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Phenotypic Characterization of Lesser Known Sheep Population in Central Dry Zone of Karnataka

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ABSTRACT

A study was carried out to characterize the lesser-known sheep population of the Central Dry Zone (CDZ) of Karnataka. Data was collected from 144 shepherds across 48 villages [Chitradurga (Group I) and Tumkur-(Group IIA & IIB)] were collected to document socio-economic aspects, flock management, and the phenotypic and morphometric traits of the sheep. The population exhibited distinct phenotypic features: predominantly black, brown with admixtures of black, brown and white, convex head profile, long pendulous ears, and absence of wattles. Tail length varied, with short tails was predominant in Group I of Hiriyur Taluk, Chitradurga and long tails in Groups IIA and IIB were observed in Sira Taluk, Tumkur district. The average body weight of male lambs in Group I, IIA, and IIB was 13.728 ± 0.878, 17.023 ± 0.729, and 17.934 ± 1.165 kg, while female lambs averaged 11.939 ± 0.685, 14.309 ± 0.574, and 15.429 ± 0.918 kg. Average body length of male lambs was 51.116 ± 1.167, 57.435 ± 0.969, and 57.907 ± 1.548 cm; females measured 49.773 ± 1.083, 55.261 ± 0.908, and 56.019 ± 1.452 cm. In the four-teeth age group, males measured 71.913 ± 0.968, 74.571 ± 0.716, and 76.000 ± 1.468 cm, while females measured 71.267 ± 0.939, 70.250 ± 0.643, and 71.615 ± 1.009 cm. Morphometric analysis showed sexual dimorphism, with males consistently heavier and larger than females. Chest girth, withers height, body length and rump height showed significant correlation. Chest girth was the best predictor of body weight.

HIGHLIGHTS

- Distinct phenotypic features: predominantly black, brown with admixtures of black, brown and white, convex head profile, long pendulous ears, and absence of wattles.
- Morphometric analysis showed sexual dimorphism, with males consistently heavier and larger than females.

Keywords: Lesser known sheep, Karnataka, phenotypic and morphometric characterization

Small ruminants, like sheep enhances significantly to rural livelihoods in India by the sale of meat, wool, skin, manure and minimum milk production. Karnataka has 1.11 crore sheep population (BAHS, 2019). Of these, 65 percent belong to migratory flocks, with a population density of 58 sheep/ km² and a sex ratio of 1:4.2. The state has five recognized breeds-Bellary, Deccani, Kenguri, Hassan, and Mandya; accounting for 48.6 per cent of the total, while 51.2 percent remain non-descript.

Majority of sheep population (35%) is present in Chitradurga, Tumkur, and Bellary districts of the Central and Northern Dry Zones in Karnataka state. In the Central dry zone (CDZ) Sira taluk of Tumkur district,

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Challekere and Hiriyur taluk of Chitradurga district have the highest sheep population. The Central Dry Zone (CDZ) of Karnataka experiences a semi-arid climate characterized by relatively low rainfall, hot summers and mild winters. The annual rainfall ranges from 453.5 to 717.7 mm, with the majority (over 55%) falling during the Kharif season (June to October). Temperatures during summer can reach 31 °C to 42 °C, while winter temperatures range from 15°C to 26°C (Seemakowsar and Gaddi, 2024). Hence in this part of Karnataka agriculture remains as a seasonal occupation while majority of the farmers rear sheep for their livelihood. According to preliminary studies conducted by Basavraj Inamdhar *et al*., (2024) the lesser known sheep population in Sira Taluk have distinct differences phenotypically from among the other registered breeds of Karnataka. Hence this study was undertaken in the sheep population of Chitradurga and Tumkur districts for in depth phenotypic characterization and to compare them with other sheep flocks in that region to find the uniqueness of these sheep flocks.

MATERIALS AND METHODS

The shepherds were surveyed across 48 villages in Chitradurga and Tumkur districts (Fig. 1) to study the sheep rearing practices and the socio-economic status of the shepherds in this region.

