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Attributes of migratory goat and sheep farming and impact of some improved management strategies en-route migration in adopted flocks of Western – Himalayan region of India

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ABSTRACT

Migratory pastoralism is common in Himalayas, practiced by *Gaddi* tribe of Himachal Pradesh. Understanding migratory system is relevant as >90% of state sheep and around 70 % goat populations is reared under this system. The study was undertaken to analyse characteristics, trends, constraints and impact assessment of improved managemental strategies enroute migration. After generation of base data, for studying the impact of improved practices and breeding management, these flocks were monitored and strategic managemental and breeding inputs were provided to these flocks throughout the year for next 3 years. Majority of the farmers belonged to medium flocks (50%), followed by small flocks (40.2%) while very few were with larger size flock (9.8%). On an average, these farmers derived more than 60% of their income of migratory goat and sheep husbandry. Farmer's own flock was the primary source (68.4%) of breeding buck and they practice selection of male buck based on indigenous knowhow. Diseases, predators, environmental extreme, veterinary aid in high hills and marketing infrastructure were major constraints. The result of adopted flock over period of 4 year revealed that there was significant improvement in body weight, reproductive parameters and pre-weaning mortality. The study concluded that the migratory system is an integral part of hill farming and is sustainable since it is a very low input system which effectively counterbalances its constraints and makes it profitable. There is need to address concern of management during migration, develop effective extension messages and breeding plans.

Key words: Characterization, Genetic improvement, Improved management, Migratory pastoralist

Migratory pastoralist is very common in Himalayas and numbers of nomadic communities practice this (Misri 1998). *Gaddi* the distinct tribe of nomadic pastoralist of Himachal Pradesh, Himalayan state of India wearing a characteristic and striking costume is involved in migratory goat and sheep husbandry. Gaddis follow *alpwirtschaft* type of strategy, associated with movement of people and animal in vertical space, communal control of pastures, combined with individual control of plots/haying fields and social institution that schedule the complex movement in space and time (Bhasin 2013). Emergence of migration of these tribes as a notable feature has strong anthropological, socio-political and economic underpinnings (Suresh *et al.* 2011). Understanding the process and constraints associated with this migratory system is very relevant. Breeding and proper management are important aspects which can be focused on to contribute significantly for improving production efficiency (Mandal 2014). Keeping in view the above facts, the present study was undertaken with the following objective to analyse the characteristics and trends in migratory goat and sheep husbandry, identify the constraints of migratory system and to assess the effect of improved management practices in adopted flock *en route*.

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MATERIALS AND METHODS

The study was conducted in the Himalayan ranges of the state of Himachal Pradesh, India and the study location is represented in Fig. 1. Data were collected through in person interview using structured questionnaire from 4 different migratory routes (35–40 farmers from each). Four flocks, 1 from each migratory route were monitored completely during their migration and various practices were recorded.

Various morphometric traits were measured en route along with body weight recording at different intervals using fabricated weighing balance designed especially to suit migratory conditions. The data recording was done only for goats although the flock were mixed with sheep and goat, the various inputs were provided to all the flock irrespective of the fact whether animals was included in the study or not. All the animals were tagged and identified and baseline data on various productive and reproductive

