PHENOTYPIC CHARACTERIZATION OF INDIGENOUS KACHHI SHEEP BREED

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ARTICLE INFORMATION

ABSTRACT

For the evaluation of the phenotypic and morphometric characteristics of Kachhi sheep, a total of 300 adult Kachhi sheep (female 240 and male 60) were selected from different study areas (Hyderabad, Matiary, Mirpurkahs, Sanghar, Umerkot and Thaparkar) of Sindh province. Among all the study areas majority of male and female Kachhi sheep physically possessed plain white coat with black and brown (tan) color, compact body shape, coarse type wool, convex face profile, roman nose, small pendulous ears, sloppy rump, dark colored hooves, and small cylindrical tail, compact udder. Moreover, majority of male and female sheep were noted with wattles, remarkably few cases of female and male Kachhi sheep were detected with deviated Morphometric characters. Average live body weight and linear body measurements (chest girth, body length, height at withers, facial length, ear length, head width and tail length) of both sexes, at Matiary area were observed comparatively (P<0.05) higher, followed by Hyderabad, Sanghar, Mirpurkhas, Umerkot and Tharparkar vicinities of Sindh. However, statistical (P<0.05) differences were recorded in the morphometric traits between male and female Kachhi sheep among all the selected vicinities of Sindh province.

1. INTRODUCTION

Pakistan is naturally gifted with the huge wealth of sheep genetic resources. According to Pakistan economic survey sheep population estimates are 31.9 million (GOP, 2021-22). In Pakistan there are about of 31 sheep breeds, which may be distributed on agro-ecological zones and provincial basis in Pakistan (Isani and Baloch, 1996). On the basis of morphological characteristics sheep breeds could be classified into two categories thin-tailed (Baltistani, Buchi, Cholistani, Damani, Hissardale, Kaghani, Kail, Kajli, Kali, Kooka, Lohi, Pahari, Poonchi, Sipli&Thalli) or fat-tailed (Balkhi, Balochi, Bibrik, Dumbi, Gojal, Harnai, Hashtnagri, Khijloo, Kohai Ghizar, Latti, Michni, Rakhshani, Tirahi&Waziri) and relatively used to produce milk, mutton, and coarse type wool (Wahid, 1982).

Conferring to (FAO) food and agriculture organization, phenotypic and genetic classifications are vital tools for categorizing animal breed, which should be initial phase towards the advance approaches for their ecological use, management, and protection. Among populations phenotypic evaluation a reasonable interpretation of genetic variations is based on morphological characters and the evaluation of morphologic characters have been verified to be appropriate in evaluating genetic difference within and between populations when all morphologic variations are considered at the same time (Lix & Sojobi, 2010).

The breed performance has been assessed with the help of phenotypic and genotypic categorization. For documentation of breed Phenotype is considered as a result of genotype and environment. The phenotype of breed can be distributed into three main classes' i-e physical description or measurement, productive traits,

and environmental adaptation. Physical attributes description includes (skin color, chest girth, body length, height, tail length and type, wool type) and presence or absence of horns. For the animal strain or breed definitions physical features are possibly the mostly used norms. For this purpose, several efforts have been performed to study these qualities to characterize the population and the categorization of sheep population on the basis of multivariate evaluation of physical traits is its example (Henson, 1992). In Sindh province more than a dozen breeds of sheep are prevailing and choice of breed is climatic reliant. Kachhi sheep breed is frequently found in district Tharparkar and adjoining desert areas of Sindh. It is mutton, milk and wool type sheep breed, they are medium sized breed comprising of white body coat and with a black or brownish stumpy head and black or brown markings on legs, also comprised of small ears, Roman nose, and a well-developed compact udder (Tahir, 2005). The main object of this study was to assess the morphological description of Kachhi sheep by using qualitative and quantitative characteristics reared at various vicinities of Sindh province. The hypothesis of this study was the assumption that phenotypic assessments of indigenous sheep breeds might be comfort and initiate the categorization of specific breed criteria and official breed authentication process, and, in return, more local business opportunities for smallholders may be created.

