

Small Ruminants: Imperatives for Productivity Enhancement Improved Livelihoods and Rural Growth** - A Review

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ABSTRACT : Small ruminants form an important economic and ecological niche in small farm systems and agriculture. Their current low level of contribution is dismal, and 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 sizes of small ruminant populations; wide distribution across various agro-ecological zones and production systems; and diversity of breeds, where 66% of all goat and 57% of sheep breeds in Asia are found in China, India and Pakistan. The advantages and disadvantages of small ruminants over larger ruminants are enumerated with reference to adaptation and environment, small size, production systems and products and interactions with the environment. Discussion focuses especially on efficiency of meat production and niche markets for higher-priced goat meat, and inefficient marketing systems given an estimated 40-45% loss of income to farmers presently. Increasing the quantity of meat produced is related to live weight and the total number of animals at slaughter, which in turn, depend on the total number of offsprings weaned and lifetime productivity. At the national level, priority attention is essential to build up numbers in concerted breeding programmes, selection for efficiency of reproduction and meat production, and improvements to make traditional markets and marketing systems to respond to the changing environmental and consumer preferences. Post-production systems are neglected and improvements are associated with collection, handling, marketing, slaughter facilities and consumer requirements. Potential opportunities to expand and benefit from integrating small ruminants into annual and perennial cropping systems remain largely unexplored. Important development imperatives include choice of species and better use of available breeds, appropriate production systems that match available feed resources, and linkages between production, products and by-products to markets. Affirmative action is necessary, backed by official policy support, institutional commitment and increased resource use, that can target poverty and directly benefit the poor, and shift subsistence production to a more market-oriented opportunity. These efforts together constitute the challenges for both the owners and producers of small ruminants in the immediate future, as also the will to accelerate increased productivity, improve their livelihoods and promote rural growth. (*Asian-Aust. J. Anim. Sci.* 2001. Vol 14, No. 10 : 1483-1496)

Key Words : Small Ruminants, Breeds, Production Systems, Meat Production, Efficiency, Markets and Marketing, Post-Production, Resource Use, Livelihoods

INTRODUCTION

Increasing the contribution to food production from components of the livestock sector in the future is a most urgent need in all countries. The task is especially compelling in Asia 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 to respond to the need for increased supplies of foods of animal origin, as well as promote improved livelihoods and rural growth.

In the search for efficiency in the use of the livestock resources, it is therefore important to examine the imperatives for improving the situation to meet the new

challenges. With specific reference to small ruminants, their socio-economic importance is widely recognised. However, potential contribution is constrained by inefficient use of potentially important breeds, inefficient and inappropriate production systems, poor strategies for improved natural resource management, weak marketing systems, inadequate official support and resource use. These together have resulted in continuing dismal low productivity that does very little to alleviate poverty, subsistence livelihoods and food security especially in rural areas. Their contribution is therefore not commensurate to their value especially in small farm systems. In a historical context, this situation has not changed, despite the considerable advances that have been made in research in several areas, such as feeding and nutrition, reproduction, and animal health.

The purpose of this article is to discuss the opportunities to improve the current situation. More importantly, it will focus on those imperatives that merit urgent attention, and can directly contribute to increased food production and food security, associated with reduced poverty and improved livelihoods of the poor in rural areas. The paper also alludes to affirmative action that is necessary to

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stimulate quantum jumps from the current level of contribution.

SMALL RUMINANT RESOURCES

The current population sizes of goats and sheep in the Asia-Pacific region are approximately 439 and 295 millions respectively (table 1). The growth rates of these populations over the last decade (1987-1997) indicate that both the goat (4.2%) and sheep (2.2%) populations grew faster than that of the buffalo and cattle populations. Between goats and sheep, the population growth rate of the former was approximately twice that of the latter.

