



## Performance evaluation of Gurez sheep in farmer's flocks—A threatened sheep breed of Kashmir

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### ABSTRACT

Gurez is an indigenous breed of sheep native to the Gurez Valley of J&K, India. Despite being a unique genetic resource, this breed is largely unexplored and meagre studies have been conducted on it. Hence, a comprehensive study was conducted to study the breed in its native breeding tract. Data on growth, wool, reproduction and morphometric traits of Gurez sheep maintained under farmers' flocks in its native tract were recorded and analyzed for performance evaluation as well as the farming practices in that area with regards to the breed. Screening for parasites and brucellosis, blood biochemistry and mineral profile were also conducted. This triple purpose breed produces milk, meat as well as apparel quality wool. The average values for wool traits were 76.12, 28.31, 4.42, 5.35 and 8.18 for clean wool yield (CWY) (%), fibre diameter (FD) ( $\mu$ ), staple length (SL) (cm), crimps per cm (NCPC) and medullation (%), respectively. The coefficient of variations % of these traits ranged from low to very high indicating that the traits had low to very high variability. The least squares mean for clean wool yield (%), fibre diameter ( $\mu$ ), staple length (cm), crimps per cm and medullation (%) were  $77.07 \pm 0.33$ ,  $29.83 \pm 0.41$ ,  $4.80 \pm 0.17$ ,  $5.04 \pm 0.28$  and  $9.26 \pm 0.79$ , respectively. The sexual dimorphism was observed in favour of males with respect to all these traits. Age had non-significant effect on these traits in the present study. Black wool samples were having higher estimates of FD, CWY (%), SL and medullation (%). NCPC was higher for white wool samples. Conservation of this unique breed and its selective breeding is highly recommended. The incidence of *Eimeria* (37.50%) was found to be highest in the area.

**Keywords:** Growth, Gurez sheep, Morphology, Morphometry, Performance evaluation, Vegetation

Domestic sheep (*Ovis aries*) have played a significant role in boosting the economy of small and marginal farmers, especially in developing countries, as they are a potential source of meat, wool, milk, hide and manure (Gorkhali *et al.* 2015). The native breeds of sheep are especially important in this regard. They possess unique alleles and their combinations are rare or absent in the exotic breeds. These breeds can also be successfully associated with typical products helping farmers manage and protect the environment (Chessa *et al.* 2013). Gurez Sheep is largest breed among native sheep genetic resources of Jammu and Kashmir, limited to Gurez valley of Bandipore district in North Kashmir. The breed is important for the livelihood of the 'Dardi' tribe. The breed is extremely well adapted to the harsh winters of the valley as compared to the exotic breeds (Kour *et al.* 2018) and crossbreds. It is also known for their sturdiness, disease resistance, and the presence of fecundity. It is also popular for its meat, milk and apparel quality fibre (Ganai *et al.* 2010) and can be managed on

very low inputs. However, very little is known about this breed due to the dearth of scientific literature which has also led to lack of dedicated conservation efforts for the breed.

Indiscriminate crossbreeding with Kashmir Merino poses a serious threat to this breed and it is important to evaluate the characteristics of this breed and to understand its morphology and distinguishing features. This would help in the establishment of this breed and its subsequent conservation.

### MATERIALS AND METHODS

A systematic field survey for evaluation and characterization of Gurez breed was undertaken in its breeding tract. Gurez, the breeding tract of Gurez breed is located on banks of river Kishenganga, in northeast of Srinagar, the main valley of Gurez extends between  $34^{\circ} 30'$  to  $34^{\circ} 41'$  N and  $74^{\circ} 37'$  to  $74^{\circ} 46'$  E latitudes at an average altitude of about 2,370 m. Some important features of Gurez valley are summarized in Table 1. It is formed by the Neelum River which flows down from east to west. The valley remains cut off from the rest of the country for about five months

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Table 1. Some important features of Gurez valley