2. MATERIALS AND METHODS

Phenotypic or morphological characterization of Kachhi Sheep

The study areas were chosen based on comprehensive survey conducted on the socioeconomic status of Kachhi Sheep at identified vicinities of Sindh province, a total of 300 adult Kachhi Sheep apiece of 50 from each identified area were selected for the morphological characteristics and body measurements characteristics determination. Total Six agro based vicinities of Sindh; Hyderabad, Matiary, Mirpurkhas, Sanghar, Umerkot and Tharparkar districts were selected on the basis of population of Kachhi breed. All these chosen vicinities are well identified concentrated (livestock populous) regions of the Sindh.

Sampling procedures and sample size determination

For this purpose of study, a multi-stage sampling process was selected for the assortment of household samples and Kachhi Sheep. For sampling sheep population, gravid ewes, neutered sheep, offspring, lambs (male and female) were not involved in the trial sheep populace to upsurge the exactness of quantifiable characters and to signify the mature sheep populace. Afterward, simple

random sampling method was applied for sample sheep collection.

Sample size fortitude for Kachhi sheep breed
Kachhi Sheep sample size at each study area of Sindh province was observed by using the Cochran's formula. Collectively 300 Kachhi Sheep were selected, each of 50 sheep samples from the locality of Hyderabad, Matiary, Mirpurkhas, Sanghar, Umerkot and Tharparkar vicinities of Sindh, Pakistan were collected for evaluating the phenotypic (qualitative) and morphometric (quantitative) traits with the 10:40 ratios of mature male and mature female sheep, respectively, according to procedure of (FAO, 2012).

Phenotypic/Morphometric characterization of indigenous sheep

To study the qualitative and quantitative characteristics of Kachhi Sheep, a breed standard description list designed by (FAO, 2012) was accurately followed for Kachhi sheep breed. Data collected for qualitative characters of both sexes (male and female) in respect of skin color type, coat color pattern, wool type, head and face profile, wattles, ears positioning, rump outline, color of hooves, and tail profile were noted by pictorial and eye observations of the Kachhi breed. All the straight-lined body sizes of both sexes of Kachhi Sheep noted in early before noon, with the standup on a smooth surface and animals in held up head position. In regard of quantitative traits (body length, chest girth, wither height, head width, facial Length, ear length and tail length) were measured by using plastic measuring tape identical in cm and body weight of animal was estimated by using spring weighing balance.

All the animals were categorized by their gender, location, and age groups. Sheep's age classification was made using dentition. All the male and female sheep were classified into three age groups: A (12-18 months), B (19-24months) and C (25-30 months), respectively.

Data collection

Data in respect of morphological characteristics and linear body measurements was collected through observations and field measurement. Data collected during the study was interpreted in the Microsoft Excel (2010).

Data analysis

The data was analyzed by using SAS version 9.3, 2014 and SPSS version 20 regarding both qualitative and quantitative characteristics for each individual variable. Chi-square test was used to estimate the numerical

consequence between categorical variables using locality as a fixed influence (SPSS, version16.0) with gender and vicinities as fixed effects were subjected to factorial analysis of variance of live body weight and linear body measurements. For separation of significance of means the Tukey's simultaneous test was used.

3. RESULTS AND DISCUSSION

Phenotypic characterization of Kachhi Sheep

Phenotypic characteristics of female and male with the ratio of 40:10 Kachhi Sheep from different study areas of Sindh province were estimated and consequences are presented in Table-1. Results revealed that majority of non-spotted skin coat pattern of female and male Kachhi sheep was recorded at (Hyderabad, Matiary, Mirpurkhas, Sanghar, Umerkot and Tharparkar) vicinities as compared to few spotted female and male sheep at above mentioned study areas. In respect of coat color patterns non-significant (P>0.05) difference was recorded in both sexes of Kachhi sheep at various vicinities of Sindh. Findings of present study are agreeing with the observations of (Hailemariam, et al., 2018) reported that the major coat colors were plain black (34%), red (19.6%) and black dominant (11.8%).

