



## Review Article

# Phenotypic Characterisation of Selected African Sheep Breeds: A Review

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## ABSTRACT

Phenotypic characterisation of animals is very important in describing the uniqueness of animal genetic resources and providing data for the conservation of sheep genetic resources. Evolutionary forces like mutation, drift, selection and migration that cause changes in allelic frequency in both space and time are what cause phenotypic variation in populations. One of the key contributors to the decreasing genetic diversity of livestock has been identified as breeders' and/or consumers' preferences for particular breeds and such concentrations on a small number of breeds result in the extinction of many indigenous breeds, which raises the uniformity of livestock products. The objective of this study was to review the phenotypic variations between different African sheep breeds. This review study shows forms of slight variation in morphological traits among sheep breeds of the same area within that country. The majority of sheep on the continent now are fat-tailed sheep as they can be found throughout eastern and southern Africa, from Eritrea to South Africa, as well as northern Africa, from Egypt to Algeria. Some breeds are able to adapt to harsh environmental conditions than others and the fat-tailed sheep are one of them as they appear to be able to survive these conditions like when they are faced with feed shortage, they can mobilise stored energy from their tail and lay down subcutaneous and intramuscular fat. This study will help sheep farmers, extension officers and researchers to understand the phenotypic variations among African sheep breeds for breeding and conservations.

### Article Information

Received 05 May 2023

Revised 22 January 2024

Accepted 19 June 2024

Available online 17 October 2024  
(early access)

### Authors' Contribution

TS, TLT: Conceptualization

TS: Writing - original draft

TLT, JN: Writing - review and editing

All the authors approve the final manuscript.

### Key words

Tail type, Coat colour, Body length, Withers height

## INTRODUCTION

Sheep (*Ovis aries*) have become important farm animals across the world through adaptation to a diverse range of environments and varied production systems (Deribe *et al.*, 2021). Sheep from Africa were domesticated outside the continent and are related to the European and Asian sheep as they share common ancestry (Muigai and Hanotte, 2013). Two identified main groups of indigenous African sheep genetic resources are fat-tailed and thin-tailed sheep (Deribe *et al.*, 2021). Thin-tailed sheep were the first to leave their area of domestication, giving rise to modern European thin-tailed breeds and the origin of the fat-tailed sheep

is unclear, but given their modern geographic distribution and lack of a putative wild fat-tailed ancestor, the fat-tailed phenotype was originally selected in local populations of thin-tailed sheep and may have been a response to extreme climatic conditions and/or human preference (Muigai and Hanotte, 2013). The first step in developing the available animal genetic resources (AnGR) is to characterize livestock breeds based on the variations in their morphological traits (Deribe *et al.*, 2021). The process of morphological characterization entails describing and recording the physical characteristics of a breed (Deribe *et al.*, 2021).

As a small ruminant, sheep can convert low-quality roughages into meat and milk for human consumption (in addition to producing fibre and hides) and are well suited to foraging on marginal grazing lands that are unable to support grazing of larger livestock species (Elshazly and Youngs, 2019). One of the main sources of red meat for human consumption and a significant contributor to the world's livestock food production is sheep (Talebi *et al.*, 2022). Sheep are crucial to the farming systems of smallholders because they offer both concrete (cash in

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0030-9923/2024/0001-0001 \$ 9.00/0



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the form of milk, meat, fibre and manure) and intangible (benefits such as prestige, savings, insurance, and cultural and ceremonial purposes) benefits (Melesse *et al.*, 2022). However, to the best of our knowledge there has been no review delineating the morphological diversity between African sheep breeds. Hence, the objective of this study is to review the phenotypic differentiation between different African sheep breeds. This study will help sheep farmers, extension officers and researchers to understand the phenotypic variations among African sheep breeds for breeding and conservations.

## METHODOLOGIES

The studies focusing on phenotypic characterization of sheep breeds from the African continent were reviewed as studies of the improvement of sheep resilience to climate change stresses. Both researchers independently conducted a publication search using “phenotypic traits of African sheep breeds”, “African sheep breed morphometric traits” and “origin of African sheep breeds” as key terms. Studies were considered for inclusion in this review provided: they included key terms used for searching. Articles that were talking about a different specie other than sheep and sheep from other continents were excluded. Duplicate studies were also excluded (Salah *et al.*, 2014).

## THE ORIGIN OF AFRICAN SHEEP BREEDS

Sheep breeds are from different African countries, this study divides the African continent in four regions (east, south, west and north) giving the origins of different African sheep breeds.

### *Eastern Africa*

There are several sheep breeds from Eastern African countries such as Afar sheep also known as Adal which is a fat-tailed sheep that originates from importations from Arabia and raised in Ethiopia (Wilson, 1991) (Fig. 1A). Somalia's native sheep breed is the Blackhead Somali sheep (Hussein Mohamed *et al.*, 2022) (Fig. 1B). Rwanda and Burundi has fat-tailed sheep that descended from the East African long-fat-tailed group raised in Rwanda, Burundi, Uganda and Tanzania (Wilson, 1991). East African blackhead sheep is a fat-tailed sheep that descended from the East African long-fat-tailed group and raised in Uganda and Tanzania (Wilson, 1991). Arsi-Bale sheep are fat-tailed and covered with coarse wool and are found in the highlands of eastern and south-central Ethiopia (Awgichew and Abegaz, 2008) (Fig. 1C). Indigenous sheep populations exist and admixtures are suspected due to two or more breeds reared together, the

