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Use of body surface area in rural buffaloes

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Significant contribution of buffaloes and its milk to country's production is well recognized. Generally, body size is assessed on the body weight of the animal and can be helpful in formulating strategy for improved breeding and feeding of animals. In absence of weighing facilities at rural level, body weight estimation is either, visual and subjective or by measuring chest girth. Estimation of body surface area (BSA) by simple approach could be useful as a tool to relate animal body size with feeding and performance. Available scanty reports in buffaloes (Buranakarl *et al*. 2012) and in cattle (Abd EI-Aleem Desoky *et al*. 2014), focus towards standardizing process of drug doses and minimum space allowance for animal. Attempt in the present investigation was made to use the photographic image of animal and estimate growth measures and body surface area (BSA).

Growth observations generated on 919 buffaloes ranging between 39 to 89 months of age maintained at the doorstep of 846 farmers spread over 555 villages in 5 districts (Allahabad, Badhohi, Fatehpur, Juanpur, and Mirzapur) of Uttar Pradesh were used as material for present study. The buffaloes were food housed in temporary (*Kuccha*) or permanent (*Pakka*) sheds and semi-intensive method of rearing was followed. Concentrates were fed only to milking buffaloes. The body condition of the animal was subjectively graded as good, normal and poor while body size as large, medium and small, respectively. Animals were grouped in 4 age groups (39–54, 55–66, 67–77 and >77 months, respectively). Farmers were grouped according to their main profession (Agriculture, Business, Dairy and service). Taking 2D photographic image of animal by digital camera (with resolution of 640 × 480 pixels) and using computer software (BIOVIS PSM_L1000), body measures and body weight were estimated as per Rath *et al.* (2003). The animal body surface area (BSA) was calculated using approach suggested by Hurnik *et al*. (1991) and adopted by Gokhale *et al*. (2015). The data so generated were statistically analyzed using IBM SPSS Package (1999).

Mean body surface area (BSA) was 2.92±0.16 sq m. The estimates observed in the present investigation were similar to those reported by Gokhale *et al.* (2015), less than those reported by Buranakarl *et al.* (2012) and more than those reported by Hurnik *et al.* (1991) and Napolitanoa *et al*. (2004). Least square analysis to estimate effect of region (district), body condition, body size, age group of the animal and the profession of the farmer on body measurements is presented in Table 1.

Marginal significance of variation in BSA is noted across districts within region, reflected differences in agro-geological variations, buffaloes of Mirzapur district although were similar in BSA to those in Bhadohi district but they showed significantly smaller BSA compared to those in other districts. District wise means of body measurements such as heart girth, height at withers, body length and estimated body weight for the districts studied are mentioned in Table 1. District differences in body measurements of adult buffaloes were insignificant.

Nearly 44.18% animals were visually found good in body condition; those in normal and poor condition were found to be 40.91% and 14.91%, respectively. The animals classed

Fig 1. Buffalo with cloth patch.

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Table 1. Least square means for different district, body size, body condition, animal age, profession, and housing type-wise body measurements (cm), estimated body weight (kg) and BSA (body surface area in m^2)