The dominant of black coat color is obvious in the cold region. Conflicting to current findings (Whannou et al., 2021) reported sheep with predominated coat color (spotted white and brown) patterns were closely related with that plateau and oueme valley zones and plain or uniform white or composite coat color with a predominantly spotted black, brown, or white patterns sheep from probe, coastal and bassila zones. Relatively higher percentage of Kachhi Sheep skin coat type was noted ash white with black in both sexes of Kachhi breed at Hyderabad, Matiary, Mirpurkhas, Sanghar, Umerkot and Tharparkar contrast to both sexes having white with brown (tan) skin color at various vicinities of Sindh province. These findings are in resemblance with (Goran et al., 2019) stated in Nigeria sheep breeds on the basis of main qualitative characters commonly used for breed description with a supremacy of spotted white and some individuals from Sahelian sheep breed of Nigeria presented in front being black or brown and white ears (bicolor coat). In regard of skin color type present study revealed that non-significant difference (P>0.05) was recorded in both male and female Kachhi sheep at various vicinities (Hyderabad, Matiary, Mirpurkhas, Sanghar, Umerkot and Tharparkar) of Sindh. Moreover (Florezc et al., 2020) reported that majority of Sudan Bayo sheep were observed yellow bay followed by clear bay and waxed bay, respectively. More than half of the Blanco sheep (Sudan) were detected brown in color, with brown and white spots, but frequently white with brown spots and remaining percentage was distinguished by entirely white coat color pattern.

Furthermore, the coat color difference was also detected in vizayangaran sheep breed (Gangaraju, 2010) and Vembur sheep breed (Selvakumar, 2016). The Pantaneiro sheep hair color was observed typically white 74.6 percent, yellow hair color 13.2 percent and spotted hair color types 11.1percent had intermediate occurrence and black hair was unusual 1.1 percent and 77.6 percent color of wool was typically white (Aranda et al., 2021). Amongst all the study areas both sexes of Kachhi sheep were observed with coarse type wool with high to medium length which agree with the findings of (Amelmal, 2011) reported that the majority (81.96%) of study area sheep population were observed with medium and smooth (coarse) type wool tracked by short and smooth (14.6%), long and (3.41%) smooth hair. Moreover, majority (98.12%) of sheep reported with hairy coat and very few (1.88%) were noted with wooly type coat (Reddy et al., 2020). In current investigation at different vicinities of Sindh beneath the facial profile of both genders of Kachhi sheep 100 percent convex face profile was observed that are in resemblance with the conclusions of (Reddy et al., 2020) reported that head profile was predominantly convex in majority of sheep while few sheep were noted with slightly convex heads.

In all the study areas both female and male Kachhi sheep were observed with small and pendulous ears as reported by (Chaudhary, 2013), (Yadav, 2011), (Reddy et al., 2020) that ear orientations frequently pendulous in Macherla and Munjal sheep breed. In all the study areas in both sexes (female and male Kachhi sheep) majority of observations of largely sloppy back rump profile was noted, at the different study parts only some observations of flat (smooth) rump profile were observed in both sexes which are in connection with findings of (Tilahun, et al., 2019) stated that larger hind rump shapes by straight, inclines up towards the rump and curved hind rump profile were observed. In most of observations rump profiles were enclosed and sloping by slight flat. Majority of male and female Kachhi sheep in all the study areas were noted with wattles, while few number of male and female Sheep were observed with absence of wattles at the selected study areas, these observations are in settlement with findings of few authors (FAO, 1982), (Devendra et al., 2009), (Chaudhary, 2013) who reported the presence of wattles in south Indian breeds.

The hooves of both sexes (female and male) Kachhi sheep were noted darker in color at all the study areas as reported by (Nazeer & Shah, 2018) that in Pakistan the indigenous small ruminants with good body linear measurements and growth traits, coat color and hooves darkerin color. In another study conducted by (Tsegaye

