
Role of Goats in Livelihood Security of Rural Poor in the Less Favoured Environments

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I

INTRODUCTION

Goats play an important role in the food and nutritional security of the rural poor especially in the rainfed regions where crop production is uncertain, and rearing large ruminants is restricted by acute scarcity of feed and fodder. Goat rearing has distinct economic and managerial advantages over other livestock because of its less initial investment, low input requirement, higher prolificacy, early sexual maturity, and ease in marketing. Goats can efficiently survive on available shrubs and trees in unfavourable environments. In pastoral societies in India, goats are kept as a source of additional income and as an insurance against income shocks of crop failure. In addition, the rural poor who cannot afford to maintain a cow or a buffalo find goat as the best alternative source of supplementary income and milk. This is one reason why poor rural households maintain a few number of goats. Unlike a cow or buffalo, a few goats can be maintained easily and can be easily liquidated in times of distress. In recent years, goat enterprise has also shown promise of its successful intensification and commercialisation (Kumar, 2007 a, b). Owing to their greater socio-economic relevance, the growth in goat population in India over the past five decades (1951-2003) has been steady adding 1.484 million goats annually. About 70 per cent of the landless agricultural labourers, marginal and small farmers in the country are associated with goat husbandry. They are not only an important source of income and employment for them, but also a vital source of animal protein for the family. In spite of having potential of good economic returns from goat rearing, goat farmers have very poor income levels. There may be a number of reasons responsible for such a situation. The productivity of goats under the prevailing traditional extensive production system is low (Singh and Kumar, 2007) mainly because of feed scarcity and lack of adoption of improved technologies and management practices. Goat rearing, which is one of the most widely adopted livestock activities in the country, has the potential to emerge as a very good source of income and employment for the rural people especially in the less favoured environments. However to harness this

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potential, the productivity and profitability of existing goat production systems needs to be improved substantially. A comprehensive understanding of the socio-economics of goat production would however be a pre-condition for any intervention for its improvement. In this background, the paper aims to analyse the socio-economics of goat production, resource flows, constraints and its role in livelihood security of the poor in semi-arid regions of the country.

II

DATA AND METHODOLOGY

The study was conducted in the semi-arid zones of two major goat-keeping states of Uttar Pradesh and Rajasthan. The location of the study was in the southwestern semi-arid zone (SWSAZ) of Uttar Pradesh and the eastern semi-arid zone (ESAZ) of Rajasthan. Both the zones truly represent the conditions of the semi-arid tropics with low and erratic rainfall (274 to 690 mm). The maximum temperature in both zones go as high as 47 °C in the months of May and June and minimum temperature up to 2 °C during the months of December and January. These two zones are also the home tracts of two of the most important and widely adapted and adopted goat breeds of Northern India. SWSAZ of Uttar Pradesh is the home tract of the 'Barbari' breed of goat and ESAZ of Rajasthan is the home tract of 'Sirohi' breed.

Using stratified random sampling, two districts from each zone; Tonk and Ajmer from Rajasthan and Etah and Agra from Uttar Pradesh were selected. Further, two blocks from each selected district and two villages from each selected block were selected randomly. A village called 'Banwal' on the border of Ajmer and Nagaur districts falling in the Nagaur district was also selected for the study, because it is considered to be the centre of the home tract of the 'Sirohi' breed. Thirty five goat farmers were randomly selected from each block, hence covering 140 farmers from each zone. Thus a total of 280 goat farmers were covered in the study. The selected farmers were post-stratified based on flock size into four categories, viz., very small (1-5 breeding goats), small (6-15 goats), medium (16-30 goats) and large category (>30 goats). The primary data on different aspects of goat rearing were collected for the year 2001-2002 through personal interview method with the help of structured and pre-tested survey schedule.

As different flock size categories were expected to have different feeding systems and constraints and influenced by access and control over resources and attitude towards goat rearing, the analysis was carried out on flock-size basis. To look at the food security issue, the goat keepers were also classified based on the size of land holding: landless, marginal (<1 ha), small (1-2 ha), medium (2-4 ha) and large (>4 ha). The standard cost concepts; variable cost, fixed cost and total cost (Vyas, 1971) were employed to examine the profitability. The goats were mostly taken care (grazing, feeding, handling, etc.) by the children and old members of the family whose opportunity cost of labour was very low. Hence the cost of goat rearing was

also calculated without accounting for the cost of labour. Consequently the family labour income from goat rearing was estimated by deducting the total cost (excluding cost of family labour) from the gross returns. There was no depreciation on the value of goats up to 3–4 years of their age. The farmers retained only 25 per cent of the breeding goats up to 4-6 years of age. The average market price of these goats received on their disposal was equal to 60 per cent of their original price. Therefore the depreciation on goats was estimated at the rate of 2.5 per cent of the value of breeding stock. Since the mortality in breeding goats caused a permanent loss of productive assets, the losses due to mortality in breeding stock was also considered as part of depreciation on the assets. The details of computation of cost and income from goat, sheep, cow and buffalo rearing and crop cultivation are given in the end notes.¹ The constraints to goat production were assessed based on the perception and information provided by the farmers. The constraints commonly observed by the goat keepers were listed out. They were graded on priority assigned by individual farmers, i.e., the constraint which was perceived as the most important was ranked highest and the next most important constraint was ranked 2nd and like wise. This information was subjected to a rank based quotient analysis to find out the constraint which is getting more weightage as per the rank assigned by the farmers. Rank based quotient (RBQ) was calculated using the following formula (Sabarathnam and Vennila, 1996).

$$\text{Ranked Based Quotient} = \sum_{i=1}^n \frac{F_i(n+1-i)}{N \times n} \times 100$$

F_i = Frequency of farmers for the i -th rank of constraint;

N = Total number of respondents;

n = Total no. of ranks;

i = Rank.

However, the losses due to diseases were estimated in terms of mortality of animals and production losses. The family members who were not engaged in other activities/jobs on a permanent basis were taken as available family labour. One man was considered equivalent to 1.25 women and 2 children (10-14 years age) for calculation purpose. One day of one person was accounted as one man-day. A linear regression was fitted to ascertain the factors affecting the size of the flock. To look at the scale economies, a multiple regression function was fitted.

