



Improvement of supply value chains in sustainable small ruminant production systems in Asia

C DEVENDRA¹

130A Jalan Awan Jawa, Kuala Lumpur 58200 Malaysia

Received: 27 May 2015; Accepted: 10 July 2015

ABSTRACT

The paper highlights the importance of meat production from goats and sheep. Goat meat is sought for its high lean meat content, but current production is inadequate, resulting in the highest price in most countries, followed by mutton. Discussions focus on the distribution across agro-ecological zones (AEZs), factors influencing meat production, transportation, types of markets (assembling, distribution markets and weekly markets), characteristics; marketing channels and outlets; buyer preferences for live animals and meats and major market players. Goat skins are core products due to 20 times value addition. Rural markets have numerous advantages and reduce current constraints to marketing. Three factors requiring urgent attention are: (i) economic opportunities to participate in improved marketing systems and value chains, (ii) increased profits and improved livelihoods will benefit the poor, and (iii) potential development of less favoured areas. Strong interdisciplinary R and D and supportive policies can directly enhance socio-economic benefits and reduced poverty among poor farmers and the landless.

Key words: Goat meat, Rural markets, Small farmers, Transportation, Types of market, Value chains

Animal production systems today more than any other time before, are confronted and challenged by complex constraints, problems, and by waning agriculture. Agriculture's key function (food production) is the single biggest challenge for small farm systems in Asia. Changing weather patterns such as low rainfall, high temperatures and weather create high risks for agriculture, exacerbating food insecurity and vulnerability of the poor. Improved, innovative farming systems adapted to the changing conditions need to be integrated to ensure the viability of agriculture, not only for food production, but also to allow small farmers to become better stewards of the environment. Coordinated and concerted action is needed for the revitalization and transformation of agriculture (Devendra 2012). The five major issues involved are: (i) Productivity growth from sustainable food and nutrition security, (ii) reduction of poverty, (iii) efficient natural resource management (NRM) and production systems, (iv) the threats and effects of climate change, and (v) challenges to our research capacity to engage in interdisciplinary resolution of the constraints, and farmers to become better stewards of the environment.

Achieving these goals is an enormous task that will require all available skills in science. The pathway to increasing productivity requires priority and efficiency for the revitalization and transformation of agriculture at all

levels of R and D. In animal production systems, the value of individual ruminant species increases in relation to their ability to adapt to the environment, cope with the effects of climate change, demonstrate multifunctional contributions, and respond to market opportunities and changing consumer preferences. For poor small farmers and landless, maximizing per animal performance is very essential, particularly since economic growth is essential for poverty reduction. Additionally, in countries such as India where religion pays homage to large ruminants during their life span, the dynamics and importance of producing alternative supplies of animal proteins from goat's and sheep becomes very challenging.

Small ruminants are especially important for the poor and landless who toil with meager resources and seek survival. Small ruminants have a historical link with man, with a unique ability to thrive and make significant contributions in harsh environments and enable man to be resilient, overcome vulnerability, and enhance survival (Devendra 2010a). In these circumstances, goats and sheep make a very valuable contribution to food security, improved livelihoods and economic security. The concentration of small ruminants in the semi-arid and arid AEZs is significant, firstly because these areas harbour subsistence and survival of the poorest of the poor. Secondly, isolation has serious implications for market access and the marketing of goats and sheep and their products, and these affect the livelihoods of poor farmers. Both goats and sheep are well adapted to the semi-arid to arid AEZs (Devendra

Present address: ¹Consulting Tropical Animal Production Systems Specialist (cdev@pc.jaring.my).

1999) such as in West Asia and North Africa (WANA) region, but goats more than sheep are particularly well adapted to these areas. Most importantly, these areas are also the least favored areas (LFAs) where small ruminant thrive and are multifunctional. In these circumstances, the value of the species increases with decreasing availability of feeds and grazing. Farmers in the WANA region (Aw-Hassan *et al.* 2010), and also the landless in South Asia (Devendra 2011) have major problems coping with the prevailing biophysical factors, and inefficient supply and value chains.