et al., 2013) reported marketing value of domestic animal Significantly affected by phenotypic traits like color of skin, compacted body structure and darker hooves of the small ruminants. Moreover, during present study in respect of tail profile of both sex of Kachhi sheep significant (P<0.05) difference was recorded. At all the selected areas of study the predominant thin and cylindrical tail trend was seen in both sexes of Kachhi sheep breed. These consequences of current investigation are in similarity with the findings of (Chaudhary, 2013), (Reddy et al., 2020) reported that majority of macherla sheep had slender type thin tail, and these findings also agree with (Singh et al., 2007) observed that majority of Nali sheep of India were noted with thin and medium sized tail. In all the study areas (Hyderabad, Matiary, Mirpurkhas, Sanghar, Umerkot and Tharparkar) majority of observations in the female Kachhi sheep with predominant compact udder profile were recorded, while only in few observations among all the study areas female sheep were seen with loose udder. Similarly, to current concerns (Monau, et al., 2018) revealed during classification of Tswana female goat's compact udder profile was recorded. In backing (Vlad et al., 2014) in the South region of Romania, evaluated the morphometric uniqueness of small ruminant noted with compact udder. The availability of feed, management conditions and natural grazing could be attributable to the differences for these traits of interest of small ruminants (Cam et al., 2010).

Quantitative and linear traits of female Kachhi Sheep

For the identification of sheep breed population growth and body conformation considered to be most valuable characters. The average body weight and linear body measurements of female Kachhi Sheep in the study area are showed in Table-4.2 (A) & (B).

Morphometric (Measureable) characters: (Body weight and linear body measurements) are the most significant characteristics, which are very supportive for classification of breeds in population. During the current study significant (P>0.05) difference observed in average body weight, chest girth, body length, body height, ear length, facial length, tail length, and width of head in both sexes of Kachhi sheep at various study areas and noted relatively (P<0.05) higher at Matiary as compared to Hyderabad, Sanghar, Mirpurkhas, Umerkot and Tharparkar. Same consequences were achieved by (Pervage et al., 2009) stated that average (body weight, chest girth, body height, body length, ear length, facial length, tail length, and width of head) were significantly influenced by locality and environmental conditions. Moreover, among this chest girth (major linear body measurement) is broadly utilized to categorize the bodily traits of small ruminant pedigree and variety (Solomon,

2009). In resemblance with present results (Gebreyowhens and Kumar, 2017), (Getahun et al., 2008), (Bekalu, 2014) stated that higher chest girth recorded in male of small ruminants associated to female ones.

In present study the chest girth was the most exceptional predictor variable of both (male and female) Kachhi sheep, chest girth might be utilized as a sole prognosticator of body weight as reported by several authors in same type of studies (Taye, et al., 2010). In concurrence with present observations various authors have established that the chest girth is considered as the first and vital tool for the estimation of live body weight and secondly body length of domestic animals (Ahmed, 2013), (Hulunim, 2014).

4. CONCLUSION

Based on present findings it was concluded that the plain white body coat with brown and black color at neck and legs in both sexes of Kachhi sheep was recorded higher at all the study areas with Roman nose, small pendulous ears, wattles, compact udder, dark colored hooves and thin and cylindrical tail. Moreover, average live body weight and linear body measurements of both sexes of Kachhi sheep at Matiary were observed significantly higher as compared to other study areas.

5. CONFLICT OF INTEREST

All authors have declared that there is no conflict of interests regarding the publication of this article.

REFRENCES

Ahmed, S. (2013). On-farm phenotypic and production system Characterization of indigenous goats in Horro Guduru Wollega Zone, Western Ethiopia *M.sc. thesis Haramaya, university*, 112.

Amelmal, A. (2011). Phenotypic characterization of indigenous sheep types of Daeuro zone and konta special woreda of SNPPR, Ethopia. *M.Sc. Thesis Haramaya University, Dire Dawa, Ethopia.*

Aranda, A.N., Silva, M.C.D., Crispim, B.A., Ledesma, L.M., Lenis, P.R., Silva, A.L.A., Leonardo, A.P., Fernando, Junior, M.V & Barufatti, A. (2021). Qualitative Characters of Indigenous Sheep in Central Brazil: Putting Phenotype into Perspective. *Academic Editor: Luc Legal. Diversity,* 13(11), 51

Bekalu, M. (2014). Phenotypic characterization of indigenous goat types and their production system in West Gojam Zone of Amhara region,

Ethiopia. *MSc. Thesis Haramaya University*, 109.