III

RESULTS AND DISCUSSION

Socio-Economic Background

Goat rearing was an important source of livelihood for the resource poor rural people. In Uttar Pradesh, only the landless, agricultural wage earners and marginal

and small farmers were involved in goat rearing. However, in Rajasthan, where drought is frequent, goat rearing was adopted by all categories of farmers. In Uttar Pradesh, goat rearing was looked at as an activity associated with the economically poor and socially backward rural people but the social opinion in Rajasthan was different. Large goat farmers rather enjoyed a status of being well off in the society. Nevertheless, goat rearing was particularly important for the livelihood security of the resource poor landless people. The largest proportion of the goat keepers (68 per cent in Uttar Pradesh and 46 per cent in Rajasthan) belonged to the landless category (Table 1). Among them, 22 per cent in Uttar Pradesh and 52 per cent in Rajasthan owned medium and large goat flocks. Similarly, the marginal and small farmers together constituted 31 per cent of the total goat keeping households in both the states. The landless, the marginal and small farmers together had controlled 99 per cent goats in Uttar Pradesh and 80 per cent in Rajasthan. It clearly demonstrates the importance of goats for the livelihood of landless, marginal and small farmers.

TABLE 1. TWO-WAY CLASSIFICATION OF GOAT FARMERS BASED ON LAND SIZE FLOCK-SIZE

State/ Flock-size (1)	Landless (2)	Marginal (3)	Small (4)	Medium (5)	Large (6)	Total (7)
<u>Uttar Pradesh</u>						
Very small flock	48 (50.53)	20 (68.96)	7 (46.67)	1 (100)	--	76
Small flock	26 (27.37)	7 (24.14)	5 (33.33)	--	--	38
Medium flock	18 (18.95)	2 (6.90)	3 (20.00)	--	--	23
Large flock	3 (3.15)	--	--	--	--	3
Sub-total	95 (100)	29 (100)	15 (100)	1 (100)	--	140
<u>Rajasthan</u>						
Very small flock	12 (18.75)	11 (42.31)	7 (41.17)	6 (19.35)	--	36
Small flock	19 (29.69)	7 (26.93)	4 (23.53)	16 (51.61)	1 (50.0)	47
Medium flock	18 (28.12)	4 (15.38)	3 (17.65)	8 (25.81)	1 (50.0)	34
Large flock	15 (23.44)	4 (15.38)	3 (17.65)	1 (3.23)	--	23
Sub-total	64 (100)	26 (100)	17 (100)	31 (100)	2 (100)	140

Source: Field survey.

Note: Figures in parentheses indicate per cent to total number of goat keepers in each land-size category.

The average flock size in Uttar Pradesh was 2.43, 11.09, 20.68 and 36 breeding goats in very small, small, medium and large category, respectively, while the corresponding figures in Rajasthan were 3.47, 10.72, 22.56 and 45.59 breeding goats (Table 2). Some of the goat keepers were also rearing sheep; however the smallest flock of sheep had at least 20 ewes. The goat keepers in both the states were also rearing buffalo and cow but their herd size was less than one buffalo/cow. The size of

land holding of goat farmers in Uttar Pradesh was very small ranging from 0.19 ha to 0.30 ha. On the other hand, in rainfed Rajasthan, the land holding size was relatively larger ranging from 0.51 ha to 3.38 ha. Availability of family labour is a crucial input for goat rearing and it was positively associated with the flock size. The magnitude of the value of total assets consisting of animals and productive assets like agricultural machinery and equipments was positively associated with the flock-size in Rajasthan where goat keepers in each category had owned some land. However the magnitude of assets was almost the same across flock size categories in Uttar Pradesh. The landless goat keepers could also equally create assets in terms of animals.

TABLE 2. SOME CHARACTERISTICS OF GOAT KEEPING HOUSEHOLDS

Particulars (1)	Uttar Pradesh				Rajasthan			
	Very small (2)	Small (3)	Medium (4)	Large (5)	Very small (6)	Small (7)	Medium (8)	Large (9)
Age of farmer (yrs)	40	39	42	38	42.5	43.36	40.50	42.00
Farmers literate (per cent)	23.61	47.06	31.58	50	11.67	12.77	9.37	9.10
No. of total goats	5.49	22.94	34.58	81.50	5.79	17.85	33.41	58.51
No. of breeding does	2.43	11.09	20.68	36.00	3.47	10.72	22.56	45.59
Landholding size (ha.)	0.30	0.19	0.25	0.0	1.12	2.39	3.38	0.51
Family labour available (man-days)	2.88	3.48	3.54	6.25	3.41	3.68	3.12	3.69
Total assets (Rs. '000)	62.67	63.77	65.42	57.50	57.50	68.98	87.34	130.48

Note: A breeding female goat is called 'doe'; a breeding female sheep is called 'ewe'.

Goat-keepers in Uttar Pradesh mainly belonged to the socially and economically backward groups- scheduled castes, scheduled tribes and other backward castes, namely, *Jatav*, *Kori*, *Dhobi*, *Baghel*, *Mali* etc. However, in Rajasthan, goat keepers were more evenly distributed among different social groups and the people considered socially and economically better-off were also engaged in goat rearing (Table 3). It shows that goat rearing as an economic activity had got a higher social acceptability. It was observed that 76 per cent of the households in the selected villages in Rajasthan and 34 per cent of the households in Uttar Pradesh were engaged in goat rearing owning flocks of different sizes (1 to 142 goats). The goat rearing activity taken up by a greater proportion of the households in the villages of Rajasthan indicates also the higher agro-ecological compatibility of goats in the rain fed areas. Agricultural productivity in Rajasthan remains severely affected by frequent droughts. Faced with low productivity and high uncertainty in crop production, rural people in Rajasthan depend heavily on livestock species such as goat that can withstand drought, are prolific in reproduction and can be easily liquidated during crisis.

TABLE 3. DISTRIBUTION OF GOAT KEEPERS AMONG SOCIAL GROUPS

Caste/ class (1)	<i>(per cent farmers)</i>							
	Uttar Pradesh				Rajasthan			
	Very small (2)	Small (3)	Medium (4)	Large (5)	Very small (6)	Small (7)	Medium (8)	Large (9)
Scheduled caste	40.28	41.18	47.37	50.00	20.60	36.28	25.00	63.64
Other backward caste	47.22	47.06	52.63	0.0	35.30	42.60	56.25	18.18
General caste	4.17	0.0	0.0	0.0	2.9	6.40	6.25	13.64
Muslims	8.33	11.76	0.0	50.00	41.10	14.80	12.50	4.55

Production System

Goats were reared mainly under an extensive system of production wherein they were grazed on common property resources (CPRs), open access grazing resources and private fallow lands. Goat rearing was well integrated with other components of the farming system (Table 4). Majority of the households (59 per cent in Uttar Pradesh and 39 per cent in Rajasthan) reared goats as their only farm activity. The other prominent production systems were goat+crop+cattle/buffalo rearing and goat+crop cultivation. Next to goat rearing, crop cultivation was the next most important farm activity followed by rearing of cattle/buffalo and sheep. The major sources of feed and fodder for goats in the existing production systems were common grazing resources, private fallow lands and tree lopping. The average cropping intensity in Uttar Pradesh was 142 per cent and that of Rajasthan was only 102 per cent.