The rapid growth of the small ruminant population in such environments is considered to be the main cause of land degradation in the WANA region (Lal 2002, Aw-Hassan *et al.* 2010), Latin America (Pariacote 1966, Iniguez 2011) and the northern part of South Asia (Devendra 2012, 2014). The many production systems here are influenced by the density of animal populations on agricultural land and its quality, available feed supplies, and especially the efficiency in natural resource management (NRM). A major challenge is pursuing rural growth, poverty reduction and environmental sustainability through the 'critical triangle' (ADB 2009). The novelty in this paper is the focus on value chains in small ruminants in Asia. The specific focus on small ruminants is justified by six important facts:

1. The extreme paucity of information on supply value chains.
2. Cattle are not slaughtered in India for religious reasons, and buffaloes are mainly slaughtered for exporting beef to Malaysia, Philippines and Vietnam.
3. The annual growth rates of ruminant populations in Asia (buffaloes, cattle, goats and sheep) and their contribution to meat production lag well behind that of the non-ruminants (poultry and pigs) which are growing at a faster rate.
4. Among ruminants, however, the annual growth rate of goats is high, and generally higher than sheep due to higher fertility. Their small size relative to large ruminants and other biological attributes (e.g. digestive efficiency in goats) provide an important link in small farm systems.
5. Most importantly, the dynamics of small ruminant production, post- production through to processing

and marketing are very complex, and yet fascinating issues from the standpoint of impacts on livelihoods, nutrition, human health, food insecurity and the environment (Devendra 2015a).

6. Both sheep and goats are particularly close to the poorest of the poor and the landless, both of whom are found in fragile less favored environments (LFEs), and provide an entry point for the development of these areas (Devendra 2015b).

The paper reviews these various issues, and includes comprehensive discussions highlighting prevailing markets, their characteristics, and patterns of marketing and specific organizational features. Brief reference is made about the various methods and unscrupulous ways used by producers, buyers, traders and middlemen; trying various ways of fixing prices; the plight of uncompetitive farmers and the landless seeking market access; problems of transportation, and the dilemma of the transported animals.

Due to the relatively larger populations of goats compared to sheep in most countries, and also their wider distribution across the various AEZs, more emphasis is given to goats, the paper alludes and links to the concept of production to consumption systems, and mentions the various stakeholders involved in the value chain.

Distribution and concentration of small ruminants

An indication of the size of the goat and sheep populations in the more prominent goat and sheep raising countries such as China, India, Pakistan and Indonesia is given in Table 1. Without exception, the goat populations were consistently higher due to several factors such as relatively higher market demand for goat meat, and availability of animals for slaughter. In other words, a stronger demand for goat meat has tended to push the prices for the meat in the market.

Asia is the most dominant region for goat production with distribution of animals across all ecosystems. Of the world population of goats of approximately 1,127 million in 2013 (FAO 2013), Asia and the Pacific had the largest goat population (Table 1) of approximately 60% (556 million), followed by Africa 33.7% (311 million). India (35.2%), China (29.3%) and Pakistan (12.0%) together accounted for about 77% of the total Asian goat population, with 42% of the total breeds. Together with the total world

Table 1. Relative populations and the products from goats and sheep in selected countries in Asia in 2011 (FAO 2013)

Country	Goats			Sheep			
	Population (10 ⁶)	Meat (mt)	Milk (mt)	Population (10 ⁶)	Meat (mt)	Greasy wool (mt)	Milk (mt)
China							
Mainland	142.0	1,887.0	260.0	138.8	250.0	393.1	1,529.00
India	157.0	596.6	4,760.0	74.5	293.4	43.0	-
Pakistan	61.5	285.0	759.0	28.1	158.0	42.5	36.0
Bangladesh	53.4	199.0	2,496.0	-	-	-	-
Indonesia	17.5	70.7	281.3	-	-	-	-
Philippines	3.9	54.7	-	-	-	-	-

population goats found in these systems, this along with sheep numbers form invaluable resources especially for resource-poor farmers and the landless.

The diversity of small ruminant species is widely distributed across the various AEZs and on small farms in Asia (< 2 ha in area), and ownership involves several million landless farmers and agricultural labourers who rear goats (Devendra 2010a). In India, it is significant to note that about 70% of the goat and sheep populations were reared by small farmers (Biswas 2010).

Goat meat production, types of products and end uses

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 greater lean meat content and possibly taste preferences. Thus in 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 (Devendra 2010a).

