Morphological characterization of the Azikheli buffalo in Pakistan

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Summary

This study aims to characterize Azikheli, an undocumented buffalo breed, in its home tract (Khwazakhela, Swat, Pakistan) under traditional farming conditions. For this purpose, 108 buffalo cows and 27 bulls were randomly selected. Mean, standard error, Student's *t* test and Chi-square test were used for various comparisons. The results show that the majority of animals have a brown coat colour. Cows have significantly higher heart girths, longer horns, longer necks and wider faces at the level of the eyes than bulls, whereas bulls have significantly longer bodies, longer ears, thicker horns, thicker necks and larger hooves than cows. Horns are flat laterally, directed backwards and then slightly upwards without twisting, leading to a sickle to semi-sickle appearance. Owing to its small body size and brown coat colour, the breed is well adapted to mountain slope grazing and thrives well away from swamps. Its adaptation to mountainous ecosystems warrants its *in situ* conservation.

Keywords: *phenotypic, morphometric, characteristics, Azikheli buffalo breed, Pakistan*

Résumé

Cette étude cherche à caractériser la race de buffle non documentée Azikheli dans son territoire d'origine (Khwazakhela, Swat, Pakistan) sous les conditions d'élevage traditionnelles. Pour ce faire, 108 bufflonnes et 27 mâles ont été sélectionnés au hasard. La moyenne, l'erreur type, le test de Student et le test du Khi-carré ont été utilisés pour faire plusieurs comparaisons. Les résultats montrent que la plupart des animaux ont un pelage brun. Les vaches ont, significativement, une circonférence thoracique plus grande, des cornes et des cous plus longs et une face plus large au niveau des yeux, par rapport aux mâles. Par contre, les mâles ont, significativement, des oreilles et des corps plus longs, des cornes et des cous plus gros et des onglons plus grands que ceux des bufflonnes. Les cornes partent horizontalement vers les côtés puis se dirigent vers l'arrière et finalement montent sans se tordre, ce qui fait que les cornes aient l'aspect d'une faucille ou demi-faucille. En raison de sa petite taille corporelle et de la couleur brune de son pelage, la race est bien adaptée au pâturage sur les flancs des montagnes et se développe bien en dehors des zones marécageuses. Son adaptation aux écosystèmes montagneux garantit sa conservation *in-situ*.

Mots-clés: *caractéristiques phénotypiques et morphométriques, race de buffle Azikheli, Pakistan*

Resumen

Este estudio pretende caracterizar el ganado Azikheli, una raza de búfalos no documentada, en su área de origen (Khwazakhela, Swat, Pakistán) y bajo condiciones de cría tradicionales. Con este fin, se seleccionaron aleatoriamente 108 búfalas y 27 machos. Se usaron la media, el error estándar, la prueba t de Student y la prueba Chi-cuadrado para realizar múltiples comparaciones. Los resultados muestran que la mayoría de los animales presentan una capa de color marrón. Las vacas tienen, significativamente, mayores circunferencias torácicas, cuernos y cuellos más largos y la cara más ancha a la altura de los ojos, en comparación con los toros. Sin embargo, los toros tienen, significativamente, cuerpos y orejas más largos, cuernos y cuellos más gruesos y pezuñas más grandes que las vacas. Los cuernos parten de forma horizontal hacia los lados para a continuación dirigirse hacia atrás y después ligeramente hacia arriba sin retorcerse, con lo que adquieren un aspecto de hoz o semi-hoz. Debido a su pequeño tamaño corporal y al color pardo de su capa, la raza está bien adaptada al pastoreo en las laderas de montaña y se desarrolla bien fuera de las zonas pantanosas. Su adaptación a ecosistemas montañosos garantiza su conservación *in-situ*.

Palabras clave: *características fenotípicas y morfométricas, raza de búfalos Azikheli, Pakistán*

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Figure 1. Map of the study area.

Introduction

Indigenous livestock breeds are known for their hardiness, disease resistance, survival on little inputs and adaptability to variable environments (Köhler-Rollefson *et al.*, 2009). Such breeds are therefore believed to be more economically efficient than other breeds when raised in their home tract (Ayalew *et al.*, 2003). Many indigenous livestock breeds are, however, on the verge of extinction because of their gradual dilution, as driven by market demands and inappropriate use of new breeding technology (Köhler-Rollefson *et al.*, 2009). Limited awareness of the adaptive characteristics of indigenous livestock breeds owing to a lack of proper scientific documentation is one of the key reasons for such dilution (Hassen *et al.*, 2007; Köhler-Rollefson *et al.*, 2009).

