

## The Morphometric Features of Azikheli Buffalo in Swat Khyber Pakhtunkhwa, Pakistan

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### ABSTRACT

This study on physical and morphometric characteristics, productive and reproductive performance was carried out on Azikheli buffalos and bulls in Khwazakhela, District Swat, Khyber Pakhtunkhwa, Pakistan. Morphometric measurements included heart girth, body length, height at wither, height at hipbone, head region (face length, ear length and width), horn, neck, back, rump, legs and tail. Azikheli buffalos have significantly higher heart girth size, longer horns, longer neck and wider face at the level of eyes than bulls, on the other hand Azikheli buffalo have significantly longer bodies, longer ears, thick horns, thick neck and large hooves than buffalo. Tail of Azikheli buffalo and of bulls are above hock as cutting of switch is routine practice. Horns are flat laterally, directed backward and slightly upwards without twisting giving a sickle or semi-sickle appearance.

**Keywords:** Azikheli, morphometric, Buffalos, Swat, Breed, physical, reproductive

## Introduction

Pakistan is endowed with rich livestock genetic resources, well adapted to the local conditions. There are 15 breeds of cattle, 5 breeds of buffalo, 33 breeds of sheep and 36 breeds of goat<sup>1-8</sup>. There are 177.247 million buffalo head worldwide in 50 countries, of which 171 million (97 %) are found in Asia, while 5.38 million (3 %) are found in rest of the world. Pakistan with 29.9 million population (14 %) is the second highest buffalo inhabiting country in the world after India which has the population of 98.7 million (56 %) of the total world buffalo<sup>9-11,8</sup>. Buffalo is the second largest (75 million tons) source of milk supply in the world<sup>12</sup>.

Interestingly Pakistan is the second largest dairy buffalo country in the world<sup>8</sup> and possesses the highest buffalo milk genetic potential in the world and they contribute 70% of the total milk produced in the country<sup>13</sup> and with annual increase of buffalo population at the rate of 3 percent, buffalo population in Pakistan is 29.9 million head and being the major source of national milk yield (62 %) is an enormous dairy genetic resource of Pakistan<sup>14</sup>. Similarly, Pakistan is also second in Asia in terms of meat produced by buffalo which is evident from the fact that number of slaughtering buffalo increased from 2.18 million in 1996 to 3.34 million in 2006 showing a 53.2 percent increase during the specified period<sup>14</sup>. Buffalo breeds in Pakistan are Nili-Ravi and Kundi which are the finest dairy buffalo in the world<sup>15</sup>.

Indigenous breeds that have been evolved and adapted from the time immemorial and exist with their own genetic makeup are disappearing by dilution and replacement<sup>16</sup> because of new market demand, use of new breeding technology<sup>17</sup> changes in the socio-economic environments of a region<sup>18</sup> and modern production techniques<sup>19</sup>. Indigenous breeds were considered as inferior to the exotic and crossbred animals but with passage of time the performance of indigenous breed reported was equal to or even better than that of exotic, improved or crossbred animals<sup>20</sup>. In the production system of harsh environmental conditions, the performance of local indigenous breeds is well than exotic breed in term of productivity, although the output is low, but the inputs required is also low hence provide better financial returns to the farmer<sup>21</sup>. Indigenous breeds are mainly kept in low-input-low-output production system<sup>22</sup>, are hardy, disease resistant, survive on little water, scanty and poor vegetation, have tasty meat and good adaptability to various environments where modern imported exotic breeds unable to exist<sup>23,24,19</sup>.

