



Role of goats in livelihood of rural poor in Uttarakhand hills: An analysis with special reference to multivariate typology of households based on farm and socio-economic characteristics

POORNIMA SONE¹, D BARDHAN² and AVADHESH KUMAR³

Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand 246 135 India

Received: 7 August 2014; Accepted: 24 March 2015

ABSTRACT

The present study was conducted on a sample of 100 goat farmers randomly drawn from 2 administrative blocks in Almora, Uttarakhand to analyze the role of goats in the livelihoods of rural households. Farm household typologies were constructed by using 2 multivariate statistical techniques, viz. principal component analysis (PCA) and cluster analysis (CA). PCA was used to transform linearly an original set of 17 variables, representing farm and socioeconomic characteristics, into a smaller set of uncorrelated variables (factors) that represents most of the information in the original set. The factors retained from the PCA were used for cluster analysis. Five homogenous groups (clusters) were obtained. Cluster 1 (20%) was identified as households with high farm family labour involvement and low female labour involvement in goat husbandry, Cluster 2 (21%) as households with high income from agriculture and dairying, Cluster 3 (18%) as households with low income from agriculture and dairying, Cluster 4 (22%) as households with high farm family labour involvement and high female labour involvement in goat husbandry and Cluster 5 (19%) as female headed households. Contribution of income from goat in animal husbandry income, farm income and household's total income for all clusters combined was 61.45, 14.23 and 7.01%, respectively. Share of income from goat was highest for cluster 3, implying that small ruminants like goats are most important for livelihood security of resource poor farmers. Hence, any improvement in goat production enhances the socio-economic status of the farmers, specially the rural poor.

Key words: Cluster analysis, Livelihood security, Principal component analysis, Small ruminants

The importance of goats for the farming community, especially the rural poor, on account of requirement of low initial capital investment and operational cost, easy liquidization of cash in times of need and adaptability to smallholder farming systems has been well documented (Berhanu *et al.* 2012). However, scant research attention has been given in the Indian context to analyze comprehensively the role of goats in livelihood of rural community, especially in the hilly regions. It is well recognized that role of goats in livelihood of rural households may vary across different production systems categorised on the basis of relevant socio-economic and farm characteristics. In order to take into account the heterogeneity that exists between different households in

rural areas, it is necessary to cluster the farm households into specific groups based upon similarities in farm and socioeconomic characteristics for comparative evaluation of constraints and opportunities pertaining to goat farming across different such groups which would help in more effective policy intervention.

The present study was carried out to assess the role of goats in livelihood security of various systems so as to identify the factors influencing the underlying variations in relative importance of goats in livelihood of rural people.

MATERIALS AND METHODS

Sampling

The study was carried out in Uttarakhand. Goats are the second most populous species in the state, accounting for about 30% of total livestock population, universally held by all categories of land holders, across all regions. The study was confined in Kumaon division of state due to greater livestock density and economic dependence on livestock in the division (Bardhan *et al.* 2010). Almora district from Kumaon region was chosen purposively for this study on account of highest goat population in the state (GOI 2012). From the district, 2 blocks having highest

Present address: ¹Veterinary Assistant Surgeon (poornima.sone@gmail.com), Government Poultry Farm, Chattisgarh; ²Senior Scientist and corresponding author (dwaipayanbardhan@gmail.com), Division of Livestock Economics, Statistics and Information Technology, Indian Veterinary Research Institute, Izatnagar–243 122, Uttar Pradesh, and ³Professor (aksvox@gmail.com), Department of Veterinary and Animal Husbandry Extension Education, College of Veterinary and Animal Husbandry Extension Education.

population of goats were chosen, viz. Hawalbagh and Lamgarha. In the next stage, 2 villages were selected from each block. From each selected village, 25 households rearing goats were selected randomly for the study. Thus, the ultimate sampling units comprised of 100 goat rearing households.

Data

The data were collected through personal interview method with the help of a well-structured, comprehensive and pre-tested interview schedule. The respondents comprised of the heads of the sample households surveyed. Data were collected on parameters like demographic particulars of households, farm and livestock inventories, technical characteristics of goat enterprise, labour utilization, etc.