S.No	Particular	Status	Reference
1.	Area (km <sup>2</sup> )	362.88	Wani <i>et al.</i> (2012)
2.	Share borders with	North: Ladakh, South: Bandipora, Southeast: Ganderbal West: Kupwara Peripheries with LoC (India and Pakistan)	
3.	Human population	30,699	2011 Census
4.	Population density (persons/Km <sup>2</sup> )	84.60	
5.	Literacy (%)	60	
6.	Rural population (%)	100	
7.	Tribe	Dards (100%)	
8.	Language	Shina and Kashmiri	
9.	Assembly constituency	1: Gurez	
10.	Tehsils	2: Gurez and Tulail	
11.	Blocks	3: Gurez, Tulail and Bagtor	
12.	Panchayats	20	
13.	Villages	27	Wani <i>et al.</i> (2012)
14.	Altitude (meters above msl)	2,460 to 3,900	
15.	Average temperature	Max: 30°C, Min: -20°C	Wani <i>et al.</i> (2012)
16.	Soil types	Sandy loam type with high silica content	
17.	Forests	Coniferous and broad leaved	
18.	Climate	Temperate	
19.	Seasons	4	
20.	Average temperature	7.88°C, Ranges between -9.02°C (winter) to 32.43°C (summer)	
21.	Average annual rainfall	124.79 mm	

during winter. Razdan (Razdan pass) located above 4,000 m a.s.l. not only connects the Gurez with the rest of Kashmir but also divides the two geographical, socio-cultural and linguistic lines.

Information/ data on different body biometric parameters, viz. body length from shoulder to pin bone, chest girth, body length from head to tail, height at withers, ear length, tail length, body weight and qualitative confirmation attributes of animals were recorded. Informal interviews and group discussions with Gurez sheep owners were held to obtain information on feeding, breeding, housing, flock size and structure, age at first lambing, inter-lambing period, litter size, milk yield, wool yield, mortality, disease prevalence in the breeding tract using a semi-structured questionnaire. Sheep farmers were also surveyed regarding the family size, family type, occupation other than sheep rearing, etc. The farmers for formal interviews were selected at random and interviewed by face to face contact interview method. The additional information needed was collected from the officials of Sheep Husbandry Department. Blood samples (114) were collected for screening animals for infectious diseases, blood biochemistry and mineral profile.

Screening for Brucellosis was done by modified RBPT (Rose Bengal Plate Test) and ELISA. The samples were centrifuged, and the supernatant was taken for the estimation of Calcium (Kaser and Stekol 1979) and Phosphorus (Amador and Urban 1977).

Study on the prevalence of parasitic infections was carried out by randomly collecting 136 faecal samples. The samples were collected directly from the rectum and brought to the laboratory in mini polythene bags for examination.

A qualitative investigation of these samples was carried out at Disease Investigation Laboratory, Nowsharah, Srinagar, J&K.

A total of 581 wool samples were collected randomly from different villages for evaluation of wool quality traits of Gurez sheep. The wool quality traits estimated were crimps per inch (CPI), staple length (SL) (cm), clean wool yield (CWY) (%), fibre diameter (FD) ( $\mu$ ) and medullation (M) (%). Statistical analysis was carried, using IBM SPSS 20. The descriptive statistics of wool quality traits were estimated by using standard statistical procedure of Snedecor and Cochran (1994). General linear model was used to estimate effects of sex, age and wool colour of wool samples on these traits. The following model was used for the estimations.

$$Y_{ijkl} = \mu + C_i + D_j + S_k + e_{ijkl}$$

where,  $Y_{ijkl}$ , observation of the  $l^{\text{th}}$  lamb, of  $k^{\text{th}}$  sex, having  $j^{\text{th}}$  dentition and  $i^{\text{th}}$  color of wool;  $\mu$ , population mean.

## RESULTS AND DISCUSSION

Results regarding the socio-economic status of the farmers indicated that majority sheep rearing families in Gurez were male dominated, more than 85% of the farmers were married, illiterate belonging to middle age group between 40–60 years. This agrees with the respective findings of Tailor *et al.* (2005), Porwal *et al.* (2006) and Arora *et al.* (2007). A total of 1,731 numbers of Gurez sheep of different age groups were identified during the present study in Gurez and Tulail tehsils. The number of Gurez was higher in Tulail than Gurez tehsil which indicates that the impact of crossbreeding was higher in lower patches

than upper patches. Average flock size per farmer in the breeding tract was estimated to be 19.29 heads of animals. The animals were let for graze on nutritious pastures for 11 to 16 h depending upon the season. The dams were let for grazing along with newborn lambs after few days of confinement. Primitive special houses made of long logs of wood were used for residence. The animals were usually housed in the ground floor of these houses. Day and night shelters were provided during cold and chilly winters whereas only night shelters were needed from May to November in some villages in Tulail. The animals were shorn in March–April and September–October.