TABLE 4. DISTRIBUTION OF HOUSEHOLDS AMONG DIFFERENT PRODUCTION SYSTEM GROUPS

Sl. No. (1)	Production system group (2)	Uttar Pradesh		Rajasthan	
		No. household (3)	Per cent (4)	No. household (5)	Per cent (6)
1.	Goat rearing only	83	59.29	54	38.57
2.	Goat+ cattle/buffalo rearing	7	5.00	4	2.86
3.	Goat+crop+cattle/buffalo rearing	22	15.71	32	22.86
4.	Goat+crop cultivation	17	12.14	35	25.00
5.	Goat+crop+sheep+cattle/buffalo rearing	3	2.14	5	3.57
6.	Goat+crop+sheep rearing	2	1.43	5	3.57
7.	Goat+sheep+cattle/buffalo rearing	6	4.29	--	--
8.	Goat+sheep rearing	--	--	5	3.57

The investment pattern in the goat rearing activity reflects its income generating capacity. Total capital investment on a goat flock in Uttar Pradesh in different categories varied from Rs. 4,148 to Rs. 59,838 and it was Rs. 6,772 to Rs. 73,897 in Rajasthan. Thus the total investment on breeding stock and sheds, structures and equipments was estimated to be Rs. 1621 to Rs. 1952 per doe (adult female goat). The value of breeding stock alone accounted for 89 to 94 per cent of the total investment in Uttar Pradesh and 98 to 99 per cent in Rajasthan. The goat sheds in Rajasthan were constructed mostly from the material obtained from common

property resources (CPRs). It shows that goat keepers hardly made any investment on goat houses, structure and equipments. The provision of appropriate house/shelter is necessary to harness the production potential of goats. Further it has become more important under the changing climatic scenario with increased number of extreme weather events.

Nature and Purpose of Goat Rearing

Goat rearing was a traditional activity and a way of life for most of the farmers and was adopted as a subsidiary or main enterprise to ensure the livelihood of the family. Most farmers practiced goat rearing for their subsistence and hence seldom calculated the cost of production. Majority of the goat keepers in Uttar Pradesh (57 per cent) wanted to maintain a small flock of less than 5 goats. Due to the intensive crop farming and shrinkage of CPRs, there was little opportunity available for grazing the goats, especially in winter season. It was possible to maintain a few goats on limited grazing on the fringes of roads, railway track and irrigation canals, some purchased feed, and household's leftover food. Having very little exposure to the improved package of practices of goat production, majority of the farmers thought that the goats would only be profitable if they were maintained on CPRs. In case of larger flocks (> 10 goats), there was every chance of goats entering in the crop fields of other farmers while grazing during the main crop season in winter. Consequent quarrels with crop owners also had prompted many goat keepers to reduce the flock size. Moreover, the children and old family members could easily maintain a few goats. Similar preference for smaller flock was also observed in Maharashtra (Rath, 1992). In contrast, majority of the farmers (75 per cent) were maintaining more than 5 goats in Rajasthan. A relatively larger flock size of goats reflects its greater relevance in Rajasthan. In the incremental stock, male goats were sold mostly for meat purpose to traders/butchers and female kids were raised to prepare breeding goats. Further the old and unproductive female goats were also sold for meat purpose.

The optimum slaughtering age of kids reared under normal feeding conditions has been observed to be 7-10 months for maximisation of net returns (Singh, 2006) but more than 50 per cent of the farmers sold goat kids at an uneconomic age of 2-6 months. This was done mainly because of the risk of mortality, feed scarcity and lack of housing space and to fulfill the family's urgent cash needs. In fact, the farmers especially in Rajasthan wanted to sell the male kids soon after weaning (about 3 months of age, when kid stops suckling), because the kids retained after weaning did not gain proper weight due to insufficient feeding. In the absence of proper housing, the kids continued to suck milk even up to 6-7 months of their age that resulted into direct loss of milk and created more stress for breeding females which affected the conception of goats. Hence most of the farmers, particularly the large flock owners, wanted to get rid of the goat kids at the earliest possible opportunity except some farmers (22 per cent in Rajasthan and 26 per cent in Uttar Pradesh), who were rearing and selling males of above 1 year of age during the *Eid* festival. That fetched them 74

per cent higher price as compared to the price of males of similar age sold during normal season (other than Eid). The majority of goats in Uttar Pradesh were non-descript of the Barbari and Sirohi breed. In Uttar Pradesh, the farmers keeping 10 or more goats preferred non-descript goats to the recommended *Barbari* breed because it was a better browser/grazer, hardier and had a higher milk yield (Kumar *et al.*, 2005). Contrary to the case of the cow and buffalo, the milk yield of goats was observed to be higher in summer as compared to rainy and winter seasons.

Determinants of Flock Size

A regression analysis was carried out to look into the determinants of the flock size. The availability of family labour, income from other sources, size of land holding, farmers' education level, caste and male-female ratio in the family were the important factors, which influenced the flock size. The association between the magnitude of family labour and flock size is positive and highly significant indicating the high labour use in the existing goat production system particularly for grazing the goats (Table 5). The land holding size negatively influenced the flock size but only in Uttar Pradesh. It indicated that large land owners in Uttar Pradesh owned smaller goat flocks. However in Rajasthan, the land holding size did not have any relationship with the flock size. In Rajasthan, goat keepers having a higher income from other sources had smaller flocks. The education level of the farmers was also negatively associated with the flock-size. The negative regression coefficient for male-female ratio in the family indicated a greater role of women in goat rearing. The positive regression coefficient of dummy for caste indicates that a higher number of larger flocks were maintained by households belonging to the socially backward castes including scheduled and other backward castes. It demonstrates a greater role of goats in the livelihoods of backward rural groups. However the regression coefficient for caste was statistically not significant as majority of the goat keeping households (97 per cent in Uttar Pradesh and 93 per cent in Rajasthan) belonged to the socially backward castes.

TABLE 5. LINEAR ESTIMATES OF DETERMINANTS OF FLOCK SIZE

Variables (1)	Uttar Pradesh		Rajasthan	
	Regression coefficients (2)	't' value (3)	Regression coefficients (4)	't' value (5)
Land holding size	-1.28**	2.56	-0.035	0.69
Income from other sources	-0.124	1.54	-0.030***	4.34
Availability of family labour	1.913***	3.84	3.810***	4.682
Education level of farmer (No. of years of schooling)	-0.067	0.28	-0.136*	2.65
Male : female ratio in the family	-0.007	0.094	-0.015	0.123
Dummy for caste (socially backward caste= 1, otherwise = 0)	0.541	0.094	0.073	0.803
Constant	4.34		10.25	
Coefficient of determination (R ²)	0.14		0.18	

Significant at 1 per cent (<0.01 P), * Significant at 5 per cent (<0.05 P), * Significant at 10 per cent (<0.10).