Analytical framework

Multivariate typology of goat keeping households: A farm typology study was used to classify groups of farm households with similar farm and socio-economic characteristics. The methodology, comprising 2 multivariate statistical techniques, viz. principal component analysis (PCA) and cluster analysis (CA), described by Bidogeza *et al.* (2007) and Garcia *et al.* (2012) were used in the study. Table 1 presents the variables considered in PCA. The factors retained from the PCA were used for CA. A hierarchical CA using Ward's method and Euclidean distance was carried out to classify the farms households.

Assessing purpose of goat keeping: The households in the study area raised goats for multiple purposes. Based upon initial focussed group discussion, these purposes were categorized into seven groups: (1) milk, (2) meat, (3) Source of income during emergency, (4) Selling of animal in a particular season, (5) Self consumption, (6) Religious and (7) mitigation of income fluctuation. Likert's scale, using a three-point continuum (viz. not agree, 0; sometimes agree, 1; and agree, 2) was used to obtain a quantitative estimate of relative importance of specific purposes for which goats were reared by households. One way ANOVA was then used to test for significant differences between the identified clusters for each specific purpose.

Analysing marketing and consumption pattern of goats

Marketing and consumption pattern of goats among the sample households was assessed by classifying the number of goats reared, sold and consumed on age basis, viz. kids, young and adult goats. To find out the significant difference between the identified clusters on marketing and consumption of goats, z-test was used for the proportions of goat marketed and ANOVA was used for comparison of the mean number of goats marketed.

RESULTS AND DISCUSSION

The main aim of multivariate typology study, as carried out in this study, was to classify groups of farm households with similar farm and socio-economic characteristics. It is

Table 1. Variables considered in principal component analysis

Variables	Mean	SE
Age of household head (years)	43.52	0.53
Education of household head*	3.97	0.09
Gender of household head (male, 0; female, 1)	0.08	0.027
Farm income per annum (₹)	99, 885	2, 693.11
Non-farm income per annum (₹)	1, 03, 456	3, 650.76
Income from goat husbandry per annum (₹)	13, 665	392.84
Share of animal husbandry in total farm income (%)	27.95	-
Share of income from goat in total farm income (%)	14.23	-
Share of income from goats in total animal husbandry income (%)	61.45	-
Family type (joint, 1; nuclear, 0)	0.49	0.05
No. of members (male and female) per family involved in farm activities	2	0.057
No. of female members per family involved in farm activities	3.17	0.13
No. of female members per family involved in goat farming	1.22	0.04
Share of female working hours in total labour hours devoted to goat rearing (%)	68.73	-
Bovine herd size (SMAU)	1.37	0.09
Goat flock size (No.'s)	11.37	0.32
Land holding (acres)	9	0.05

*Illiterate, 0; read and write, 1; primary, 2; middle, 3; high school, 4; intermediate, 5; graduation, 6.

expected that different types of farm households obtained from typology development will yield specific information needed to understand diversity of farms and how such diversity influence the role of goats in rural livelihoods. In the first step, to examine the relationships between original variables, Principal Component Analysis (PCA) was applied to the original set of 17 variables. Bartlett test was performed in order to check whether the data set of 100 sample households and 17 variables could be factored or not. The results of the test showed that Bartlett's sphericity was highly significant ($P < 0.01$). This means the use of PCA towards dimension reduction in this case is justified.

A total of 7 principal components (factors) emerged with eigen values greater than 1. These 7 factors explained 72% of total original variability. Based on the loadings of the original variables on each of the identified factors, Factor 1 was identified as 'agricultural and dairy income', Factor 2 as 'farm family labour employment', Factor 3 as 'income from goat', Factor 4 as 'landholding size', Factor 5 as 'female member involvement in goat rearing', Factor 6 as 'gender and educational profile of household head' and Factor 7 as 'age of household head'.

In the next step, in the typology study, Cluster analysis (CA) was carried out with the seven factors as identified through the PCA exercise. Five distinct clusters emerged

Table 2. Distribution of sample households across different clusters

Clusters	Cluster name	Number of sample households	% of total no. of sample households
Cluster 1	Households with high farm family labour involvement and low female labour involvement in goat husbandry	20	20.00
Cluster 2	Households with high income from agriculture and dairying	21	21.00
Cluster 3	Households with low income from agriculture and dairying	18	18.00
Cluster 4	Households with high farm family labour involvement and high female labour involvement in goat husbandry	22	22.00
Cluster 5	Female headed households	19	19.00
	Total	100	100.00

from the analysis. In order to name each of the identified cluster, one-way ANOVA was conducted to determine on which classifying factors are significantly different between

the clusters. Significant differences were observed in the means of various clusters for all the factors, except Factor 2 and Factor 3, as denoted by the F-values and significance levels. This indicated that all the identified factors, except Factor 2 and Factor 3 reliably distinguished between the 5 clusters. With a significant ANOVA and 5 clusters, a Tukey *post-hoc* test was conducted to determine where exactly the differences lied.