Random and uncontrolled flock mating was practiced using inferior young male hoggets for breeding while fast growing quality rams were sold for mutton at young ages and no respondents reported controlled breeding. Similarly, castration of inferior males was also not done. The animals were mostly reared under mixed crop-livestock farming system using a mixture of grazing, semi-stall feeding, stall feeding and grazing alone practices. Grazing was mostly practiced in pastures of mountainous topology surrounding the villages. The predominant grasses in the pasture were *Trifolium pratense*, *Trifolium tomentosum*, *Lespedeza serices* and few important herbaceous components were *Trollius acaulis*, *Geum elatum*, *G. urbanum*, *Bergenia ciliata*, *Saussurea* spp and *Sedum* spp. The important shrubs were *Rhododendron*, *Anthopogon* and *Cassiope fastigiata*. The animals were allowed to drink from streams, brooks and small water channels flowing through pastures with the water source at the melting glaciers.

During winters, the animals were only stall fed, while during summers grazing alone was practiced. During winters, animals were fed cultivated oats, maize straw, dried leaves and dried natural grasses harvested from mountains, meadows, community lands and forest lands in the vicinity of the villages. Hay making for harsh winters from surplus fodders and grasses available in forest lands and common property resources during summers was the priority activity of the farmers. Concentrate feeding was done in a limited manner since it is impractical in the breeding tract of Gurez sheep.

Overall serum glucose, calcium and phosphorous levels of  $64.24 \pm 0.76$  g/dl,  $10.57 \pm 0.25$  g/dl and  $4.27 \pm 0.09$  g/dl, respectively were estimated in the present study. The normal values are 42 to 76 g/dl, 11.5 to 12 g/dl and 5 to 7.3 for serum glucose, calcium and phosphorous, respectively in sheep. Therefore, it is observed from the biochemistry of blood that the area is deficient in phosphorous and calcium without clinical symptoms. However, no efforts to treat the deficiency were observed or reported by farmers. Common salt (NaCl) was fed to the animals traditionally and no fortification of fodders was done.

The main sheep diseases prevalent in the tract were sheep pox, pneumonia, diarrhoea, foot rot, FMD, PPR, enterotoxaemia, lung and gastrointestinal helminth infestation, wounds caused by barbed wires used for security reasons by the Indian Army. The prevalence of

Strongyle, *Strongyloides*, *Monezia*, *Nematodirus* and *Eimeria* were found to be 30.15%, 5.15%, 3.68%, 21.32%, 37.50% and 28.68%, respectively. *Fasciola*, Amphistome and *Dicrocoelium* were not observed in the study. However, Ganai *et al.* 2010 also reported prevalence of *Dicrocoelium*, Clostridial and *Fasciola* in the breeding tract.

Vaccination against diseases like sheep pox, PPR, FMD, clostridial infections and dosing with antihelmintics against parasitic infestations and dipping against ectoparasites were practiced by the Department of Sheep Husbandry. The farmer demand was only first aid for wound management caused by barbed wires used by army and in the area. The farmers reported very less mortality in Gurez sheep. Ganai *et al.* (2010) also reported mortality percentage of 3.62% and 4.76% in lambs up to one month and four months and above respectively.

The skin colour of both the sexes was pink. Predominant body colour was white (69.86%) (Fig. 1a), followed by black (18.49%) and brown (11.64%). Most of the animals were brown and black spotted. However, no distinct colour prototype was observed. Black animals were having black limbs, ears and head. However, animals having white colour were having limbs and face either black or brown. Head profile of this sheep was narrow and long with convex nasal bridge. The predominant face colour was white, followed by brown spotted, black spotted, and black. The legs were medium in size and colour was mostly white. Although animals having black, brown and even spotted (Black and Brown) limbs were also common. The ears of Gurez sheep were horizontal, broad and leafy with varying length (4.5–15 cm). However, some sheep had even rudimentary as well as tubular ears. The average lengths of ears (EL) in different age groups across two sexes are presented in Table 2. The ear colour was white, brown, black and animals having ears with black and brown spots were also common. Majority of females of Gurez were polled (88.33%) whereas 8.33% were horned and 5% were having rudimentary horns. However, majority of males were horned (86.67%) whereas 6.67% were polled and 13.33 were having rudimentary horns. The horns in males were oriented in curved, backward-forward- outward direction. The animals mostly possess two horns; however, four to six horns (Fig. 1b) were also seen (polycerrous). Polycerrous condition was observed in 1.67% females and 8.8% males. The horns were brown to creamy with average length of 29.5 (10 to 42.5 cm) and 14.4 cm, (7.75 to 25.5 cm) in males and females,



Fig. 1. (a) Gurez Female; (b) Polycerrous Gurez Sheep.