Tumele and small short fat tailed sheep (SSFT) are found in the north eastern region of Ethiopia and the Gumz, Rutana and Begayit sheep are found in the north western region of Ethiopia (Deribe *et al.*, 2021) (Fig. 1D, E, F). Horro sheep is the indigenous sheep breed of Ethiopia found in the western humid mid-highlands of the country (Tibbo, 2006) (Fig. 1G). This fat tail sheep is larger than most other indigenous sheep of Ethiopia (Awgichew and Abegaz, 2008). Menz is the indigenous sheep breed of Ethiopia found in the central and western highlands of the country (Tibbo, 2006). This fat and short tail sheep is the most widely recognized sheep in Ethiopia producing coarse wool (Awgichew and Abegaz, 2008) (Fig. 1H, I). It is clear that the Macina was given a supposed origin in central-west Asia (Wilson, 1983). Washera is Ethiopian indigenous sheep native to Ethiopia (Gizaw *et al.*, 2007). Red Masai also known as Masai is a fat-tailed sheep that descended from the East African long fat tailed group and raised in Kenya and Tanzania (Wilson, 1991). Ethiopian Highland also known as Abyssinian is a fat-tailed sheep that descended from importations from Arabia is raised in Ethiopia (Wilson, 1991) (Fig. 1J).

### *Southern Africa*

There are several sheep breeds from Southern African countries such as Swazi sheep breed which is a fat-tailed sheep that migrated with Nguni people (Mavule, 2012). This sheep exists in the Southern African region, Swaziland and is considered part of the Nguni group breed (Almeida, 2011). Landim sheep breed which exists in Mozambique and is considered part of the Nguni group breed (Almeida, 2011). The Nguni people migrated down Africa's east coast, bringing with them sheep that are now recognized as Nguni sheep (Mavule, 2012). Zulu sheep is the oldest indigenous Nguni sheep breed of South Africa (Ngcobo *et al.*, 2022) (Fig. 2A). Bapedi sheep is one of the three South African Nguni sheep that migrated down Africa's east coast with the Bapedi people (Mavule, 2012) (Fig. 2B). Namaqua Afrikaner is a South African indigenous breed migrated southward with Khoi people (Soma *et al.*, 2012) (Fig. 2C). Tswana sheep is a fat-tailed sheep breed from Botswana and it is most likely that East Africa is where the majority of the ancestral population of southern African fat-tailed sheep came from (Muigai and Hanotte, 2013) (Fig. 2D). The different South African Persian breeds, including the Redhead Persian, Blackhead Persian, and Redhead Speckled Persian, are of Somalian or Saudi-Arabian origin and have existed in South Africa for many years (Soma *et al.*, 2012). The African long fat tailed sheep type includes the Damara, a sheep breed that originated in Namibia (Almeida, 2011) (Fig. 2E). Since its seaborne arrival from Bukhara, Asia, in 1907,



Fig. 1. East African sheep: A, Afar sheep (Awgichew and Abegaz, 2008); B, Flock of blackhead Somali sheep (Hussein Mohamed *et al.*, 2022); C, Arsi-Bale sheep (in background) (Awgichew and Abegaz, 2008); D, Gumz sheep (Amane *et al.*, 2023); E, Rutana sheep (Gizaw *et al.*, 2011); F, Begayit male (Amane *et al.*, 2012); G, Horro sheep (Awgichew and Abegaz, 2008), H, Menz ewes (Awgichew and Abegaz, 2008); I, Washera sheep (Awgichew and Abegaz, 2008); J, Red Masai sheep (Muigai and Hanotte, 2013).

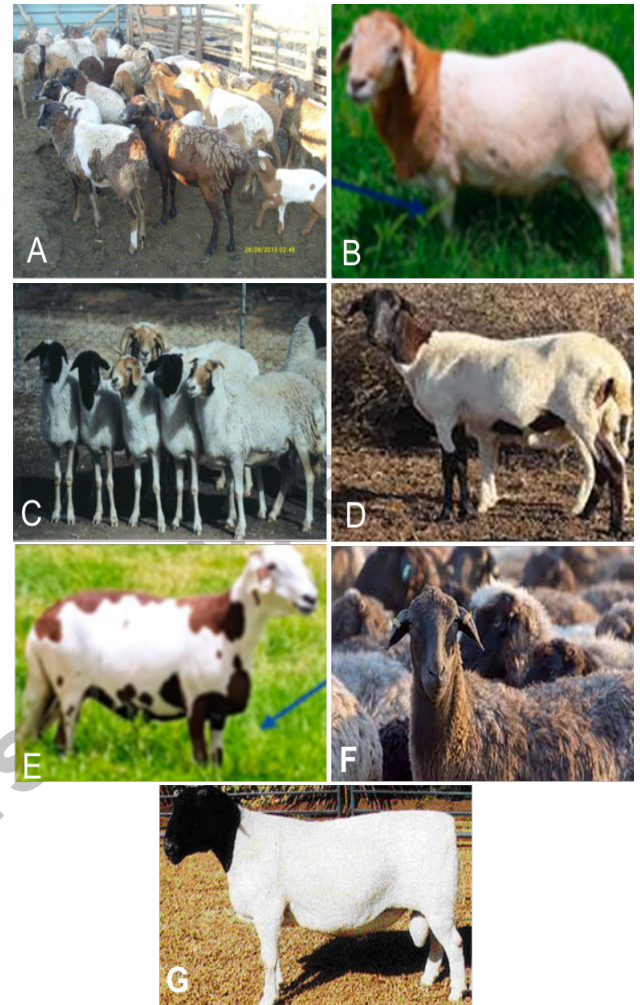


Fig. 2. South African sheep: A, Flock of Zulu sheep (Mavule, 2012); B, Bapedi sheep (Ngcobo *et al.*, 2022); C, Namaqua Afrikaner sheep (Qwabe, 2011); D, Tswana ewe (Bolowe *et al.*, 2021); E, Damara sheep (Ngcobo *et al.*, 2022); F, Swakara sheep (Mumba, 2022); G, Dorper ram (Awgichew and Abegaz, 2008).

the fat-tailed medium-sized breed of sheep known as the Swakara (formerly Karakul) has been bred in Namibia (Kandiwa *et al.*, 2019) (Fig. 2F). Dorper is a hardy South African composite breed, derived from a cross between the Black-headed Persian and the Dorset Horn (Cloete *et al.*, 2000) (Fig. 2G).