The 5 clusters were named as: cluster 1 - households with low female labour involvement in goat husbandry, cluster 2 - households with high income from agriculture and dairying, cluster 3 - households with low income from agriculture and dairying, cluster 4 - households with high female labour involvement in goat husbandry and cluster 5 - female headed households. The distribution of sample households across the 5 identified clusters (Table 2).

Socio-economic profile of respondents belonging to different clusters: Table 3 elicits the socio-economic profile of respondents belonging to different clusters as identified in the typology study. The average age of household heads in cluster 5 was significantly higher than that of rest of the clusters. The proportion of male household heads in cluster 5 was significantly lower than that of rest of the clusters. Educational profile of household heads revealed that majority of the respondents was educated up to high school level, followed by middle school level. Disaggregated analysis across the clusters revealed that significantly higher proportion of respondents in cluster 5 had middle school

Table 3. Socio-economic characteristics

S.No.	Parameters	C1	C2	C3	C4	C5	Pooled
1	HH specific characteristics						
A	Age	42 ^a (0.60)	42.67 ^b (0.80)	41.06 ^c (0.71)	41.14 ^d (0.52)	51.16 ^{a, b, c, d} (1.44)	43.52(0.53)
B	Gender of HH head						
	Male (%)	100 ^a	100 ^b	100 ^c	100 ^d	57.89 ^{a, b, c, d}	93.00
	Female (%)	0 ^a	0 ^b	0 ^c	0 ^d	42.11 ^{a, b, c, d}	7.00
C	Education						
	Primary (%)	5	0	0	0	10.5	1
	Middle (%)	30 ^a	14.2 ^a	22.2 ^b	27.2	52.6 ^{a, b}	29
	High school (%)	40 ^a	57.1	77.7 ^{a, b}	50	36.8 ^b	54
	Intermediate (%)	10	9.5	0	9.0	0	4
	Graduate (%)	15	19 ^a	0 ^a	13.6	5.26	12
D	Caste						
	General (%)	60 ^a	90.5 ^{a, b}	66.66 ^b	50 ^b	42.11 ^{a, b}	60
	SC (%)	40 ^a	9.5 ^{a, b}	27.78 ^{a, b}	50 ^b	57.90 ^a	39
	OBC (%)	0	0	5.56	0	0	1
E	Family size	8.55 ^{a, d} (0.51)	4.76 ^{a, b} (0.21)	5.44 ^{d, c} (0.44)	9.5 ^{b, c} (0.25)	6.95 ^{a, c} (0.72)	7.08(0.27)
F	Family type						
	Nuclear (%)	30 ^{a, c}	95.24 ^a	88.9 ^c	0 ^{a, c}	47.3	51
	Joint (%)	70 ^{a, c}	4.7 ^a	11.1 ^{b, c}	100 ^{a, b, c}	52.6 ^{a, b, c}	49
2	Farm specific characteristics						
A	Operational land holdings (acres)	0.83(0.09)	0.73 ^{a, b} (0.08)	0.89(0.14)	1.05 ^a (0.1)	1.01 ^b (0.09)	0.90(0.047)
B	Herd size (SMAU)	0.77 ^a (0.80)	1.69 ^{a, b} (0.17)	0.78 ^b (0.13)	1.88 ^{a, b} (0.19)	1.70 ^{a, b} (0.26)	1.37(0.09)
C	Flock size	11.5(0.54)	10.75(0.69)	11.5(0.82)	11.5(0.52)	11.58(0.85)	11.37(0.32)

Figures having at least one similar superscript are significantly different up to 10% level of significance. Figures in parenthesis indicate the standard error.

level of education than respondents from cluster 1, cluster 2 and cluster 3. Significantly higher proportions of respondents from cluster 4 were educated up to high school level than their counterparts in cluster 1 and cluster 5. The proportion of respondents who were graduates was significantly higher in cluster 2 than cluster 3. There were no significant differences across different clusters in regard to proportion of respondents who were educated up to primary and intermediate level. The overall inference that can be drawn from the educational profile of respondents across different clusters is that cluster 5 had the lowest level of education, while cluster 2 had the highest level of education.

