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Principal Component Analysis of Morphometric Traits of Tripura Desi Cattle

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ABSTRACT

Background: In 234 cows of Tripura desi cattle from three districts, 18 different biometric traits were measured and analyzed by PCA to explain body conformation. These traits included body length, height at withers, heart girth, paunch girth *etc.* The native cattle in Tripura are of a smaller breed, according to the average of these several traits.

Methods: Six factors that accounted for roughly 75.67% of the variation overall were found using factor analysis with promax rotation. Explaining 26.07% of the total variation, factor 1 characterized the overall body structure. The measurements of tail length, shank length, heart girth, paunch girth, circumference of horn and horn length were significantly positive with high loadings.

Result: The outcome indicates that a significant decrease in the number of biometric parameters required to record in order to explain body conformation could lead to the application of principal component analysis (PCA) in breeding programmes. As a result, the study will support conservation efforts and the stabilization of this non-descript breed of cow.

Key words: Biometric traits, Principal component analysis, Tripura desi cattle.

INTRODUCTION

Body measurements provide an indication of body conformation, they have been used to signify breed, origin, relationship, or size and shape of an individual. However, when the recorded traits are connected, principal component analysis (PCA) can provide a better explanation of the correlations between biometric traits. Tripura's native cattle are still regarded as non-descript cattle in the nation. Thus, the goal of the current study is to investigate the different body measurements, the correlations between them and the development of latent or unobservable factors in order to determine which of these measures best captures the body conformation of cows from Tripura's desi cattle. The annual income of the farmers was around 69333.33 rupees (Majumder *et al.*, 2023).

MATERIALS AND METHODS

Data collection

18 distinct biometric traits were taken from 234 native Tripura cows (3 years of age and older) in three regions *viz.* South, North and West Tripura with heavy concentration of these cows (Fig 1). The authors are thankful to Animal Genetics and Breeding Department, College of Veterinary Science and Animal Husbandry, Selesih, Central Agricultural University for conducting the study during 2018-2021. Almost all the biometric traits were recorded in the present study with standard procedure and data, thus obtained were put to statistical analysis (SPSS, 2001).

RESULTS AND DISCUSSION

Morphometric traits

Most of the cattle are small in size in Tripura where 72.46% was having medium body size for gangatiri cattle (Kumar *et al.*, 2017) and Hill cattle were small in size with strong legs which make them adaptable for hilly areas of Uttarakhand (Patoo *et al.*, 2015). The average body length (BL), height

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at withers (HW), heart girth (HG), paunch girth (PG), length of arm (AL), elbow length (EIL), foreshank length (FSL), thigh length (THL), hindshank length (HSL), pes length (PesL), tail length (TL), switch length (SL), ear length (EL), head length (HDL), eye to eye space (EES), circumference of horn (HOC), space between the horns (SBHO) and horn length (HL) in adult female cattle were 85.39±1.71 cm, 87.86±1.71 cm, 112.80±2.86 cm, 112.02±2.91 cm, 26.35±1.03 cm, 39.76±1.24 cm, 27.29±0.50 cm, 39.24±1.32 cm, 35.16±0.59 cm, 39.67±0.43 cm, 47.33±1.34 cm, 17.16±1.00 cm, 15.96±0.40 cm, 33.35±0.86 cm, 11.63±0.30 cm, 7.23±0.75 cm, 11.04±0.46 cm and 8.73±0.89 cm, respectively (Table 1). In the age group of above 3 years, females exhibited lower values than the males for most of the biometric traits in local cattle of Tripura. The average values of BL, HW, HG and PG were significantly lower in females than the males. It was also observed that all the morphometric traits were lower in females than males.

The village had no significant effect similar with Red Kandhari cattle (Das *et al.*, 2018). The non-significant district effect on all traits under study may conclude the stabilized population of this breed in the breeding tract. Tripura's native cows having short, horizontally oriented ears and a long tail that resemble Sikkim's Siri cattle, according to the morphometric features seen in this study (Phanchung and Roden, 1996).