#### Western Africa

There are several sheep breeds from Western African countries such as the West African Dwarf (WAD) sheep that descended from the fine-tailed, hairy sheep from Western Asia that made its way to Africa via the Bab el Mandeb and Suez Canal (Whannou, *et al.*, 2021). Yankasa

which is a composite breed developed in Nigeria from the Fulani Group of Sahel Type and WAD (Rasali *et al.*, 2006) (Fig. 3A, B). The thin-tailed breed Peul-Peul also known as Fulani in English is a descendant of West African Sahel raised in Senegal (Wilson, 1991) (Fig. 3C). Mossi is a composite breed developed in Burkina Faso from the Toronké (or Peul Voltaïque) and West African Dwarf (Rasali *et al.*, 2006). Hamadou *et al.* (2019) reported the multi-attribute choice experiment that was used to examine how breeders from Tillabéri, Niger, where the Koundoum breed originated, value their sheep. Djallonke sheep is native to Burkina Faso (Traoré *et al.*, 2008) (Fig. 3D). Balami sheep is a thin-tailed sheep that descended from the West African Sahel raised in Nigeria (Wilson, 1991) (Fig. 3E). The thin-tailed sheep known as Toronke is raised in Mali and Burkina Faso, and descended from the West African Sahel (Wilson, 1991).

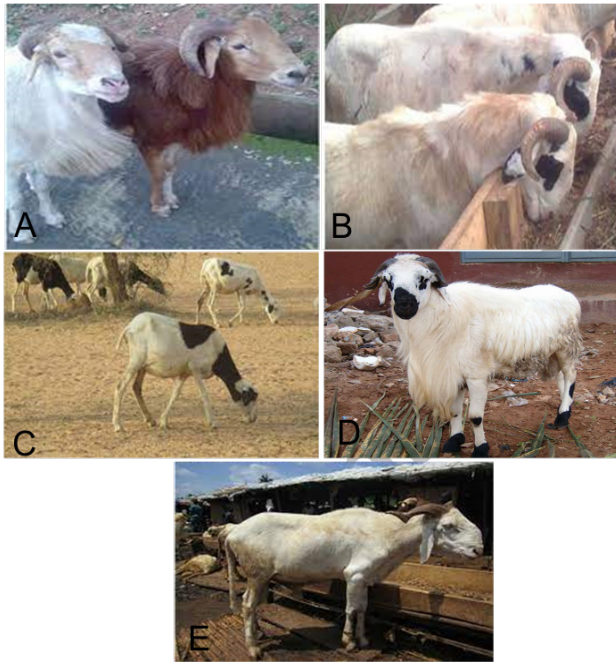


Fig. 3. West African sheep: A, WAD rams (Salako, 2013); B, Yankasa rams (Salako, 2013); C, Peul-peul sheep (Ndiaye *et al.*, 2018); D, Djallonke ram (Whannou, *et al.*, 2021); E, Balami ram (Yunusa *et al.*, 2013).

#### Northern Africa

The Ouled-Djellal was originally raised in the Biskra region (north-eastern Algeria) after it was brought by the Romans from Italy in the fifth century (Gaouar *et al.*, 2015). Uda sheep also known as Oudah, Peul, Bali-bali and Fellata descended from the West African Sahel and raised in Niger, Nigeria, Chad, Sudan and Cameroon (Wilson,

1991) (Fig. 4A). Black Maure is a thin-tailed sheep which descended from the Maghreb type of Morocco is raised in Mauritania (Wilson, 1991). An indigenous breed of sheep from Algeria known as the Tazegzawt is well adapted to the region's environmental conditions; however, only a small population remains in the breed's area of origin in the Kabylia Mountains, in North Central Algeria (Moulla, 2018) (Fig. 4B). Sudan Desert is a thin-tailed sheep breed also known as the northern Sudanese, Desert Sudanese or Sudanese Desert probably descended from ancient Egyptian stock (Wilson, 1991) (Fig. 4C). Touabire also known as White Maure and White Arab is thin-tailed descended from the West African Sahel is raised in Mauritania (Wilson, 1991) (Fig. 4D).

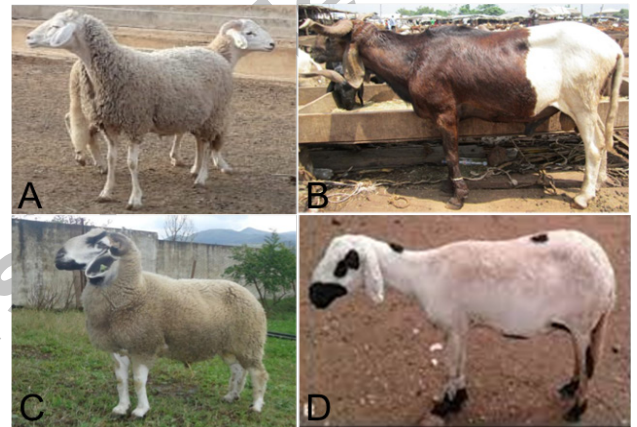


Fig. 4. North African sheep: A, Ewe of Ouled-Djellal with its lamb (Belhaj *et al.*, 2021); B, Uda ram (Yunusa *et al.*, 2013); C, Tazegzawt sheep (El-Bouyahiaoui *et al.*, 2019); D, Sudan desert sheep (Ali *et al.*, 2016).