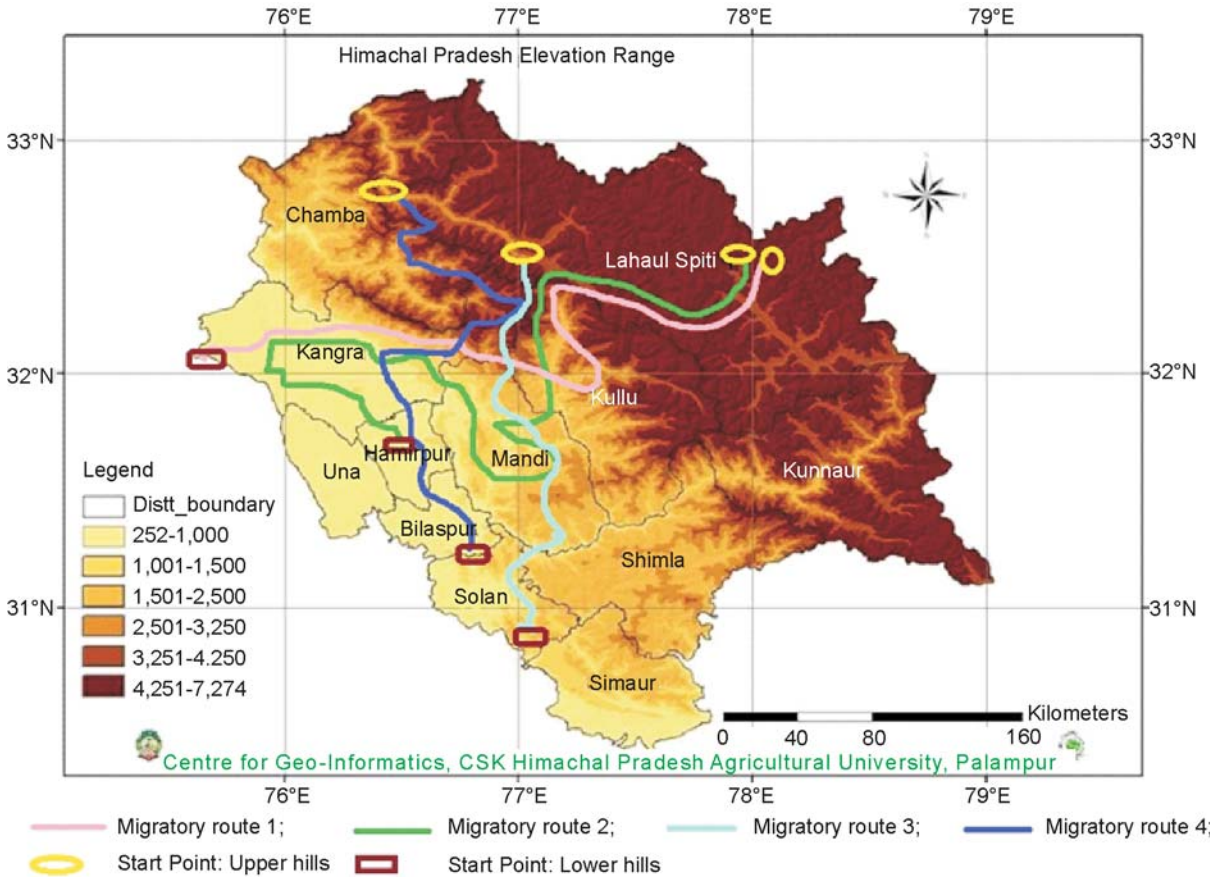


Fig. 1. Map depicting the study area and different migratory routes

traits were recorded initially. After generation of base data, for studying the impact of improved practices and breeding management, these flocks were monitored and strategic managemental and breeding inputs were provided to these flocks throughout the year for next 3 years. Every year 25–30 male kids selected on their 3 month body weights were purchased from different flocks for rearing at institutional farm for 1 year. These were provided scientific management, screened for reproductive disorders and 8 best males (on the basis body weight, average daily gain, breed confirmation and semen evaluation/reproductive screening) were supplied to the adopted units. The objective was to ensure buck rotation, screening for diseases (which can cause abortion through sexual transmission) and to supply superior breeding bucks. The flocks were monitored regularly during their entire route and performance was compared to base year (2011) for reproductive parameters, while for body weight data was recorded from 2012. The primary or secondary data generated was organized and subjected to statistical analysis. Descriptive statistics were computed and body weights were subjected to ANOVA using GLM (SAS version 9.2).