Trends in the volume of goat meat produced in Asia between 1985 and 2012 are summarized in Table 2. The total supply is the sum of production in South Asia, South East Asia and East Asia. Asia alone produced 72.6% of the total global production, and over the period 1985–2012, the volume of contribution increased by 6.8%/year, much higher than the 6.0% for the world production. An analysis of the prices of goat meat and mutton in various countries in Asia, indicate that with the exception of China and Indonesia where the prices were the same, in 6 countries (Bangladesh, India, Nepal, Philippines, Malaysia and Thailand) the difference was higher for goat meat ranging from 17 to 121%. For goat meat, the highest price was in Malaysia and the lowest in China. The lower price for mutton could well be associated with imported mutton from overseas, usually from unproductive and old animals with 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.

The average carcass weight is a rough measure of the efficiency of meat production. The number of animals maintained will reflect the biological cost, the amount of meat produced, and the returns. Improvements to the latter will indicate increased net return to the producers. In good breeding programmes, increased meat production and more numbers for local slaughter are associated with changes in production systems including efficient use of 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/head in the developing countries of Asia over the last 3 decades indicate that the average weight in sheep (14–16 kg) was higher than in goats (12–13 kg). The difference is due to the use of imported improved sheep breeds that have been selected for increased growth rate, better carcasses, crossbreeding, and application of improved technology from industrialized countries.

Currently, meat is produced from sheer numbers that are available for slaughter at the abattoirs. These include both young (8–12 months old), mature and unproductive culled animals (6 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 and prices. Quality of animals or meat is not a consideration in the marketing of the animals. The market demand is mainly met by the availability of animals, and live weight at sale times, which in turn also affects the relative prices of the meats. Uncontrolled sale of animals for slaughter, especially the young and valuable for breeding has the serious effect of depleting breeding animals, erosion of the genetic base, collapse of breeding programs, and reduced supply of animals.

Ironically however, goat populations in all countries in Asia except China are 49% higher than that of 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 and 2000.

In these circumstances, it is relevant and compelling to ask how the efficiency of goat 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 buildup of numbers that need to be pursued to increase the level of small ruminant meat production? These aspects are discussed in the following sections.

An important prerequisite for improved efficiency of production involving increased quantity and better quality products, is the need for clear production objectives. Concerning quantity, total amount of lean meat in the carcass, measured by live weight at slaughter, and total number of animals available for slaughter is important.

The slaughter of goats results in a variety of products, by-products, uses, and more importantly, value addition to these. These will vary from country to country, but the fact remains that there is extensive use of the materials. Detailed data from India are given in Table 3, probably the lead

Table 2. Goat meat production in Asia (FAO 2013; mt)

Production	1985	1995	2005	2012	Av. annual growth rate (%)
In Asia	1281.6	2229.8	3236.7	3847.2	6.8
Total world	2028.3	3237.7	4638.8	5300.8	6.0

Table 3. Goat products and services in Asia

Products	Services
Meat (raw, cooked, blood, soup, goat meat extract - "Zeungtang" in Korea)	Cash income and investment
Milk (fresh, sour, yoghurt, butter, cheeses)	Security and insurance
Skins (clothes, shoes, water/ grain containers, tents, handicraft, shadow play in Indonesia, thongs etc.)	Prestige in ownership
Hair (cashmere, mohair, garments, coarse hair rugs, tents, ropes, wigs, fish lures)	Gifts and loans
Horns	Religious rituals e.g. sacrificial slaughter
Bones (handicraft)	Human nutrition – characteristics of meat and milk
Manure and urine (crops, fish)	Pack transport and draught power
	Draught power
	Medicine
	Control of bush encroachment
	Guiding sheep

country in Asia where there is considerable knowledge on post-production aspects as well as commercialization. The data pertains to both goats and sheep.

Slaughter products, viz. skins, blood, intestines, liver, bile, rumen ingesta, tannery hair and wool, and skin trimmings and flashings (Table 3). It is clear that a range of end products are involved, as also their uses. Data from CLRI in India indicate several type of industries involved, and more importantly the value addition, e.g., with skins the latter is 2–5 times, blood 2–6 times, liver 8–10 times, and tannery hair and wool 4–5 times.