### GEOGRAPHICAL DISTRIBUTION OF AFRICAN SHEEP BREEDS

Sheep breeds are from different African countries, Figure 5 shows the countries within the African continent where the sheep breeds originate from.

### QUALITATIVE TRAIT VARIATIONS OF AFRICAN SHEEP BREEDS

#### Tail type

Different sheep have different tail types and this can also be seen by the countries of origin and the regions of the continent make it simple to categorise them according to tail types.

Fat tailed sheep such as, Afar, Tumele and, small short fat tailed sheep (SSFT) are from the eastern African region (Deribe *et al.*, 2021). Gumz, Rutana and, Begayit are thin

tailed sheep from the eastern region of Africa (Deribe *et al.*, 2021). Arsi-Bale, Horro, Menz, Washera and Blackhead Somali are fat-tailed (Awgichew and Abegaz, 2008). Red Masai, East African Blackhead, Rwanda and Burundi are fat-tailed sheep (Wilson, 1991).

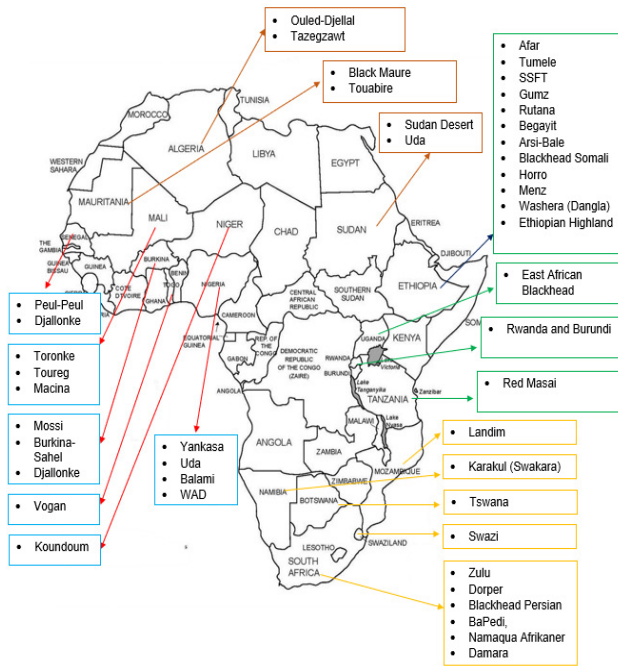


Fig. 5. Geographical distribution of African sheep breeds. Adapted from “Blank map of Africa | Large outline map of Africa” by Islam. (2022).

Fat-tailed southern African sheep are Namaqua Afrikaner, Zulu, Tswana, Karakul, Sabi, Landim and Swazi (Wilson, 1991). Bapedi and Damara are fat-tailed sheep (Ngcobo *et al.*, 2022).

Djallonke, Mossi, Toronke, Toureg, Macina and Vogan are thin tailed sheep found in the western African region (Wilson, 1991).

Sudan Desert, Touabire and Uda are thin-tailed sheep found in northern Africa (Wilson, 1991). Ouled-Djellal has long and medium sized tail (Harkat *et al.*, 2015).

#### Coat type

Different sheep have different coat type which depends on their production (wool or meat) and the origin. This subtopic outlines the different coat types found in different African sheep breeds. Afar, Blackhead Somali and Horro are characterised by short, stiff and shiny hair with Menz having coarse wool (Awgichew and Abegaz, 2008). Ethiopian Highland has long mixed hair and wool, Red Masai and Rwanda and Burundi have long hair that

is stiff while East African Blackhead has short and coarse hair that is without wool undercover (Wilson, 1991).

Zulu sheep has coarse wool and hair (Mavule, 2012). Namaqua Afrikaner sheep is characterised by soft, shiny covering wool and hair (Qwabe, 2011). Tswana, Sabi and Landim are characterised by coarse hair with Swazi being hairy and longer along back and on rib cage (Wilson, 1991). Blackhead Persian is characterised by inner coat of fine wool fibre, Karakul with coarse wool in adults and Dorper showing short, loose light covering with wool (Wilson, 1991). Djallonke, Moss and Burkina-Sahel are characterised by short hair (Traoré *et al.*, 2008). Vogan is characterised by short hair, Peul-Peul and Toureg by short hair that is stiff and Macina by coarse wool mixed with hair (Wilson, 1991). Sudan Desert is characterised by short to long and fine to coarse hair, Black Maure by long and coarse hair with softer undercoat, Touabire by short and stiff hair and Uda by short and coarse hair (Wilson, 1991).

#### Coat colour

Different sheep have different coat colour which depends on their production (wool or meat) and their origin. This subtopic reviews the different coat colours of different African sheep breeds. Afar is characterised by solid blonde, Blackhead Somali by a black head and white body and Menz and Horro by variable colours such as light brown, dark brown, black, white and roan (Awgichew and Abegaz, 2008). Ethiopian Highland is characterised by extremely variable; self or mix colours predominate depending on type and region, Red Masai by red, East African Blackhead by black head and fore part of neck, remainder of body white with black spots or splotches and Rwanda and Burundi being generally black and white pied with red admixtures present at times (Wilson, 1991). Namaqua Afrikaner is characterised by a black head and brown head on white boy with black head more common (Qwabe, 2011). Tswana sheep are usually white but pied sheep are common, Swazi sheep are usually brown and reddish in whole colours, Dorper sheep are white with black confined to head and neck, Blackhead Persian have black head and neck with the black not extending father back and karakul with variable colours (Wilson, 1991). Damara sheep are brownish in colour and BaPedi sheep are white with brown head and occurrence of variety of colours (Ngcobo *et al.*, 2022).