There are quite a number of indigenous livestock breeds that still need to be scientifically documented and characterized to enable their conservation (Bhatia & Arora, 2005). To make the conservation of indigenous breeds a reality and ensure sustainable use of their genetic diversity, it is particularly desirable that their phenotypic characteristics and performance be evaluated in their home tracts and under traditional management conditions (Zarate,

1996). Identification of specific breed attributes can also contribute to better use of these genetic resources by farmers (Mwacharo *et al.*, 2006).

In Pakistan, the most thoroughly studied indigenous buffalo breeds are Nili-Ravi and Kundi, though 37 percent of the buffalo population has been categorized as non-descript (Khan *et al.*, 2007). These non-descript breeds also include Azikheli, which is known for its adaptation to the mountain environment (Khan *et al.*, 2011). The present investigation is thus designed to study the morphological (physical and morphometric) characteristics of Azikheli in its home tract under traditional management conditions.

Materials and methods

Home tract and study area

The Azikheli is named after its original home tract known as Azikhel (Khwazakhela union council). Khwazakhela, which covers an approximate area of 124 km^2 and is one of several tributary valleys of the Swat River, has been chosen as the study area for this investigation (Figure 1). Khwazakhela has a mean temperature ranging from $-2°C$ to $33°C$ and an average annual rainfall of 1400 to 1500 mm (Khan & Atta-ur Rahman, 2010).

The broader home tract of the breed includes the watershed of the Swat River (Swat district) and the Panjkora River (Lower and Upper Dir districts), as well as the Shangla, Buner, Batagram, Manshera and Malakand districts, and covers approximately 20 000 km^2 and has an elevation range from 516 to 3 314 m a.s.l. Pockets of the breed can also be found in the districts of Mardan, Charsadda, Nowshera and Sawabi as a result of buffalo transhumance that prevails in some farming communities.

Sampling pattern

Khwazakhela union council includes seven main villages. Three villages were randomly selected: Tikdarai, Tetabat and Bar Shamak (Figure 1). The number of cows (with at least one parturition) and bulls (aged 3 years or more, and which are used for breeding purposes) randomly selected from these villages is presented in Table 1. For the cows, measurements were made within 2–3 months

Table 1. Sampling pattern.

Name of village	Total number of households	Number of adult cows			Number of adult bulls	
		Total	With at least one parturition	Randomly selected	Total	Randomly selected
Tikdharai	248	992	252	36	22	9
Tetabat	218	872	220	36	18	9
Bar Shamak	211	844	214	36	16	9
Total	677	2 708	686	108	56	27

after parturition by using measuring tape according to Food and Agriculture Organization (1986).

Physical characteristics (colour of the body coat, forehead, eyelashes, eyes, horns, muzzle, forelegs, hind legs and hooves) were recorded for each selected animal, and measurements were taken for the heart girth (body circumference immediately posterior to the front leg), body length (distance from shoulder point to pin bone), height at withers (the vertical distance from the ground level to the highest point of withers) and at hip bone (the vertical distance from the ground level to the hipbone), width of head (between horns and between eyes), ear length (distance from the tip of the ear to the base of the ear), ear width (at the widest part of ear), face length (the distance between the head pol and muzzle), horn length (the distance from the tip of the horn to the base of the horn both along greater and smaller curvatures), horn circumference (at base, middle region and below tip), neck length (the distance from at the junction with shoulder to at the junction with head) and circumference (at the midway from the junction with shoulder and junction with head), loin length (distance from withers to last rib), chine (distance from last rib to hipbone), rump length (distance from hip to pin bone) and width (distance between the lateral surfaces of the tuber coxae), height of front leg below the knee (vertical distance from knee to the ground level), height of hind leg below hock (vertical distance from hock to the ground level),

Figure 2. Azikheli cow.

height of pastern (vertical distance from pastern to ground level) and circumference of hoof and length of tail (distance from the tail drop to the tip of the tail).

Statistical analysis

Chi-square tests of independence were used to compare the physical characteristics of bulls and cows. Mean, standard error and Student's *t* test were calculated for morphometric measurements of both sexes.