Pundir *et al*. (2007) documented that the average BL, HW, HG and PG were reported to be 123, 119, 162, 182 cm respectively in cows of Red Sindhi cattle breed which was higher than the cows of Tripura local cattle. The studies conducted on cows of Mizoram local cattle population (Anal, 2015) revealed that the overall average of length of body, height at wither, length of head, chest girth, paunch girth, length of ear and circumference of horns were higher than the Tripura local cows of local cattle. The average height at wither, body length and heart girth (121.62±0.47, 155.88±0.79 and 171.73±0.90 cm, respectively) in female Vrindavani cattle of above 3 years of age (Singh *et al*., 2011) were reported to be higher than the present findings for each trait.

In phenotypic characterization of Bachaur breed of cattle, Singh *et al*. (2010) reported that the average length of horn, length of ear, length of face, heart girth, body length, height at withers and length of tail of adult females were 10.13±0.21, 18.73±0.11, 39.02±0.12, 140.22±1.99, 109.79±1.06, 110.41±0.84 and 72.90±0.31 cm respectively

Table 1: Mean±SE (N = 234) of various biometric traits of Tripura desi cattle.

Traits	Mean±SE (cm)	Coefficient of variation (%)
BL[1]	85.39±1.71	14.16
HW[2]	87.86±1.71	13.76
HG[3]	112.80±2.86	17.93
PG[4]	112.02±2.91	18.36
AL[5]	26.35±1.03	27.63
EIL[6]	39.76±1.24	22.06
FSL[7]	27.29±0.50	12.93
THL[8]	39.24±1.32	23.78
HSL[9]	35.16±0.59	11.86
PesL [10]	39.67±0.43	7.66
TL[11]	47.33±1.34	20.00
SL[12]	17.16±1.00	20.20
EL [13]	15.96±0.40	17.73
HDL[14]	33.35±0.86	18.23
EES[15]	11.63±0.30	18.23
HOC [16]	7.23±0.75	73.31
SBHO[17]	11.04±0.46	29.44
HL [18]	8.73±0.89	72.05

*body length[1], height at withers[2], heart girth[3], paunch girth[4], length of arm[5], elbow length[6], foreshank length[7], thigh length[8], hindshank length[9], pes length[10], tail length[11], switch length[12], ear length[13], head length[14], eye to eye space[15], circumference of horn[16], space between the horns[17], horn length[18]



Fig 1: A cow of Tripura desi cattle.

which was higher than the findings in the cows of Tripura local cattle.

Factor analysis

The computed Anti-image correlations revealed low partial correlations, suggesting the presence of real factors in the data. Component number with eigen values of cows have shown in scree plot (Fig 2). The Kaiser-Meyer-Olkin (KMO) measure of sample adequacy was 0.369 in current study. The results in the present study is in accordance with Pundir *et al.* (2011), however higher values of sampling adequacy was reported in Kankrej cows.

Table 2 displays the estimated factor loading derived from factor analysis, as well as the eigen values and variation explained by each factor. Seventy-six percent (75.673%) of the variance was explained by six factors that were retrieved and had eigen values larger than one. Factor 1 described the general body conformation and explained 21.85% of total variation in case of Tripura bull (Majumdar *et al.*, 2021).

However, by examining 14 morphometric features of White Fulani cattle, Yakubu *et al.* (2009) extracted two factors in the age group of 2.5 to 3.6 years explaining 86.47% of the overall variation. Out of all measures used in the study, the first factor explained 26.07% of the difference. In cows

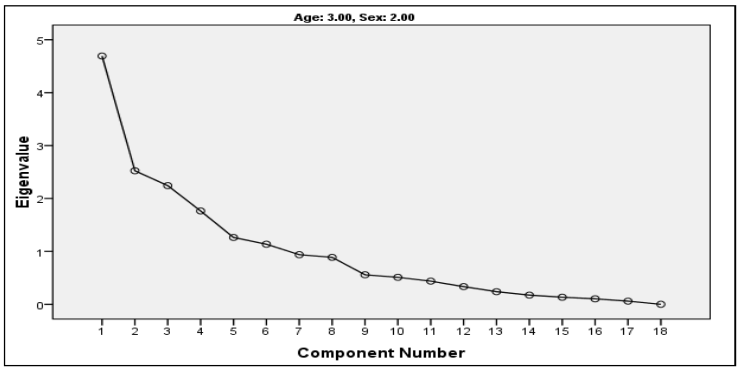

Fig 2: Component number with eigen values of cows in scree plot.

Table 2: Total variance explained by different factors in Tripura desi cattle.