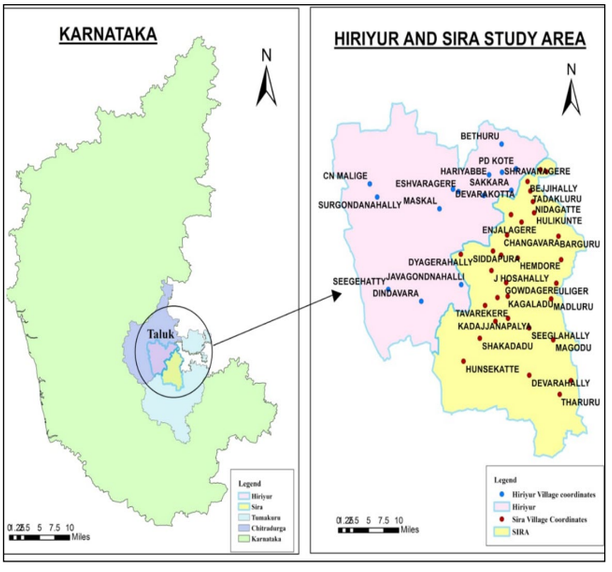

Fig. 1: Location of study

The sheep populations were purposefully divided into three groups based on the phenotypic differences grossly observed in the sheep population: Group I from Hiriyur taluk (16 villages), Chitradurga, and Groups IIA (23 villages) and IIB (9 villages) from Sira taluk, Tumkur. Morphological traits like coat color (black, brown, white, grey, black and brown, black and white, black and grey, brown and white, brown and grey, admixture of all colours), head profile (convex, slight convex, straight), horn shape (spiral, curved, straight), ear orientation (pendulous, erect), coat type (coarse curly, coarse straight) and presence or absence of wattle were documented from 144 flocks of sheep in the study area.

Morphometric measurements, including body weight, chest girth, paunch girth, rump height, height at withers, body length, ear length, face length and tail length were recorded using standard procedures. The data was recorded from 1152 number of sheep and was classified according to sex (male and female) and of different age groups based on eruption of permanent incisors, as all milk teeth of less than 12 months of age (N = 576), two teeth of 12 to 18 months age (N = 150), four teeth of 18 to 24 Months (N = 135), six teeth of 24 to 36 Months (139) and full mouth with all permanent incisors of more than 36 Months (N = 153) from all the three studied groups for further analysis. The collected data was analysed statistically (descriptive, parametric and non-parametric) using statistical software (SPSS version 16 software). Stepwise regression analysis was performed to predict body weight from body measurements. Group differences were detected using analysis of variance technique using the following model.

$$Y_{ijk} = \mu + X_i + e_{ijk}$$

Where,

Y_{ijk} = Observation on trait studied with effects and subscripts as follows,

μ = Overall mean

X_i = Effect of i^{th} sex/ age group/ block from a population with mean 0 and Variance

σx^2 = (i = 1, 2 for sex, i = 1, 2, 3, 4 for age group and i = 1, 2 for block)

e_{ijk} = Random error

RESULTS AND DISCUSSION

Socio-economic status of the shepherds and rearing practice

The study found that sheep rearing in the CDZ is a male-dominated occupation (96.53% of shepherds). The average age of shepherds was 43 years, with over half of them being older than 40. Sheep rearing was the sole occupation for 100 per cent of respondents in Tumkur and 93.75 per cent in Chitradurga and only 6.25 per cent combined it with agriculture and other animal husbandry activities. The majority of shepherd households in the study area were having the small landholdings of less than two acres. Overall, 46.53 per cent of respondents ($n = 67$) were small farmers, followed by 30.55 ($n = 44$) marginal farmers, 9.03 per cent ($n = 13$) large farmers, and 13.89 per cent ($n = 20$) landless households. The average flock size across the surveyed districts was 120.86 animals, with the smallest recorded flock having 29 animals and the largest reaching 328. The average flock size in Chitradurga was 108.29 (range: 29–280), while Tumkur recorded a highest average of 127.15 (range: 34–328) which is higher than other recognized breeds in Karnataka like Kenguri, Hassan, and Mandya sheep were 87, 34 and 16 respectively (Yadav *et al*., 2013 and Govindaiah *et al*., 2006).

Majority of the respondents (72.91%) reported that their sheep houses were located adjacent to the dwelling house of the shepherd ($n = 105$). This close proximity likely offers advantages such as ease of supervision, enhanced protection from theft or predators, and convenience in feeding and management.