Local indigenous breeds those adapted to harsh environment of developing countries have not yet been sufficiently characterized and in the case of their extinction the value lost to humankind is not known<sup>22</sup>. It is therefore necessary first to evaluate local breeds for phenotype, special characteristics, performance and performance potential and crossbred suitability especially in their home tracts and under existing management condition<sup>25,26</sup>. Traditionally external or internal phenotypic characters have been adopted to ascribe a given animal to a breed<sup>27</sup>. Phenotypic and genetic characterization of populations, breeds and species is essential for the development of appropriate breeding strategies, sustainable use of genetic diversity, genetic conservation and assessment of genetic variability<sup>28,29</sup> and thus the variations at molecular level are based on the phenotypic variations among breeds<sup>7</sup>. Phenotypic as well as adaptive characteristics are important in identifying breed attributes for immediate use by farming communities<sup>30</sup>. The commonly used

phenotypic characteristics are morphological (physical and morphometric), productive, reproductive performance, birth and adult body weight of the animals. The breed of azikheli buffalo at different ages of various natural positions and locations of khwazakhela swat is shown in (Figure 1). While the map of the study area of azikheli Buffalo breed home tract and the encircled regions represent the sampling areas of research area in (Figure 2). The labelled diagram of Azikheli buffalo showing various body parts measured in this study are shown in (Figure 3).



**Figure 1:** The azikheli buffalo breed of different ages at various natural positions & locations of khwazakhela swat.

## Physical and morphological characteristics

Ranking animal breeds in a population according to their levels of phylogenetic distribution is done because of morphological characters<sup>31-33</sup> and morphological characters evaluate breeding goals<sup>34-38</sup>. In traditional system in which breeding practices are not documented, it determines such goals retrospectively<sup>39</sup>, indicating animal size and weight in a simple and less expensive way<sup>40</sup>. Type and function of animals for beef or dairy purposes and their values as potential breeding stock are also assessed by morphological characters<sup>41-45</sup>.

## Morphometric characteristics

Morphometric measurements have been used to evaluate the characteristics of the animal that may vary due to the influence of breed evolution, environment, nutrition, sex, age and physiological status and rearing system<sup>46-49</sup>. Morphometric measurements can be easily measured under field condition and are biologically related to cost traits<sup>50,51</sup>. Morphometric measurements have been suggested as more objective measures of body conformation of animal<sup>52,53</sup> which is an important component of breeding and selection decision both in dairy<sup>54</sup> and beef animals<sup>55,56</sup> and could serve as a guideline in selection of high yielding females particularly in areas where performance records are not available<sup>57</sup>. The water buffalo of Asia has been classified on morphological and behavioral criteria into two types of the River and Swamp buffalo<sup>58</sup>. However, studies on buffalo with respect to body conformation, productive and reproductive potentialities are very limited, particularly in most local breeds which have been described as non-descript<sup>59</sup>.

In Pakistan, mostly studied buffalo breeds are Nili-Ravi and Kundi and there is 37% of the buffalo population (10.13 million) which is non-descript. Although these buffalo breeds have been considered non-descript, they are highly adapted to the environmental condition of the area and have great potential. Azikheli is a buffalo breed, in Swat, acclimatized to the local conditions and is reared by farming communities.

Only introductory information about the breed is available, emphasizing the scientific characterization of the breed<sup>59</sup>. It is

an important indigenous animal genetic resource of the area and got its name from its original home tract called Azikheil, one of the several tributary valleys of river Swat. The broader home tract includes the watershed of River Swat (District Swat) and River Panjkora (District Lower and Upper Dir), District Shangla, Bunair and Malakand agency. Pockets of the breed can also be found in District Mardan, Charsadda, Nowshera and Sawabi because of transhumant migration during winter season from upland pastures of District Swat and Dir. This breed needs characterization, description and improvement for sustainable future use in the adapted area. The present investigation is thus designed to study Azikheli buffalo breed with the following objective to determine morphological and morphometric characteristics of Azikheli buffalo.