Component	Initial eigen values			Extraction sums of squared loadings			Rotation sums of squared loadings[a]
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %	Total
1	4.69	26.07	26.07	4.69	26.07	26.07	3.78
2	2.52	14.02	40.09	2.52	14.02	40.09	3.19
3	2.24	12.46	52.55	2.24	12.46	52.55	2.98
4	1.76	9.80	62.35	1.76	9.80	62.35	2.32
5	1.26	7.02	69.37	1.26	7.02	69.37	1.71
6	1.14	6.31	75.67	1.14	6.31	75.67	1.56
7	0.94	5.21	80.89				
8	0.89	4.93	85.82				
9	0.56	3.10	88.92				
10	0.51	2.84	91.75				
11	0.44	2.43	94.19				
12	0.34	1.86	96.04				
13	0.24	1.33	97.37				
14	0.17	0.97	98.34				
15	0.13	0.75	99.08				
16	0.10	0.58	99.66				
17	0.06	0.34	100.00				
18	0.00	0.01	100.00				

*Body length[1], height at withers[2], heart girth[3], paunch girth[4], length of arm[5], elbow length[6], foreshank length[7], thigh length[8], hindshank length[9], pes length[10], tail length[11], switch length[12], ear length[13], head length[14], eye to eye space[15], circumference of horn[16], space between the horns[17], horn length[18].

Table 3: Communalities of different morphometric traits in Tripura desi cattle.

Morphometric traits	Initial	Extraction	Unique factor
BL[1]	1.000	0.797	0.203
HW[2]	1.000	0.654	0.346
HG[3]	1.000	0.879	0.121
PG[4]	1.000	0.860	0.140
AL[5]	1.000	0.830	0.170
ElL[6]	1.000	0.722	0.278
FSL[7]	1.000	0.699	0.301
THL[8]	1.000	0.797	0.203
HSL[9]	1.000	0.818	0.182
PesL [10]	1.000	0.705	0.295
TL[11]	1.000	0.568	0.432
SL[12]	1.000	0.816	0.184
EL [13]	1.000	0.792	0.208
HDL[14]	1.000	0.758	0.242
EES[15]	1.000	0.692	0.308
HOC [16]	1.000	0.784	0.216
SBHO[17]	1.000	0.750	0.250
HL [18]	1.000	0.700	0.300

*body length[1], height at withers[2], heart girth[3], paunch girth[4], length of arm[5], elbow length[6], foreshank length[7], thigh length[8], hindshank length[9], pes length[10], tail length[11], switch length[12], ear length[13], head length[14], eye to eye space[15], circumference of horn[16], space between the horns[17], horn length[18]

the first factor was represented by significant high positive loading of HW (0.716), HG (0.668), PG (0.648), FSL (0.611), TL (0.638), HOC (0.650) and HL (0.610). This factor seems to be describing the overall size of the local cattle cows, or the body type of the female cattle. According to Pundir *et al.* (2011), the first component accounted for 38.89% of the variation in Kankrej cows.

The second factor, which had a relatively greater loading for HG in Tripura female cattle, explained 14.02 per cent of the total variability. The third factor , which had a somewhat greater loading for PG characteristics, explained 12.46% of the overall variability. The fourth factor, which had a significant loading of shank length, explained 9.80% of the variation overall. The sixth component, which had high loading for both HL and HOC, accounted for 6.31% of the total variation, whereas the fifth factor, which had high loading for tail length, accounted for 7.02%. Tolenkhomba *et al.* (2012) extracted 7 factors with eigen value more than 1 in local cows of Manipur.

For all of the various biometric parameters under investigation, the estimated communality ranged from 0.879 (HG) to 0.568 (TL), while the unique factors varied from 0.121 to 0.432 (Table 3). Sadek *et al.* (2006) reported range of 0.42 to 0.87 and Yakubu *et al.* (2009) found higher estimates of communality, ranging from 0.79 to 0.93.

CONCLUSION

The source of shared variability to explain body conformation in Tripura cows is determined by the six extracted factors. The first component successfully explains the typical body conformation of Tripura cows. The findings imply that the number of biometric parameters required to record in order to explain body conformation could be drastically reduced when using principal component analysis (PCA) in breeding programmes.

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Conflict of interest

There is no conflict of interest.

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