Koundoum sheep are characterised by black as well as white colour (Hamadou *et al.*, 2015). Djallonke, Mossi and Burkina-Sahel are characterised by black, brown and white colour (Traoré *et al.*, 2008). Toureg sheep are white and notably red occur, Yankasa are white with black ears and around eyes, muzzle and on top of tail, Macina are generally white and spotted with black and red particularly

around eyes and ears, Vogan are red and black pies most common and Toronke are most common in red pied, black pied and white with fewer in red and black (Wilson, 1991)

Ouled-Djellal are characterised by off-white, pale yellow and few in white chalk colour (Harkat *et al.*, 2015). Black Maure are generally black with white tip on tail, Touabire are usually white with variable amounts of black spotting and Uda are found with black and white pied colours (Wilson, 1991).

#### *Ear type*

Different sheep have different ear types; this subtopic outlines the different ear types of the different African sheep breeds. Afar, Blackhead Somali and Menz are characterized by small ears (Awgichew and Abegaz, 2008). Red Masai and Rwanda and Burundi are seen with medium ears, East African Blackhead with short ears and Ethiopian Highland with short to medium ears (Wilson, 1991). Swazi, Landim and Sabi are characterised by short ears while karakul has medium sized ears and Blackhead Persian has moderately long ears (Wilson, 1991). Zulu sheep have natural, elf and gopher also present (Mavule, 2012).

Toronke, Toureg and Macina are characterised by medium sized ears while Vogan have medium long ears, Yankasa have relatively short ears and Djallonke have short ears (Wilson, 1991). Ouled-Djellal sheep mostly have short ears with medium sized and long also present (Harkat *et al.*, 2015). Sudan Desert and Touabire have medium to long ears while Black Maure have long ears and Uda have long to very long ears (Wilson, 1991).

#### *Horn presence*

Horro sheep are hornless, with Blackhead Somali usually hornless and males sometimes having rudimentary horns and Menz sheep are characterised by hornless females and males mostly having twisted horns (Awgichew and Abegaz, 2008). East African Blackhead and Burundi and Rwanda are usually hornless while Red Masai have horns in both sexes and Ethiopian Highland females are hornless while males have horns (Wilson, 1991)

Namaqua Afrikaner are horned and few females are hornless (Qwabe, 2011). Zulu sheep are usually hornless with few having horns (Mavule, 2012). Damara sheep are horned and BaPedi sheep are hornless (Ngcobo *et al.*, 2022). Landim and Blackhead Persian are hornless, Swazi and Karakul usually have horns in males with the females hornless and Sabi males are hornless while the females are usually polled (Wilson, 1991).

Koundoum sheep males usually have horns while females are hornless (Hamadou *et al.*, 2015). Toureg and Yankasa have horns in males and females are hornless

while Toronke, Vogan and Macina having horns in males and only a few females having horns (Wilson, 1991). Males are horned and only a few females are horned in Ouled-Djellal sheep (Harkat *et al.*, 2015). Sudan Desert, Black Maure, Touabire and Uda's males are horned and the females are usually hornless with Sudan Desert and Uda having females that sometimes have horns (Wilson, 1991).

## **DESCRIPTION OF QUANTITATIVE TRAITS OF AFRICAN SHEEP BREEDS**

According to FAO (2012), measuring tapes are used for linear body measurements such as body length, chest girth and rump height and mobile weight measuring sets consisting of a tripod, a spring balance and a hanging canvas sling are used to measure live body weights.

Identified quantitative trait measurements to be conducted as follows: Body weight: live weight, which is the weight of the animal standing squarely; Body length: measured diagonally from the lateral tuberosity on the scapula to the pin-bone; Chest girth: measured at the most dorsal point of the chest in line with the elbow and hence bisecting the chest at the approximate position of the heart; Withers height: height from the top of the withers to the ground; Rump height: measured vertically as the distance from the ground to the top of the pelvic girdle; Ear length: measured as the distance from the point of attachment to the tip of the ear; Tail length: distance from the root of the tail to the tip.

## **MORPHOMETRIC TRAITS OF DIFFERENT AFRICAN SHEEP BREEDS**

This review divided the continent into four different regions (east, south, west and north) according to the locations of countries. Therefore, this subtopic reviews sheep morphometric trait variations within the different regions.

#### *Eastern African sheep breeds*

Ethiopia has a lot of sheep breeds phenotypically characterised in terms of morphometric traits compared to other countries in the east region of the continent as shown in Table 1. The average body weight of the sheep from the east region is 31.5kg with the heaviest sheep being the Red Masai castrates from Tanzania weighing 45kg followed by the Rutana females aged between one and three years from Ethiopia weighing 43.1kg and the least heavy sheep being the Afar females aged between one and three years from Ethiopia weighing 18.9kg as well as the Arsi-Bale lambs aged under one year from Ethiopia weighing 14.2kg. The

average body length of the sheep from the east region is 56.7kg with the longest sheep being the Red Masai sheep from Tanzania being 70cm long followed by the Rwanda and Burundi sheep from Rwanda being 55-65cm long and the least long sheep being the Afar females aged between one and three years from Ethiopia with 46.6cm. The average chest girth of the sheep from the east region is 74.9cm with the biggest sheep being the Rutana females aged one to three years from Ethiopia being 82.7cm followed by the Begayit females aged one to three years from Ethiopia being 60-70cm long and the smallest sheep being the Afar females aged one to three years from Ethiopia with 66.6cm. Ethiopia represents the east region sheep breeds phenotypically characterised in terms of rump height with the average rump height of the sheep from the east region is 67.5cm with the biggest sheep being the Rutana females aged one to three years from Ethiopia with 74.3cm followed by the Begayit females aged one to three years from Ethiopia with 73.7cm and the smallest sheep being the Afar females aged one to three years from Ethiopia with 58.4cm. The average withers height of the sheep from the east region is 68.7cm with the biggest sheep being the Rutana females aged one to three