The sheep are reared under an extensive management system without any supplementary feeding except for breeding rams and ram lambs where they have been given additional concentrates. Since all the sheep were penned together, uncontrolled mating occurred year-round. Ram lambs were never castrated, as they were typically sold at 3–4 months of age. Breeding rams were kept until they reached 5 years of age before being culled, while ewes were maintained up to a maximum of even 8 years age and were maintained up to five to ten lambings.

Morphological characters

The predominant coat colour pattern in CDZ area of studied groups was in group I black was the most predominant coat colour (34.9%), followed by brown (17.7%), black and brown (17.2%), and white (10.9%).In Group IIA, black was again the most common (24.3%), followed by black and brown (17.8%), white (17.0%) and brown (16.8%). In Group IIB, black remained predominant (30.9%), followed by brown (17.1%), black and brown (16.6%), and white (12.0%). The coat colour and other morphological characters of sheep from the study area are different from the other sheep breeds of Karnataka (Bellary, Mandya, Kenguri and Hassan (Jain *et al*., 2005a, Jain *et al*.,2005b, Jain *et al*., 2006a and 2006b).

Predominant head profile in all groups of both genders was convex which is similar to Mandya sheep breed (Jain *et al*., 2005b).

Ear pattern were pendulous across the three groups studied which again different from other breeds of Karnataka where in Bellary sheep was reported with tubular-shaped ears of medium size (Jain *et al*., 2005a), Mandya sheep with medium-long, drooping ears (Jain *et al*., 2005a), Hassan and Kenguri have medium ears (Jain *et al*., 2006a).

The present study recorded the presence of wattles at 22.9 per cent, 17.4 per cent, and 24.9 per cent in Groups I, IIA, and IIB, respectively—indicating a moderate to low prevalence. These values are much lower than those reported in Mandya (almost 100%; Jain *et al*., 2005b), Yalaga (70.50%; Dayanand, 2013).

The present study noticed the coat pattern of coarse straight in majority in all the studied groups this is in accordance with the Bellary, Deccani, Hassan, Kenguri and Mandya sheep breeds of Karnataka (Jain *et al*., 2005a, 2005b, 2006a and 2006b).

Across all three groups, horn presence was observed in 91.99 per cent of males and 8.01 per cent of females, while horn absence occurred in 34.48 per cent of males and 65.52 per cent of females. Curved horn shape is the characteristic feature of these sheep populations, with spiral and straight forms being less frequent.

Tail length varied, with short tails predominant in Group I and long tails in Groups IIA and IIB which is different from other breeds Bellary, Kenguri and Yalaga indicating the uniqueness with respect to tail length (Jain *et al*., 2005a, Jain *et al*., 2006a), Dayanand (2013).

Body measurements

Body measurements are necessary for the description of a breed and to study the growth in different age group. Morphometric measurements indicate the skeletal growth of the animals. The least squares means for body weight (BW), body length (BL), chest girth (CG), height at withers (HW), rump height (RH), paunch girth (PG) and tail length (TL) at milk teeth, two teeth, four teeth, six teeth and full mouth age groups pooled over sex of the animals and groups indicated an increasing trend and least square means of various body measurements are presented in Table 1 to Table 5.

The average body weight of male lambs in Group I, IIA and IIB was 13.73 ± 0.88, 17.02 ± 0.73 and 17.93 ± 1.17 kg, while female lambs averaged 11.94 ± 0.69, 14.31 ± 0.57 and 15.43 ± 0.92kg. Average body length of male lambs was 51.12 ± 1.17, 57.44 ± 0.97 and 57.91 ± 1.548 cm; females measured 49.77 ± 1.08, 55.26 ± 0.91 and 56.02 ± 1.45 cm. In the four-teeth age group, males measured 71.91 ± 0.97, 74.57 ± 0.72 and 76.00 ± 1.47 cm, while females measured 71.27 ± 0.94, 70.25 ± 0.64 and 71.62 ± 1.01 cm. Morphometric analysis showed sexual dimorphism, with males consistently heavier and larger than females. These sheep were heavier than Mandya, Hassan, and Deccani, closer to Bellary and comparable to Kenguri ewes. Chest girth was the best predictor of body weight. This evidence establishes the CDZ sheep population of Hiriyur taluk, Chitradurga district and Sira Taluk, Tumkur district as morphologically, morphometrically distinct from other sheep breeds of Karnataka that warrants further genetic studies for possible recognition as a separate breed.