RESULTS AND DISCUSSION

Flock and socio-economic characteristics: The data generated from present study and those from secondary sources revealed that migratory goat and sheep husbandry were performed by *Gaddi* tribe which forms ixogamus union of castes of *Rajputs*, *Khatris*, *Rana* and *Thakurs*. Different commission has been set by state government to regulate the grazing and land tenure by these tribes (Verma 1996). The result of survey is outlined in Table 1. The primary data generated through in-person surveys of farmers in various routes revealed that majority of the farmers now belong to medium flock size followed by small flocks while very few were with larger size flock. During interviews from various farmers, it was concluded that over the years due to factors such as difficulty in handling, changing of occupation, shrinkage of forest land and forest policies of the state, farmer prefers medium size flocks. Each flock has 3–4 ponies and 2–3 dogs associated with them. The majority of flocks had goats and sheep in almost equal proportion but two to three decades earlier sheep used to be in majority. Exclusive goat flocks were also owned by some farmers, which was earlier not in practice. This can be explained from the fact that earlier the wool industry in the state was growing at rapid pace but in the last 10 –15 years, it has shown negative growth and farmers do not get attractive price for wool. On the other hand, over the years the demand of chevon had increased compared to mutton due to consumer preference of goat meat. In spite of the reduction in the percent population, sheep in migratory flock still occupies substantial proportion, albeit lower as compared to a decade earlier. Singh *et al.* 2006 reported

Table 1. Socio- economic characteristics and breeding management of migratory sheep and goat farmer

Particulars	Flock			
Flock characteristic	Small	Medium	Large	Overall
Flock (No)/ Proportion of total	40(40.8)	49(50)	9(9.2)	98
Total flock size	2477	7529	3416	13422
Average flock size (mean ± SE)	61.9 ±2.72	153.7 ±6.36	379.6 ±15.45	136.9 ±10.49
Sheep (%)	56.51	56.71	59.25	57.44
Goat (%)	42.83	42.57	39.81	41.92
Others (dogs, ponies etc.)	0.65	0.71	0.94	0.76
Social characteristics				
Average family size (mean ± SE)	5.53± 0.22	5.74 ±0.27	6.89 ±0.91	5.76 ±0.18
Land holding (Bighas) (mean ± SE)	8.87 ±0.95	7.25 ±0.88	9.94 ±1.03	8.15 ±0.60
Economic characteristics				
Income (all sources)/ year, INR	53,625	57,143	71,111	56,990
Income (migratory farming/year)	26,875	36,120	43,333	32,959
Proportional income from migratory farming (%)	57.25	63.03	60.54	60.94
Breeding management				
Source of breeding buck				
Own flock	24(60.0)	36(73.5)	7(87.5)	67(68.4)
Fellow farmer	6(15.0)	4(8.2)	0(0)	10(10.2)
Fairs/middleman	10(35.0)	9(18.3)	1(13.5)	20(20.4)
No of buck in flock	1–2	1–3	1–3	1–3
No of years buck used	3–4	4–5	4–5	4–5

Figure in parenthesis indicate the relative proportion of particular class compared to overall.

and goat both recorded decline in population over the years but reduction in sheep is more marked than goat. Contrary to sheep, over the last 15 years, goat population has even shown positive growth for 2003–2007, and also the contribution of goat to total livestock population remains more or less same for the past four livestock census, while sheep has shown a clear cut decreasing trend.

The flock size was independent of family size and average land holding, since they were more or less similar in different flock sizes. The annual average income as reported by farmers is around 56,960 INR (876 USD/ annum), which may be underestimated as it is reported by farmers and many times these farmers were reluctant to reveal the actual income and most of them will stick to lower side. Primary recording and subsequent economic analysis in the flock adopted and monitored revealed that around 800 INR (12 USD) rupees net profit per animal per year can be realized after including various losses in this system. According to this, most of the farmers belonging to medium category will earn between Rs 100,000 to 120,000 INR (1,540–1,850 USD). The income reported by other workers (Suresh *et al.* 2013, Kaul *et al.* 2004) in nomads of other part of country was comparatively lower.