Asia and Africa are the world's largest goat producing and consuming continents, but have minimal impact on international trade and exports. The reasons are probably due to high intra-regional consumption of the meat, strict international regulations, and serious effects of trade-related diseases like peste des petis (PPR) ruminants, foot and mouth, goat pox and Rift Valley (Brown 2011), and inadequate infrastructure for the movement of animals and meat handling system

Value chains for goat meat production

Value chains are important to enable improved understanding of the various elements and stages from production to consumption systems. They include *inter alia* resource inputs, access to credits, supplies, production, handling, transportation and processing. More particularly, the assessment provides information and clear identification of those factors that need to be improved to benefit small farmers. Presently, there exists a diversity of supply and value chains, ranging from small links with individual small farmers who are dependent on unscrupulous middlemen, to more advanced capital intensive agri-business systems. The market chain involves rural, peri-urban, urban and international markets, and a major challenge lies in ways to link small farmers with the major players in these

Table 4. The extent of yields of by-products in slaughtered sheep (CFTRI, India 2014)

Product	As % of live weight
Carcass	46.8–48.0
Blood	1.5–4.0
Head	3.0–4.0
Skin	7.5–10.0
Feet	1.5–2.0
Stomach (empty)	2.5–3.0
Small intestine (empty)	1.5–2.0
Large intestine (empty)	1.0–1.5
Liver	0.9–2.2
Kidneys	0.4–0.6
Spleen	0.1–0.4
Lungs	1.5–2.0
Bones	6.0–8.0

markets, marketing systems and services.

Small farmers have major problems coping with a range of difficulties in the face of the complexity, lack of organisation, weak negotiating and marketing skills, and general inefficiency of the prevailing marketing chains. Foremost among these are ways of access to marketing and to the marketing chain. At present, inadequate access to market outlets and weak marketing arrangements represent a major constraint to the production to consumption systems and to the owners and producers of sheep and goats. As a consequence, small farmers are often denied compelling opportunities and economic benefits. The market chain involves rural, peri-urban, urban and international markets, and a major challenge will lie in ways to link small farmers with these markets and marketing systems.

Joint partnerships can also be very useful to sustained and improved value chains. An additional feature that can be beneficially used is a business approach in which key goals are identified and monitored through quantitative performance targets (Clark *et al.* 2008). The capacity and ability to implement this business approach will be critical to determine success (Burrow *et al.* 2008). In India, empirical evidence from dairy development suggests benefits from strong cooperative participation and empowerment in well developed value chains (Birtal *et al.* 2005).

Markets and marketing

Markets link the products and the consumers, and the production to consumption pathway. It is dependent on the type of product and the production system used. Longer marketing pathways increase the transaction costs and vice versa. Presently, the marketing pathways are more commonly termed supply and value chains for goat meat. In most countries however, the terms are haphazard and have not been clearly defined. The main reasons for this state of affairs are the monopoly of the trade in the hands of a few individuals, lack of policies that can coordinate production and demand of quality meat, too many middlemen or actors along the supply chain, and poor

management of the slaughter houses, poor quality and very variable abattoirs and municipalities.

The marketing of goats starts at the farm with the owners and producers of these. The farmer sells the animals at the farm gate, and expects payments for his produce before the goats leave his possession. Alternatively, some financial arrangements are made to cover the various costs involved. It is important to keep the marketing pathways and the transaction costs low.

Assembling markets, distribution markets, and weekly markets are the 3 broad types of markets concerned with the marketing of goats.

Assembling markets: The assembling markets are the focal points for centralized concentration of animals from farms for sale and collection. Goats are often sold along with sheep since they are often reared and managed together. It is at these assembling markets that most of the transactions take place. Middlemen, butchers and also traders converge to this market to make the best purchases and value for money. In Mumbai, India, about 4,000–6,000 goats and sheep are sourced daily to maintain a constant meat supply. The main characteristics of these markets are:

- integrated complexes with live animal market and by-product processing plants,
- farmers here have more confidence and experience concerning the sale of animals,
- guarantee for a constant supply of good quality animals from short supply chains,
- good slaughter facilities to produce hygienic meat,
- good facilities to store carcass and meat for local and export trade,
- professional veterinary *ante* and *post-mortem* inspections, and
- suppliers and licensed individuals.

Distribution markets: The distribution markets are usually found in peri-urban areas close to big cities, with some being found within the cities. Usually, these are also located adjacent to large abattoirs and processing plants. Traders purchase the animals from the assembling markets, bring them to the distribution markets, and then sell them to butchers and wholesale meat dealers. The transactions in these markets are made to synchronize with the operations of the abattoirs and processing plants.

The main characteristics of these markets are:

- dependence on uncertain and unpredictable supplies of animals,
- high number of sellers, middlemen and traders,
- variable quality of animals,
- highly variable prices for animals and service fees,
- prevalent use of unauthorised locations and potential pollution risks, and
- presence of veterinary personnel to oversee the sale of disease-free high quality meat.

