance of goat milk in human nutrition and emphasised two aspects. One concerns treating people afflicted with cow milk allergies and gastro-intestinal disorders. The other is the trend and market demand to meet the growing gastronomic needs of connoisseur consumers in the developed countries. Apart from the anti-allergy properties in goat milk, other important characteristics in goat milk are the presence of higher levels of six of the ten essential amino acids and also monounsaturated, polyunsaturated and medium chain triglycerides which are all known to benefit human health (Posati and Orr, 1976).

Economic Contribution

The economic contribution of small ruminants to poor farm households and livelihood systems is much higher than is imagined. Recent reviews of the situation reflect the extent of this contribution, not only to household income, but also to food security to the rural poor:

Semi-arid and arid areas: Goats and sheep provide the main means of survival and security. In these situations, the sale of animals, milk and manure accounted for between 27.2 to 30.7%, 19.7% to 84.8%, and 1.0-4.5% of total farm income, respectively.

Sub-humid and humid areas: Mixed farming is more common here, and goats contributed between 17.1 to 58.0% of total farm income mainly through the sale of animals.

These levels of income can be much higher than is reported, because of a lack of market access, in which the farmer generally only receives 55 to 60% of the total value of the animal, the remaining 40-45% going to middlemen who exploit the situation.

Research for Development

Most countries in the region have undertaken research and development on small ruminants. These efforts have been variable, depending on such factors as priorities for research, relative importance of the species, research support, research capacity and institutional support. With rare exceptions, there has been negligible national support for both species, with the exception of India, Pakistan, Indonesia and Vietnam. Critical reviews of the Proceedings of the International Goat conferences in India in 1992, China in 1996, as well as other regional meetings, indicate that most of the work that has been done, while generally useful, has been piecemeal and uncoordinated. The bulk of the work has been very discipline-oriented in which the focus has been on feeding and nutrition, genetics and crossbreeding, and health issues. Very limited research and development effort has been directed at socio-economic aspects, the role of both species in smallholder farming systems as well as transhumance systems, contribution to nutritional security and poverty alleviation, and post-production systems.

In view of the urgent need to accelerate productivity growth and increase the contribution from both species in the future emphasis must now shift to consolidate the valuable efforts made, embark on large scale technology transfer at the farm level, as well as expanding needs-based research. The development of small ruminants in the future will need to address the following aspects *inter alia* :

- The concept of production to consumption that links the owner, producer and consumer
- The importance of needs-based research, in which research is focused in resolving farmers' problems and constraints
- Systems approaches and interdisciplinary efforts that consider whole farm systems
- Formulating a research and development agenda that addresses real needs and opportunities for national goat production
- Large scale development to enhance the build up of numbers required for meat and milk production, in programmes that have clear production objectives (Table 2).
- Accelerate the transfer of technologies on-farm and wide dissemination of information.

Post-Production Systems

- Marketing of goats throughout the developing countries is generally very haphazard and very variable. Post-production systems have been poorly studied in the past and research in this area has much economic significance. It is especially important to link production with post-production systems in which there is organised collection, transportation and marketing to

Table 2. Production objectives for improved quantity and quality of goat and sheep products.

Commodity	To improve quantity (improvement/increase)	To improve quality
Meat (goat meat and mutton)	Total meat yield per animal Total amount of lean meat in the carcass Growth rate Total number of animals available for slaughter	Control of the quantity and distribution of fat-excess, undesirable except for some Middle East markets
Milk	Total yield Lactation length Number of lactations	Control of milk composition (butter-fat and solid-not-fat)
Skins	Total number Weight per unit	Skin thickness Surface area Any external damage Grain structure Elasticity Improved storage
Carpet wool	Amount of clean wool	Fibre diameter (coarse fibre desirable) Staple length Presence of medullated fibres (hair) Removal of kemp (shed fibres, or those with the medulla occupying 90% of the diameter)

include products and by-products from them. These aspects are generally neglected, resulting in:

- Reduced revenue to farmers. Observations in several countries in Asia suggest that farmers generally receive 55%-66% of the total value of the animal, the remaining 40%-45% going to middlemen and/or butchers whose total effort in terms of production process time is about one to two days.
- Reduced revenue from the sale of animals as well as their products. These involve the meat, skins, by-products and derivation of value-added products from skins. Recent studies in India indicate that goats transported for more than 400 km for 15-38 hours showed weight losses of 9%-10%, which in quantitative terms is quite high. These data exclude losses also due to the effects on poorer quality products, by-products and also herd wastage. Skins from goats are considered a core product.
- The animals slaughtered specifically for meat production are of doubtful quality. In several countries, animals from unknown background and production systems with no reference to consumer preferences are slaughtered at random. The majority of animals sold (70%-80%) are 1-2 years old.
- Where the demand for both meats and consumption is widespread, and organised programs are not in place, there is serious erosion of the breeding population in which increasingly younger animals are slaughtered. The net effect is reduced output of goat meat. Surveys in two states in India indicated that 50%-73% of the goats slaughtered were below six months of age, and 26%-50% were 6-12 months of age (Naidu et al., 1991).

The components in post-production systems are:

- *Collection* - methods of collection including transportation are important since these affect slaughter weight
- *Handling* - includes mode, duration and management during transportation
- *Marketing* - distinct outlets, organisation and their capacity

- *Slaughter facilities* - size, adequacy, hygiene, strategic location, and methods to salvage by-products, and
- *Consumer requirements* - nature, extent and characteristics. These need to be addressed in relation to changing trends (preferences, incomes and purchasing power).

Development imperatives

These are a number of important development imperatives that need to be urgently pursued. These include *inter alia* (Devendra, 2000):

- Choice of species and better use of available breeds
- Official support and increased resource use
- Choice of production systems
- Matching production to available feed resources
- Build up of numbers
- Knowledge of markets and marketing systems
- Linking production, products and by-products to markets
- Targeting poverty and improved livelihood

The sections below discuss these aspects

Choice of species and use of available breeds

While the husbandry of goats and sheep is complementary, both species have some distinct characteristics and it is important that these are recognised in the choice of animals appropriate to individual production systems. Both species are often run together in traditional management systems, but where there is a specific demand for products from one or the other species or when the prevailing situation favours a particular species, the appropriate choice is therefore realistic. Goats for example, favour drier conditions and where there is abundant browse. Sheep, by virtue of their less inquisitive habits are more suited to situations where there is herbage for grazing. Within each use, it is essential to make more efficient use of the available breeds (Devendra and Burns, 1983).

In the semi-arid and arid regions multi-species (sheep, goats, camels, but rarely cattle) are usually reared together in essentially nomadic and transhumant pastoralist systems. In the humid tropics of Asia, while goats and sheep are run together, use of individual species is a distinct possibility for both practical and economic reasons. The choice of individual small ruminant species and indeed breeds within species is an important consideration.

There exist distinct differences in the feeding behaviour and use of feeds by both species (Table 3). Knowledge of these differences, for example in the use of feed mixtures and use of leguminous forages, will be important in ensuring maximum performance from animals. The relative price of meats is an important consideration and also the market demand. Biomass production is dictated by age at first breeding, interval between parturitions, litter size, lifetime productivity and mortality.

The following factors influence the choice of species:

- Feeding behaviour and nutrition
- Availability of animals
- Biomass production
- Relative price of meats
- Market outlets for meats

Official support and increased resource use

More concerted official support is necessary to promote the development of both species. This will require explicit statements that can hasten development, and institutional commitment to provide increased resource use. Both species are generally neglected in comparison to the allocation of funds for buffalo and cattle development.

Table 3. Comparative feeding behavior and digestive physiology in goats and sheep (Devendra, 1987)

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
Variety in feeds	Greater preference	Smaller preference
Taste sensation	More discerning	Less discerning
Salivary secretion rate	Greater	Moderate
Recycling of urea in saliva	Greater	Less
Dry matter intake:		
- for meat	3% body weight (BW)	3% (BW)
- for lactation	4-6% (BW)	3% (BW)
Digestive efficiency of coarse roughages		
4. Retention time	Longer	Shorter
5. Water intake/unit dry matter intake	Lower	Higher
6. Rumen NH ₃ concentration	Higher	Lower
7. Water economy	More efficient	Less efficient
- turnover rate	- lower	- higher
8. Fat mobilization increased during periods of feed shortages	More evident	Less evident
9. Dehydration		
- faeces	Less water loss	Relatively high water
- urine	More concentrated	Less concentrated
10. Tannins	More tolerance	Less tolerance

Choice of production systems

The choice of production system will largely depend on the level of production (subsistence or commercial) and the use of production resources to support this. In addition, access to both appropriate technology as well as credit and services are important drivers of the system. Small ruminant production systems throughout the developing countries are divided into three categories as follows (Devendra, 1999):

- Extensive systems
- Systems using biomass from:
 - by-products of arable cropping
 - road-side, communal and arable tethered or grazing systems
 - cut-and-carry feeding
- Systems integrated with tree crops such as coconuts or oil palm.