Source	N	Body length (cm)	Height at withers (cm)	Chest girth (cm)	Body weight (kg)	BSA (m^2)
District						
Allahabad	121	101.49±1.67^{a}	128.47±1.74	151.79±2.48	221.84±9.77^{a}	2.99±0.06 ^{a}
Badhohi	49	100.98±2.16^{a}	131.47±2.25	152.01±3.20	219.39±12.63^{a}	2.94±0.10 ^{a}
Fatehpur	336	101.06±1.36^{a}	127.99±1.42	154.25±2.02	228.67±7.96^{ab}	3.03±0.05^{ab}
Juanpur	265	102.63±1.46^{a}	129.14±1.52	152.93±2.16	226.21±8.53^{ab}	2.97±0.06^{ab}
Mirzapur	148	96.54±1.53^{b}	128.85±1.59	150.01±2.27	207.06±8.94 ^{a}	2.83±0.06^{ab}
Body size						
Large	269	101.71±1.52	131.64±1.58^{a}	156.67±2.26^{a}	238.64±8.87^{a}	3.07±0.06^{a}
Medium	420	99.81±1.40	127.83±1.47^{bc}	150.62±2.08^{bc}	214.02±8.22 ^{b}	2.90±0.05^{bc}
Small	230	100.10±1.50	128.08±1.56^{bc}	149.30±2.22^{bc}	209.23±8.76 ^{c}	2.89±0.06^{bc}
Body condition						
Good	406	102.75±1.46^{a}	130.84±1.52	154.33±2.17	229.64±8.56	3.03±0.05
Normal	376	99.98±1.39^{b}	128.71±1.44	152.55±2.06	220.88±8.12	2.96±0.05
Poor	137	98.89±1.66^{b}	127.99±1.73	149.71±2.46	211.85±9.71	2.86±0.06
Animal age group						
39 to 54	221	97.66±2.17	127.61±2.26	150.23±3.23	209.49±12.70	2.94±0.23
55 to 66	465	99.80±1.07	128..02±1.10	150.94±1.58	216.12±6.22	2.94±0.24
67 to 77	188	101.55±2.00	128.76±2.08	149.79±2.96	213.21±11.68	2.94±0.25
78 to 89	45	103.16±3.86	132.35±4.02	157.82±5.73	243.70±22.56	2.94±0.26
Main profession						
Agriculture	788	98.42±1.01^{a}	127.81±1.05	153.04±1.50	221.38±5.91	2.95±0.03
Business	30	98.38±2.53^{a}	130.50±2.64	153.02±3.76	220.25±14.83	2.91±0.11
Dairy	42	109.31±2.21^{b}	131.69±2.30	152.25±3.28	235.36±12.93	3.10±0.09
Service	59	96.04±1.88^{a}	126.72±1.96	150.47±2.80	205.53±11.03	2.83±0.08
Housing type						
Kaccha	618	99.07±0.84	128.10±1.52^{a}	154.59±1.66^{a}	226.20±7.57^{a}	3.02±0.04^{a}
Pakka	301	98.03±1.43	124.16±1.80^{b}	148.65±1.79^{b}	207.35±7.87^{b}	2.88±0.06^{b}
Total	919	98.73±0.44	126.81±0.44	152.64±0.64	220.03±0.02	3.01±0.02

Means in column with different superscript differ significantly (P<0.05).

as poor body condition showed significantly lesser BSA than those classed as good body condition although the difference between normal and good condition animals were non-significant. In the population studied, 29.27% were large sized animals while 45.70% and 25.03% were medium and small sized animals. BSA estimates for larger size animals were significantly higher than those of medium or smaller sized animals.

Majority (85.75%) of buffalo keepers were farmers practicing agriculture for their livelihood, while and 3.26% were involved in business, 4.57% in dairy production as main profession 6.42% were in service. Generally the farmers rearing buffaloes for dairy as a profession had animals of larger BSA (3.10±0.09) and higher body measurements compared to farmers of other professions.

More than two-third fraction (67.25%) of animals housed in temporary housing were of significantly larger BSA (3.02±0.04 sq. mtrs) compared to 32.75% animals housed in permanent housing having mean BSA as 2.88±0.06 sq. m. More airy space and soft floor in temporary housing might have helped animals to grow in size to have a larger BSA.

The correlations between different body measurements studied and body surface area were estimated (Table 2).

Table 2. Correlation between the estimates of body surface area and body measurements

Approach	Body length (cm)	Height at withers (cm)	Chest girth (cm)	Body weight (kg)	BSA (m^2)
Body length (cm)	-	0.633	0.500	0.673	0.691
Height at withers (cm)	0.633	-	0.617	0.680	0.702
Chest girth (cm)	0.500	0.617	-	0.952	0.957
Body weight (kg)	0.673	0.680	0.952	-	0.993
BSA (m^2)	0.691	0.702	0.957	0.993	-

Correlations ranged from 0.500±0.03 to 0.993± 0.03 and were highly significant indicating their utility in field level standardization of animal size and relating it with the feeding evaluation.

From this study, it was concluded that body surface area of rural buffaloes can be assessed using digital photographic image and computer software. Field level estimation of body measurement parameters using such an approach can be useful for strategizing feeding and performance evaluation.

SUMMARY

The study on 919 rural Murrah adult buffaloes aging between 39 to 89 months belonging to 846 farmers spread in 555 villages of 5 districts in Uttar Pradesh was conducted to estimate body surface area (BSA) using 2D photographic image by digital camera and using computer software BIOVIS PSM_L1000. Mean BSA was 2.92±0.16 sq. m. Effect of district, body condition and age of animal was not significant while animal body size and profession of buffalo keeper were found to have important effect on the BSA of animal. Mean body length, height at withers, chest girth and estimated body weight were 98.73±0.44 cm, 126.81±0.44 cm, 152.64±0.64 cm and 220.03±0.02 kg, respectively. Correlations between different body measurements studied and BSA were highly significant and ranged from 0.500±0.03 to 0.993±0.03 indicating their utility at field level for selecting traits effective in strategizing breeding programs in districts of eastern Uttar Pradesh region.

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