Weekly markets: The weekly markets are very common in the peri-urban and urban areas of most large cities throughout Asia. Large ruminants, camels and chickens are also sold in these markets. They are wholesale assembling

markets held in open areas, and receive the minimum of management in terms of feed and water supply. Farmers have to pay an entry fee to participate in the sale of animals. The animals are held here until the transaction is over, failing which they either return to the village or are disposed of at very low prices. Village markets are held on specific days during the week and usually function all day.

The main characteristics of these weekly markets are:

- main sources of supplies of goats and sheep for slaughter,
- markets are held on fixed days, which are convenient to the majority,
- small and large ruminants are sold here and often include camels and horses,
- animals are generally raised in extensive production systems by the breeders,
- extensive systems often include migrations, whose duration is very variable, usually for 2 to 3 months over 40–70 km in search of feed and water,
- sale of a larger number of animals results in more discerning sales, and is based again on sex, live weight and physical inspection,
- price negotiation and ultimate fixing of the price can be long drawn, and is in part influenced by experience in negotiating skills,
- transport costs, losses and service fees to middlemen are reduced, and
- village markets are important pathways for empowerment, cooperative development and information exchange.

Physical examination for the sale of the animals is invariably tilted in favor of middlemen and traders, and less with farmers. Chandramouli *et al.* (1997) reported that farmers only received 60% of the value of an animal, compared with 40% for the middlemen. The revenue to farmers is also dictated by the urgency to sell, reasons for disposal, age, sex, and condition of animals.

Rural markets: Aside from the 3 traditional markets mentioned above, attention is drawn to a fourth category called rural markets. These are very common and the concept probably originated in Asia. These centres are intermediary, attempting to have most of the key features of the city abattoir but at the lowest possible cost. Much smaller abattoirs are common, and these have the supreme advantage of overcoming current constraints in the marketing of goats and sheep. In India for example, the constraints involve the transportation of animals over long distances for several days (2–4 days), dubious quality of vehicles, variable weight loss, loss of animals from mismanagement such as dehydration, and sale of contaminated meat. If up to 84 h of travel is involved, the animals are very rarely fed, and usually starve during this time.

Major characteristics of rural market are as follows:

- serves as a centre for linking farmers with municipality and government officials,
- transportation costs and access to the markets,

- reduced transportation over short distances means lesser losses of animals,
- lower cost of meat for the consumers,
- increased bargaining power for farmers and increased income,
- exploitation by middlemen and traders is reduced and removed,
- serves as a centre for information exchange, technology delivery empowerment, training and government intervention, and
- promotes village and rural cohesion, and perhaps cooperative development.

Animals for sale in the rural areas are usually herded and driven on foot to the weekly market area. Occasionally, bicycles, buses or taxis are used for transportation. Petty traders often use empty trucks to collect animals for sale from individual farmers and deliver these to the weekly market.

The process of sale of animals is interesting and involves several features:

- goats and sheep are sold in one of three ways: *per head, per pair or per group*; of these the *per pair* mode is the most common,
- prices are negotiated and fixed through open discussions with the help of the commission agent; once agreed to, the unit price is applied for the purchase of all other animals,
- commission agent is responsible for settling the deals on any related problems,
- major determinant of price for the animal is anticipated yield of meat in addition to the sex, age, live weight and body condition of the animal,
- anticipated meat yield is ascertained by the buyer by physical examination of the loin area, the thighs and back areas; occasionally, crude measurements of the live weight are made by just lifting the animal,
- animals sold are then transported by trucks that hold 50–100 animals to various abattoirs,

- quite often farmers share the cost of transportation of the animals sold, and
- occasionally there are goats and sheep that remain unsold for one reason or other, return to the farm, and are brought back for sale at the next weekly market.

In the prevailing meat trade in India (Fig. 1), there are two types of value chains: traditional village level small slaughter houses (the right column), which cater for small number of animals from traditional farming systems and where there is no processing; and larger abattoirs (left column) that cope with larger animal numbers. Most animals come from commercial farms in peri-urban and urban areas. The latter is distinctly several times larger and depending on the capital available, monitoring responsibilities for ensuring good hygiene.

Post – production systems are an integral part of the food chain. The market chain involves rural, peri-urban, urban and international markets, and a major challenge lies linking small farmers with these markets, marketing systems and services.