The Asia and Pacific region has 36% of all goat breeds and 25% of all sheep breeds. However, the major proportion of breed diversity is only found in a few countries, notably China, India and Pakistan. Thus for goats, 66% of all breeds and 57% of the sheep breeds, are found in these three countries.

DISTRIBUTION AND VALUE ACROSS AGROECOLOGICAL ZONES

Existing statistics on small ruminant populations unfortunately do not indicate their relative concentrations and distribution across agroecological zones (AEZs). However, this has recently been attempted (Devendra, 1994), and the analysis indicated that both species were largely concentrated in the rainfed lowlands, including the semi-arid and arid AEZs, 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 lowlands and upland sites indicated wide ownership by farm households.

Goats and sheep are valued for a variety of important contributions. Thus, farmers raise them with several objectives to meet the socio-economic, cultural and recreational needs. Small size is especially significant as it relates directly to economic, managerial and biological

Table 1. Statistical data on small ruminants in the Asia-Pacific region

Characteristic	Goats	Sheep
Population (1998, 10 ⁶)	439.1	295.1
Percent of world population (%)	53.1	20.7
Annual growth rate (%) ⁺	4.2	2.2
Number of breeds ⁺⁺	96	155
Percent of all breeds (%)	36	25
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 breed are found in China, India and Pakistan.

⁺ For 1987-1997.

(FAO, 1998)

advantages. This is associated in turn with the following benefits (Devendra, 1998):-

- Income: important means of earning supplementary income
- Food: provide animal proteins (milk and meat) for the nutritional well-being of peasants and especially the undernourished
- Security: source of investment, assets, security and stability
- Employment: creation of employment, including effective utilisation of unpaid family labour
- Fertiliser: contribution to crop production, and farm fertility through the return of dung and urine
- Product utilisation: they enable economic utilisation of non-marketable crop residues to generate value-added products, e.g. meat, fibre and skins
- Social values: ownership has been shown to increase cohesiveness in village activities and religious ceremonies, and
- Recreation: socio-economic impact of animal ownership also includes a recreational contribution to small farmers, eg. ram fighting, buck races.

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 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 eg. feeding habits, but the groupings present more general features that are especially relevant to both species. Of course there are also disadvantages and these are also indicated.

The various benefits together with their small size enable farming families to spread risks through diversification. These risks, especially environmental, are much greater in the more marginal and rangeland areas where rainfall and available feeds are sparse, typical of the arid and semi-arid tropics. Since both species are heavily concentrated in these same areas, their effective use here becomes especially important. 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.

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

size, production and products:

(i) Adaptation and environment

Advantages

- Generally wide adaptation with some exceptions eg. heavy woolled sheep in humid environments
- Suitability to small farm systems
- Less affected by droughts, 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 land less 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.

(ii) 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.

(iii) 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

Both species are widely distributed, with goats being more concentrated in the drier and harsh environments, notably the semi-arid and arid agro-ecological zones (AEZs), where the value of the species increases with decreasing quality of available feeds and grazing. 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. Likewise there is also evidence that there is genetic variation in resistance to helminths in both goats (Mandonnet et al., 1997; Pralomkarn et al., 1997) and sheep (Baker, 1996). Between species, there is more evidence of resistance to helminths in sheep compared to goats.

The controversy concerning environmental damage that relates mostly to the goat is associated with several interactions with the environment, and alleged resource degradation. Such criticisms are not unique and can apply to other herbivores, but with goats, the allegations are more severe because of their unique mouth parts, selection of feeds, ability to adapt to varying forage quality, and capacity to use coarse grazing and shrubs to advantage. The evidence for environmental damage stems from two interactive forces. One is their sheer ability to thrive in harsh environments and be productive on meagre feeds. In the semi-arid environments where feeds are in critical shortage, and mixed grazing of herbivores is common, there are consistent preferential and differential selection in which sheep dietary selection was generally intermediate between those of cattle (dominated by *Gramineae* - 60% - but rejecting woody species - 1%) and goats (dominated by woody species - 43% - but rejecting *Gramineae* - 10%). It is also pertinent to note that research in continuous and rotational grazing, stocking rate and animal ratio under rangeland conditions in South Africa concluded that for animal production stocking rate had the main effect; that sheep had a greater potential for range degradation than cattle or goats (O'Reagan and Turner, 1993). Mixed grazing is therefore an important tool to increase the total output of animal products per unit area, and is higher due to increased efficiency of use of the available biomass, provided there is an appropriate mix and number of different animal species.