years from Ethiopia with 75cm followed by the Begayit females aged one to three years from Ethiopia with 74.7cm and the smallest sheep being the Afar females aged one to three years from Ethiopia with 59.6cm. The average tail length of the sheep from the east region is 10.4cm with the sheep with the biggest ear being the Red Masai sheep from Tanzania with 11-15cm followed by Rutana females aged one to three years from Ethiopia with 14.8cm the smallest sheep with the smallest ear are the Afar females aged one to three years from Ethiopia with 4.4cm. The average tail length of the sheep from the east region is 34.2cm with Begayit females aged one to three years from Ethiopia with 52.1cm having the longest tail followed by Rutana females aged one to three years from Ethiopia with 49.9cm and Afar females aged one to three years from Ethiopia with 17.3cm being the shortest tails.

#### *Southern African sheep breeds*

South Africa has a lot of sheep breeds morphometrically characterised compared to other countries in the southern region of the continent as shown in Table II. The average body weight of the sheep from the south region is 45.6kg

**Table 1. Eastern African sheep morphometric traits.**

Breed	Age (years)	BW (Kg)	BL (cm)	CG (cm)	RH (cm)	WH (cm)	EL (cm)	TL (cm)	Author
Afar (F)	1-3.0	18.9	46.6	66.6	58.4	59.6	4.4	17.3	Deribe <i>et al.</i> , 2021
Afar (M&F)	N/A						10		Wilson, 1991
Tumele (F)	1-3.0	26.3	51.3	72.7	64.9	64.1	7.4	25.8	Deribe <i>et al.</i> , 2021
SSFT (F)	1-3.0	24.5	51.6	71.6	64.9	64.6	10.2	21.2	Deribe <i>et al.</i> , 2021
Gumz (F)	1-3.0	35.9	54.4	77.4	68.8	70	12.6	38.7	Deribe <i>et al.</i> , 2021
Rutana (F)	1-3.0	43.1	58.2	82.7	74.3	75	14.8	49.9	Deribe <i>et al.</i> , 2021
Begayit (F)	1-3.0	39.7	57.8	81.4	73.7	74.7	14.5	52.1	Deribe <i>et al.</i> , 2021
Arsi-Bale (M&F)	N/A	14.2							Awgichew & Abegaz, 2008
Blackhead Somali (M&F)	N/A	30-35							Awgichew & Abegaz, 2008
Horro (M&F)	N/A	38.2							Awgichew & Abegaz, 2008
Menz	N/A	35							Awgichew & Abegaz, 2008
Washera	N/A	22.7							Awgichew & Abegaz, 2008
Ethiopian Highland (M)	N/A	35	60						Wilson, 1991
Ethiopian Highland (F)	N/A	25-28	60						Wilson, 1991
Red Masai (M)	N/A	41	70			72	11-15		Wilson, 1991
Red Masai (c)	N/A	45	70			72	11-15		Wilson, 1991
Red Masai (F)	N/A	32	70			66	11-15		Wilson, 1991
East African Blackhead (F)	N/A	25					5-8.0		Wilson, 1991
Rwanda and Burundi (M&F)	N/A		55-65	72					Wilson, 1991

SSFT, small, short fat-tail; M, Males; F, Females; c, castrates; M&F, males and females; N/A, not mentioned in the article; BW, body weight; BL, body length; HG, heart girth; RH, rump height; WH, withers height; EL, ear length; TL, tail length.

with the heaviest sheep being the Blackhead Persian males from South Africa weighing 70kg followed by the Damara males from South Africa weighing 61kg and the least heavy sheep being the Swazi sheep from Swaziland weighing between 25-35kg. The average body length of the sheep from the southern region is 65.13 with the longest sheep being the Namaqua Afrikaner sheep from South Africa being 68.7-71.2cm long followed by the Tswana male castrates from Botswana being 60-70cm long and the least long sheep being the Tswana male castrates from Botswana with 60-70cm. South Africa represents the southern region sheep breeds phenotypically characterised in terms of chest girth with the average chest girth of the sheep from the southern region is 89.05cm with the biggest sheep being the Namaqua Afrikaner aged one to two years from South Africa being 95.8-100.6cm and the smallest sheep being the Zulu sheep from South Africa with 79.9cm. The Zulu males aged two years from South Africa with 63.1cm are the only sheep breed characterised and represent the region. South Africa represents the southern region sheep breeds phenotypically characterised in terms of withers height as shown in Table I. The Zulu males aged two years from South Africa with 62.6cm are the only sheep breed characterised and represent the region. Mozambique and South Africa represent the southern region sheep breeds phenotypically characterised in terms of ear length with average ear length of the sheep from the southern region is 10.9cm with Landim sheep from

Mozambique with 12.9 having the biggest ears and Zulu males from South Africa with 8.9cm having the smallest ears. The average tail length of the sheep from the southern region is 35cm with the sheep with the longest tail being the Namaqua Afrikaner sheep aged one to two years from South Africa with 41.0-43.7cm followed by Landim sheep from Mozambique with 35.6cm and the sheep with the shortest tail are the Zulu sheep aged two years from South Africa with 27.0cm.