The production to consumption systems concept has two development impacts. Firstly, it will encourage greater resource inputs, intensification, potential replication of the location of production of the model, slaughter and distribution, marketing and product flows. Secondly, it will also significantly enhance the linkages between rural and peri-urban areas which are most essential in the marketing of the produce. The strength of these linkages, impact-oriented R and D, and improved marketing systems also has the potential to promote rural growth.

Skins

One important components of the production to consumption pathway is the range of byproducts that are produced at slaughter. Among these, the most important by-product components in goats and sheep are hides and skins. They serve as the basic raw materials for the tanning industry

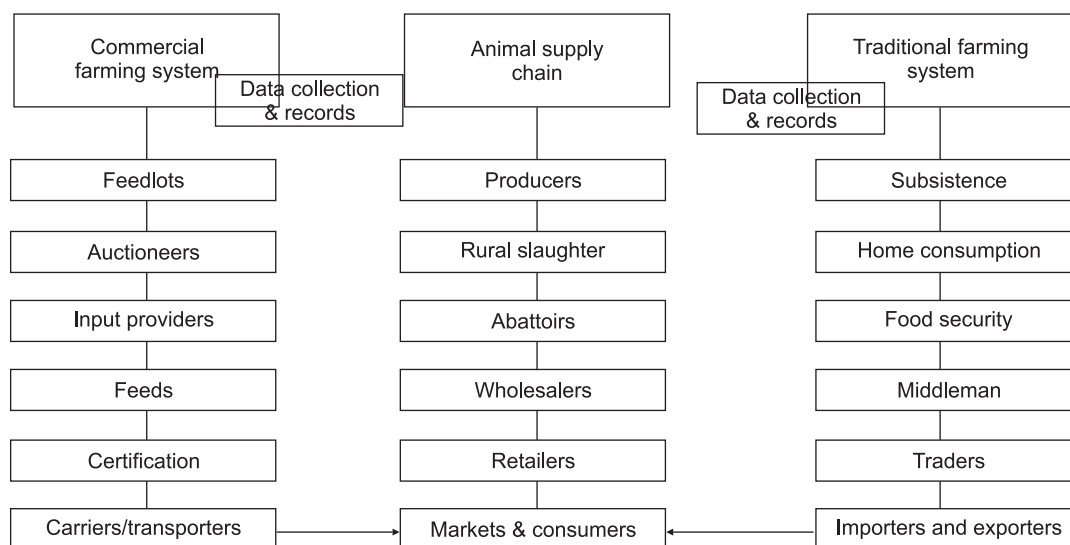


Fig. 1. A generalized generic value chain for meat from animals

and are usually recovered from slaughtered and dead animals and then sent to the tanneries (Naidu *et al.* 1991).

India is one of the largest exporters of hides and skins mainly to Europe. The annual turnover of skins in India is approximately 8–12 million pieces. Next to goat meat they are the second most commercial product, which has been estimated to be 12% of the total cost of the animal when it is sold (Seshagiri Rao 1988). It is also important to note that there are a few goat breeds that are valued specifically for skins: Black Bengal (Bangladesh and India), Barbari (India), Nachi (Pakistan), West African dwarf (Nigeria) and Maradi (Ghana).

Major opportunities for R and D: Very few national programmes are involved with the subject, resulting in poor understanding of value chains, which in turn does not enhance the livelihoods of poor small farmers and the landless, and the productivity of animals. One institute that has been involved with studying the value chains for goat meat, mutton and skins is the Central Leather Research Institute (CLRI), Chennai, India. The interest started with a very large Government of India mandated study on raw hides and skins markets (CLRI 2005), and a two-phased project on Meat Handling Systems, supported by the Canadian International Development Research Centre (IDRC).

The IDRC project explored the construction, operations, community response and sale of meat in Chennai with considerable success. The benefits were obvious and this rural meat production and processing centre (RMPCC) demonstrated an important marketing model. The model also created considerable interest and its replication elsewhere has been suggested with the added possibility of greater interest by the producers of goats and sheep to increase numbers for slaughter as well as the processing of skins for the tannery (Naidu *et al.* 2011).