Table 2. Physical characteristics of Azikheli.

Body part	Colour pattern (%)	Cow, $n = 108$	Bull, $n = 27$	Chi-square value	*P*-value
Coat	Brown	62.04	59.26	$\chi^2_{(3)} = 0.32$	>0.05
	Black	22.22	22.22		
	Black and white	11.11	14.82		
	White	04.63	03.70		
Forehead	Completely white	61.11	55.56	$\chi^2_{(2)} = 2.93$	>0.05
	White-spotted	29.63	29.63		
	White extended to nose bridge	09.26	14.81		
Eyelashes	White	50.00	44.44	$\chi^2_{(3)} = 0.45$	>0.05
	Black	27.78	29.64		
	Brown	17.59	22.22		
	Reddish with black tinge	04.63	03.70		
Eyes	Shiny blue	80.00	76.00	$\chi^2_{(1)} = 0.45$	>0.05
	Black	20.00	24.00		
Horns	Completely brown	34.26	29.63	$\chi^2_{(3)} = 0.54$	>0.05
	Black	51.85	51.85		
	Brown with black tips	09.26	11.11		
	Black with brown tips	04.63	07.41		
Muzzle	White	55.55	51.85	$\chi^2_{(3)} = 0.17$	>0.05
	Black	15.74	18.53		
	Black and white	14.81	14.81		
	Black-pigmented to whitish-pigmented	13.90	14.81		
Forelegs	White below knee	75.00	70.37	$\chi^2_{(2)} = 0.96$	>0.05
	Completely white	10.19	07.41		
	Black and white	14.81	22.22		
Hind legs	White below hock	65.74	59.26	$\chi^2_{(2)} = 0.41$	>0.05
	Completely white	14.82	18.52		
	Black and white	19.44	22.22		
Hoof	Brown	60.19	55.55	$\chi^2_{(2)} = 0.22$	>0.05
	Black	37.04	40.75		
	Brown with black striation	2.77	03.70		

Figure 3. Azikheli bull.

Table 3. Mean values (±SEM) of morphometric measurements (cm) of Azikheli.

Variables	Cow	Bull
Heart girth	191.36 ± 1.26	177.68 ± 3.76***
Body length	140.39 ± 0.94	147.89 ± 2.60***
Height at withers	131.35 ± 0.57	130.01 ± 0.78[NS]
Height at hip bone	123.41 ± 0.41	124.08 ± 0.67[NS]
Width of head between horns	22.74 ± 0.27	22.15 ± 0.47[NS]
Width of head between eyes	20.37 ± 0.13	19.43 ± 0.32***
Ear length	21.39 ± 0.18	22.80 ± 0.23[NS]
Ear width	16.46 ± 0.12	16.86 ± 0.21[NS]
Face length	52.45 ± 0.2	52.67 ± 0.55[NS]
Horn length along greater curvature	42.52 ± 1.02	35.7 ± 1.36***
Horn length along smaller curvature	27.55 ± 0.82	21.62 ± 0.68***
Horn circumference at base	22.60 ± 0.22	25.12 ± 0.41***
Horn circumference in middle region	20.13 ± 0.22	20.83 ± 0.31[NS]
Horn circumference below tip	7.63 ± 0.13	7.13 ± 0.21[NS]
Neck length	42.57 ± 0.37	40.50 ± 0.57*
Neck circumference	89.60 ± 0.61	97.32 ± 1.81***
Loin length	35.97 ± 0.36	34.55 ± 0.55[NS]
Chine	45.95 ± 0.54	46.76 ± 0.80[NS]
Rump length	41.45 ± 0.31	42.03 ± 0.39[NS]
Rump width	51.03 ± 0.37	50.43 ± 0.59[NS]
Height of front leg below knee	30.34 ± 0.25	31.34 ± 0.43[NS]
Height of hind leg below hock	46.27 ± 0.32	47.51 ± 0.38[NS]
Height of pastern	5.92 ± 0.11	5.65 ± 0.14[NS]
Hoof circumference	51.26 ± 0.38	53.53 ± 1.00*
Tail length	71.39 ± 1.04	67.38 ± 1.58[NS]

NS, non-significant.
*$P < 0.05$, ***$P < 0.01$.