In case of distribution of sample respondents across different caste categories, it was observed that majority of respondents across all the clusters belonged to general category followed by Scheduled Caste (SC) category. Proportions of the respondents belonging to general category were significantly higher in cluster 2, cluster 3 and cluster 1 as compared to cluster 4 and cluster 5. Proportion of respondents belonging to SC category was significantly higher in cluster 5 and cluster 4 than that of cluster 1, cluster 2 and cluster 3. These findings are different from that of Singh *et al.* (2013) who had observed in a study carried out in 2 districts Hamirpur and Mahoba in Bundelkhand region of Uttar Pradesh that majority of goat keepers belong to the backward social community (54%), followed by scheduled caste (37%) and general category

(9%). Average family sizes of Cluster 1 and cluster 4 were significantly higher than that of clusters 2, 3 and 5. proportion of nuclear families was highest in cluster 2, followed by cluster 3. Proportions of nuclear families in these 2 clusters were significantly more than that of clusters 1 and 4. Proportions of joint families in cluster 4 and cluster 1 were significantly higher than that of other clusters. Proportion of joint families in cluster 5 was significantly higher than that of clusters 2 and 3.

Average size of land holding per household was significantly lower in cluster 2 as compared to clusters 4 and 5. Average herd size in terms of standard milch animal unit (SMAU) per household in case of cluster 4 was significantly higher than all other clusters. Herd sizes in cluster 5 and cluster 2 were significantly higher than those of cluster 1 and cluster 3. No significant differences were found in goat flock size across different clusters.

Income specific characteristics: The income specific characteristics of the sample goat rearing households are given in Table 4. Annual household income of the goat rearing households in cluster 3 was significantly lower than that of all other clusters. On the other hand, annual household income of cluster 4 was the highest, which was significantly different from that of all clusters, except cluster 1. Annual household income of cluster 2 and cluster 5 was significantly higher than that of cluster 3, although they were nonsignificantly different from that of cluster 1.

Average annual farm income of the goat farmers

Table 4. Income specific characteristics

Particulars	C1	C2	C3	C4	C5	pooled
Total HHI	210394a (11366.06)	203082.4b (10032.56)	164650a,b,c (8619.76)	231935.7b,c (7688.87)	199747.6c (11683.28)	167650 (4864.55)
FI	103954a (8037.80)	106449b (4640.92)	80705.56a,b,c,d (3111.22)	107898.2c (4898.97)	97238.42d (6568.04)	99885 (2693.11)
NFI	106440a (7035.49)	96633.33b (9071.22)	83944.44a,c (7170.11)	124037.5b,c,d (4654.51)	102509.2d (10187.23)	103456 (3650.76)
Income from agriculture	64550 (2777.23)	62238.09a (2192.96)	63444.44b (2691.34)	69522.73a,b (2501.62)	64473.68 (2447.54)	64945 (1135.74)
Income from dairy	13554a,b (3577.43)	24621.43a,c (1168.11)	0a,b,c	20360.45b (2396.50)	15823.42c (3774.99)	15367.05 (1408.16)
Income from goat	14400 (844.27)	12466.7a (908.67)	13616.67 (1052.92)	14609.09a (693.79)	13168.42 (909.99)	13665 (392.84)
Share of AH in HHI	13.57a (1.79)	18.69a,b,c (0.82)	8.59a,b,c (8.29)	14.91b (0.89)	14.69c (2.029)	14.19 (0.67)
Share of AH in FI	26.50a,c (2.80)	35.39b,c (1.29)	17.22a,b (1.41)	32.03a (1.62)	27.44b (2.75)	27.95 (1.09)
Share of goat in HHI	7.22a -0.63	6.29b -0.49	8.59a,b,c,d -8.29	6.41c -0.33	6.81d -0.45	7.01 -0.25
Goat share in FI	14.65a -0.95	11.80a,b -0.73	17.22a,b,c -1.41	14.10b -0.88	13.93c -0.81	14.23 -0.45
Goat share in AHI	67.41a -7.21	33.39a,b -1.87	100a,b 0	48.34a,b -5.48	63.12b -7.67	61.45 3.23

Figures inside the parenthesis showing the standard error. Figures having at least one similar superscript are significantly different up to 10% level of significance.