The least square means were compared between different groups of studied population at different ages reported the significant difference for all the morphometric traits in the milk teeth age group and as age increases the difference was diminishing (Table 1 to 5). However there was significant difference between Group I form Chitradurga and Group II A and B from Tumkur districts revealing the differences between the sheep populations. In the two-teeth age group the females exhibited significant differences amongst the gropus with respect to body weight (BW), paunch girth (PG), wither height (WH), body length (BL), and tail length (TL). However the males of two tooth age group were similar except for the tail length (Table 2). In the four-tooth age group, significant differences were recorded in males for BL and TL, whereas females

Table 1: Least square means (Mean±SE) of different morphometric data in lambs from different groups

Category	Group(n)	BW (kg)	FL (cm)	EL (cm)	CG (cm)	PG (cm)	WH (cm)	BL (cm)	RH (cm)	TL (cm)
Male Lambs	I(95)	13.73 ± 0.88^{a}	15.04 ± 0.33^{a}	13.50 ± 0.27^{a}	51.01 ± 1.23^{a}	54.60 ± 1.52^{a}	51.12 ± 1.03^{a}	51.12 ± 1.17^{a}	54.54 ± 1.10^{a}	10.78 ± 0.29^{a}
	IIA(138)	17.02 ± 0.73^{b}	16.05 ± 0.28^{b}	14.23 ± 0.22^{ab}	56.68 ± 1.02^{b}	59.83 ± 1.26^{b}	56.44 ± 0.86^{b}	57.44 ± 0.97^{b}	60.59 ± 0.91^{b}	13.15 ± 0.24^{b}
	IIB(54)	17.93 ± 1.17^{b}	16.11 ± 0.44^{b}	14.91 ± 0.36^{b}	56.96 ± 1.63^{b}	60.19 ± 2.02^{b}	56.00 ± 1.37^{b}	57.91 ± 1.55^{b}	61.65 ± 1.46^{b}	13.67 ± 0.38^{b}
Overall	(287)	16.23 ± 0.54	15.74 ± 0.21	14.21 ± 0.17	54.88 ± 0.76	58.21 ± 0.94	54.52 ± 0.64	55.49 ± 0.72	58.93 ± 0.68	12.53 ± 0.18
p value		0.004	0.043	0.006	0.001	0.017	<0.001	<0.001	<0.001	<0.001
Female Lambs	I(97)	11.94 ± 0.69^{a}	14.38 ± 0.30^{a}	13.54 ± 0.27^{a}	49.04 ± 1.16^{a}	52.47 ± 1.46^{a}	49.38 ± 0.92^{a}	49.77 ± 1.08^{a}	53.34 ± 1.01^{a}	10.44 ± 0.25^{a}
	IIA(138)	14.31 ± 0.57^{b}	14.96 ± 0.25^{ab}	13.49 ± 0.23^{a}	53.84 ± 0.97^{b}	56.67 ± 1.22^{ab}	53.91 ± 0.77^{b}	55.26 ± 0.91^{b}	58.26 ± 0.85^{b}	12.48 ± 0.21^{b}
	IIB(54)	15.43 ± 0.92^{b}	15.45 ± 0.40^{b}	14.43 ± 0.36^{b}	54.39 ± 1.56^{b}	57.54 ± 1.96^{b}	54.69 ± 1.23^{b}	56.02 ± 1.45^{b}	59.39 ± 1.36^{b}	12.35 ± 0.34^{b}
Overall	(289)	13.89 ± 0.43	14.93 ± 0.19	13.82 ± 0.17	52.42 ± 0.72	55.56 ± 0.91	52.66 ± 0.57	53.68 ± 0.68	57.00 ± 0.63	11.76 ± 0.16
p value		0.004	0.089	0.076	0.003	0.045	0.000	<0.001	<0.001	<0.001
Over all	(576)	15.09±0.30	15.34±0.10	13.98±0.11	53.73±0.40	56.98±0.49	53.68±0.34	54.63±0.37	57.93±0.35	12.15±0.11
p value		<0.001	0.001	0.054	0.012	0.026	0.012	0.049	0.027	0.004

The means with different alphabetic superscripts differ significantly ($p \leq 0.05$).