Results

Physical characteristics

No significant differences were observed between cows and bulls (Table 2). Figures 2 and 3 show examples of the Azikheli cow and bull, respectively.

Morphometric characteristics

Table 3 shows that Azikheli cows have a significantly larger heart girth, wider forehead, longer horns and longer neck than bulls. On the other hand, bulls have a significantly longer body, thicker horns and neck, and larger hooves than cows. Horns are flat laterally, and directed backwards and slightly upwards without twisting. The upward curve is variable and gives the horn a sickle or semi-sickle appearance. This is a specific characteristic of the Azikheli breed.

Discussion

Buffaloes show a variety of coat colours, with most riverine buffaloes being black to ashy grey (Soysal *et al.*, 2007), while the coat colour of swamp buffaloes ranges from grey to completely black, with very few having a white coat (Miao *et al.*, 2010). The common buffalo breeds of Pakistan are predominantly black (Khan *et al.*, 2005) with only occasional occurrence of brown coats (8 percent) in Nili-Ravi and Kundi buffalo (Maqsood, 1980). A dark coat causes heat intolerance because it absorbs a great deal of solar radiation and this is one of the reasons why dark-coated breeds wallow in swamps (Marai & Haeeb, 2010). The dominant brown coat colour (62.04 percent) in Azikheli seems to be an adaptation to the mountainous environment, where swamps are not available.

The farmers of the area prefer *Sra Chargai* (a brown coat colour with a completely white forehead) to *Sra Tikai* (a brown coat colour with a white spot on forehead).

The non-significant difference between the colour patterns of various body parts of the Azikheli cow and bull may be due to the prevalence of natural selective forces over social preferences in determining coat colour in bovines (Seo *et al.*, 2007).

Information on morphological characteristics is helpful in ensuring effective management and conservation of animal

Table 4. Comparison of morphometric measurements (cm) of Azikheli and Nili-Ravi.

Characteristics	Azikheli		Nili-Ravi[a,b]	
	Cow	Bull	Cow	Bull
Heart girth	191.36 ± 1.26	177.68 ± 3.76	215–225	225–226
Body length	140.39 ± 0.94	147.89 ± 2.60	145–149	159–165
Height at withers	131.35 ± 0.57	130.01 ± 0.78	125–135	135–137

[a]Khan, Younas & Hanjra (1982), Ranjhan & Pathak (1993), Borghese & Moioli (2005).
[b]Values for morphometric measurements of Nili-Ravi are in ranges.

genetic resources with a view to obtaining phenotypically pure local genetic resources for future selection and breed improvement strategies (Yakubu *et al.*, 2010). Berthouly *et al.* (2009) recorded heart girth, body length, height at withers, neck circumference, ear length and thorax depth as appropriate variables to differentiate the local Vietnamese swamp buffalo population from other buffalo breeds. For Pakistani buffalo breeds, such information is limited to heart girth, body length and height at withers, hence comparative measurements shown in Table 4 are limited to these three parameters.

Comparison of these parameters between the two breeds reveals that the body size of Azikheli is smaller than that of Nili-Ravi, a breed that is well adapted to life in the plains. Owing to their low maintenance requirements (Ibrahim & Brannang, 2001), smaller animals are considered less susceptible to fodder shortages (Hall, 1998) and are able to move more easily and rapidly on mountain slopes (Ouma *et al.*, 2004). As the Azikheli is native to mountain valleys with high seasonal fluctuations in the availability of feed resources, its smaller body size can be interpreted as an adaptive trait to fodder fluctuations, as well as to grazing in mountain terrain and transhumance. Sexual size dimorphism has been observed in the present study, with a longer body of the bull, whereas the cow has a large heart girth size and wider head at the eyes.

Conclusion

Given its small body size and brown coat colour, it appears that the breed is well adapted to mountain slope grazing and variable availability of feed resources. Differentiating characteristics of the Azikheli include the dominant brown coat colour and the sickle-shaped horns. In view of climate change and the likelihood of an increase in the frequency of extreme weather events in mountain regions in particular, livestock breeds like the Azikheli could prove to be a valuable resource for mountain dwellers in terms of adaptation to such weather extremes. The morphometric characteristics described here provide a basic description of the breed, but studies on genotypic characteristics and plans for *in situ* participatory conservation of the Azikheli are suggested measures to secure its appropriate conservation.

Acknowledgements

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