Access and Control

Goat rearing was observed to be a major source of income for women. Women in very small category had control over returns from goat rearing in 73 and 44 per cent households in Uttar Pradesh and Rajasthan, respectively (Table 6). Women in these households were taking decisions with regard to production and marketing of goats. They were also responsible for grazing/feeding the goats. The role of women in goat rearing in large categories was relatively less. In fact, a number of women had started with only one goat received as a gift from relatives or purchased; and through increment in numbers, their current flock size was up to 10–15 goats even after regular sale of surplus animals. Many women especially from scheduled caste households started rearing 1-5 goats as a source of their supplementary income and milk for their children and they managed this activity independently. Many of these women could reduce their dependence on wages after taking up goat rearing (as self employment). Thus goat rearing as an income generating activity helped in the empowerment of rural women.

TABLE 6: ACCESS AND CONTROL OF GOAT FARMERS

State/ category (1)	Control over returns from goat			Decisions on rearing method and marketing		
	Men (2)	Women (3)	Both (4)	Men (5)	Women (6)	Both (7)
	Uttar Pradesh					
Very small flock	8	73	19	15	79	6
Small flock	71	20	9	62	21	17
Medium flock	95	--	5	82	12	6
Large flock	100	--	--	50	--	50
	Rajasthan					
Very small flock	41	44	15	25	30	45
Small flock	56	34	10	28	32	40
Medium flock	75	10	15	60	5	35
Large flock	95	0	5	80	5	15

Resource Use Structure and Flows

Housing

Majority of the goat keepers (82–88 per cent) in very small flock size, in both the states did not have any structure to house their goats. These goats were kept in the family's house. In large flock size categories in Uttar Pradesh, 40–56 per cent farmers had covered goat sheds inside their house. These sheds were congested without any provision for separate enclosure for kids. Such poor housing conditions many times appeared to have resulted in higher disease incidence and kids' mortality. The rest of the farmers either had open shed attached to the house or thatched separate shed. In Rajasthan, majority of the farmers did not have goat shed, only 32 to 36 per cent farmers had an open shed (only fencing) attached to the house. This might be due to

dry conditions with less rainfall in Rajasthan and also due to less security threats to animals of being stolen. The construction of goat shed in Rajasthan was done mostly from the material obtained from CPRs. The annual contribution of CPRs for goat shed was estimated at Rs. 231, Rs. 520, Rs. 834 and Rs. 945 in very-small, small, medium and large flock category, respectively.

Labour Utilisation

The labour used for grazing goats accounted for 82 to 94 per cent of the total labour use (Table 7). Maintaining a breeding goat required 5 to 16 man-days per year in small, medium and large flock categories. The labour use per goat in very small flocks was comparatively very high mainly because of the indivisible nature of labour used for grazing.² The labour use per animal decreased with the increase in flock size, which appeared to be due to the efficient use of labour in the large category. In case of very small flocks, young children and women who have little opportunity cost of labour generally take this responsibility. Though it is clear from the analysis that the labour is used more efficiently in larger flocks mainly due to economies of scale, but higher use of labour per goat in very small flocks is not because of the inefficient system of production per se. Further, the small flock-holders cannot be equated with large flock-holders as for the latter goat rearing is their main activity while for the former it is a subsidiary activity. The male members of the household owning very small flocks were mostly engaged in some employment other than goat rearing, and the women were keeping a few goats as a source of supplementary income. But they could not increase the flock size because of certain factors such as lack of space to keep more goats and lack of exclusive family labour for goat rearing. In Uttar Pradesh, the very small flocks even used small patches of bushy/grazing area surrounded by cultivated crops and this requires more labour for controlling the goats during grazing. In fact the number of such small flocks is increasing where rural women, besides undertaking their household activities, rear 1-5 goats; old members and children in the family also contribute their labour in rearing these goats. The contribution of women in total labour utilisation in Rajasthan was 54, 31, 13 and 13 per cent in very-small, small, medium and large flocks, respectively. Similarly, in Uttar Pradesh also, the contribution of female labour was relatively higher in small flocks. Children's role in goat rearing in Rajasthan was higher as compared to that in Uttar Pradesh. It might be due to the fact that proportionately a larger number of children in Uttar Pradesh was attending school. A higher share of male labour in larger flocks was because of the fact that grazing of these flocks was done only by male labour.

TABLE 7. LABOUR USE IN GOAT AND SHEEP ENTERPRISE

Particulars (1)	<i>(man-days)</i>							
	Uttar Pradesh				Rajasthan			
	Very small (2)	Small (3)	Medium (4)	Large (5)	Very small (6)	Small (7)	Medium (8)	Large (9)
Labour use in goat rearing	123.1	148.0	236.37	179.29	98.87	168.0	281.15	238.97
Labour use in sheep rearing	--	84.62	19.16	104.39	151.58	132.50	31.16	35.28
Labour use in grazing (per cent of total labour use)	85.25	85.54	83.52	82.40	94.50	91.74	89.32	85.16
Labour use per goat	50.66	13.35	11.43	4.98	28.49	15.67	12.46	5.24