The other aspect is ownership by landless pastoralists

and transhumans who live in poverty and are able to survive only because of goats and sheep. Both people and animals are involved in annual migrations in search of feeds and water. Survival for these poorest of the poor takes precedence over environmental protection in circumstances where they perceive that inefficient use of natural resources and resource degradation is unimportant if their immediate needs and subsistence living are not assured. Such situations are not uncommon, and are apparent particularly in the more marginal areas of Asia (e.g. Pakistan, India and China), Africa (e.g. Tanzania and Sudan), and Latin America (e.g. Mexico and Peru).

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 crop-goat interaction with small ruminants concerns the practice of folding. 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, this means for example, 2000-3000 goats and sheep 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 eg. maize and black pepper, as well as produce forage for goats in a zero grazing system indicated a mean annual income of US\$1,354 per 0.5 ha, equivalent to a mean internal rate of return of 38.7% (Laquihon et al., 1997).

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 and also to forests.

EFFICIENCY OF MEAT PRODUCTION

Average carcass weight is a rough measure of the efficiency of meat production. The number of animals maintained will reflect the biological cost, and the amount

of meat produced the returns. Improvements to the latter will indicate increased net returns to the producers. In good breeding programmes, increased meat production and more numbers for local slaughter are associated with replacements in production systems that match efficient use of especially feeds. On the other hand, decreased production per head and increased numbers will indicate in the more extensive systems, overgrazing in the face of reduced feed supplies.

An examination of carcass weight per head in the developing countries of Asia over the last three decades indicates that the average weight in sheep (14-16 kg) was higher than in goats (12-13 kg). The difference is due to the use specially in sheep of imported improved breeds, crossbreeding, breeding more than once a year, control of production and access to improved technology from industrialised countries.

Throughout Asia and elsewhere, meat is the most important product from goats and sheep. This is reflected in the demand for their meats, which in all countries is income elastic. Between the two, goat meat is in greater demand mainly because of the greater lean meat content, and possibly also taste preferences. Thus in many countries such as Malaysia and Bangladesh, the cost of goat meat is about two times higher than that of mutton, most of which is imported from elsewhere. Table 2 confirms this point with data from selected countries in Asia.

An analysis of the prices of goat meat and mutton in various countries in Asia (table 2) indicated that with the exception of China and Indonesia where the prices were the same, in all the other six countries, the difference, with higher values for goat meat was apparent and was in the range of 17-121%. For goat meat, the highest price was in Malaysia and the lowest was in China. The lower price for mutton could well be associated with imported mutton from overseas, usually from unproductive and old animals with

Table 2. Relative prices of goat meat and mutton in selected countries (US\$ per kg)

Country*	Goat meat**	Mutton***	% difference
South Asia			
Bangladesh	4.00	1.88	113
India	3.02	2.37	27
Nepal	3.32	2.84	17
South East Asia			
Indonesia	2.90	2.90	Same
Philippines	4.60	3.34	38
Malaysia	5.30	2.40	121
Thailand	2.92	2.29	28
East Asia			
China	1.85	1.85	Same

* The prices given are for May 2001.

** Produced entirely from local sources.

*** Includes both local and imported sources.

relatively larger content of body fat. For these reasons, it is possible that the total edible value is likely to be higher in goats compared to sheep. On the other hand, the total saleable proportions in both species are comparable.