Breeding management: Farmers' own flock is the primary source of breeding buck (Table 1) followed by buck purchased from middleman while in few cases the buck is purchased from fellow farmer's flock. Irrespective of the size of flock, number of breeding buck used at given time in flock usually range between 1– 3 with most of the flock usually maintaining 2 bucks. The breeding bucks are used continuously for upto 4–5 breeding seasons and this practice is common in flocks of all sizes. Almost all the farmers mentioned that they practice selection of male buck either from their own flock or neighboring flock, although mostly it is based on indigenous know how, traditional system and certain myth which are passed on as inheritance with flock but few criteria fits well on the scientific breeding male

Table 2. Livestock population of studied area over period of 15 year

	16th census (1997)	17th census (2003)	18th census (2007)	19th census (2012)	Annual change/year (1997–2012) (%)
Goat (million)	1.17	1.13(–3.42)	1.24(+9.73)	1.12(–9.67)	–0.3%
Sheep (million)	1.08	0.93(–13.88)	0.90(–3.23)	0.81(–10.00)	–1.67%
Total livestock(TL) (million)	5.22	5.21(–3.83)	5.05(–3.07)	4.85(–3.96)	–0.47%
Goat (%) of TL	22.41	21.68 (–3.25)	23.96(+10.5)	23.09(–3.63)	+0.20%
Sheep (%) of TL	20.68	17.85–(16.58)	17.82(–0.02)	16.70(–6.28)	–1.28%
Sheep and Goat(%) of TL	43.10	39.54(–8.26)	42.38(+7.18)	39.79(–6.11)	–0.51%

TL, Total livestock; figure in parenthesis indicate percent change in particular category over the previous census.

that in Kangra district, sheep and goat constitute about 67.9% and 33.1% of flock respectively, while the present investigation revealed sheep and goat contribution to flock size as 57.4% and 41.9%, respectively. This fact can be further corroborated from analysis of livestock census which also revealed similar pattern in sheep and goat population trend. Although over the last few census (Table 2), sheep

selection. Major criteria include strong body confirmation, white colour (black coloured buck and white buck with patches are not selected), ear size (long pendulous ear are preferred over short ears). Similar breeding buck selection strategies based on traditional system were also reported by Gebreyesus *et al.* (2012) in Somali goat of Ethiopia. Another problem associated with breeding management is

Table 3. Seasonal feature of migratory system of management

	Mating	Kidding	Shearing	Dipping	Camping	Migration	Vaccination	Sale
Jan					***			
Feb		*			***			
Mar	**	*	***	***	*	**		***
Apr	***	*	**	**		***	***	***
May	***					*	***	*
June	**				*			*
July	**							*
Aug			**	**	*			*
Sep	*	**	***	***		***	**	
Oct	*	**				***	**	**
Nov		***			**			**
Dec		***			***			

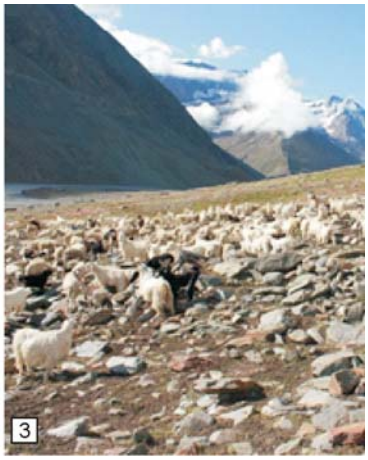
*, Least common; **, moderately common; ***, most frequent.

that farmer usually keeps only one or two breeding bucks in their flocks thus widening the buck doe ratio. The periodical rotation of breeding buck is also not regularly adopted and buck may be used continuously for 4 to 5 breeding season or sometime even more, which may lead to development of inbreeding in the flock. Female goat selection is usually not practiced and almost all the potential breedable does are use for breeding, occasionally few animals which are old and suffer from some ailments are culled through selling.

Seasonal feature of goat management: The most common breeding season (Table 3) in case of migratory goat is summer (March–May), with occasional breeding occurring during winter (Sept-Oct). Generally *Gaddis* prefers to take only 1 kidding/year. The season of mating and harvesting of only single kid crop/year is mainly because of their traditional migratory practices in which kidding are more suited in winter so that while migrating up on hills, few young kids can be sold on the way back to lower and mid hill settlement during the migration and rest are reared for around 3–4 months in upper hills so that they attain marketing weight (15–18 kg) and can be sold while migrating downhill in the summer. Mostly the migration is intense for few months when farmers travel miles of distance by continuously moving throughout the day and resting at night. This is in practice when migration is either started from lower hills (Fig. 2) to higher hills (Fig. 3) just before onset of summers or when migration is to lower hill before onset of winters.