Cam, M.A., Olfaz, M., & Soydan, E. (2010). Possibilities of using morphometric characteristics as a tool for body weight prediction in Turkish hair goats (Kilkeci). *Asian Journal of Animal and Veterinary Advances*. 5 (1), 52-59.

Choudhury, M. P., Sarkar, A., Islam, S. C. F., Ali, A., Bhuiyan, A., Ibrahim, M., & Okeyo, A. (2012). Morphometry and performance of Black Bengal Sheep at the rural community level in Bangladesh. *Journal of Animal Science*, 41 (9), 83-89.

Devendran, P., Kandasamy, N., Panneerselvam, S., & Thiruvenkadan, A.K. (2009). Rearing Environment and husbandry practices of Coimbatore sheep. *Indain Journal of Animal Science,* 80, 470-472.

FAO. (1982). Sheep and Goat breeds of India by Acharya R.M.

FAO. (2012). Phenotypic characterization of Animal Genetic Resources. FAO Animal production and health guidelines. *FAO. Rome, Italy*.

Florez M., Julie, Hernandez P., Bustamante, M., Vergara, Y., Oscar, G. (2020). Morphological and phenoroptic characterization of Sudan female Colombian Creole Hair Sheep "OPC". *Revista MVZ Cordoba, Univerdae de Coridoba, Colombia,* (25), 1.

Ganguraju, G. (2010). Studies on characterization and performance of Vizianagaram sheep of north coastal Andhra Pardesh. *Ph.D. Thesis. Sri. Venkateswara Veterinary University, Tirupatti.*

Gebreyowhens, W., & Kumar, R. (2017). Phenotypic characterization of indigenous Maefur goat population in Tigray, Northern Ethiopia. *International Journal of Biodiversity Conservation, 9*(5), 130-145.

Getahun, L. (2008). Productive and Economic performance of Small Ruminant production in production system of the Highlands of Ethiopia. *Ph.D. dissertation. University of Hohenheim, Stuttgart-Hohenheim, Germany.*

GOP, (2022). Pakistan Economic Survey (2021-22). *Economic Advisor's Wing, Finance Division, Government of Pakistan, Islamabad.*

Goran, K.E., Kouadja, G. S., Kouassi, N. C., Loukou, N.E., Eka, J. Y., & Dayo, G. K. C. (2019). Primary morphological characterization of west Africa dwarf (Djallonke) ewes from cot d" lvoire based on qualitative and quantitative traits. *International Journal of Genetics and Molecular Biology,* 11(2), 16-28.

Hailemariam, F., Gebremicheal, D., & Hadgu, H. (2018). Phenotypic characterization of sheep breeds in Gamogofa zone. *Agriculture & Food Security*, 7: 27

Henson, E.L. (1992). In-situ conservation of livestock and poultry. *FAO Animal Production and Health*, 99

Hulunim, G. (2014). On-farm phenotypic characterization and performance evaluation of Bati, Borena and short eared Somali goat populations of Ethiopia. *MSc. thesis submitted to the School of Graduate Studies of Haramaya University, Ethiopia,* 140.

Isani, G.B., & Baloch, M. N. (1996). Sheep and goat breeds in Pakistan. *Press Corporation, Karachi, Pakistan*, 23-29.

Lix, L. M., & Sojobi T. T. (2010) Discriminant analysis for repeated measured data: *A Review of Psychology*1: 146.

Monau, P. I., Visser, C., Nsoso, S.J., & Marle-Koster, E. (2018). Phenotypic and genetic characterization of indigenous Tswana goats. *South African Journal of Animal Sciences*, *48*(5), 925-934.

Nazeer, M., & Shah, S.H. (2018). Morphological characterization of indigenous goat breeds of Khyber Pakhtunkhwa, Pakistan. *Sarhad Journal of Agriculture*, *34*(2), 258-267.

Pervage, S., Ershaduzzaman, M., Talukder, M. A. I., Hasan, M. N., & Khandoke, M. A. M. Y. (2009). Phenotypic Characteristics of Indigenous Sheep of Bangladesh. *Bangladesh Journal of Animal Science,* 38(1&2), 1-6

Reddy,P. P., Vinoo, R., Muralidhar, M., Venkatasesaiah, Ch., AswaniKumar, K. & Sudhakar, K. (2020). Socio-economic status, sheep husbandry practices and morphological patterns of Macherla sheep, as lesser-known sheep breed of Andhra Pardesh. *Journal of Animal Research,* 827-835.