Table 2: Least square means (Mean±SE) of different morphometric data in sheep with two teeth age from different groups

Category	Group(n)	BW (kg)	FL (cm)	EL (cm)	CG (cm)	PG (cm)	WH (cm)	BL (cm)	RH (cm)	TL (cm)
Male two teeth	I(24)	35.76±1.41	22.13±0.46	16.92±0.64	76.33±1.31	83.08±1.38	69.88±0.83	72.63±1.05	74.42±1.01	14.96±0.49^{a}
	IIA(26)	38.33±1.35	21.58±0.44	16.35±0.61	74.81±1.25	81.42±1.32	70.27±0.80	73.27±1.01	76.15±0.97	16.62±0.47^{b}
	IIB(17)	38.84±1.67	21.94±0.55	17.29±0.76	76.00±1.55	82.94±1.64	71.41±0.99	74.53±1.25	77.53±1.20	17.00±0.58^{b}
Overall	(67)	37.64±0.86	21.88±0.28	16.85±0.39	75.71±0.80	82.48±0.84	70.52±0.51	73.48±0.64	76.03±0.61	16.19±0.30
p value		0.289	0.686	0.605	0.682	0.642	0.487	0.507	0.138	0.014
Female two teeth	I(31)	26.88±0.76^{a}	19.65±0.21	16.03±0.37	70.13±0.71	77.26±0.92^{a}	64.42±0.69^{a}	67.13±0.75^{a}	70.19±0.66^{a}	12.65±0.38^{a}
	IIA(38)	29.87±0.70^{b}	20.11±0.19	15.97±0.33	70.87±0.65	75.22±0.84^{ab}	67.30±0.63^{b}	69.03±0.69^{ab}	73.05±0.60^{b}	15.57±0.35^{b}
	IIB(14)	30.57±1.13^{b}	19.86±0.31	17.07±0.55	72.36±1.06	80.14±1.37^{b}	67.50±1.03^{b}	70.50±1.12^{b}	74.00±0.98^{b}	15.29±0.57^{b}
Overall	(83)	29.11±0.51	19.87±0.14	16.36±0.25	71.12±0.48	77.54±0.62	66.41±0.47	68.89±0.50	72.40±0.44	14.50±0.26
p value		0.005	0.267	0.206	0.226	0.010	0.005	0.034	0.001	<0.001
Over all	(150)	33.28±0.57	20.90±0.20	16.55±0.21	73.42±0.75	79.83±0.93	68.51±0.64	71.15±0.70	74.23±0.67	15.34±0.20
p value		<0.001	<0.001	0.150	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

The means with different alphabetic superscripts differ significantly ($p \leq 0.05$).

Table 3: Least square means (Mean±SE) of different morphometric data in sheep with four teeth age from different groups

Category	Group(n)	BW (kg)	FL (cm)	EL (cm)	CG (cm)	PG (cm)	WH (cm)	BL (cm)	RH (cm)	TL (cm)
Male four teeth	I(23)	38.36±1.29	21.96±0.39	16.17±0.61	76.74±1.19	84.17±1.39	69.65±1.66	71.91±0.97^{a}	74.70±0.87	14.91±0.52^{a}
	IIA(42)	40.38±0.96	21.74±0.29	16.62±0.46	77.60±0.88	83.48±1.03	69.81±1.23	74.57±0.72^{ab}	77.21±0.65	16.45±0.39^{b}
	IIB(10)	41.04±1.96	23.00±0.59	16.00±0.93	79.20±1.81	86.50±2.12	74.10±2.52	76.00±1.47^{b}	77.60±1.32	17.30±0.79^{b}
Overall	(75)	39.93±0.85	22.23±0.26	16.26±0.40	77.85±0.78	84.72±0.91	71.19±1.09	74.16±0.63	76.50±0.57	16.22±0.34
p value		0.371	0.168	0.760	0.526	0.441	0.281	0.033	0.051	0.020
Female four teeth	I(15)	30.08±1.10	19.87±0.36	16.67±0.46	72.53±1.19	78.27±1.70	63.53±2.14	71.27±0.94	67.47±2.15	14.6±0.44^{a}
	IIA(32)	31.14±0.75	20.13±0.25	15.91±0.31	72.03±0.81	77.84±1.16	67.69±1.47	70.25±0.64	73.19±1.47	15.44±0.30^{ab}
	IIB(13)	31.89±1.18	20.54±0.39	16.15±0.49	74.39±1.27	80.23±1.82	69.46±2.30	71.62±1.01	72.85±2.31	16.15±0.47^{b}
Overall	(60)	31.03±0.59	20.18±0.19	16.24±0.25	72.98±0.64	78.78±0.92	66.89±1.16	71.04±0.51	71.17±1.16	15.40±0.24
p value		.527	.445	.394	.301	.541	.146	.447	.086	.502
Over all	(135)	35.69 ±0.61	21.11 ±0.22	16.36 ±0.22	75.17 ±0.80	81.46 ±0.98	68.65 ±0.68	72.33 ±0.74	74.11 ±0.71	15.58 ±0.21
p value		<0.001	<0.001	0.561	<0.001	<0.001	0.022	<0.001	<0.001	0.848