Constraints associated with migratory production system: The major constraints as determined from survey were predators, disease and poisoning during migration, followed by lack of veterinary and institutional facilities, marketing, accidental death, thefts and environment extremes.

Predators, disease and poisoning: Predators cause huge loss of livestock especially young and growing animals. Various predators including leopard and wolf attack animals while migrating through dense forests. Migratory flocks are at a greater risk to diseases, including viral, bacterial, parasitic infection and poisoning. Mortality and morbidity rates are usually higher since most of the time, immediate veterinary aid is not available particularly if disease occurs in high hills. Jithenderan (1998) reported that under normal condition, the animals do possess a certain degree of GI parasitism without any clinical symptoms but worm burden reaches pathogenic level during monsoon and post-monsoon season.



Figs 2–3. **2.** Migratory flock in foot hills **3.** Migratory flocks in upper hills.

Veterinary and institutional facilities: Although state department of animal husbandry ensures delivery of proper health care and has several dedicated institutions for the same but since migration route is very long and usually flock migrates from lower hill (350 mts above MSL) to inner Himalayan ranges (up to 5000 mts above MSL), these facilities are usually limited in low hills to middle hills. Moreover flocks in summer migrate to alpine pastures which are far flung from human settlements and institution and it is very difficult to provide health care facility at such places.

Table 4. Different parameters observed during adoption of migratory Gaddi goat flock for managemental intervention over period of 4 year

Trait	Year				Percent improve-ment**
	2011*	2012	2013	2014	
Does bred	382	414	492	518	24.34 % (475)
No of does kidded	354	383	459	483	24.86% (442)
Kids born	452	480	553	585	19.24% (539)
No of twins	70	82	103	104	—
No of abortion/still birth	28	31	33	34	—
Kid died (Pre weaning)	71	52	48	52	—
Percentage of twin births (%)	19.77	21.40	22.44	21.53	10.21% (21.79)
Percent of abortion/ still birth (%)	7.32	7.48	6.70	6.56	5.60% (6.91)
Pre weaning mortality (%)	15.70	10.83	8.67	9.05	39.36% (9.52)
Population growth (%)	99.47	103.82	106.14	104.73	5.5% (104.89)

*2011 is taken as the base year to see effect of adopted strategies; **per cent improvement is assessed by comparing mean of trait for 3 year (2012, 2013 and 2014) compared to the corresponding value in base year; figure in parenthesis are mean of 3 years.

Marketing: Due to lack of organized markets, farmers usually sell their animal and young kids predominately at their own level. Moreover, the window for sale is only available while migrating in the lower hills and near human settlements. Similar marketing constraints have also been reported in neighboring country of Nepal of Himalayan region by Nepali *et al.* (2007). The existing sheep and goat marketing system in lower hills of Himachal Pradesh encompasses farmers/flock owner, middleman and consumer itself. Both survey and enroute monitoring revealed that migratory farmers felt that they are usually subjected to sub-optimal prices by the buyer. Ansari-Renani *et al.* (2013) also reported the same constraints of marketing infrastructure in nomadic pastoralism in southern Iran.

Accidental deaths, thefts and environmental extreme: The accidental deaths are very common during migration to upper hill through narrow and treacherous path which makes animal prone to accidental slip from cliffs. Theft is the constraint which is reported more frequently while migrating in lower hills resulting in substantial loss. Usually farmers are not in position to report this problem immediately to local authority and many times these unscrupulous thieves are not caught. The problem of theft has become more prominent recently. Animals were not provided any shelter during migration, therefore they become vulnerable to environmental extreme such as heavy monsoon which makes animal susceptible to diseases. Also animals have to cross tracks which are filled with snow and sometime even long glacier has to be crossed which also results in foot infection and other problems.