#### *Western African sheep breeds*

Morphometric traits of countries in the east region of the continent are shown in Table III. The average body weight of the sheep from the west region is 34.21kg with the heaviest sheep being the Toureg sheep from Mali weighing 40-60kg followed by the Peul-Peul sheep from Senegal weighing 30-50kg and the least heavy sheep being the Mossi females from Burkina Faso and Djallonke females from Senegal both weighing 20-25kg. The average body length of the sheep from the west region is 58.2cm with the longest sheep from Mali. Toureg being 75-80cm. Toronke 70-80cm and Macina. The least long sheep being the Koundoum males aged between zero to four and above years from Niger with 50.8-58.0cm. The average chest girth of the sheep from the west region is 75.17cm with the biggest sheep being the Balami sheep aged two to four years from Nigeria being 100.3cm followed by the Uda sheep aged two to four years from Nigeria being 91.8cm

**Table II. Southern African sheep morphometric traits**

Breed	Age (years)	BW (Kg)	BL (cm)	CG (cm)	RH (cm)	WH (cm)	EL (cm)	TL (cm)	Author
Tswana (c)	3	35.7	60-70						Wilson, 1991
Tswana (F)	N/A	31.7	61						Wilson, 1991
Zulu (F&M)	2	34.3	63.9	79.9	63.1	62.6	8.9	27	Mavule, 2012
Dorper (M)	1-5.0	36.8							Tyasi <i>et al.</i> , 2023
Blackhead Persian (M)	N/A	70							Wilson, 1991
Blackhead Persian (F)	N/A	50							Wilson, 1991
BaPedi (F)	N/A	40							Ngcobo <i>et al.</i> , 2022
Namaqua Afrikaner	N/A	58.7	68.7-71.2	95.8-100.6				41-43.7	Ngcobo <i>et al.</i> , 2022
Damara (M)	N/A	61							Ngcobo <i>et al.</i> , 2022
Damara (F)	N/A	45							Ngcobo <i>et al.</i> , 2022
Swazi (M&F)	N/A	25-35							Wilson, 1991
Landim (M)	N/A	55	65				12.9	35.6	Wilson.,1991
Landim (F)	N/A	35	65				12.9	35.6	Wilson, 1991
Karakul (M)	N/A	54							Wilson, 1991
Karakul (F)	N/A	41							Wilson, 1991

See Table I for abbreviation.



and the smallest sheep being the WAD sheep from Nigeria with 27.84cm. Nigeria represents the west region sheep breeds phenotypically characterised in terms of rump height with the average rump height of the sheep from the north region is 81.4cm with the biggest sheep being the Balami sheep aged two to four years from Nigeria with 87.0cm followed by the Uda sheep aged two to four years from Nigeria with 82.6cm and the smallest sheep being the Yankasa sheep aged two to four years from Nigeria with 74.6cm. The average withers height of the sheep from the west region is 70.1cm with the biggest sheep being the Balami sheep aged two to four years from Nigeria with 88.3cm followed by the Uda sheep aged two to four years from Nigeria with 83.9cm and the smallest sheep being the WAD sheep from Nigeria with 54.99cm. Burkina Faso has a lot of sheep breeds phenotypically characterised in

terms of ear length compared to other countries in the west region of the continent with the average ear length of the sheep from the west region is 12.6cm with the sheep with the biggest tail being the Burkina-Sahel sheep aged two and half to five years from Burkina Faso with 16.80cm followed by Toureg sheep from Mali with 15cm and the sheep with the smallest ears are the Djallonke sheep aged two and half to five years from Burkina Faso with 9.43cm. The average tail length of the sheep from the west region is 36.4cm with the sheep with the longest tail being the Uda sheep aged two to four years from Nigeria with 51.0cm followed by Balami sheep aged 2 to four years from Nigeria with 48.9cm and the sheep with the shortest tail are the Djallonke sheep aged two and half to five years from Burkina Faso with 24.50cm.

**Table III. Western African sheep morphometric traits.**

Breed	Age (years)	BW (Kg)	BL (cm)	CG (cm)	RH (cm)	WH (cm)	EL (cm)	TL (cm)	Author
Koundoum (M)	0-4 and above	22.5-48.3	50.8-58	66-81.2		63.6-78.4	13.1-14	35.2-36	Hamadou <i>et al.</i> , 2015
Koundoum (F)	0-4 and above	24.4-31.1	51.2-53	70-76.8		65.6-69.9	13.3-13.5	36.1-36.5	Hamadou <i>et al.</i> , 2015
Peul-Peul (M&F)	N/A	30-50	65-75						Wilson, 1991
Djallonke (Senegal) (M)	N/A	25-30	54.1			56.49	10		Wilson, 1991
Djallonke (Senegal) (F)	N/A	20-25	54.1			56.49	10		Wilson, 1991
Toronke (M)	N/A	40	70-80						Wilson, 1991
Toronke (F)	N/A	30-35	70-80			74.1			Wilson, 1991
Toureg (M&F)	N/A	40-60	75-80				15		Wilson, 1991
Macina (M)	N/A	40	60-80				12		Wilson, 1991
Macina (F)	N/A	30	60-80				12		Wilson, 1991
Yankasa (M)	N/A	40	70.9	84.1	74.6	75.8		40.6	Wilson, 1991
Yankasa (M&F)	2-4								Yakubu and Ibrahim, 2011
Uda (M&F)	2-4		76.6	91.8	82.6	83.9		51	Yakubu and Ibrahim, 2011
Balami (M&F)	2-4		78.2	100.3	87	88.3		48.9	Yakubu and Ibrahim, 2011
WAD (M&F)	N/A		58.53	27.84		54.99	10.28	26.38	Awobajo, 2018
Mossi (M)	N/A	25-30	54.45			59.58	11.81	28.46	Wilson, 1991
Mossi (F)	N/A	20-25	54.45			59.58	11.81	28.46	Wilson, 1991
Burkina Sahel (M&F)	N/A		60.81			69.09	16.8	37.07	Traoré <i>et al.</i> , 2008
Djallonke (Burkina Faso) (M&F)	N/A		54.1			56.49	9.43	24.5	Traoré <i>et al.</i> , 2008
Vogan (M)	N/A	45	69-73				14	30-40	Wilson, 1991
Vogan (F)	N/A	40	69-73				14	30-40	Wilson, 1991

WAD, West African Dwarf; For other abbreviations, see Table I.