Currently, meat is produced from sheer numbers available for slaughter at the abattoirs. These include both young (8-12 months old), mature and unproductive cull animals (six years and above). With goats, most of the animals slaughtered are at the younger end of the scale because of the very high market demand for goat meat. During some periods of the year, especially festivals, relatively more mature and especially fattened sheep are sold at much higher live weights. The key point in these circumstances is that numbers, and to a lesser extent live weight at slaughter, are the major driving forces for the sale of animals. Quality of animals or meat is not a consideration in the marketing of the animals. The market demand is thus mainly met by the availability of animals, which in turn also affects the relative prices of the meats. Uncontrolled sale of animals for slaughter has the serious effect of depleting breeding animals, the genetic base, and the inability of both species to sustain the need for number.

Associated with this situation is the rampant substitution of goat meat by both locally produced and imported mutton to benefit from the higher prices of goat meat. Often the consumer is put to a disadvantage with unscrupulous marketing and delivery of poorer quality mutton with a much higher content of subcutaneous fat. Goat meat by comparison, has most of the fat in the viscera.

It is pertinent to draw attention to the considerable demand for these meats in Middle East markets. Several delegations and individuals have approached many countries in the Asian region to cope with this request, but most countries are not ready as yet, to respond to this potentially lucrative demand for goat meat and mutton.

Ironically however, goat populations in all countries in Asia except China, are higher than that of sheep. Goats are about 49% higher in numbers than that of sheep and also have an annual growth rate of about 4.2% which is twice that of 2.2% in sheep. The greater demand for goat meat and higher price for the meat, together with uncontrolled breeding and poor selection have resulted in increased extraction rates for slaughter. These together may have also contributed to the lower meat production per head in this species compared to sheep. In the Philippines, the sheep population is negligible in size compared to goats, with the latter growing at the fastest rate among all ruminant species by about 4.1% between 1990-2000.

In these circumstances, it is relevant and compelling to ask how the efficiency of small ruminant meat production can be improved, and specifically what can be done to improve the situation? Associated with this, it is also pertinent to ask what development strategies, together with

the elements related to the build up of numbers that need to be pursued to increase the level of small ruminant meat production? The sections following discuss these aspects.

An important prerequisite for improved efficiency of production involving increased quantity and better quality products is the need for clear production objectives. These are indicated in table 3. Concerning quantity, total amount of lean meat in the carcass, measured by live weight at slaughter, and total number of animals available for slaughters is important. This is related to two important parameters:

- Mean number of offsprings
born at one parturition

$$\frac{\text{Mean number of offsprings born at one parturition}}{\text{Interval between parturition}} \times 365$$

Interval between parturition

-Total weight of offsprings measured/year/female exposed to the male

- Flock meat productivity can be calculated as follows:-

Flock meat productivity = litter size/year × litter size × number of offsprings weaned × kids/lambs weaning weight × annual mortality in does/ewes.

The relevance of the first two parameters is seen in table 4 concerning calculations of gross economic returns with increasing level of fertility in Katjang goats in Malaysia. Lifetime productivity is essential, and females must be retained in the flock for 5-7 years in order to enable does to express their fertility ceilings.

More importantly, table 4 clearly emphasizes the importance of efficient management on the extent of the income generated. Apart from the genetic capacity of the goats, the number of offspring born and weaned depend to a very great extent on feeding and nutrition. With reference to type of production systems, extensive grazing gave maximum economic gains compared to intensive grazing of cultivated grasses because of the costs of production used in the latter. Reducing the level of cost will be associated with the use of low cost inputs available in the farm such as various crop residues and leguminous tree forages, and use of strategic protein supplements when these are justified. On the other hand, the table also illustrates that with cultivated grasses, and with informed management to achieve maximum expression of fertility, the difference in the annual margin of profits between the 80 and 140% levels was about 68%.