The means with different alphabetic superscripts differ significantly ($p \leq 0.05$).

showed significance only in TL (Table 3). In the six-tooth age group, males showed significant differences in BW and TL, while females differed significantly in BW, WH, and TL (Table 4). In the full-mouth age group, significant variation was observed only in tail length among males (Table 5).

The lesser-known sheep of the Central Dry Zone of Karnataka exhibited moderate growth and robust body conformation compared to other regional breeds. Body weight, face length, and body length were intermediate, higher than Bellary (Jain *et al*., 2005a), Mandya (Jain *et al*., 2005b), Hassan (Jain *et al.,* 2006b), and Deccani (Ayanar *et al*., 2024) breeds, but lower than Yalaga (Dayanand, 2013), Mouli (Shashikant, 2014), and Macherla (Reddy *et al*., 2021) sheep. Chest girth, paunch girth, height at withers, and tail length indicated good thoracic, abdominal, and cranial development, with males consistently exceeding females, showing clear sexual dimorphism (Jain *et al.,* 2006a; Murali *et al*., 2024). Group-wise differences were most pronounced in lambs, with Groups IIA and IIB

Table 4: Least square means (Mean±SE) of different morphometric data in sheep with six teethage from different groups

Category	Group(n)	BW (kg)	FL (cm)	EL (cm)	CG (cm)	PG (cm)	WH (cm)	BL (cm)	RH (cm)	TL (cm)
Male six teeth	I(15)	47.87±1.27^{b}	23.53±0.29	16.13±0.68	84.13±1.33	92.87±1.62	75.67±0.88	79.60±1.33	79.00±0.96	15.80±0.59^{a}
	IIA(28)	43.96±0.93^{a}	23.39±0.21	16.57±0.50	82.29±0.97	89.32±1.19	73.86±0.64	78.93±0.97	79.79±0.70	17.46±0.43^{b}
	IIB(16)	49.74±1.23^{b}	23.56±0.28	16.88±0.66	83.63±1.29	89.75±1.57	75.50±0.85	81.00±1.29	80.75±0.93	17.13 ±0.57^{ab}
Overall	(59)	47.19±0.66	23.50±0.15	16.53±0.36	83.35±0.70	90.65±0.85	75.01±0.46	79.84±0.70	79.84±0.50	16.80±0.31
p value		0.001	0.862	0.732	0.484	0.200	0.161	0.444	0.426	0.077
Female six teeth	I(24)	33.24±0.93	20.92±0.26	16.75±0.43	75.75±0.82	81.92±1.07	66.79±0.74^{a}	71.04±0.67^{a}	71.92±0.77^{a}	13.42±0.48^{a}
	IIA(34)	34.72±0.78	20.68±0.22	16.06±0.36	74.15±0.69	80.59±0.90	68.27±0.62^{ab}	72.21±0.57^{a}	73.77±0.65^{ab}	15.79±0.40^{b}
	IIB(22)	33.65±0.97	20.86±0.28	16.50±0.44	75.50±0.86	82.55±1.12	70.18±0.78^{b}	74.05±0.70^{b}	74.36±0.81^{b}	15.82±0.50^{b}
Overall	(80)	33.87±0.52	20.82±0.15	16.44±0.24	75.13±0.46	81.68±0.60	68.41±0.41	72.43±0.38	73.35±0.43	15.01±0.27
p value		0.440	0.755	0.445	0.263	0.365	0.009	0.011	0.073	<0.001
Over all	(139)	39.77±0.59	22.04±0.21	16.50±0.21	78.72±0.78	85.62±0.96	71.23±0.66	75.60±0.72	76.25±0.69	15.87±0.21
p value		<0.001	<0.001	0.696	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

The means with different alphabetic superscripts differ significantly ($p \leq 0.05$).