**Table IV. Northern African sheep morphometric traits.**

Breed	Age (years)	BW (Kg)	BL (cm)	CG (cm)	RH (cm)	WH (cm)	EL (cm)	TL (cm)	Author
Ouled-Djellal (M)	2 and above	95.87	126.6	113.07	88.95	91.4	17.24	51.87	Harkat <i>et al.</i> , 2015
Ouled-Djellal (F)	2 and above	61.27	114.08	97.33	78.76	80.13	17.28	43.6	Harkat <i>et al.</i> , 2015
Tazegzawt	0-1.0	36.8-41.2		76.7-79					Moulla <i>et al.</i> , 2018
Sudan Desert (M)	N/A	60	80				12-18.0		Wilson, 1991
Sudan Desert (F)	N/A	50	80				12-18.0		Wilson, 1991
Uda (M)	N/A	65	75-85				22		Wilson, 1991
Uda (F)	N/A	45	65-75				22		Wilson, 1991
Black Maure (M)	N/A	45	80				20	36	Wilson, 1991
Black Maure (F)	N/A	32	74				20	36	Wilson, 1991
Touabire (M&F)	N/A	45-50	75-90						Wilson, 1991
Touabire (F)	N/A		65-80						Wilson, 1991

See Table I for abbreviation.

#### *Northern African sheep breeds*

Northern African region sheep breeds morphometric traits are shown in Table IV. The average body weight of the sheep from the north region is 54.1kg with the heaviest sheep being the Ouled-Djellal males aged two and above years from Algeria weighing 95.87kg followed by the Uda males from Sudan weighing 65kg and the least heavy sheep being the Black Maure females from Sudan weighing 32kg. Sudan and Mauritania have a lot of sheep breeds phenotypically characterised in terms of body length compared to other countries in the northern region of the continent with the average body length of the sheep from the north region is 86.6cm with the longest sheep being the Ouled-Djellal male aged two and above years from Algeria being 126.6cm long followed by the Ouled-Djellal females aged two and above years from Algeria and the least long sheep being the Uda females from Sudan with 65-75cm and Touabire females with 65-80cm from Mauritania with 65-80cm. Algeria represents the north region sheep breeds phenotypically characterised in terms of chest girth with the average chest girth of the sheep from the north region is 96.08cm with the biggest sheep being the Ouled-Djellal males aged two and above years from Algeria being 113.07cm followed by the Ouled-Djellal females aged two and above years from Algeria with 97.33cm and the smallest sheep being the Tazegzawt males from Algeria with 76.7-79cm. The average rump height of the sheep from the north region is 83.9cm with the biggest sheep being the Ouled-Djellal males aged two and above years from Algeria with 88.95cm followed by the Ouled-Djellal females aged two and above years from

Algeria with 78.76cm. The average withers height of the sheep from the north region is 85.8cm with the biggest sheep being the Ouled-Djellal males aged two and above years from Algeria with 91.40cm followed by the Ouled-Djellal females aged two and above years from Algeria with 80.13cm. Sudan has a lot of sheep breeds phenotypically characterised in terms of ear length compared to other countries in the north region of the continent as shown in Table IV. The average ear length of the sheep from the north region is 18.3cm with the sheep with the biggest tail being the Uda sheep from Sudan with 22cm followed by Black Maure sheep from Mauritania with 20cm the sheep with the smallest ears are the Sudan Desert sheep from Sudan with 12-18cm. The average tail length of the sheep from the north region is 43.8cm with Ouled-Djellal males aged 2 and above years from Algeria with 51.87cm having the longest tail followed by Ouled-Djellal females aged two and above years from Algeria with 43.60cm and Black Maure sheep from Mauritania with 36cm being the shortest tails.

## CONCLUSIONS

This review paper investigated the morphological variations of sheep breeds found in Africa and recognised that morphological differentiation of the African sheep breeds exists. Firstly, within animals existing in the same country at different locations. The observed sheep breeds had clear distinctive coat colour variation and a variety of features in coat marks. The colours were white, black, red, dark brown, light brown, though it may appear that the

most dominant colour for sheep is white. as to why white is dominant remains a research question. Fat-tailed sheep are found throughout eastern and southern Africa. as well as northern Africa which are drier areas. these sheep are able to adapt to harsh environmental conditions like feed shortage because they can mobilize stored energy from their tail and lay down subcutaneous and intramuscular fat. The results of this study state that the biggest sheep are found in the northern African region with the Ouled-Djellal breed found in Algeria being the biggest sheep. This study revealed smallest sheep are mostly found in the eastern African region with the battle being between the Afar from Ethiopia and the WAD from Nigeria. An indication that variation does exist within species of the same sex. Also, that variation further extends to same breed with different sex. Males in the obtained literature. showed higher measurements than females in some areas. while in other areas there were no records of difference between males and females as they were grouped together.

## DECLARATIONS

### Acknowledgement

The authors are thankful to the South African National Research Foundation (PMDS230508103565) for their financial support. The research work is part of the PhD degree program.

### Statement of conflict of interest

The authors have declared no conflict of interest.

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