Effect of improved management practices in adopted flock en route: The study continued for a period of 4 years to see the effect of intervention on production potential of migratory goat system and results are summarized in Tables

Table 5. Body weight at different ages for the adopted flock enroute migration

Factor	Weight (Kg)				
	Birth	3M	6M	9M	12M
Year					
2012	2.70±0.02(158)	14.91±0.39(178)	18.18±0.21(118)	21.16±0.34(142)	26.21±0.23(150)
2013	2.91±0.03(171)	14.88±0.13(235)	19.32±0.20(142)	23.65±0.16(128)	27.32±0.23(169)
2014	2.98±0.02(206)	15.03±0.13(209)	19.17±0.17(173)	23.57±0.12(163)	26.80±0.18(213)
	*	NS	*	*	*
Sex					
Male	3.08.03(218)	15.18±0.34(268)	20.15±0.32(84)	23.64±0.49(61)	28.67±0.52(54)
Female	2.72±0.03(317)	14.46±0.29(354)	18.19±0.23(349)	22.56±0.26(372)	26.40±0.24(478)
	*	NS	*	NS	*
Unit					
1	2.88±0.05(176)	14.81±0.28(214)	18.76±0.36(172)	22.54±0.39(145)	26.88±0.49(173)
II	2.88±0.06(120)	14.98±0.39(189)	19.25±0.43(113)	23.39±0.54(143)	26.54±0.61(159)
III	2.85±0.04(97)	15.00±0.26(172)	19.02±0.39(115)	22.79±0.49(121)	26.65±0.51(169)
IV	2.89±0.05(42)	14.92±0.36(47)	19.15±0.51(33)	23.70±0.56(24)	27.43±0.59(30)
	NS	NS	NS	NS	NS
Overall	2.88±0.02(535)	14.94±0.31(622)	18.95±0.18(433)	22.80±0.21(433)	26.80±0.21(532)

4 and 5. The result revealed that there was significant improvement in body weight at different ages in every unit every year, which can be attributed to the strategic managemental and breeding inputs. Also, the differences observed between different units were not significant and almost all units revealed similar trend of improvements which further strengthen the finding of the study that with improved management strategy, the production potential of migratory system can be increased. The reproductive performance and mortality losses are summarized in Table 3. The analysis of various reproductive parameters revealed that over the year there is continual improvement in population growth (5.5%), kidding rate, percent twin birth (10.92%) and decrease incidence of abortion/still birth (5.6%)

The pre-weaning kid loss which are the major losses in migratory farming showed substantial improvement over the base year (39.42%) along with gradual improvement in kid birth weight. This improvement might be attributed to some extent to improved managemental strategies and it can be visualized that better management practices adopted by farmer and periodical monitoring of flock helped in reducing kid mortality. The effect of improved buck on the performance of flock can be visualized only after span of breeding by the improved buck for at least three to four breeding seasons although initial results are promising with reduction in abortion/stillbirth improvement of birth weight. Acceptability of the breeding buck is very high among the flock owner and they are now having more accommodative approach in response to breeding management compared to initial phase of implementation of study, when they were reluctant to change their buck.

The migratory system is the cornerstone of sheep and goat farming in the region and it is practiced from long time and will remain as an integral part of the agro-economy of hill farming system. In spite of various constraints, the migratory system is still sustainable owing to the fact that it is a very low input system which effectively counterbalances its constraints and makes it a profitable venture. Moreover, the tagging of migratory system with tribal population and their cultural heritage will ensure its propagation as long as the entity of tribe is maintained. Sustainable migratory sheep and goat farming will greatly be affected by developing solutions for the constraints, which will require institutional and extension support. The majority of farmers although less adaptive to managemental intervention but effective extension message with potential to increase the profitability of migratory farming will eventually be accepted by farmers. So there is need to divert focus of research to identify those technology which have potential for improvement along with good chance of adoption by farmers. Simultaneously, there must be effective mechanism to assess the effect of improved strategies which will require allocation of sufficient funds and maximizing the research contribution.

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