Owing to the extreme paucity of knowledge on the subject, the R and D agenda is large and includes *inter alia* the following:

1. The subject of rural markets needs proper definition, description, more awareness, and ways of demonstrating direct benefits to small farmers.
2. The concept of production to consumption, its rationale and significance, is poorly understood and needs more discussion and integration with project formulation on production systems.
3. Detailed characterization of the various types of markets for the sale of animals, and the infrastructure.
4. Knowledge of markets and marketing systems and patterns of value chains are inadequate. There is an urgent need for more information on the diversity of markets, several aspects of marketing as follows:
 - i. procurement of live animals for slaughter,
 - ii. methods used for procurement from remote farms and mode of transportation,
 - iii. marketing infrastructure and facilities,
 - iv. ways to reduce long distance travel and transportation costs,

- v. market channels and outlets,
- vi. buyer preferences for live animals and their meats,
- vii. major market players,
- viii. government intervention, and
- ix. role of the private sector.
5. Details of the management of animals from the time of procurement to their delivery will be important to know.
6. At the market level where monetary negotiations are finalized, more information is needed on the methods used and determination of ways to ensure fair returns to farmers.
7. Explore opening up market access to assist farmers increase the supply of quality meat.
8. There is need for organizational and institutional commitment and priority interventions that ensure efficiency and sustainability.
9. These rural centres can be very effective platforms for exchange of information, improved technology delivery, empowerment and for cooperative development.
10. Definition and implementation of policy, currently vague and unavailable on several fronts: management during transportation, hygiene, pollution control and slaughter procedure.
11. Trans - boundary diseases are major constraints and will need to be monitored and removed.

Emerging policy issues

Increasing the multifunctionality and promoting the potential future contribution of goats, underline the importance of policy elements. These include: (i) policy through advocacy (i.e., education and empowerment R and D); (ii) gender; investment in R and D; (iii) direct government action; and (iv) through law (i.e., microcredits and NGO participation). The overriding challenge is to define policies that can improve the livelihoods of small farmers and the landless who own goats, foster greater institutional involvement and investments in target agro-ecosystems, promote increased adaptive R and D that impact on productivity, enhancing technology application, and vigorous scale up production and post-production systems, linkages and market access. The resolution of these constitutes the challenges for coordinated and concerted R and D in the immediate future.

Supply and value chains for goat meat and mutton are poorly understood and the prevailing systems are outdated and arbitrary. The opportunities for urgent improvements to sustain supplies of live animals for slaughter and efficient value chains are enormous. This objective needs priority attention to address the following key issues:

1. Identify and understand the major marketing constraints,
2. Methods of procurement of animals and competitive process for farmers,
3. The role of the rural centres to enhance the marketing of small ruminants and improve the negotiating skills

of farmers,

4. Ensure safe collection and transportation of animals old to assembling markets,
5. Oversee humane treatment of animals being transported,
6. Participate in the distribution of good quality goat meat nationally, regionally and internationally.

The harvest from goats is also dependent on institutional commitment, resource availability and supportive policies. The strategy for development needs to encourage more proactive participation of small farmers and the landless to increase productivity of goats from yield-inducing interventions and revitalization of animal –agriculture in the LFAs. This strategy is aimed at enhancing multifunctionality, and is associated with integrated natural resource management (NRM), wider recognition of the attributes of goats, good adaptation and survival in semi-arid and arid AEZs, the resolution of which can directly impact socio-economic benefits and reduce poverty among poor farmers and landless throughout the developing world (Devendra 2010b). The basic strategy is to have a well-defined improved package of technologies, enthusiastic institutional commitment, predictable success and collective action for demonstratable impact in the immediate future.