Table 5. Purpose of keeping of goats

S.No.(1)	Particulars(2)	Milk(3)	Meat(4)	Source of income during emergency(5)	Selling of animal in a particular season(6)	Self consumption (7)	Religious(8)	Mitigate income fluctuation(9)
1	C1							
	Not agree%	100	0	0	5	85	80	0
	Sometimes% agree	0	0	20	60	15	20	5
	Agree%	0	100	80	35	0	0	95
	Mean score	0	2	1.8	1.3	0.15	0.2 ^a	1.95
2	C2							
	Not agree%	100	0	0	0	100	90.5	0
	Sometimes agree%	0	0	19.05	47.62	0	9.5	19.05
	Agree%	0	100	80.95	52.38	0	0	80.95
	Mean score	0	2	1.82	1.52	0 ^a	0.095 ^{b,c}	1.81
3	C3							
	Not agree%	100	0	0	0	72.22	66.67	0
	Sometimes agree%	0	0	11.11	50	27.78	33.33	11.11
	Agree%	0	100	88.88	50	0	0	88.89
	Mean score	0	2	1.89	1.5	0.28	0.33 ^b	1.89
4	C4							
	Not agree%	100	0	0	0	59.1	45.45	0
	Sometimes agree%	0	0	31.82	50	36.4	54.55	9.1
	Agree%	0	100	68.18	50	4.545	0	90.9
	Mean Score	0	2	1.68	1.5	0.45 ^a	0.54 ^{a,c,d}	1.91
5	C5							
	Not agree%	100	0	0	0	73.68	68.42	0
	Sometimes agree%	0	0	21.05	68.42	26.32	31.58	15.79
	Agree%	0	100	78.95	31.58	0	0	84.21
	Mean score	0	2	1.79	1.32	0.26	0.32 ^d	1.84
6	Pooled							
	Not agree%	100	0	0	1	78	70	0
	Sometimes agree%	0	0	22	55	21	30	12
	Agree%	0	100	78	44	1	0	88
	Mean score	0	2	1.79	1.43	0.23	0.3	1.88

Mean score is computed as per the scores assigned to different responses, i.e. Not agree, 0; sometimes agree, 1; agree, 2. Figures having at least one similar superscript across rows in column 8 are significantly different up to 10% level of significance.

belonging to cluster 3 was significantly lower than that of all other clusters. Cluster 3 was identified as per the household typology study as households with low income from agriculture and dairying. Thus, it is obvious that the average farm income of households from this cluster was low. There were no significant differences in annual farm income across clusters 1, 2, 4 and 5.

Non-farm income of households in cluster 4 was significantly higher than that of clusters 2, 3 and 5. Non-farm income of cluster 1 was significantly higher than that of cluster 3.

Annual income from agriculture for households in cluster 4 was significantly higher than that of cluster 2 and cluster 3. Annual agricultural income for households in cluster 4 was also higher than that of clusters 1 and 5, although these differences were statistically nonsignificant.

Households belonging to cluster 3 had no income from dairying. Income from dairying was highest for cluster 2 amongst all clusters and it was significantly different from that of clusters 1 and 5. Cluster 2 was identified in the

typology study as households with high income from agriculture and dairying. Thus, the above finding regarding income from dairying corroborates the basis of categorisation of this cluster. Cluster 3 on the other hand was classified as households with low income from agriculture and dairying. This is validated by the above finding which revealed zero dependence of households belonging to this cluster on dairying.

Income from goat rearing was highest in cluster 4 and lowest for cluster 2. Annual income from goat rearing for the former cluster was significantly different from that of the later. Income from goat rearing for the clusters 1, 3 and 5 were not statistically different from the annual income from goat for cluster 4. The share of goats in total household income across all clusters was about 7%, which is lower than the findings of Chenyambuga *et al.* (2014) who reported contribution of 25–30% of goats in total household income in Babati and Kongwa districts of Tanzania.

Given the average flock size of 11.37/household, the average income per goat per household per annum thus

amounted to ₹ 1, 202. This finding is comparable to that of Kumar *et al.* (2006) who reported net annual income to be ₹ 1, 383 to ₹ 1, 788/goat in different flock sizes in Uttar Pradesh and ₹ 1, 302 to ₹ 1, 873/goat in Rajasthan in India.