### Study Area

Khwazakhela valley (Azikheil) of Swat District was selected as the study area which is a central location in the original home tract of the Azikheli buffalo (Figure 2). This is one of the most fertile valleys of Swat and lying about 20 kilometers from Mingora, the head quarter of Swat district. The Valley is almost 30 kilometers long and 20 kilometers wide. Major crops are wheat, rice and maize whereas; apple, fersimen (*Dyospirus kaki*) and shaftalo (*Prunus persicum*) are the main orchards. Different ethnic groups mostly occupy different ecological niches/units hence landowners are dominant in valley bottom, tenants on hill slopes and hilltops with cropping potentials and Gujar (settled livestock herders with cattle and buffalo herders; Ur-Rahim and Viaro, 2002) at hill slope and hill tops with grazing potentials. This stratification, however, is not strict/ watertight compartment and tenants and Gujar may be present in specific location in valley bottom and landowners at hill slope and hilltops. For this study the season was classified as autumn (September-October, temperature 24-26 C°), winter: (November-February, temperature zero to minus eight C°) spring (March-April, temperature 22-24 C°), summer (May-August, temperature 21-38 C° ; Urdu Tourists Guide) (Figure 2).



**Figure 2:** Map of the study area of azikheli Buffalo home tract, the encircled regions represent the sampling areas.

### Morphological characteristics

Data on physical and morphometric characteristics was collected as per standard procedure of random sampling from both Azikheli buffalo cows and buffalo bulls. i. Physical characteristics: Physical characteristics like color of the coat; forehead, eyelashes, eyes, horn, muzzle, forelegs, hind legs and hooves on each animal were recorded. ii. Morphometric characteristics: The following morphometric measurements (cm) were taken using measuring tape with animals standing on flat

surface in normal position. In case of buffalo cows, measurements were taken within two to three months after parturition and adult bulls were also measured. The morphometric studies conducted were as follows which are also shown in (Figure 3).

- Heart girth, body length, height at wither and height at hipbone.
- **Head region:** Measurements taken in head region were the width of head between horns, width of head between eyes, ear length and width and face length.
- **Horns:** Measurements taken were length of horn at greater and small curvatures, circumference of horn base, mid and below tip.
- **Neck:** Measurements taken were neck length and circumference of neck at middle region
- **Back:** Measurements taken were loin length (length from last rib to hipbone) and chine (length from wither to the last rib).
- **Rump:** Measurements taken were rump length (length from hipbone to pin bone) and width (distance between hipbones).
- **Legs:** Measurements taken were height of the leg below knee and hock, height of pastern, hoof circumference and tail length.



**Figure 3:** Labelled diagram of Azikheli buffalo showing various body parts measured in this study (a) 1) width of head between horns 2) width of head between eyes 3) muzzle (b) 4) hoof circumference 5) pastern 6) rump length 7) hip height 8) loin length 9) chine 10) heart girth 11) height at wither 12) nick length 13) ear width 14) ear length 15) length of horn at greater curvature 16) horn base circumference 17) horn mid circumference 18) horn length at smaller curvature 19) horn circumference below tip 20) face length 21) nick circumference 22) height of fore leg below knee 23) height of hind leg below hock (24) body length.

### Statistical analysis

Mean, standard error and Student's T-test were calculated for various comparisons. Chi-square test and analysis of variance was also performed using GraphPad Prism-5 (GraphPad Software, San Deigo, CA).

### Results

This study was carried out on 618 Azikheli buffalo and bulls. The recorded parameters were morphological characteristics, milk production and reproductive performance. Morphometric characteristics of 135 Azikheli buffalo and bulls were studied.

### Morphological characteristics

Morphological characteristics included physical and morphometric characteristics. This study was carried out on



135 buffalo of which 108 were buffalo and 27 were buffalo bull from Khwazakhela valley (Azikheil) of District Swat, Khyber Pakhtunkhwa, Pakistan.

### Morphometric characteristics

This study was conducted on 135 buffalo out of which 108 were buffalo and 27 were buffalo bulls. Morphometric measurements taken were heart girth, body length, height at wither, height at hipbone, head, horn, neck, back, rump, legs and tail.