These production systems are unlikely to change in the foreseeable future. New proposed systems and returns from them would have to be demonstrably superior and supported by massive capital inputs and other resources (Mahadevan and Devendra, 1986; Devendra, 1989). However, it is quite predictable that there will be increasing intensification and a shift within systems, especially from extensive to systems combining arable cropping, induced by population growth and the fact that population density and intensity of land use are positively correlated (Boserup, 1981). This

situation is increasingly likely with decreasing availability of arable land, which will occur in many parts of South East Asia.

An analysis of these systems led to the conclusion that the principal objective should be to maximise the use of the available feed resources, notably crop residues and low quality roughages, and also various leguminous forages as supplements to maximum advantage in appropriate feeding systems. This conclusion is consistent with the findings in two detailed assessments of livestock research priorities in South Asia and South East Asia (Devendra, 1989) (Devendra et al., 1997). Currently, the extensive systems that use available biomass in grazing areas are by far the most important.

Matching production to available feeds

Of the production resources, matching available feeds to production systems is especially important, since feeding and nutrition determine to a very large extent productivity from small ruminants. The application of available technology and services will also promote intensification and commercialisation. The justification for particular emphasis on improved feeding and management is seen in the low level of performance. In goats for example, the importance of poor versus good nutrition on the reproductive performance of Barbari and Jamnapari goats was studied in India. In both breeds, the total number of kids born was increased by between 66.6% - 73.9% and twins between 34.3% and 38.6% (Sachdeva et al., 1979) by improved feeding. A parallel situation has been reported for meat production in Katjang goats where liveweight at slaughter, hot carcass weight, dressing percentage and weight of meat were improved by as much as 53.8, 79.3, 7.1 and 47.1%, respectively (Devendra, 1979).

Build up of numbers

Associated with the efficiency of meat production is the need for build up of numbers and meat production to meet national requirements. This also facilitates improved breeding programmes and selection to promote the efficiency of reproduction and meat production. Reproductive rate is the all important factor, and the build up of numbers is associated with the following components:

- Age at first mating
- Productive life span of males and females
- Annual mortality in the breeding flock
- Number of young females reared per 100 breeding females. This is influenced in turn by proportion of breeding females failing to reproduce, incidence of multiple births, frequency of parturition, and mortality rate up to first mating.

Knowledge of markets and marketing system

An important aspect of production and its response to demand and supply is knowledge of markets and marketing systems. The inability presently of the producers to translate higher production activities into profitable opportunities has its roots in inefficient marketing systems. These inefficiencies persist, due to the failure of traditional marketing patterns to adapt to a changing environment, consumer preferences and demands, and need for adjustments to ensure more efficient marketing systems. With specific reference to small ruminants and meats from them, there is an extreme paucity of information on both aspects especially in South East Asia, unlike more exhaustive studies for example in India (Naidu et al., 1991). It is especially important that urgent studies be undertaken that can address a number of major aspects to include *inter alia*:

- Marketing infrastructure and facilities
- Market channels and outlets
- Buyer preferences for live animals and their meats
- Major market players
- Government intervention
- Role of the private sector.

The answers to many of these and other related aspects currently remain largely unknown. Marketing infrastructure and facilities involved with small ruminant production include holding pens in farms, collection centres, fattening units, rural and urban abattoirs, cold storage, meat processing plants, and public markets. Market channels and outlets for live animals and meat include several components from the producer to consumer and include village agents, village markets, middlemen, city dealers, retail butchers and consumers. The bulk of the goat meat and mutton produced locally is used for household consumption, followed by supplies to rural areas and finally to urban areas (Figure 1).

It is important in improved systems of small ruminant production, to have clear knowledge of buyer preferences for goats and sheep and also their meats. The question relates to whether buyers have systematic preferences for specific species and breeds, the reasons for these, and whether they pay significantly higher prices for the preferences and also why. Visits to most village and urban-fringe markets indicate that strong buyer preferences exist but the reasons and extent of these will need to be established in more quantitative terms. Such market intelligence data can have the effect of producers targeting specific buyer categories and timing to sell animals as well as the meats. Major market players include producers, village agents, middlemen, butchers and retailers.