Share of animal husbandry income in total household income in case of Ccluster 3 was significantly lower than that of all other clusters. On the other hand, share of animal husbandry income in total household income in cluster 2 was significantly higher than the other clusters. Share of animal husbandry income in total farm income was significantly lower in cluster 3 than that of the other clusters. The same figure was higher in case of cluster 2 which was significantly higher than that of clusters 1, 3 and 5. These findings validate the criterion for identification of these two clusters, viz. cluster 2 and cluster 3 as households with high and low income from agriculture and dairying, respectively.

Share of goat in household income for cluster 3 was significantly higher than that of other clusters. Cluster 3 was identified as households with low income from agriculture and dairying. As such, the greater contribution of goat in total household income for this cluster suggested that goat farmers belonging to cluster 3 were dependent more on goat farming for their livelihood. In present study, overall share of income from goat in total household income was 7.01% across all the clusters. This finding is in contrast to that of Kumar *et al.* (2006) who reported that goat alone contributed 49 to 86% of total household income in semi-arid parts of Uttar Pradesh and Rajasthan. Kumar and Upadhyay (2009) observed that share of goat in the household's total income was 35% to 37% and contribution to the total farm income was 41% to 43% in arid Rajasthan. Share of goat in farm income of cluster 3 was significantly higher than that of all other clusters. The same figure was lowest for cluster 2.

Goat rearing contributed cent% of total animal husbandry income in case of cluster 3, as households in this cluster had zero income from dairying. Contribution of goats to total animal husbandry income for cluster 1 and cluster 5 was significantly higher than that of cluster 2 and cluster 4.

Purpose of keeping goats: The respondents were asked

to mention the purpose of keeping goats on a 3 point continuum, viz. not agree, 0; sometimes agree, 1; and agree, 2. The results are presented in Table 5. All of the sample respondents reported that they did not keep goats for milk purpose. On the other hand, cent percent of the respondents observed that they keep goats for earning income by selling the meat. Mitigating income fluctuation was cited as the next major purpose of keeping goats followed by source of income during emergency and selling of animal in a particular season. Boogaard *et al.* (2012) in a study in Inhassoro District in Mozambique had also reported that the main motivation for keeping goats was to generate cash income for emergencies such as food shortage and health care. Consumption purposes and religious purposes were ranked by the respondents as relatively less important reasons for keeping goats. Disaggregated analysis across different clusters revealed significant differences only in case of consumption and religious purposes. Significantly greater proportion of respondents belonging to cluster 4 reported that they kept goats for consumption purpose than their counterparts belonging to cluster 2. Significantly greater proportion of respondents belonging to cluster 4 reported that they keep goats for religious purpose than their counterparts belonging to all the other clusters. Cluster 4 was identified as households with high female labour involvement in goat husbandry. The above finding thus provides some indication that households with greater female involvement in goat rearing are also the ones which keep their goats mainly for self consumption rather than for livelihood enhancement or stabilizing purpose.

Marketing and consumption pattern of goats: Marketing and consumption pattern of goats is given in Table 6. No significant difference in age-wise flock size was observed between the different clusters. The respondent households were observed to sell only adult goats. No kids were sold by the respondents of all the clusters.

On an average, households across all the clusters sold 89.26% of adult goats. Significant differences were observed in regard to proportion of adult goats marketed between different clusters. Proportion of adult goats

Table 6. Marketing and consumption pattern of goats

Particulars	C1	C2	C3	C4	C5	pooled
Stock (No.)						
Kids	3.86 (0.33)	3.57 (0.23)	3.95 (0.32)	3.82 (0.39)	3.8 (0.35)	3.91 (1.47)
Young	2.64 (0.31)	2.13 (0.39)	2.49 (0.38)	1.96(0.39)	2.88 (0.49)	2.38(0.17)
Adults	5 (0.2)	5.05 (0.27)	5.06 (0.32)	5.86 (0.25)	4.9 (0.39)	5.08 (0.13)
Goat flock size	11.5	10.75	11.5	11.64	11.58	11.37
Marketed (No.)						
Young	0	0.57(0.27)	0	0	0	0.12
Adult	4.65(0.31)	4.82(0.27)	4.32(0.39)	4.23(0.37)	4.6 (0.5)	4.62
No. of goat marketed /year	4.65 (0.31)	5.62(0.46)	4.32(0.30)	4.23 (0.37)	4.6 (0.5)	4.74
% of adult goat marketed/year	92.25 ^a	100 ^{b,c,d}	88.49 ^b	79.86 ^{a,c}	85.86 ^d	89.26
Consumption of adults (no.)	0.35 ^a (0.19)	0 ^{bcd}	0.5 ^c (0.22)	0.91 ^{ab} (0.25)	0.5 ^d (0.21)	0.46(0.09)