Table 2. Measurements of different morphometric traits of Gurez sheep

Particular	Sex	N	BW (kg)	BL1 (cm)	BL2 (cm)	CG (cm)	PG (cm)	WH (cm)	EL (cm)	TL (cm)
MT1 (~6 Months)	Male	21	18.23±0.30	75.63±0.45	48.54±.34	56.15±0.39	50.65±1.6	49.90±0.35	11.15±0.14	15.63±0.36
	Female	30	15.80±0.74	76.25±0.84	51.25±.67	55.63±0.40	50.83±1.28	52.81±0.48	10.56±0.36	17.81±0.40
	Total	51	17.10±0.24	75.88±0.29	49.63±0.23	55.94±0.20	50.71±1.16	51.06±0.21	10.90±.12	16.5±0.20
MT2 (~9 Months)	Male	29	23.10±0.34	85.00±0.55	60.99±0.46	69.61±0.35	71.04±2.07	57.63±0.33	10.86±.10	17.89±0.22
	Female	35	21.87±0.58	87.29±0.52	62.29±0.61	69.38±0.69	72.70±1.58	63.44±0.89	12.00±0.20	17.85±0.49
	Total	64	22.31±0.23	85.89±0.54	61.49±0.26	69.52±0.23	71.39±1.43	59.88±0.28	11.3±0.07	17.69±0.16
2T (1 to 1.5 year)	Male	17	37.2±0.33	93.82±0.28	68.31±0.65	75.44±0.41	78.57±2.15	62.87±0.22	10.66±0.10	20.59±0.20
	Female	20	35.14±0.29	97.00±0.45	64.88±0.23	76.50±0.39	80.43±1.77	62.44±0.20	11.21±0.10	18.88±0.18
	Total	37	36.09±0.16	95.54±0.61	66.45±0.22	76.01±0.20	79.77±2.50	62.64±0.10	10.96±0.05	19.66±0.10
4T	Male	3	45.65±0.14	91.67±0.28	65.00±0.29	69.17±0.88	73.00±5.68	62.92±0.68	10.580±05	21.67±0.92
	Female	18	36.12±0.38	91.67±0.45	63.33±0.38	73.19±0.37	75.36±4.91	62.85±0.43	10.28±0.16	18.19±0.29
	Total	21	37.05±0.47	91.67±0.50	63.57±0.41	72.62±0.37	74.94±2.28	62.86±0.40	10.18±0.13	18.69±0.25
6T	Female	29	38.40±0.35	91.67±1.02	63.5±0.14	76.11±0.60	80.27±2.28	60.83±0.18	11.55±0.20	18.61±0.90
	Female	35	38.04±0.22	92.4±0.16	65.50±0.03	76.50±0.14	80.55±1.41	64.38±0.24	11.78±0.04	18.60±0.33

N, Number of observations; BW, Body weight; BL1, Body length from head to tail; BL2, Body length from shoulder to pin bone; CG, chest girth; PG, Paunch girth; WH, Height at withers; EL, Ear length; TL, Tail length.

respectively. Similar observations were also reported by Ganai *et al.* (2010). The non-lustrous and course woolly coat was covering entire body, excluding head, face and partially legs. On average 0.948 kg (range 0.245 to 1.25 kg) of wool were produced by Gurez sheep. The averages were higher in males and adult animals than females and young animals. Ganai *et al.* (2010) reported 0.622 kg of wool in autumn clip. The legs, ears and face were covered with short hair and devoid of wool. Animals having wattles were also found during the study (Fig. 1b). The tail was straight, medium sized thick at base and thin at tip. The average length of tail was 15.63±0.36 to 21.67±0.92 cm. The average estimates for different biometric traits are presented in Table 2.