Feeding Management

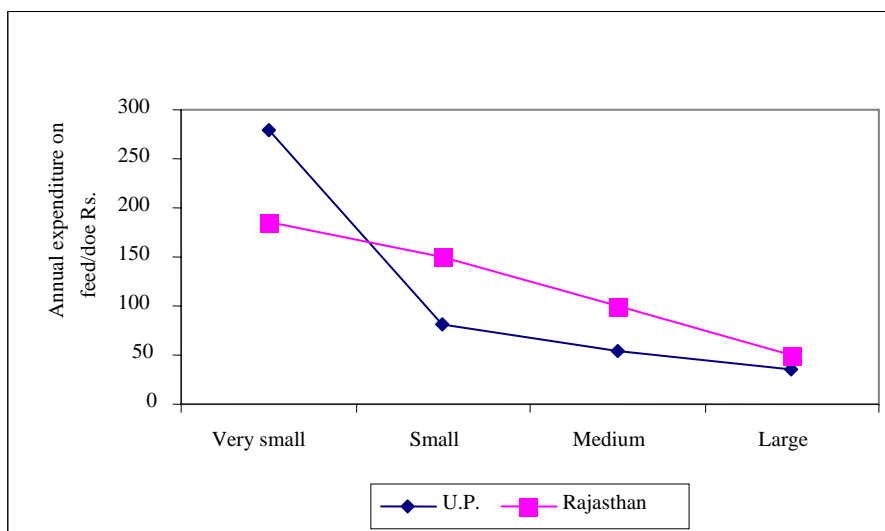
The goats were grazed for 3 to 6 hours per day in Uttar Pradesh and the duration of grazing was less during the main cropping season (November-February) due to lack of fallow land for grazing while in Rajasthan, goats were grazed for more than 7 hours daily throughout the year, across all categories. The goats in both the states were heavily dependent on CPRs for meeting their feed and fodder requirements. Common ponds in the villages were mostly used for providing water to the goats; this sometimes led to parasitic infestation. The large flock owners provided supplementary feeding only in winters and on rainy days. However in the small units of 1 to 5 goats, the supplementary feed including left over food of the households was given throughout the year. In Rajasthan, during winters, the goats were mainly fed on lopped tree leaves of *Khejri* (*Prosopis cineraria*), *Neem* (*Azadirachta indica*), *Ardu* (*Ailanthus exclusa*), *Babool* (*Acacia nilotica*), *Siras* (*Albizia procera*) and *Heens* (*Capparis horrida*). The dry fodder available was *Pala* (dry leaves of *Ziziphus nummularia*), groundnut hull, wheat straw, sorghum stover, moth-bean stalk etc. The other supplements given to the goats were grains of barley and pearl millet (Table 8).

TABLE 8: SUPPLEMENTARY FEEDING FOR GOAT

Particulars (1)	<i>(per annum)</i>							
	Uttar Pradesh				Rajasthan			
	Very small (2)	Small (3)	Medium (4)	Large (5)	Very small (6)	Small (7)	Medium (8)	Large (9)
Concentrates (kg.)	96	91	133	--	39	56	103	83
Dry fodder (kg.)	275	474	579	1000	29	109	45	132
Lopped tree leaves (kg.)	136	53	68	--	694	1728	2331	1710
Mustard oil, turmeric (Rs.)	1	18	19	--	78	275	426	307
Total expenditure on feed (Rs.)	668	829	1135	1000	647	1572	2153	1733
Annual exp. on feed/doe (Rs.)	275	75	55	28	186	147	95	38

The mustard oil in the summer season and turmeric powder in the winter season were also commonly given to goats in Rajasthan. The annual expenditure on supplementary feed per doe was negatively associated with the flock-size (Figure 1).

It was due to the fact that the large-flock owners intentionally provided a comparatively less supplementary feed to their goats and had a higher dependence on CPRs for which they did not need to pay. The relationship between flock size and feed expenditure as depicted in Figure 1 indicates a decrease in feed cost with an increase in flock size. It also shows that a decrease in expenditure on feed across flock categories was greater in Uttar Pradesh as compared to Rajasthan. Even the large flock owners in Rajasthan had to considerably depend on purchased feed mainly lopped leaves (by paying Rs. 100 to 300 per tree) and dry fodder during winters.



Figures 1. Relationship Between Flock Size and Feed Expenditure

The practice of migration of goat and sheep in search of feeding resources to fulfill their nutritional requirement was prevalent in large flocks in Rajasthan. Fifty nine per cent farmers in this category followed the migratory practice, while in other categories only 2 to 9 per cent farmers resorted to migration. The goats from the Tonk district migrated to hillocks of Bundi district of Rajasthan (150 km) during July to October for grazing, whereas goats from Ajmer migrated to Western Uttar Pradesh and Madhya Pradesh (up to 500 km) during March to July (summers). During migration, farmers sold their surplus and weak adult animals and kids to minimise the transit losses. The large magnitude of sale of goats by migratory farmers suppressed the price of live goats in the area visited by them. Poor access to veterinary aid/vaccines/drugs was a major constraint during migration. Availability of telephones/mobile has made communication of these goat keepers with their families easier but their lives were very tough during migration.

The area under common lands has been declining over time due to forces of privatisation and allotment of these lands to non-designated and non-community purposes by the government (Pasha, 1991). By farmers' perception, the area under CPRs during the last two decades (1980-2000) has been depleted by about 65 per cent in Uttar Pradesh and about 50 per cent in Rajasthan and so also their quality. Farmers also mentioned conflict in use of CPRs mainly because of the unfair dealings by the Gram Panchayat (local elected body) and the resource rich rural people. In Uttar Pradesh, the conflicts were mainly because of the unintentional damage to the other farmers' crops by goats. Interestingly 11 to 29 per cent goat farmers in Rajasthan were willing to pay for the use of CPRs. This could be converted into an opportunity to develop the dwindling CPRs, whose sustainability is crucial for millions of resource poor livestock keepers.

Flock Management

The scientific management of goat flock is essential not only to exploit the genetic potential of the animals but also for taking care of the animals and use the resources in an optimal manner. Most farmers owning large flocks maintained their own breeding buck for natural breeding. The ratio of breeding male:female in Uttar Pradesh was 1:11 to 1:18, which was quite close to the recommended male female ratio of 1:15 to 1:20. However, in Rajasthan the male: female ratio in large flocks was as high as 1:35. Small goat-flock owners hardly had any breeding buck and were dependent on hired buck. These small flocks did not have a choice to select a superior buck. As most of the farmers could not realise the importance of keeping pure breed animals and did not own pure bred buck, and neither such bucks were available on hire basis and hence used available bucks of any breed. Moreover it was not economic for small flock owners (1-5 goats) to maintain a breeding buck as the market for hiring breeding bucks was not yet developed. As a result there has been a continuous dilution of goat breeds. It is a well known fact that dilution of goat breeds would adversely affect the productivity and sustainability of the goat production system. Lack of access to buck also resulted in a lower conception rate in some flocks and hence production of less number of kids per goat per year. It may be mentioned that majority of the medium and large flock owners in Rajasthan maintained a breeding buck of the same breed (Sirohi) which helped in maintaining purity of the breed. The kidding rate was higher in Uttar Pradesh possibly due to the difference in breed and access to feed. Moreover many farmers (41 per cent) in Rajasthan did not allow their goats to conceive at least for six months from the time of kidding in order to maintain proper health of goats under feed scarcity situation and have longer lactation period to produce more milk.