Table 5: Least square means (Mean±SE) of different morphometric data in sheep with full mouth age from different groups

Category	Group(n)	BW (kg)	FL (cm)	EL (cm)	CG (cm)	PG (cm)	WH (cm)	BL (cm)	RH (cm)	TL (cm)
Male full mouth	I(35)	48.54 ± 0.85	23.51 ± 0.21	15.96 ± 0.40	84.86 ± 0.87	92.03 ± 0.85	75.06 ± 0.69	77.43 ± 0.74	79.43 ± 0.68	15.49 ± 0.36^{a}
	IIA(42)	47.36 ± 0.77	23.00 ± 0.19	16.50 ± 0.36	83.33 ± 0.79	90.71 ± 0.78	75.50 ± 0.63	79.38 ± 0.67	80.00 ± 0.62	17.02 ± 0.33^{b}
	IIB(12)	49.19 ± 1.45	23.58 ± 0.35	16.58 ± 0.68	83.67 ± 1.49	89.67 ± 1.47	74.08 ± 1.18	78.92 ± 1.26	80.00 ± 1.16	17.25 ± 0.62^{b}
Overall	(89)	48.36 ± 0.62	23.37 ± 0.15	16.35 ± 0.29	83.95 ± 0.63	90.80 ± 0.62	74.88 ± 0.50	78.58 ± 0.54	79.81 ± 0.49	16.59 ± 0.26
p value		0.418	0.129	0.542	0.426	0.311	0.569	0.147	0.807	0.004
Female full mouth	I(25)	36.91 ± 0.95	21.56 ± 0.26	16.48 ± 0.36	77.60 ± 0.82	85.76 ± 1.18	70.84 ± 0.79	73.52 ± 0.73	74.68 ± 0.69	14.16 ± 0.45
	IIA(34)	34.70 ± 0.82	21.24 ± 0.22	16.68 ± 0.31	75.21 ± 0.70	82.71 ± 1.02	68.94 ± 0.67	72.88 ± 0.62	73.85 ± 0.59	14.77 ± 0.38
	IIB(05)	35.62 ± 2.13	20.80 ± 0.58	17.00 ± 0.80	76.40 ± 1.83	86.00 ± 2.65	67.80 ± 1.76	71.40 ± 1.62	73.80 ± 1.54	16.00 ± 0.1
Overall	(64)	35.74 ± 0.83	21.20 ± 0.23	16.72 ± 0.31	76.40 ± 0.71	84.82 ± 1.02	69.19 ± 0.68	72.60 ± 0.63	74.11 ± 0.60	14.98 ± 0.39
p value		0.221	0.413	0.813	0.094	0.121	0.114	0.472	0.642	0.528
Over all	(153)	42.71 ±0.57	22.43 ±0.20	16.55 ±0.21	80.71 ±0.76	88.18 ±0.93	72.87 ±0.64	76.36 ±0.70	77.55 ±0.67	15.77 ±0.20
p value		<0.001	<0.001	0.346	<0.001	<0.001	<0.001	<0.001	<0.001	0.226

The means with different alphabetic superscripts differ significantly ($P \leq 0.05$).

belonging to Sira Taluk of Tumkur district out performing Group I belonging to Hiriyur Taluk, Chitradurga district highlighting the population's potential for breed characterization and improvement programs.

CONCLUSION

The lesser known sheep population of Central dry zone of Karnataka occupy a distinct position among Karnataka sheep breeds. Morphometrically, they are heavier than Mandya, Hassan and Deccani while closer to Bellary and have lesser body weight than Kenguri rams but comparable to Kenguri ewes. The studied sheep population of this region consistently show greater body length, ear length and tail length than any of the recognized breeds showing distinctiveness phenotypically. The characteristic coat colour of predominant, black, black and brown and admixture of black, brown and white is unique to the population of Sira taluk, Tumkur district which is different from other breeds of Karnataka. However the genotyping of the sheep population in Chitradurga (Group I) and Tumkur district (Group IIA and B) have to be studied in

depth to classify these populations as a separate breed from the existing registered breeds.

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