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

Table 3. Production objectives for improved quantity and quality of goat and sheep products

Commodity	To improve quantity	To improve quality
1. Meat (goat meat and mutton)	<ul style="list-style-type: none"> - Total meat yield per animal - Total amount of lean meat in the carcass - Growth rate - Total number of animals available for slaughter 	<ul style="list-style-type: none"> - Control of the quantity and distribution of fat-excess, undesirable except for some Middle East markets
2. Milk	<ul style="list-style-type: none"> - Total yield - Lactation length - Number of lactations - Persistency 	<ul style="list-style-type: none"> - Control of milk composition (butter fat and solid-not-fat)
3. Skin	<ul style="list-style-type: none"> - Total number - Weight per unit 	<ul style="list-style-type: none"> - Skin thickness - Surface area - Minimum external damage - Grain structure - Elasticity - Improved storage
4. Carpet wool	<ul style="list-style-type: none"> - Amount of clean wool - Density 	<ul style="list-style-type: none"> - 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) - Elasticity

extent of this contribution, not only to household income, but also to food security for the rural poor:-

security, employment and income generation (Kumar and Deoghare, 2000).

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 poor farmers.

Recent studies on the role of goats in the economy of the rural poor in India indicated that farmers had access to milk for between 60-150 days, which was consumed by children. Additionally, goats generated Rs 1972, 7978 and 17,500 in small (<5 heads), medium (5-10 goats), and large (>10 heads) respectively. Also, poor rural women benefited from employment and financial autonomy. The study clearly showed the benefits to household nutrition and food

POST-PRODUCTION SYSTEMS

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

- 1) 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.
- 2) 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

Table 4. Estimated gross margin of profits per annum from indigenous Katjang goats for meat production with varying levels of fertility

Fertility level (% kids weaned/does mated)	80	100	120	140
I. The goat flock				
Flock size (breeding does)	10	10	10	10
Increase due to kids born	8	10	12	14
Less mortality ¹⁾	6	8	9	10
Net increase in numbers less culls ²⁾	16	16	17	18
Cost of goats ³⁾ (\$ US)	450	480	510	540
Cost of cull goats ³⁾ (\$ US)	75	75	75	75
Less cost of foundation does ³⁾	300	300	300	300
Total gross revenue (\$ US)	825	855	885	915
II. Cost of production				
(i) On cultivated grass with labour ⁴⁾	51.4	54.9	58.3	61.7
(ii) On uncultivated grass with family labour ⁵⁾	-	-	-	-
III. Gross margin of profit (\$ US)				
(i) Grazing cultivated grass:				
Per flock	338.6	455.1	511.7	568.3
Per breeding doe	33.9	45.5	51.8	56.8
Per month	28.2	37.9	42.6	47.4
(ii) Grazing uncultivated grass:				
Per flock	825	855	885	915
Per breeding doe	82.5	85.5	88.5	91.5
Per month	68.8	71.3	73.8	76.3

¹ 10% among breeding ewes and 15% among kids, ² 25% culling per annum, ³ US\$ 30 per goat weighing about 20 kg, ⁴ Cost of cultivated grass is US\$ 3.6 cents per kg. fresh weight. ⁵ No cost attached; both components are considered free.

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.

- 3) 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.
- 4) 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):-

- (a) Choice of species and better use of available breeds
- (b) Official support and increased resource use
- (c) Choice of production systems
- (d) Matching production to available feed resources
- (e) Build up of numbers
- (f) Knowledge of markets and marketing systems
- (g) Linking production, products and by-products to markets
- (h) Targeting poverty and improved livelihoods

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 transhuman 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. The following factors influence the choice of species:

- (a) Feeding behaviour and nutrition
- (b) Availability of animals
- (c) Biomass production
- (d) Relative price of meats
- (e) Market outlets for meats

There exist distinct differences in the feeding behaviour and use of feeds by both species (table 5). 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 for these. Biomass production is dictated by age at first breeding, interval between parturitions, litter size, lifetime productivity and mortality.

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.