Very few farmers used prophylaxis to prevent diseases in goats. In Uttar Pradesh, only 3 per cent of the farmers in the small flock category used a vaccine against Enterotoxaemia (ET) and 5 to 8 per cent drenched their goats. In Rajasthan, the

situation was a little better, where 3 to 6 per cent farmers used vaccines of ET and Hemorrhagic septicemia (HS) in very-small and small category, and 9 to 32 per cent farmers protected their animals against internal parasites. The total cost of implementing annual prophylaxis schedule has been estimated to be merely Rs. 25 to Rs. 35 per goat. But no farmer was using vaccine even against the deadly disease peste des petits ruminants (PPR) and against foot and mouth disease (FMD).

Resource Flows

Besides goat rearing, the other components of the farming system were cow and buffalo rearing, crop farming, agricultural wages, trade and services. Household's cash needs were met out of the income from goats, milk, manure, crop produce, wages and other sources. Family labour and feed resources from CPRs were observed to be the critical inputs used in the goat production system. The supplementary feed was another major input, which cost Rs. 38 to Rs. 186 per doe per annum in different flock categories in Rajasthan and Rs. 28 to Rs. 275 in Uttar Pradesh. More than half of the expenditure on purchased feed in Rajasthan was incurred on acquiring tree leaves. The landowners sourced the supplementary feed mostly from their own farm.

Goat rearing was the major source of income. The expenditure on food, education, festivities and inputs for crops was mainly met from income from the goats. The large flock owners were selling milk to the vendors but for small flock owners, it was used for family consumption for kids and elders and for preparing tea. Besides feed resources and wood for the goat shed, the CPRs in Rajasthan also contributed towards fuel wood. The main sources of information for the goat keepers were their neighbouring farmers, middlemen, livestock traders, quacks, and veterinarians and livestock supervisors. The most inputs were available from within the village system.

Majority of the traditional goat farmers (54 per cent) in both the states very strongly favoured own extensive system of rearing wherein goats are completely dependent on common property or open access resources for grazing or browsing. However, the continuous use of common grazing/feed resources in the absence of efforts for their re-generation has resulted in their serious degradation. At the same time, the rising incomes, urbanisation, globalisation of trade and shift in consumers' preference towards high value food (Birthal and Joshi, 2006) have been creating increased demand for goat meat. The increased demand for goat meat has resulted in a three-fold increase in its price over the past one decade. The favourable market conditions would provide a boost to the fast increasing goat population which is already more than 125 million. But, with the continuous shrinkage of community grazing lands, it may not be possible to sustain fast growing population of goats under an extensive system of management. The farmers will have no option but to switch over to semi-intensive and intensive systems not only to maintain but also to improve the productivity of animals.

Cost and Returns and Role in Livelihood Security

In both the states, the total cost per doe per annum was negatively associated with the flock size. This was mainly attributed to a higher expenditure on supplementary feed in smaller flock sizes and efficient utilisation of labour in large ones. The imputed value of family labour was found to be the major component of the total expenditure, which accounted for 51 to 79 per cent of the total cost across different flocks, whereas the feed cost accounted only for 7-11 per cent of the total cost. It may be mentioned that family labour was not used efficiently as many times one full labour was engaged for grazing of a few goats (2-5 Nos.) who may otherwise manage 30-40 goats. It shows that the actual cost of rearing a goat (excluding imputed value of family labour) was very little. This ranged from Rs. 225 to Rs. 616 per annum in Uttar Pradesh and Rs. 276 to Rs. 395 per annum in Rajasthan (Table 9). Though some more expenditure was essentially required to be made on supplementary feeding and prophylaxis to attain higher productivity, but the farmers did not do so mainly because of lack of resources and awareness. Per goat expenditure was even less than one rupee per day on supplementary feeding and less than a rupee per month on prophylaxis.

TABLE 9: COSTS INVOLVED IN GOAT REARING

Particulars	<i>(Rs./annum)</i>							
	Uttar Pradesh				Rajasthan			
	Very small	Small	Medium	Large	Very small	Small	Medium	Large
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<u>Fixed cost:</u>								
Depreciation and interest	505	2449	4198	6941	772	2670	4953	8577
Value of breeding goats died	114	917	1021	--	153	83	434	2136
Total fixed cost (TFC)	619	3420	5219	6941	925	2753	5387	10713
<u>Variable cost</u>								
Feed	668	829	1135	1000	379	1081	2112	1667
Imputed value of family labour	4924	5920	9455	7172	3955	6720	11246	9559
Grazer's charges	92	--	--	--	9	17	--	--
Fee for use of CPRs	--	--	--	--	48	107	196	105
Miscellaneous expenditure: vet. drugs, buck-hiring, repair	119	185	147	172	11	41	46	116
Total variable cost (TVC)	5801	6934	10737	8344	4402	7966	13600	11447
Total cost (TFC+TVC)	6420	10354	15956	15285	5327	10719	18987	22160
Total cost per doe	2642	934	772	425	1535	1000	842	486
Actual cost per doe (Total cost – imputed value of family labour)	616	400	314	225	395	373	343	276
Feed cost as per cent of TVC	11.52	11.96	10.57	11.98	8.61	13.57	15.53	14.56
Feed cost as per cent of total cost	10.40	8.00	7.11	6.54	7.11	10.08	11.13	7.52

The existence of economies of scale was also analysed by fitting a linear regression function (Table 10). The decrease in average cost per doe with the increase in flock size as demonstrated from the cost analysis clearly showed the existence of economies of scale. The regression analysis also demonstrated existence of economies of scale in Rajasthan. But the coefficient of flock size in case of Uttar Pradesh was positive and did not show economies of scale. The influence of average grazing hours per day on average cost was found to be significantly negative. That also supports the fact that large flock owners spent less on the supplementary feeding of goats and depended more on free grazing/browsing in CPRs/private fallow lands. The scale economies as appeared in the cost and regression analysis thus were mainly due to greater dependence of larger flocks on free CPRs for their feeding.

TABLE 10. RELATIONSHIP BETWEEN AVERAGE COST AND FLOCK SIZE
(DEPENDENT VARIABLE: AVERAGE ANNUAL COST OF REARING A GOAT)

Explanatory variables (1)	Uttar Pradesh		Rajasthan	
	Regression coefficients (2)	't' value (3)	Regression coefficients (4)	't' value (5)
Flock size	2.19*	1.788	-2.10**	2.371
Average grazing hours per day	-70.70***	3.972	-41.31***	3.109
Constant	807.07		34.92	
Coefficient of determination (R ²)	0.11		0.15	