#### Heart girth, body length, height at withers (from hoof to shoulder girdle) and height at hipbone

Mean heart girths, body length, height at withers and height at hip bone of Azikheli buffalo and bulls is shown in (**Table 1**). Azikheli buffalo have significantly ( $t(133) = 4.36$ ;  $P < 0.05$ ). On the other hand, Azikheli buffalo bulls have significantly ( $t(133) = 3.28$ ;  $P < 0.001$ ) long body than buffalo. Azikheli buffalo bulls were also taller at hip bone than buffalo, but the difference was statistically not significant ( $t(133) = 0.75$ ;  $P > 0.05$ ).

**Table 1:** Measurements (cm) of heart girth, body length, height at withers and height at hip bone of Azikheli buffalo and bulls in Khwazakhela valley of District Swat, KP, Pakistan.

Sex	Variables	Mean	Range
Buffalo (108)	Heart girth	191.36±1.26	149.86-223.52
	Body length	140.39±0.94	114.30-167.64
	Height at wither	131.35±0.57	119.38-147.32
	Height at hip bone	123.41±0.41	111.76-137.16
Bulls (27)	Heart girth	177.68±3.76 ***	136.25-205.74
	Body length	147.89±2.60 ***	117.58-164.25
	Height at wither	130.01±0.78	118.11-134.69
	Height at hip bone	124.08±0.67	116.84-129.56

Mean±SE a = Azikheli buffalo vs bulls  $P < 0.001$ \*\*\*

### Head Region

Measurements of head region like width of head between horns, width of head between eyes, ear length and width and face length are presented in (**Table 2**). Azikheli buffalo has a wider head region between horns and between eyes than bulls. However, the difference for the former was statistically not significant, whereas for the latter it was significant ( $t(133) = 3.28$ ;  $P < 0.001$ ). Compared to buffalo, bulls have longer and wider ears and longer faces than buffalo, but the difference for these measurements was also statistically not significant.

**Table 2:** Measurements (cm) of head region of Azikheli buffalo and bulls in Khwazakhela valley of District Swat, Khyber Pakhtunkhwa, Pakistan.

Sex	Variables	Mean	Range
Buffalo (108)	Width of head between horns	22.74±0.27	17.78-30.48
	Width of head between eyes	20.37±0.13	17.15-22.86
	Ear length	21.39±0.18	17.78-30.48
	Ear width	16.46±0.12	15.24-20.32
	Face length	52.45±0.2	45.72-63.50
Bulls (27)	Width of head between horns	22.15±0.47	20.16-30.48
	Width of head between eyes	19.43±0.32***	17.18-23.54
	Ear length	22.80±0.23	20.32-24.86
	Ear width	16.86±0.21	15.24-19.05
	Face length	52.67±0.55	47.42-58.42

Mean±SE a = Azikheli buffalo vs bulls  $P < 0.001$ \*\*\*

### Horns

Mean length of the horn along the grater and smaller curvature and circumference at base, mid region and below the tip of Azikheli buffalo and buffalo bull is presented in (**Table 3**). Azikheli buffalo have significantly longer horns (both along greater curvature;  $t(133) = 3.13$ ;  $P < 0.001$ ) Than Azikheli bulls. However, Azikheli bulls have significantly ( $t(133) = 5.13$ ;  $P < 0.001$ ) thicker horns at base than Azikheli buffalo. Horn circumference at mid region and tip was not significantly different in both sexes.

**Table 3:** Measurements (cm) of horns of Azikheli buffalo and bulls in Khwazakhela valley of District Swat, Khyber Pakhtunkhwa, Pakistan.