Body weight (BW) was positive and highly correlated with BL1, BL2, CG, PG and whereas positive and moderately correlated HW. Similarly, the correlation of body length from shoulder to pin bone (BL2) was positively and highly correlated with BL1, HW and PG and moderately correlated with CG. Ear length was negatively correlated with BL2, CG and PG and Tail length was negatively correlated with HW. The correlation between all the traits was statistically significant except between EL and BW, BL1, BL2, HW, CG and PG. Similarly, correlation of TL with BL2, HW and PG was not statistically significant (Table 3).

The average milk production of 331 ml/ day /ewe (range 300 ml to 900 ml) was reported by respondents. The milk production increases up to fourth parity then gradually decreases. However, Ganai *et al.* (2010) reported milk yield of 181.05±8.87 ml/ day/ animal (range 0.05 to 0.3 ml) at seventh day 338.16±17.13 ml (range 50 to 550 ml) at 50th day.

Table 3. Correlation coefficients between measurements of different morphometric traits of Gurez sheep

	BW	BL1	BL2	HW	CG	PG	TL	EL
BW	1	0.50 <sup>#</sup>	0.59 <sup>#</sup>	0.45 <sup>#</sup>	0.65 <sup>#</sup>	0.50 <sup>#</sup>	0.25 <sup>#</sup>	0.10 <sup>N</sup>
BL1		1	0.68 <sup>#</sup>	0.56 <sup>#</sup>	0.53 <sup>#</sup>	0.53 <sup>#</sup>	0.21 <sup>#</sup>	0.01 <sup>N</sup>
BL2			1	0.63 <sup>#</sup>	0.45 <sup>#</sup>	0.58 <sup>#</sup>	0.10 <sup>N</sup>	-0.03 <sup>N</sup>
HW				1	0.43 <sup>#</sup>	0.57 <sup>#</sup>	-0.04 <sup>N</sup>	-0.04 <sup>N</sup>
CG					1	0.52 <sup>#</sup>	0.21 <sup>#</sup>	0.07 <sup>N</sup>
PG						1	0.07	-0.01 <sup>N</sup>
TL							1	0.15 <sup>*</sup>
EL								1

<sup>#</sup>, Correlation is significant at the 0.01 level (2-tailed); <sup>\*</sup>, Correlation is significant at the 0.05 level (2-tailed); <sup>N</sup>, Correlation is non-significant.

The least squares means and corresponding coefficient of variations for different wool quality traits are presented in Table 4. The sexual dimorphism was observed in favour of males with respect to all wool quality traits. Age had non-significant effect on these traits in the present study. The black wool samples were having higher estimates of FD, CWY (%), SL and Medullation (%). However, NCPC was higher for white wool samples. More or less similar,

Table 4. Average estimates along with standard errors of wool quality traits of Gurez sheep

	N	CWY (%)	FD ( $\mu$ )	SL (cm)	NCPC	Medullation (%)
Coefficient of variation	4.21	14.06	50.75	36.50	92.12	
Overall	581	77.07 $\pm$ 0.33	29.83 $\pm$ 0.41	4.80 $\pm$ 0.17	5.04 $\pm$ 0.28	9.26 $\pm$ 0.79
Sex	P value	0.056	0.033	0.609	0.730	0.699
Male	68	77.47 $\pm$ 0.47	30.37 $\pm$ 0.58	4.85 $\pm$ 0.24	5.10 $\pm$ 0.40	9.45 $\pm$ 1.11
Female	512	76.68 $\pm$ 0.30	29.28 $\pm$ 0.37	4.74 $\pm$ 0.15	4.98 $\pm$ 0.25	9.07 $\pm$ 0.71
Age	P value	0.484	0.589	0.425	0.938	0.623
MT	110	76.67 $\pm$ 0.36	29.46 $\pm$ 0.45	4.52 $\pm$ 0.18	5.11 $\pm$ 0.31	9.13 $\pm$ 0.86
2T	360	76.77 $\pm$ 0.26	29.30 $\pm$ 0.32	4.58 $\pm$ 0.13	4.93 $\pm$ 0.22	8.63 $\pm$ 0.61
4T	84	76.46 $\pm$ 0.41	29.20 $\pm$ 0.50	4.80 $\pm$ 0.21	5.17 $\pm$ 0.34	7.95 $\pm$ 0.97
6T	11	78.22 $\pm$ 0.97	30.95 $\pm$ 1.19	4.88 $\pm$ 0.49	4.93 $\pm$ 0.82	11.33 $\pm$ 2.30
FM	15	77.25 $\pm$ 0.86	30.21 $\pm$ 1.06	5.20 $\pm$ 0.44	5.04 $\pm$ 0.73	9.27 $\pm$ 2.04
Colour	P value	0.013	0.000	0.017	0.001	0.238
White	493	76.61 $\pm$ 0.33	28.89 $\pm$ 0.40	4.57 $\pm$ 0.17	5.56 $\pm$ 0.28	8.74 $\pm$ 0.77
Black	87	77.54 $\pm$ 0.43	30.76 $\pm$ 0.53	5.02 $\pm$ 0.22	4.51 $\pm$ 0.36	9.79 $\pm$ 1.02