***Significant at 1 per cent (<0.001 P), ** Significant at 5 per cent (<0.05 P), * Significant at 10 per cent (<0.10).

The direct benefits from goat rearing were the sale of live goats, milk and manure and increment in flock inventory. The average milk yield per goat per annum was higher in Uttar Pradesh as compared to Rajasthan. It may be due to better access to feed resources in Uttar Pradesh. In Uttar Pradesh, the non-descript goats were higher milk yielders as compared to Barbari breed, which had higher prolificacy. The value of the incremental stock constituted the largest share of gross returns from goat rearing followed by value of milk and manure. Even in case of very small flocks, the value of incremental stock formed the largest share of gross returns. The family of goat keeper earned a net annual income of Rs. 1298 to Rs. 1705 per doe in different categories in Uttar Pradesh and Rs. 1216 to Rs. 1819 per doe in Rajasthan (Table 11). Income per man-day generated from goat rearing for small, medium and large flocks was much higher as compared to the prevalent average daily wage of an unskilled worker in agriculture. The goat rearing contributed a major share to the total income and provided livelihood security to the family of resource-poor people in both the states (Table 12). Its share in the household income ranged from 49 to 85 per cent except in the very small flock. The other major sources of income of goat farmers were agricultural wages, crops and other livestock. The family's annual net income from goats was up to Rs. 55,450. The income from goat rearing was used mainly for arranging food for the family and paying medical expenditure and books and school fees of the children of the goat keeping households. The other uses of goat income were house construction, purchase of agricultural inputs and social ceremonies, etc.

TABLE 11. FAMILY'S INCOME FROM GOAT REARING

Particulars (1)	<i>(Rs./annum)</i>							
	Uttar Pradesh				Rajasthan			
	Very small (2)	Small (3)	Medium (4)	Large (5)	Very small (6)	Small (7)	Medium (8)	Large (9)
Milk (kg)	323.9	1057.7	2037.9	3420	329.8	1005.6	2110.1	3314.7
Value incremental stock (sold/maintained)	3104	12324	17390	29000	3400	15568	26381	42727
Value of milk	2268	7404	14265	23940	2507	7039	15826	21860
Value of manure	229	896	1616	4000	276	870	1941	3464
Rent of buck	37	122	66	300	--	24	--	--
Gross returns	5638	20746	33337	57240	6183	23501	44148	68051
Net returns	-782	10392	17381	41955	856	12782	25161	45891
Family labour income	4142	16312	26836	49127	4813	19502	36407	55450
Family/labour income (per doe per annum)	1705	1471	1298	1355	1387	1819	1614	1216
Family/labour income (per cow/buffalo per annum)	1094	2196	2719	--	1047	1749	2225	3300
Goats' income per man- day	34	110	114	274	49	116	129	232

TABLE 12. SOURCES OF GOAT-KEEPERS' FAMILY INCOME AND RELATIVE SHARE OF GOATS

Particulars (1)	<i>(Rs. annum)</i>							
	Uttar Pradesh				Rajasthan			
	Very small (2)	Small (3)	Medium (4)	Large (5)	Very small (6)	Small (7)	Medium (8)	Large (9)
Goat	4142	16312	26836	49127	4813	19502	36407	55450
Agricultural wages	3153	2500	421	--	7724	8487	5406	2500
Non-farm wages	2458	--	3947	--	6765	2170	--	--
Rural trade, etc.	2930	1618	--	--	--	--	--	--
Crop	2950	2276	4123	--	9879	3578	5015	3167
Cattle/ buffalo	569	2196	843	--	764	1242	1602	759
Sheep	--	3077	1095	11500	2057	5087	927	3513
Family's total income	16202	27979	37271	60627	32002	40066	49357	65389
Share of goats in total income (per cent)	25.56	58.30	72.00	81.03	15.04	48.67	73.76	84.80

Moreover the family had access to goat milk for about 190 days in Uttar Pradesh and 250 days in Rajasthan in a year. The goats provided a ready liquidity to the farmers. However the returns from goat rearing fluctuated and reduced drastically in bad years. It happened mainly because of large-scale mortality of goats due to diseases and scarcity of fodder during droughts.

Over the past one and half decades the number of large flocks (with more than 20 goats) in the selected villages has declined by 35 per cent in Uttar Pradesh and by 20 per cent in Rajasthan. Due to feed scarcity it was becoming difficult to maintain non-migratory large goat flocks on CPRs in Rajasthan in summers and in Uttar Pradesh in winters. Hence these farmers have reduced the size of their goat flock and some of the large flock owners in Uttar Pradesh have replaced goats with sheep, which can be managed easily while grazing on a limited piece of land. However, proportionately

more number of households in the village have started rearing small units of goats with the provision of supplementary feeding. Due to feed scarcity in Rajasthan farmers sell majority of the male kids at an uneconomic age of 2-4 months. Now a market for these young kids has emerged (Kumar, 2007 a, b), wherein 2-3 months age kids of 'sirohi' goat from Rajasthan are sold to resource poor rural families in Uttar Pradesh, Bihar and West Bengal and they raise them under semi-intensive or/and intensive system for festive sale. There is need to encourage and institutionalise such linkages between fodder scarce and surplus regions for sustainable development of goat production.

Constraints to Goat Production

Constraints to goat production were assessed in terms of the farmers' perception based on the ranking given to a particular constraint by each farmer. Ranking of the constraints as perceived by the goat farmers and analysed based on the rank based quotient (RBQ) of each constraint has been given in Table 13. Realisation of a lower price for the animal sold which was mainly due to the involvement of the chain of middlemen, lack of market information and poor holding capacity, was perceived by farmers as the biggest constraint to goat rearing in Uttar Pradesh followed by losses due to diseases and parasites and scarcity of fodder. In Rajasthan, the scarcity of fodder was perceived to be the most important constraint to goat rearing followed by losses due to diseases and parasites in goats and a realisation of the low prices of the animals. The other important constraints were lack of knowledge of improved flock management practices and good quality breeding bucks, lower price of goat milk and repeat breeding in goats. There was almost no demand for goat milk in Uttar Pradesh whereas it had some local demand in the villages itself in Rajasthan. Lack of the breeding buck was a constraint mainly in Uttar Pradesh, where a majority of the flocks were very small and did not maintain breeding males that had resulted into production of poor quality and less number of off-springs per unit time. Maintaining a breeding male was economically not viable for the smaller flock as the market for providing the services of buck on rent has not yet developed properly. In fact, the best male kids attracted a higher price and were sold to the butcher at an early age of 1-6 months. Hence the farmers used leftover poor quality bucks for breeding.

Besides the analysis of the farmers' perception of the constraints in goat rearing, losses due to different diseases and parasites were actually estimated in terms of morbidity and mortality in goats based on the information provided by the farmers on a recall basis for the past one year period. The losses due to diseases were higher in Uttar Pradesh than in Rajasthan. The difference in disease incidence between the two states may be due to variations in the level of adoption of prophylactic measures, climatic conditions and susceptibility to the diseases of Sirohi and Barbari goat breeds. The losses due to diseases in the goats per household were estimated as Rs.242, Rs. 2323, Rs. 3611 and Rs. 2675 in Uttar Pradesh and Rs. 244, Rs. 257,

Rs.771 and Rs. 3200 in Rajasthan in very-small, small, medium and large flock-size categories, respectively. These losses could be minimized through recommended prophylaxis.