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):-

- (a) Extensive systems
- (b) Systems using biomass from:
 - the by-products of arable cropping
 - roadside, communal and arable tethered or grazing systems
 - cut-and-carry feeding
- (c) 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 recent detailed assessments of livestock research priorities in South East Asia (Devendra et al., 1997) and South Asia (Devendra et al., 1998).

Currently, the extensive grazing system as well as use of biomass along roadsides and the like are by far the most important. Increased productivity and commercialisation will necessitate a shift from these systems to integrated systems involving both annual and perennial crops especially in the rainfed areas, and these offer particular challenges. In this context, integration with large areas under tree crops (coconuts, oil palm and rubber) remain an untapped potential (table 6), accounting in South East Asia of about 210×10^6 ha. The benefits of integration with oil palm include increased yields (Devendra, 1991; Chen et al., 1993), reduced weeding costs (Chee and Faiz, 1991; Chen et al., 1993), increased income with coconuts (Deocareza and Diesta, 1993; PCARRD, 1994). Table 6 gives an

Table 5. Comparative feeding behaviour and digestive physiology in goats and sheep

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

(Devendra, 1987)

Table 6. The effect of mixed cattle and goat grazing on the yield of fresh fruit bunches in oil palm cultivation in Malaysia

Year	Grazed area (mt/ha/year)	Non-grazed area (mt/ha/year)	Difference (mt/ha/year)
1980	30.55 (C)+	25.61	4.94
1981	17.69 (C)+	15.87	1.82
1982	25.12 (C+G)	22.97	2.15
1983	23.45 (C+G)	18.29	5.16
Mean	24.20	20.69	3.51

*C = cattle, **C + G = cattle + goats (Devendra, 1991)

example of the results.

The main areas in which research has been undertaken include:

- Characterisation of environmental conditions within plantations
- Measurements of forage and AIBP availability and quality, and seasonality of production
- Evaluation and selection of grasses and legumes for environmental adaptation and increased herbage production
- Measurements of animal performance under different nutritional and management regimes

- Measurements of soil compaction and tree damage resulting from the introduction of ruminants
- Measurements of tree crop yields in integrated systems
- Management of animals under tree crops
- Analyses of the economic benefits of integrated systems

The first three areas are the most studied. In contrast, long-term animal production data for the different ruminant species are limited, as are data on the effects of grazing management. In addition, socio-economic analyses have been addressed only superficially in the studies. Considerable opportunities exist therefore for more research in these integrated systems, and on the impacts of crop and animal interactions on environment indicators.

Potential integration is not confined to these examples of tree crops and has been extended to include fruit trees eg. mango and citrus, and other crops like cashew, tamarind, and teak as is being attempted in the Philippines and India.

Considering the potential carrying capacity that is feasible, the offtake of meat (goat meat and/or mutton) from the land is therefore enormous. In Malaysia, for example, the total land under oil palm and rubber is approximately 4.0 million hectares. Even if only half of this land is used and assuming a carrying capacity of three goats or sheep per

hectare, the total number of animals that can be supported is about 6.0 millions. Likewise in the Philippines, considering the land area of about one million hectares under coconuts using only half of this area can support about one million additional goats or sheep at a stocking rate of two goats or sheep per hectare.

Matching production systems 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 in India. In both breeds, the total number of kids born was increased by between 66.6-73.9% and twins between 34.3-38.6% (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 (table 7 and fig. 1)

Build up of numbers

Associated with the efficiency of meat production is the

Table 7. Magnitude of improvement feasible in indigenous katang goats from rural areas due to improved nutritional management in Malaysia

Parameter	Rural goats**	Experimental goats** (%)	Improvement feasible (%)
Liveweight at slaughter (kg)	18.6	28.6	54
Hot carcass weight (kg)	8.2	14.7	79
Dressing (%)	44.2	51.3	7
Weight of meat (kg)	5.5	8.1	47
Meat: bone ratio	4.1	4.9	20
Forequarter (kg)	1.2	2.9	108
Hind leg (kg)	1.2	2.2	83
Total edible weight (kg)	13.2	18.2	37
Total saleable weight (kg)	17.9	24.0	34