Sex	Variables	Mean	Range
Buffalo (108)	Horn greater curvature	42.52±1.02	24.13-68.58
	Horn smaller curvature	27.55±0.82	15.24-45.72
	Horn base circumference	22.60±0.22	17.78-27.94
	Horn mid region circumference	20.13±0.22	13.97-25.40
	Horn below tip circumference	7.63±0.13	05.08-12.70
Bulls (27)	Horn greater curvature	35.7±1.36 ****	24.13-50.80
	Horn smaller curvature	21.62±0.68****	13.97-27.94
	Horn base circumference	25.12±0.41****	21.45-30.48
	Horn mid region circumference	20.83±0.31	16.51-23.46
	Horn below tip circumference	7.13±0.21	05.08-08.89

Mean±SE a = Azikheli vs bull  $P < 0.001$ \*\*\*

### Neck Region

Neck length and circumference of Azikheli buffalo and bulls is shown in (**Table 4**). Azikheli buffalo have significantly ( $t(133) = 2.57$ ;  $P < 0.05$ ) longer but narrow neck ( $t(133) = 5.09$ ;  $P < 0.001$ ) than Azikheli buffalo bulls.

**Table 4:** Measurements (cm) of neck region of Azikheli buffalo and bulls in Khwazakhela valley of District Swat, Khyber Pakhtunkhwa, Pakistan.

Sex	Variables	Mean	Range
Buffalo (108)	Neck length	42.57±0.37	35.36-53.34
	Neck circumference	89.60±0.61	73.66-101.6
Bulls (27)	Neck length	40.50±0.57 *	34.58-45.72
	Neck circumference	97.32±1.81 ****	71.12-114.3

Mean±SE a = Azikheli vs bull  $P < 0.05$ \*  $P < 0.001$ \*\*\*

### Back Region

Measurement of the back region like chine length and loin length are shown in (**Table 5**). Azikheli buffalo bulls have longer chine than buffalo, whereas loin was longer in buffalo compared to bulls. However, there was no significant difference in chine and loin length between both sexes.

**Table 5:** Measurements (cm) of back region of Azikheli buffalo and bulls in Khwazakhela valley of District Swat, Khyber Pakhtunkhwa, Pakistan.

Sex	Variables	Mean	Range
Buffalo (108)	Loin length	35.97±0.36	25.40-43.18
	Chine	45.95±0.54	35.56-66.04
Bulls (27)	Loin length	34.55±0.55	28.45-43.18
	Chine	46.76±0.80	38.10-55.88

Mean±SE

## Rump Region

mean rump length and rump width of Azikheli buffalo and bulls is presented in (Table 6). Azikheli buffalo have shorter but wider rump than bulls but the difference for both measurements was statistically non-significant between buffalo and bulls.

**Table 6:** Measurements (cm) of rump of Azikheli buffalo and bulls in Khwazakhela valley of District Swat, Khyber Pakhtunkhwa, Pakistan.

Sex	Variables	Mean	Range
Buffalo (108)	Rump length	41.45±0.31	33.02-48.26
	Rump width	51.03±0.37	41.91-58.42
Bulls (27)	Rump length	42.03±0.39	38.10-45.72
	Rump width	50.43±0.59	44.45-55.88

Mean±SE

## Legs Region

Height below knee, height below hock, height of pastern and hoof circumference of Azikheli buffalo and bulls is shown in (Table 7). Azikheli bulls had longer front leg below knee joint and hind leg below hock joint compared to buffalo, but the difference was statistically not significant for both measurements. Pastern height was more in buffalo than bulls but the gender difference for the measurement was not significant. On the other hand, Azikheli bulls have significantly ( $t(133) = 2.5$ ;  $P0.05$ ).

**Table 7:** Measurements (cm) of Legs in Azikheli buffalo and bulls in Khwazakhela valley of District Swat, Khyber Pakhtunkhwa, Pakistan.