The demand for goat meat and mutton, as with all the meats from animals is very income elastic. With rapid income growth, consumption patterns also undergo marked changes. The extent to which farmers and producers can respond to these demand developments will be influenced by government intervention as well as organised marketing. It will be also important to know the role and functions of the private sector in the production and marketing of both live animals and their meats. The concept of contract farming involving both the producer and private sector is a case in point.

Linking production, products and by-products to markets

It is essential to consider these in the context of the production to consumption systems in the food chain. Recognition of this chain ensures promotion of the interdependence between the production resources, producer, processor and consumer. This will require coordination and government support to link production, processing and distribution to consumer. The situation will also apply to post-production aspects such as the marketing of skins and leather. Farmers will generally not undertake production if there is no market demand and distinct opportunities of generating income, which in the case of small ruminants presents an attractive proposition.

The production to consumption concept that links the producer, distributor and consumer has two development effects. One is that it will encourage the location of production, slaughter and distribution, marketing and product flows. The other is that it will also significantly enhance the linkages between rural and peri-urban areas. The current large market demand for small ruminant meats has the potential with improved marketing systems, to promote rural growth. Beyond the production to consumption chain, attention also needs to be given to by-products from meat production. These have considerable economic value, but their collection, processing and use are underestimated. The sale of small ruminant skins is a major export earner in India (Naidu, 2000) and Indonesia (Soedjana, 1993). Associated with the production to consumption markets is the need for a proactive agribusiness orientation. This situation will also help shift production from subsistence to a more commercial outlook.

Targeting poverty and improved livelihoods

Both species are very closely associated with the poorest of the poor, often in marginal and harsh environment (Devendra, 1992; Devendra, 2000). Development programmes that focus on improving productivity thus also have the effect of alleviating poverty. Increased resource use is therefore also justified to target the poor and the poverty focus. Resource allocation by national programmes and donor agencies for research and development projects concerned with these species merits additional support. Their association with the poor, poverty alleviation and food

security further justifies this focus. Targeting the poor is therefore an important development strategy, particularly in harsh environments, such as in the semi-arid and arid AEZs where potential improvements are associated with a complex web of interactions between poverty, population dynamics, agricultural growth, survival and sustainability. The latter is of no significance to poor people, whose main objective is subsistence living, and who perceive that inefficient use of natural resources and environmental degradation are unimportant if their immediate needs and short-term survival are not assured. Development strategies must therefore target the poor as direct beneficiaries. Integrated natural resource management and use, interdisciplinary and community-based participatory approaches need to be addressed. Practical guidelines that link technology to social, economic and organizational requirements for improving goat production have recently been made available (Peacock, 1996).

Conclusions and suggestions

The development of goats can significantly contribute to increased food production of animal origin and improved livelihoods. Affirmative action is required that can promote the following:

1. *Policy support and institutional commitment.*

These are very important prerequisites, and without such institutional commitment, small ruminants will continue to receive only lip service. Policy instruments that can seize this initiative can make a significant impact on increased production and improved livelihoods.

2. *Small ruminants provide a unique niche in small farm systems and especially rainfed environments.*

Their value in low input agricultural systems, poverty focus, food security and life of poor people is underestimated, which further justifies increased research and development efforts.

3. *Increased production will need more efficient use of available breeds and commercially-oriented production systems.*

Production systems need to shift more aggressively from a subsistence base to more market-oriented outlook to match the market demand with changing consumer preferences. Improved prerequisites for meat production include efficiency of meat production, reproductive rate and build up of numbers.

4. *Understand markets and marketing systems.*

This is a major weakness presently, and better understanding of these and agribusiness will enable producer response, and need for policy interventions and more efficient marketing systems.

5. *Owners and producers of small ruminants must think nationally and regionally.*

They need to relate these to the considerable opportunities to benefit from the demand for more meat and market potential.

6. *Need for awareness of the concept of production-to-consumption systems.*

This is important so as to link production, processing, distribution and consumption in the food chain. This link will help promote the development of location of slaughter facilities and post-production systems, rural and peri-urban areas and rural growth.

7. *Delivery systems and technology transfer*

There also needs to be efficient delivery systems to enhance high adoption rates of appropriate technologies. This involves interdisciplinary efforts, participatory team efforts involving farmers, researchers and extension personnel, and whole farm systems. Figure 1 illustrates the development process, the links between these groups, and the market outlets.