Note: Figures having at least one similar superscript are significantly different up to 10% level of significance. Figure inside the parenthesis indicate the standard error.

marketed was highest in cluster 2 which was significantly different from that of all other clusters except cluster 1. Cluster 4 households marketed the lowest proportions of their adult goat stock, which was significantly lower than that of clusters 1 and 2. The lower marketed surplus for cluster 4 is in consonance with the earlier finding that households belonging to this cluster mostly kept their goats for the purpose of self consumption and for religious occasion.

Data on 17 variables obtained from 100 households are evaluated by multivariate analytical method. This multivariate analysis approach, combining principal component with cluster analysis, allowed identification of five typical farm households based on farm and socio-economic characteristics. Households belonging to cluster 3 (low household income) had highest share of income from goats in total household income and total farm income. They also used goats for self consumption purpose. They had low income from agriculture and dairying and goats played an important source of income for their livelihood security. The results of the study revealed that goat rearing was observed to be profitable source of income generation in the study area particularly for the weaker section of the society. Hence, improvement in goat production has direct effect on socioeconomic development of the rural poor.

ACKNOWLEDGEMENT

The authors gratefully acknowledge Dean, College of Veterinary and Animal Sciences and Director, Experiment Station, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar 243122, Uttarakhand, India for all the facilities and support provided for carrying out this study.

REFERENCES

- Bardhan D, Sharma M L and Saxena R. 2010. Livestock in Uttarakhand: Growth patterns and determinants of composition and intensity. *Indian Journal of Animal Sciences* **80** (6): 584–89.
- Berhanu T, Thiengtham J, Tudsri S, Abebe G, Tera A and Prasanpanich S. 2012. Purposes of Keeping of goats, breed preferences and selection criteria in pastoral and agro-pastoral districts of South Omo Zone. *Livestock Research for development* **24** (12): 45–49. www.lrrd.org/lrrd24/12/berh24213.htm.
- Bidogeza J C, Berensten P B M, Graff J D and Lansink A G L M. 2007. Multivariate typology of farm households based on socio-economic characteristics explaining adoption of new technology in Rwanda. *Proceedings of American Agricultural Economics Association Conference*. pp. 275–81. 29 July – 1 August, 2007, Portland, Oregon.
- Boogaard B K, Hendrickx S C J and Swaans K. 2012. Characterization of smallholder goat production and marketing systems in Inhassoro District, Mozambique: Results of a baseline study. *ILRI Research Brief*, 1 July 2012.
- Chenyambuga S W, Jackson M, Ndemaniho, E E and Konwihangilo D M. 2014. Profitability and contribution of small-scale dairy goat production to income of smallholder farmers in Babati and Kongwa districts, Tanzania. *Livestock Research for Rural Development*. **26** (27). www.lrrd.org/lrrd26/2/chen26027.html.
- Government of India. 2012. *Basic Animal Husbandry Statistics*. Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, New Delhi.
- Garcia C G M, Dorward P and Rehman T. 2012. Farm and socio-economic characteristics of smallholder milk producers and their influence on technology adoption in Central Mexico. *Tropical Animal Health and Production* **44**: 1199–211.
- Kumar S and Upadhyay A. 2009. Goat Farmers' Coping Strategy for Sustainable Livelihood Security in Arid Rajasthan: An Empirical Analysis. *Agricultural Economics Research Review* **22**: 281–90.
- Kumar S, Sagar R L and Vaid R K. 2006. Contribution of goats to livelihood security of small ruminant farmers in semi arid region. *Indian Journal of Small Ruminant* **12**: 61–66.
- Singh M K, Dixit A K, Roy A K and Singh S K. 2013. Goat Rearing: A Pathway for Sustainable Livelihood Security in Bundelkhand Region. *Agricultural Economics Research Review* **26**: 79–88.