Sex	Variables	Mean	Range
Buffalo (108)	Height of the leg below knee	30.34±0.25	25.40-41.91
	Height of the leg below hock	46.27±0.32	40.64-53.34
	Height of the pastern	5.92±0.11	02.54-70.62
	Hoof circumference	51.26±0.38	40.64-58.42
	Tail length	71.39±1.04	55.88-101.6
Bulls (27)	Height of the leg below knee	31.34±0.43	27.25-35.56
	Height of the leg below hock	47.51±0.38	43.18-50.80
	Height of the pastern	5.65±0.14	05.04-07.62
	Hoof circumference	53.53±1.00**	45.72-76.20
	Tail length	67.38±1.58	53.34-76.46

Mean±SE a = Azikheli buffalo vs bull  $P<0.05^*$

Statistical analyses were applied to analyze the data. Different tests of significance were applied to ascertain significant or non-significant differences among variables under study. Where needed Chi-square test of significance, t-test, analysis of variance and regression analysis of variance were applied. Morphological features were studied because of the reason that they constitute information regarding the identification of this breed. Unless we identify any breed the description of it shall be of no importance. Since Azikheli buffalo is a non-descript breed it was essential to describe the details of its morphological traits. Gender differences have also been analyzed. The analysis showed that Azikheli buffalo have significantly higher heart girth, longer horns, longer neck and wider face than bulls. But the bulls compared to buffalo have longer bodies, longer ears, thick horns, thick neck and large hoofs.

## Discussion

Azikheli buffalo is an indigenous breed of District Swat, Khyber Pakhtunkhwa. Very meager information is available on

phenotypic as well productive and reproductive characteristics of this breed. The present study was conducted to investigate the physical and morphometric characteristics and performance of Azikheli buffalo in District Swat, Khyber Pakhtunkhwa whereas morphometric measurements of different body parts were taken.

Morphometric measurements are used to evaluate the characteristics of the animal and they vary due to the influence of breed evolution, environment, nutrition, sex, age, physiological status, rearing system and related to cost traits<sup>46-49,51</sup>. Morphometric measurement is the measurement of body conformation of animal<sup>53</sup> which is an important component of breeding and selection decision<sup>54</sup> and could serve as a guideline in selection of high yielding females particularly in areas where performance records are not available<sup>57</sup>. Azikheli buffalo have significantly higher heart girth size, longer horns, longer neck and wider face at the level of eyes than bulls (Table.1-4. On the other hand, Azikheli bulls, compared to Azikheli buffalo, have significantly longer bodies, longer ears, thick horns, thick neck and large hooves (Table.1-4 and Table. The body length and height at hipbone of Azikheli bulls were higher than buffalo whereas, height at wither was higher in buffalo than bulls (Table.1). Soysal, et al also reported higher values for body length and height at hipbone in Anatolian bull<sup>60</sup>. Tail in Azikheli buffalo is above hock as cutting point of switch, is routine practice. In Nili-Ravi buffalo tail is long extending below hock and had a white switch compared to that in Azikheli buffalo<sup>61</sup>. Azikheli buffalo had smaller heart girth size (191.36±1.26 cm) than Nili-Ravi buffalo<sup>62-64</sup> whereas height at wither of Azikheli buffalo (131.35±0.57 cm) falls within the range of Nili-Ravi buffalo<sup>62-64</sup>. However, Nili-Ravi buffalo are longer<sup>62-64</sup> than Azikheli buffalo (140.39±0.94). On the other hand, Azikheli bull has smaller heart girth, smaller at wither and have shorter body than Nili-Ravi bulls 225-226 cm; 135-137 cm; 159-165 cm<sup>62-64</sup>. There is low heart girth in Azikheli buffalo compared to that in kundi buffalo 205 cm<sup>62,64</sup> but are taller at wither height 112-125 cm<sup>62,64</sup> and have longer body 137 cm<sup>62,64</sup> than kundi buffalo. Bulls of Azikheli buffalo breed have smaller heart girth size than Kundi bulls 217 cm<sup>62,64</sup>. However, the height at wither and body length of Azikheli buffalo approximate that of the Kundi bull<sup>62,64</sup>. Pandharpuri buffalo have comparable heart girth size 192.79 cm<sup>65</sup>. and height at wither 132.92 cm<sup>65</sup> to that of Azikheli but the latter is longer than the former 130.02 cm<sup>65</sup>. Gaddi buffalo have also comparable values to that of Azikheli buffalo with respect to heart girth, height at wither and body length 194.98±1.8, 131.3±1.1 cm; 141.2±1.63 cm<sup>66</sup>. Nagpuri buffalo had smaller heart girth, height at wither and body length than that of Azikheli buffalo 172.61±4.12 cm; 121.41±2.34 cm; 128.00±3.70 cm<sup>67</sup>. There was no significant difference in face length between Azikheli buffalo and bull. Ranjhan and Pathak also reported no difference in face length in Nili-Ravi buffalo (58 cm) and bull (58 cm)<sup>63</sup>. Rump length and rump width in both sexes were not significantly different in Azikheli breed. Ranjhan and Pathak also reported the same values for mean rump length (45 cm each for buffalo and bull) and rump width without marked variation (61.2 cm for buffalo and 62 cm for bull) in both sexes of Murrah buffalo<sup>63</sup>. However Terzano, et al, reported that in Romania buffalo heifers rump length was significantly different in intensive feeding (34.5% mais silage, 31% hay, 13.8% maize meal, 10.9% Soya been and 9.8% wheat flour on DM basis (14% crude protein and 0.88 MFU/kg DM) as compared to pasture system (45±12% grass, 12±9% legume, 29±11% composite and