Selvakkumar. R., Sivakumar, T., MeenakshiSundaram, S., Jawahar, K.T.P. & Vanan T.T. (2016). Phenotypic Characterization of Vembur sheep in its inbreeding tract. *Indian veterinary Journal,* 93 (11), 36-38.

Singh, G., Jain, & Yadav, D. K. (2007). Evaluation of Nali Sheep under field conditions. *Indian Journal Animal Science,* 77(11), 1158-1160.

Solomon, G. (2009). *Goat breeds of Ethiopia*: Technical Bulleting No.27. A guide for identification and utilization. Editors: Alemu Y, Kassahun, T.A. Gipson and R.C. Merkel. *Sheep and Goat Productivity Improvement Program* (ESGPIP).

Tahir M., (2005). Breeds of sheep in Pakistan. Animal Breeding and Genetics, *University of Agriculture, Faisalabad, Pakistan, Wikipedia,* 1-1.

Taye, M., Abebe, G., Gizwa, S., Lema, S., Mekoya, A. (2010). Traditional Management system and

linear body measurements of washera sheep in the western highland of the Amhara National Regional State, *Ethopia Livestock Research and Rural Development, 22*, 169.

Tilahun, H., Haile, A., &Seid, A. (2019). Phenotypic characterization of indigenous goats in North Shewa Zone, Amhara region, Ethiopia. *International Journal of Research Studies in Agricultural Sciences*, *5*(7), 44-55.

Tsegaye, D., Belay B., & Haile, A. (2013). Morphological Characterization of Indigenous Hararghe Highland Goat Breed in Their Native Environment, West Hararghe, Ethiopia. *American-Eurasian Journal of Scientific Research*, (8), 72-79.

Vlad, I., Maftei, M., Ianiţki, D., Stanciu M., &Fiţa, A. (2014). Morpho-productive characteristics of Saanen goats in the south of Romania. *Animal Science and Biotechnology*, *47*(1), 300-305.

Wahid A. (1982). General pattern of production, breeds, management, disease, nutrition performance and problems. Pakistan agriculture research council, Islamabad. *In. proc. international seminar on sheep and wool,* 14-38.

Whannou, H.R.V., Afatondji, C.U., Ahozonlin, M.C., Spanoghe, M., Demblon, D.LD. Romuald M. (2021). Morphological variability within the indigenous sheep population of Benin. *PloS ONE,* 16 (10), 0258761.

Yadav, D.K., Arora, R., Bhatia, S., and Singh, G. (2011). Morphological Characterization, production and reproduction status of Munjal-a threatened sheep population of Northwest India. *Indian Journal of Animal Sci*ence, 81, 943-945

Table-1   Morphologic/Phenotypic traits of Kachhi sheep in different vicinities of Sindh, Pakista2