estimates for FD were observed by Mehta *et al.* (2004) and Nehra *et al.* (2005) in Magra and Marwari sheep, respectively. However, lower estimates for FD were observed in Kashmir Merino sheep and its crosses by Rather *et al.* (2019 a, b and c) and Baba *et al.* (2020). Whereas higher estimates were of FD were found by Dass and Singh (2001) and Tariq *et al.* (2013b) in Marwari and Mengali sheep, respectively. Taggar *et al.* (2018) in Poonchi sheep reported the least squares means for CWY (%), FD ( $\mu$ ), SL (cm), NCPC and medullation as 63.14 $\pm$ 0.23, 2.98, 24.99 $\pm$ 0.13, 3.82 $\pm$ 0.07, 8.67 $\pm$ 0.18 and 2.22 $\pm$ 0.19, respectively. However, same traits were observed by Baba *et al.* (2020) in Kashmir Merino and its crosses as 67.19 $\pm$ 0.02, 20.04 $\pm$ 0.002, 4.03 $\pm$ 0.02, 4.35 $\pm$ 0.02 and 0.10 $\pm$ 0.001, respectively. The sexual dimorphism in favour of males with respect to wool quality traits was also reported by Rather *et al.* (2019 a, b and c) and Baba *et al.* (2020). Sheep is seasonal breeder therefore, ewes exhibited estrus only during April–May and August–November with oestrous cycle 18 to 22 days with estrus period lasting for 20–26 h. Rams are kept continuously with the flock throughout the year because the farmers could not manage males and females separately. Keeping rams with females continuously with flock decreases age at sexual maturity, age at first lambing and inter-lambing period, therefore, adds to production and profitability. Respondents reported age and weight at sexual maturity as 10-14 months and 23-27 kg respectively in both the sexes. However, spring born lambs attained sexual maturity earlier than autumn born lambs. This may be due to availability of lush green grasses in pastures during spring and summer. Age at sexual maturity agreed with the report of Dixit *et al.* (2005) in Rampur Bushair. Gestation period of 5 months was reported by the farmers. Respondents reported the age at first lambing as 16.28 $\pm$ 0.19 (Range=14.5-19) months. The present findings are in corroboration with Das *et al.* (2012) who reported mean age at first lambing in Kashmir Merino to be 19.7 months. Average weight at first lambing of 29.62 $\pm$ 0.79 (25 to 33) kg was reported by respondents. The overall inter-lambing interval of 6.92 $\pm$ 0.17 (6.5-9) months

was reported by farmers. The average litter size of 1.21 was reported by respondents. Ewes produced twins from second lambing onwards and usually once in two lambing. Higher longevity under adverse conditions is one of the adaptation traits of tropical livestock. The average reproductive life span was 8.82 $\pm$ 0.33 (Range =5.75-11.50) years.

Harsh winters, limited accessibility to pastures due to security reasons, increased the pressure on available pastures for migratory sheep populations from other parts of J&K and led to diminution of grazing areas due to utilization of common property resources for non-agriculture purposes were some of the problems faced by farmers in the breeding tract. The lack of organized efforts for selection and improvement of the breed is also a major concern as far as the conservation of this breed is concerned. There is a need to keep crossbreeding under check and organize awareness programmes for educating the farmers regarding breeding (in particular data recording) and management of this breed. Setting up of a Government run Sheep Breeding Farm in its ecological niche would go a long way in the genetic improvement, evaluation, multiplication and *in situ* conservation of this breed. Open Nucleus Breeding Scheme (ONBS) combined with multiple ovulation and embryo transfer (MOET) are also necessary for exploiting the genetic potential of this breed. Further studies on this breed including molecular characterization of this breed are recommended.

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