REFERENCES

- ADB (Asian Development Bank). 2009. *The Economics of Climate Change in South East Asia: A Regional Review*. Asian Development Bank, Manila, Philippines, 225 pp.
- Aw-Hassan, Shoma F and Iniguez L. 2010. Trends in small ruminant meat production, -consumption gaps in West Asia and North Africa: implications for intra-regional trade. *Outlook on Agriculture* **39**: 41–47.
- Biswas S. 2010. The Black Bengal goat as a tool in sustainable livelihoods in rural West Bengal. *Case study 07–10 of the Program Food Policy for Developing countries*. The role of the Government in the global food system. Cornell University, Ithaca, USA, (Mimeograph).
- Brown C. 2011. Transboundary diseases of goats. *Small ruminant Research*: **98**: 21–25.
- Birthal P S, Joshi P K and Gulati A. 2005. Vertical coordination in high value commodities: implications for the smallholders. MTID Discussion Paper No. 85. Washington, DC: IFPRI USA.
- Burrow H M, Matjuda E, Strydom P, Nengovhela B Nkhane, Madzivhandila P, Motiang D, Griffith G and Clark R. 2008. *Developing Profitable Beef Business Systems for Previously Disadvantaged Farmers in South Africa*. ACIAR Final Report available online at <http://www.aciar.gov.au/publication/FR2008-44>
- Central Leather Research Institute (CLRI). 2005. *Report on Raw Hides and Skins Markets*. Central Leather Research Institute, Chennai, India. 309 pp.
- Chandramouli D, Naidu A S and Rao K S. 1997. Socio-economic perspectives of small ruminant production. *Proceedings in Small Ruminant Production and Post-production Systems*. pp.216–38. (Eds) Krishna N, Naidu A S and Chandramouli D. Central Leather Research Institute, Chennai, India.
- Clark R A, Timms J, Parnell L P F and Griffith G R. 2008. The sustainable improvement and innovation model. *Australian Farm Business Management Journal* **5**: 29–32. <http://www.csu.edu.au/faculty/science/saws/afbmnetwork/afbmjournal/volume5/>
- Devendra C. 1999. Small ruminant production systems in semi-arid and arid environments. *Annals of Arid Zone* **37**: 215–32.
- Devendra C. 2007. *Goats: Biology, Production and Development in Asia*. 246 pp. Academy of Sciences Malaysia, Kuala Lumpur, Malaysia.
- Devendra C. 2010a. *Small farms in Asia. Revitalising Agricultural Production, Food Security and Rural Prosperity*. pp.175. Academy of Sciences Malaysia, Kuala Lumpur, Malaysia.
- Devendra C. 2010b. Concluding synthesis and the future for sustainable goat production. *Small Ruminant Research* **89**: 125–39.
- Devendra C. 2012. Rainfed areas and animal agriculture in Asia. The wanting agenda for transforming productivity growth and rural poverty. *Asian-Australasian Journal of Animal Science* **25**: 212–14.
- Devendra C. 2013. Investments on pro-poor development projects on goats: ensuring success for improved livelihoods. *Asian-Australasian Journal of Animal Science* **26**: 1–18.
- Devendra C. 2014. The search for efficiency in the management of natural resources. *Outlook on Agriculture* **43**: 1–12.
- Devendra C. 2015a. Goats: Imperatives for developing the champions of the poor and the landless. *Agrotechnology* **4**: 113–16.
- Devendra C. 2015b. Dynamics of goat meat production in extensive systems in Asia: Improvement of productivity and transformation of livelihoods. *Agrotechnology* **4**: 131–52.
- Devendra C and Chantalakhana C. 2002. Animals, poor people and food insecurity: opportunities for improved livelihoods through efficient natural resource management, *Outlook on Agriculture* **31**: 161–75.
- FAO (Food and Agriculture Organisation). 1985. FAO AGROSTAT 1995, 49, FAO, Rome, Italy
- FAO (Food and Agriculture Organisation). 1995. FAO AGROSTAT 1995, 49, FAO, Rome, Italy
- FAO (Food and Agriculture Organisation). 1996. FAO AGROSTAT 1996, 49, FAO, Rome, Italy
- FAO (Food and Agriculture Organisation). 2005. FAO AGROSTAT 2005, 49, FAO, Rome, Italy
- FAO (Food and Agriculture Organisation). 2013. FAO AGROSTAT 2013, 49, FAO, Rome, Italy
- Iniguez L. 2011. The challenges of research and development of small ruminant production in dry areas. *Small Ruminant Research* **98**: 9–20.
- Lal R. 2002. *Carbon sequestration in dryland ecosystems of West Asia and North Africa*. School of Natural Resources, Ohio State University, Columbus, Ohio., USA. John Wiley and Sons, New York, U.S.A.
- Naidu A S, Rao K S, Chandramouli D and Seshagiri Rao K. 1991. Marketing of goats and sheep. *Proceedings of Meat and Slaughter By-products Handling Systems*. pp.45–70. (Eds) Seshagiri Rao K, Rao K S and D Chandramouli. Central Leather Research Institute, Chennai, India,
- Naidu A S, Devendra C and D Chandramouli. 2011. Rural meat production and processing centre (RMPCC). *Journal of Rural Development* **30**: 81–90.
- Pariacote F A. 1966. Goat development in Venezuela. *Proceedings 8th International Conference on Goats*. Pretoria, South Africa, pp. 169 (Abstr.).
- Seshagiri Rao K. 1988. By-products from goat meat production and their marketing in India. *Proceedings of a Workshop on Goat Meat Production in Asia*. pp. 230–37. (Ed.) Devendra C. International Development Research Centre, Ottawa, Canada.