8. *Increased resource use*

Increased resource use is urgent and needs to be targeted at increasing productivity, reducing poverty, improving livelihoods of the poor and promotion of rural growth.

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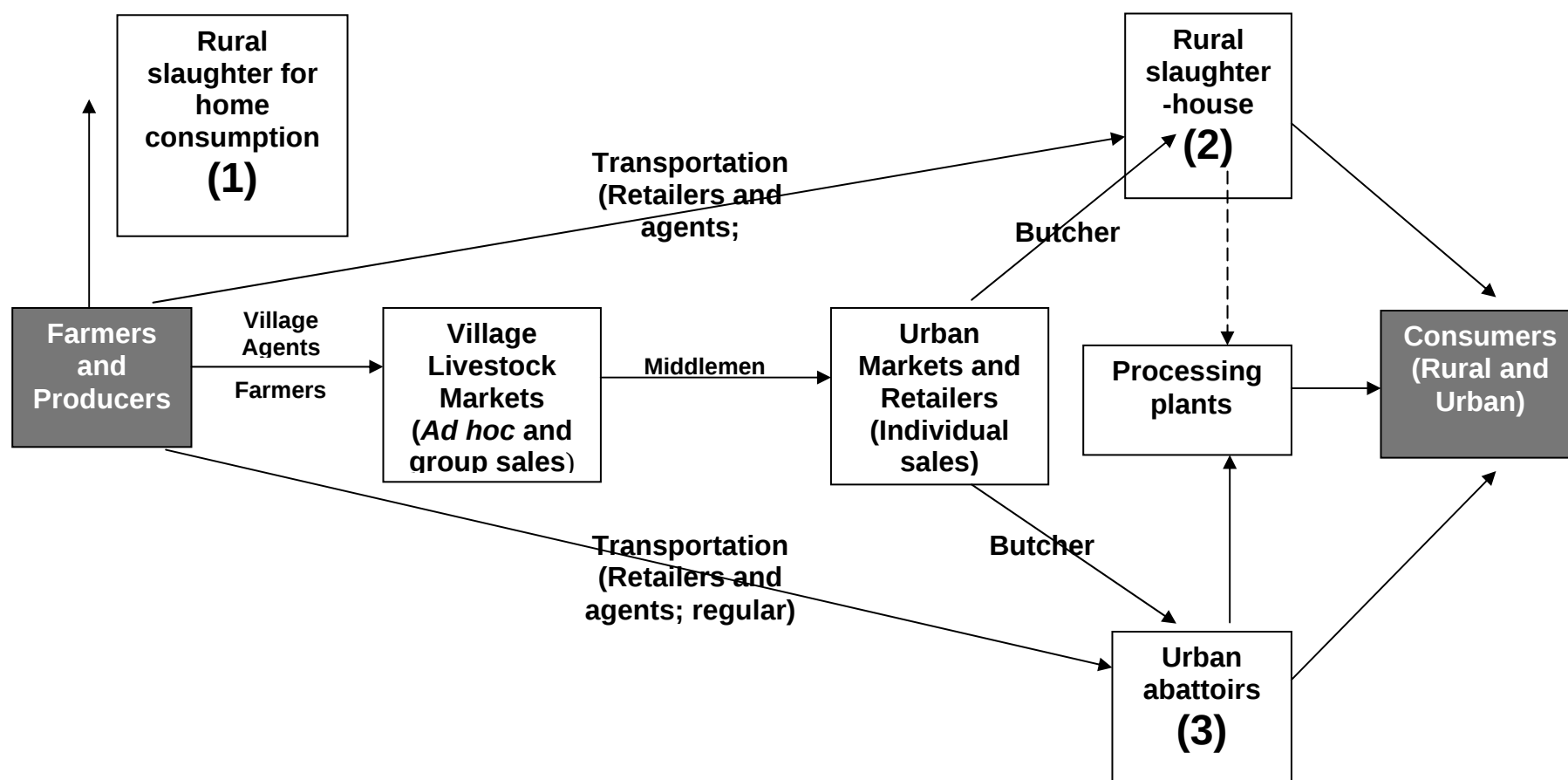
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Figure 1. Marketing channels and outlets for small ruminants and their meats.



Order of importance in terms of volume: (1) > (2) > (3)