Phenotypic characteristics		Vicinities of Sindh Province					
		Hyd. N (%)	Matiary N (%)	MPK N (%)	Sanghar N (%)	Umerkot N (%)	Tharparkar N (%)
Coat color Pattern	Female sheep spotted/patchy	4(10)	6(15)	5(12)	4(10)	3(7)	2(5)
	Female sheep plain	36(90)	34(85)	35(88)	36(90)	37(93)	38(95)
	Male sheep spotted/patchy	2(20)	1(10)	2(20)	2(20)	1(10)	1(10)
	Male sheep plain	8(80)	9(90)	8(80)	8(80)	9(90)	9(90)
X^2value =	8.61 ^{NS}				P -value (0.05) = 0.9870		
Skin color type	Female sheep white and brown	6(15)	4(10)	6(15)	7(18)	8(20)	6(15)
	Female sheep white and black	34(85)	36(90)	34(85)	33(82)	32(80)	34(85)
	Male sheep white and brown	2(20)	1(10)	1(10)	2(20)	2(20)	2(20)
	Male sheep white and black	8(80)	9(90)	9(90)	8(80)	8(80)	8(80)
X^2value =	6.94 $^{(NS)}$				P- value (0.05) = 0.9969		
Wool type	Female sheep curly	0(00)	0(00)	0(00)	0(00)	0(25)	0(00)
	Female sheep coarse	40(100)	40(100)	40(100)	40(100)	40(75)	40(100)
	Male sheep curly	0(00)	0(00)	0(00)	0(00)	0(00)	0(00)
	Male sheep coarse	10(100)	10(100)	10(100)	10(100)	10(100)	10(100)
X^2value =	4.68 $^{(NS)}$				P -value (0.05) = 0.9114		
Nose profile	Female sheep straight	0(00)	0(00)	0(00)	0(00)	0(00)	0(00)
	Female sheep roman type	40(100)	40(100)	40(100)	40(100)	40(100)	40(100)
	Male sheep straight	0(00)	0(00)	0(00)	0(00)	0(00)	0(00)
	Male sheep roman type	10(100)	10(100)	10(100)	10(100)	10(100)	10(100)

X²value = 4.68(NS)							P- value (0.05) = 0.9114
Phenotypic characteristics		**Vicinities of Sindh Province**					
		Hyderabad N (%)	**Matiary N (%)**	**Mirpurkhas N (%)**	**Sanghar N (%)**	**Umerkot N (%)**	**Tharparkar N (%)**
Head/facial profile	Female sheep Straight	0(00)	0(00)	0(00)	0(00)	0(00)	0(00)
	Female sheep Convex	40(100)	40(100)	40(100)	40(100)	40(100)	40(100)
	Male sheep Straight	0(00)	0(00)	0(00)	0(00)	0(00)	0(00)
	Male sheep Convex	10(100)	10(100)	10(100)	10(100)	10(100)	10(100)
X²value = 4.68(NS)							**P-value (0.05) = 0.9114**
Ear orientation	**Female sheep Erect**	**0(00)**	**0(00)**	**0(00)**	**0(00)**	**0(00)**	**0(00)**
	Female sheep Pendulous	40(100)	40(100)	40(100)	40(100)	40(100)	40(100)
	Male Erect	0(00)	0(00)	0(00)	0(00)	0(00)	0(00)
	Male sheep Pendulous	10(100)	10(100)	10(100)	10(100)	10(100)	10(100)
X²value = 4.68(NS)							**P-value (0.05) = 0.9114**
Rump profile	Female sheep Flat	4(10)	2(5)	1(3)	0(0)	2(5)	1(3)
	Female sheep Sloping	36(90)	38(95)	39(97)	40(100)	38(95)	39(97)
	Male sheep Flat	2(10)	2(20)	1(10)	1(10)	0(0)	0(10)
	Male sheep Sloping	8(80)	8(80)	9(90)	9(90)	10(100)	10(100)
X²value = 15.12(NS)							**P-value (0.05) = 0.7697**
Wattles	Female sheep with wattles	36(90)	36(90)	38(95)	35(88)	37(93)	38(95)
	Female sheep without wattles	4(10)	4(10)	2(5)	5(12)	3(7)	2(5)
	Male sheep with wattles	9(90)	8(80)	9(90)	8(80)	9(90)	9(90)
	Male sheep without wattles	1(10)	2(20)	1(10)	2(20)	1(10)	1(10)
X²value = 8.22(NS)							**P-value (0.05) = 0.9903**
Hooves	Female sheep Dark color	40(100)	40(100)	40(100)	40(100)	40(100)	40(100)
	Male sheep	10(100)	10(100)	10(100)	10(100)	10(100)	10(100)

	Dark color					
X²value =	**4.68(NS)**				**P-value (0.05) = 0.9114**	
Tail	Female sheep Thin and cylindrical	40(100)	40(100)	40(100)	40(100)	40(100)	40(100)
	Female sheep fat	0(00)	0(00)	0(00)	0(00)	0(00)	0(00)
	Male sheep Thin and cylindrical	10(100)	10(100)	10(100)	10(100)	10(100)	10(100)
	Male sheep Fat	0(00)	0(00)	0(00)	0(00)	0(00)	0(00)
X²value =	**4.68(NS)**				**P-value (0.05) = 0.9114**	
Udder	Female Compact	38(94)	36(90)	39(97)	35(88)	37(92)	39(97)
	Female Loose	2(6)	4(10)	1(3)	5(12)	3(8)	1(3)
X²value =	**9.93(NS)**				**P-value (0.05) = 0.4467**	

(N) = Number of sheep showing a specific qualitative character, (%) = Percent, X^2 = (Pearson chi-square),
*Significant difference (P < 0.05), (NS) = non-significant difference.