** Adult goats approximately three years of age.

(Devendra, 1979)

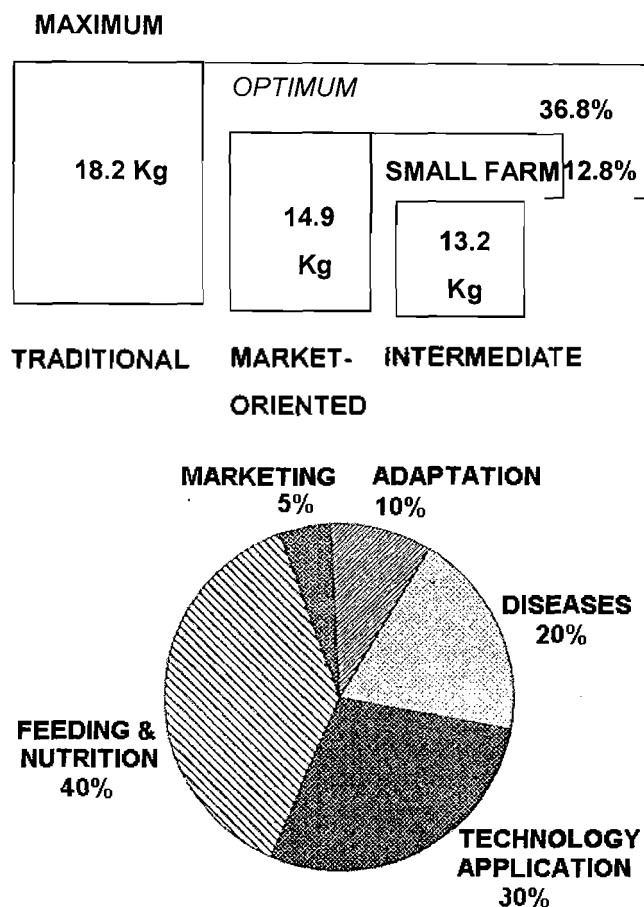


Figure 1. Total edible meat yields under different systems (above) and the relative importance of various factors contributing to these differences in yield. (Adapted from Devendra, 1979.)

need for build up of numbers and increased 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 too 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.

Few national programmes in the Asian region are concerned with this task which in itself makes little and no contribution to productivity enhancement to meet national

requirements. It is an area that also merits critical review.

Knowledge of markets and marketing systems

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 2).

Small ruminants are currently marketed by individual farmers selling the village agents with up to eight heads, often with underestimated live weights and costs, either on live weight basis or on the hoof (figure 2). The animals are then sold or more commonly assembled for transportation over long distances. In itself this is reflective of low producer participation by farmers, and the current emphasis on cattle and buffalo marketing where more organised marketing is apparent. In order to improve the situation, and increase farmer participation in the marketing of small ruminants, collective action is necessary. In most countries, this is missing and can be strengthened by the development of cooperatives. Government intervention is necessary to

assist the development of organised marketing of cattle, parallel to that which has been developed for cattle and buffaloes.

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 impacts. One is that it will encourage the location of production, slaughter and distribution, marketing and product flows. The other is that will also significantly enhance the linkages between rural and peri-urban areas. The current large market demand for small ruminant meats have the potential with improved marketing systems to promote rural growth. Beyond the production to consumption chain, attention also needs to be given to by-