14±15% other species (0.49±0.11 MFU/kg DM, 14.6±6.0% crude protein and 22.8±3.4% crude fiber)<sup>68</sup>. Similarly, there was no significant difference in the height of forelegs below knees, height of the hind legs below hock and height of pastern in both sexes. Ranjhan and Pathak also reported mean height of legs below knee in Murrah buffalo was 21.6 cm and it was 24.6 cm for Murrah bull without mentioning any statistical analysis<sup>63</sup>. Based on horns, buffaloes are also divided into two groups. One group consists of the horns which are closed and set close to head and are down swept: e.g Murrah, Nili-Ravi, Mehsana, Jaffarabadi and Sambalpur and the other group consists of the horns which are sickle shaped and un-swept: e.g Bhadawari, Kalahandi, Kanara, Nagpuri, Tarai and Toda<sup>69</sup>. The Azikheli buffalo breed falls in the second group of horn shapes. Horns are flat laterally, directed backward and slightly upwards without twisting. Upwards turning is variable and gives a sickle or semi-sickle appearance to the horn in the breed under study. It is like Surti breed<sup>64</sup>. It is different from that of Nili-Ravi and Kundi in which the horns are short and twisted/ curled<sup>64</sup>. Size of the horn of Azikheli buffalo observed in this study is smaller than Nagpuri 50-65 cm, Gauli 51.82±3.28 cm<sup>70</sup> and Chilika 49±0.2 cm<sup>71</sup>, but longer than Nili-Ravi<sup>72</sup> and Kundi<sup>64</sup>. Horns of Azikheli buffalo were significantly longer than bull whereas, bulls have significantly thicker horn base circumference than buffalo. Soyal, et al, reported longer and thicker horn in female Anatolian buffalo<sup>73</sup>. However, Roth in Asian buffalo reported smaller horn in female buffalo as compared to that of bull<sup>74</sup>. This study reported information on morphometry, like leg color patterns, makes different buffalo breeds distinct from each other, perhaps this may also be used as a good identification mark.

## Conclusions

The present study evaluated the morphological characteristics of the Azikheli buffalo in khwazakhela swat Khyber Pakhtunkhwa Pakistan. Azikheli buffalo is kept in its home tract by different social groups such as landowners, Gujars and tenants, under the different topographic conditions such as hill slopes, undulating areas and valley bottoms. They are currently caring more for the breed as they are primarily dependant for their livelihood on the sale of livestock and livestock products. Azikheli buffalo had large body size (heart girth) than bulls whereas bulls had longer body (body length) than Azikheli buffalo.

## Conflict of Interest

The authors declare that there are not any potential conflicts of interest regarding the publication of this paper.

## Data availability

The data used to support the findings of this study are included within the article.

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