TABLE 13. RANK BASED QUOTIENTS OF CONSTRAINTS PERCEIVED BY GOAT FARMERS

Constraints (1)	Frequency distribution of ranking of constraints							RBQ (9)	Rank of constraints (10)
	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)	6 (7)	7 (8)		
Uttar Pradesh									
Lower price of animals	77	54	5	-	-	-	-	90.61	I
Diseased and parasites	54	69	11	3	-	-	-	87.65	II
Scarcity of fodder	8	8	81	35	6	-	-	68.06	III
Lower price of milk	-	5	38	89	4	-	2	60.20	IV
Lack of breeding buck	-	-	-	5	52	7	21	21.53	V
Lack of knowledge of flock management	-	-	-	-	54	6	8	18.57	VI
Repeat breeding	-	-	-	-	-	53	11	11.94	VII
Rajasthan									
Scarcity of fodder	119	21	-	-	-	-	-	97.86	I
Disease and parasites	21	108	8	2	-	-	-	86.02	II
Lower price of animals	-	-	123	9	5	3	-	68.57	III
Lack of knowledge of flock management	-	-	-	78	18	7	-	38.78	IV
Lower price for milk	-	-	-	-	7	8	5	4.29	V
Lack of breeding buck	-	-	-	-	-	5	11	2.14	VI
Repeat breeding	-	-	-	-	-	6	7	1.94	VII

A very low adoption of improved technologies was another major constraint resulting in low productivity of goats. Though goat-research has generated a number of useful technologies (Kumar and Pant, 2003), but there were constraints in their dissemination and adoption. Due to lack of awareness and innovativeness, majority of the goat keepers did not seek an improved package of practices and had aimed at low input and low output system. On the one hand, institutions imparting practical training on goat-rearing are very few and on the other, the traditional goat keepers were not keen to attend training programmes. Inadequacy of veterinary facilities was a major constraint in the adoption of health related technologies. The limited available veterinarians were largely involved in the curative care of large animals.

Moreover, many of the technologies were suitable for large commercial farms but not for small traditional units. The small and large/commercial farmers should be provided with separate technological options suiting their respective needs and resources. Non-availability of recommended inputs like vaccines, fodder seeds, area specific mineral mixture and cost effective complete feeds was one of the most critical constraints in the adoption of improved technologies. Poor access to credit from institutional sources was a constraint in the promotion of goat farming. The bankers need to be educated about the economic potential of goat farming. The poor goat farmers hardly have any asset for collateral security except their goats.

IV

CONCLUSIONS

The study has enriched our understanding on the socio-economics of goat production in the semi-arid parts of Uttar Pradesh and Rajasthan and demonstrated that goat rearing in an economically viable rural enterprise. Goats were found to play an important role in the livelihood security of the rural resource poor people. It was found to be a useful income generating option for the rural poor and equally promising in both the regions. However, there were constraints such as seasonally related low levels of nutrition, mortality and morbidity losses, lack of good quality breeding stock and poor flock management, and poor marketing opportunities that needs to be overcome. For improving fodder availability for the small ruminants, besides the development of CPRs by involving panchayats and user groups, there is a need to institutionalise linkages between the goat farmers in fodder scarce regions and areas with better fodder availability. Appropriate extension programmes, prophylaxis of animals, timely availability of critical inputs, remunerative price for goats and its products and easy access to institutional finance would be crucial for the sustainable development of goat enterprise in the country. Providing the farmers with timely access to information on improved technologies, inputs, market and credit would be an important step in overcoming different constraints in goat production. The lack of good quality breeding stock being a major constraint, the private/co-operative goat farms managed on scientific lines should be encouraged to become a centre of production for superior quality breeding animals. Encouraging the sale of goats on body weight basis by providing weighing machines at the village level may help farmers in realising a better price for their goats. In the coming years, goat rearing under the intensive and semi-intensive system would gain prominence. Goat rearing under the traditional extensive system would shrink because of continuous shrinkage in common grazing resources. However the demand for goat meat, which is leaner and has low cholesterol, is expected to rise at a faster pace in the domestic as well as international markets. The market demand, price, technology and resource availability would thus decide the direction and shape of the goat industry in the country. There would be three distinct goat production systems, viz., large-scale commercial farms, smaller units under semi-intensive and intensive system, and small to medium sized flocks under the extensive system raised on CPRs. Each goat production system would require a different type of technological, policy and institutional support.

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NOTES

1. The following cost and income concepts were used for computation for goat, sheep, cow, buffalo rearing and crop farming:

For goat and sheep rearing:

Fixed cost = depreciation and interest on fixed assets including breeding stock + value of breeding goats died

Variable cost = feed cost + grazer's charges + imputed value of family labour + fee for use of CPRs + veterinary expenditure + buck-hiring + annual repair + rope etc.

Total cost = fixed cost + variable cost

Gross returns = value of milk produced + value of incremental stock (sold/maintained) + value of manure + rent received from buck hiring

Net income = gross returns – total cost

Family labour income = gross returns – total cost excluding imputed value of family labour

For cow and buffalo rearing

Fixed cost = depreciation and interest on fixed assets

Variable cost = feed cost + grazer's charges + imputed value of family labour + fee for use of CPRs + veterinary expenditure + buck-hiring + annual repair + rope etc.

Total cost = fixed cost + variable cost

Gross returns = value of milk produced + incremental value of young stock+ value of manure

Net income = gross returns – total cost

Family labour income = gross returns – total cost excluding imputed value of family labour

For crop cultivation (wheat, bajra, moong, mustard, barley, pigeon, pea, potato, cluster bean)

Fixed cost = depreciation and interest on fixed assets+ tax on land

Variable cost =expenditure on inputs like seed, fertiliser, manure, pesticide, weedicide, diesel + hiring charges of tractor, thresher and sprayer and irrigation + imputed value of family labour+ charges of hired labour + annual repair etc.

Total cost = fixed cost + variable cost

Gross returns = value of main produce (grains) + value of by-product (straw/stover)

Net income = gross returns – total cost

Family labour income = gross returns – total cost excluding imputed value of family labour

2. One labour which can manage 30-40 goats during grazing was many-times handling only 2-5 goats in very small flocks. Only some farmers in very small category had got the opportunity to give their goats to a grazer for grazing them by paying monthly charges.

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