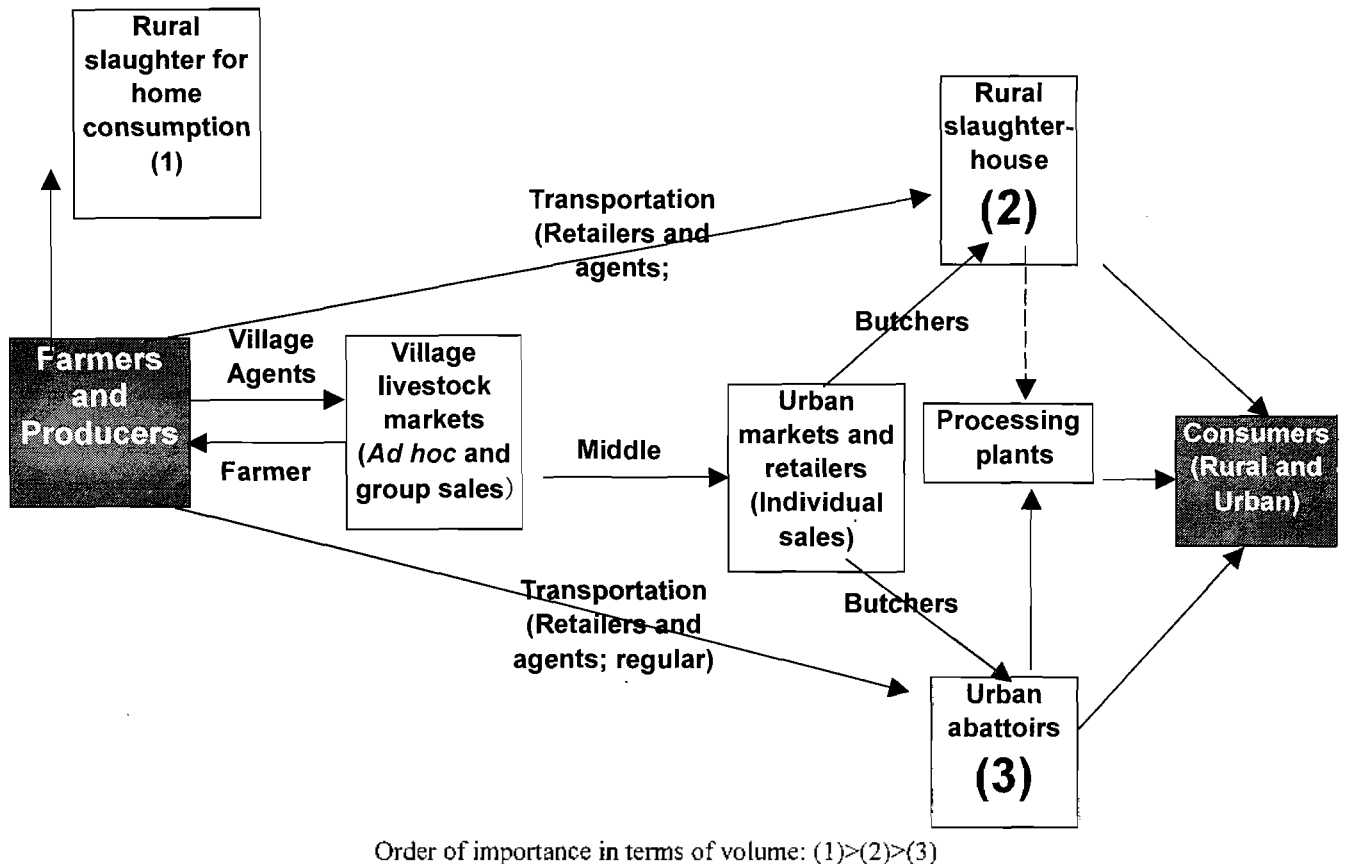


Figure 2. Marketing channels and outlets for small ruminants and their meats

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 et al., 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 this 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 agroecological zones 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 also 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

There is no doubt that the development of small ruminants can significantly contribute to increased food production of animal origin and improved livelihoods. For these to be realised, affirmative action is required that can promote the following:-

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.

Small ruminants provide a unique niche in small farm system and especially rainfed environments

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

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.

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.

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.

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.

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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