Table 4.2 (A) Quantitative traits of Female Kachhi sheep at different vicinities of Sindh province.

Vicinities of Sindh	Body weight (Kg)	Chest girth (Cm)	Body length (Cm)	Body Height (Cm)	Ear length (Cm)	Face length (Cm)	Tail length (Cm)	Head width (Cm)
Matiary	35.16ᵃ	76.40 ᵃ	73.45 ᵃ	73.68 ᵃ	12.05	21.11 ᵃ	15.53 ᵃ	11.84 ᵃ
Hyderabad	33.96ᵃ	74.23 ᵃᵇ	71.58 ᵇ	72.43 ᵃ	11.98	20.15 ᵇ	14.15 ᵇ	10.80 ᵃ
Sanghar	32.73ᵃ	73.51 ᵇ	70.35 ᵇ	71.95 ᵃ	11.88	19.66 ᵇ	13.65 ᵇ	9.95 ᵃᵇ
Mirpurkhas	32.43ᵃᵇ	72.70 ᵇ	69.95 ᵇ	71.10 ᵃᵇ	11.78	18.10 ᶜ	12.88ᵇᶜ	9.46 ᵇ
Umerkot	31.88ᵃᵇ	71.66ᵇᶜ	68.61ᵇᶜ	70.38 ᵇ	11.70	18.70 ᶜ	12.35 ᶜ	8.95ᵇᶜ
Tharparkar	30.95ᵇ	70.74 ᶜ	67.26 ᶜ	69.65 ᵇ	11.60	17.98 ᶜ	11.70 ᶜ	8.70 ᶜ
P value	0.043	0.037	0.032	0.044	0.311*ᴺˢ	0.041	0.038	0.036
SE	0.357	0.308	0.310	0.208	0.121	0.147	0.170	0.114

*NS= non-significant
*(abc) = Superscripts with different letters in same column varied significantly from one another.

Table 4.2. (B) Quantitative traits of Male Kachhi sheep at different vicinities of Sindh province.

Vicinities of Sindh	Body weight (Kg)	Chest girth (Cm)	Body length (Cm)	Body Height (Cm)	Ear length (Cm)	Facial length (Cm)	Tail length (Cm)	Head width (Cm)
Matiary	44.30 [a]	86.10 [a]	78.80 [a]	81.77 [a]	14.33 [a]	22.70 [a]	15.90 [a]	12.00 [a]
Hyderabad	42.85 [b]	84.00 [b]	76.60 [b]	79.20 [b]	13.20 [ab]	21.20 [b]	15.10 [a]	11.30 [a]
Sanghar	41.40 [b]	83.60 [b]	75.00 [b]	78.10 [b]	12.50 [b]	20.45 [b]	14.80 [a]	10.90 [a]
Mirpurkhas	40.90 [b]	82.00 [bc]	74.70 [b]	76.50 [c]	11.85 [b]	19.00 [bc]	13.20 [ab]	9.90 [b]
Umerkot	39.10 [b]	81.00 [c]	73.20 [c]	75.10 [c]	11.45 [b]	18.05 [c]	12.70 [b]	9.70 [b]
Tharparkar	37.50 [c]	79.15 [c]	72.50 [c]	73.30 [c]	10.90 [b]	17.85 [c]	11.95 [b]	9.20 [b]
P value	0.039	0.035	0.041	0.032	0.043	0.027	0.037	0.044
SE	0.818	0.788	0.467	0.382	0.291	0.228	0.251	0.228

*(abc) = Superscripts with different letters in same column varied significantly from one another.