EVALUATION OF BREEDING PRACTICES AND MORPHOLOGICAL CHARACTERISATION OF DONKEYS IN THREE SELECTED VILLAGES OF THE BLOUBERG LOCAL MUNICIPALITY, IN THE LIMPOPO PROVINCE, SOUTH AFRICA

By

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DECLARATION

I declare that this dissertation hereby submitted for the degree of Master of Science in Agriculture (Animal Production) to the University of Limpopo, is my original work and has not been submitted for any other purposes to this or any other university and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

Signature…….. Date……

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DEDICATION

This dissertation is dedicated to the scientific community in research and development, with the aim to encourage them not to be afraid of venturing into uncharted territory and to perform research aimed at improving the lives of farmers.

ABSTRACT

Donkeys continue to play a significant role in draught power activities for both rural and urban regions in underdeveloped countries, where they are commonly employed for transportation of goods and movement of people at extremely low prices. The study sought to determine donkey farmers' breeding practices as well as donkey morphological characterization in three villages such as Thorp, Archibalt and Genau of the Blouberg Local Municipality. A total of 21 donkey farmers and 74 donkeys were used to collect data. The following Morphological traits characterized were; Head length (HL), Ear length (EL), Neck length (NL), Chest width (CW), Back length (Bal), Body length (BoL), Hips width (HW), Umbilical circumference (UC), Back height (BH), Height at the rump (HR), Thoracic circumference (TC), Chest depth (CD), Withers Height (WH), Front leg length (FLL), Cannon circumference (CC), Cannon length (CL), Cannon height (CH) and Body weight (BW). Descriptive statistics, Chi-square tests, Analysis of variance (ANOVA), Pearson correlation, and Rank Index were used for data analysis. Education level of the farmers in the three villages was significantly different ($p<0.05$) with the majority of farmers having secondary education. There was no significant difference ($p>0.05$) amongst the villages on different reasons behind keeping donkeys. The results showed a significant difference ($p<0.05$) in inbreeding knowledge by the farmers amongst the three villages. The selection criteria used across the three villages were not significantly different ($p>0.05$). Rank and Indices in selection of male donkeys looked at body size (0.39), growth rate (0.19), Draught power performance (0.14), and for overall preference in female donkeys it was body size (0.26), twinning ability (0.23) and mothering ability (0.15). Body size and growth rate where the most important traits to donkey farmers. The coat colours were not significantly different ($p>0.05$). In all the eighteen measured traits, only four (BaL, HW, BH and FLL) showed a significant difference ($p<0.05$) among the three villages. BW in male donkeys was not significantly correlated ($p>0.05$) with HL, EL, NL, BaL, HW, FLL, CC, CH, CL but was positively correlated ($p<0.05$) with BoL (r = 0.34), UC (r = 0.35), TC (r = 0.33), CD (r = 0.31), CW (0.94), BH (r = 0.41), HR (0.60), and WH (r = 0.58). BW in female donkeys was not significantly correlated ($p>0.05$) with NL, BaL, TC, and CL but positively significant correlated ($p<0.05$) with HL, EL, BoL, HW, UC, FLL and CC CW, BH, HR, WH and CH with correlation coefficient values ranging from 0.34 to 0.75. The farmers had no breeding program in place the donkeys were allowed

to mate on their own without designed breeding program. Selection of donkeys to be part of the heard was based on physical attributes, such length It was concluded that donkey farmers in Genau, Archibalt, and Thorp villages engaged in breeding practices that could be valuable in construction of a community-based breeding program.

Keywords: coat colour, Pearson's correlation, preferred traits, selection criteria, inbreeding

TABLE OF CONTENTS

LIST OF TABLES

TABLE **TITLE** **PAGE**

LISTS OF FIGURES

FIGURE **TITLE** **PAGE**

LIST OF ABBREVIATIONS

BW	Body weight
Bal	Back length
BoL	Body length
BH	Back height
CC	Cannon circumference
CL	Cannon length
CH	Cannon height
CW	Chest width
CD	Chest depth
cm	Centimetres
EL	Ear length
FLL	Front leg length
GLM	General linear model.
HL	Head length
HR	Height at the rump
HW	Hip width
Kg	Kilograms
NL	Neck length
N	Population size

Ns	Not significant
n	Sample size
PROC FREQ	Procedure of frequency.
PROC MEAN	Procedure of means.
R1	Rank 1
R3	Rank 3
SAS	Statistical Analysis Software
SE	Standard error
TC	Thoracic circumference
UC	Umbilical circumference
WH	Withers Height
^{o}C	Degree Celsius
χ^2	Chi-square
%	Percentage

CHAPTER ONE

INTRODUCTION

1.0 INTRODUCTION

1.1 **Background**

Mthi and Nyangiwe. (2020) put it on record that low reproduction performance of animals is a result of poor breeding management by communal farmers. Over the past years the dependency on cattle for draught power has decreased and preference to use donkeys has increased, especially in the semi- arid parts of Southern Africa (Nengomasha *et al*., 2000). Donkeys have excellent draft power abilities, as well as disease resistance and stress tolerance (Tuaruka and Agbolosu, 2019). Donkeys can survive better under drought conditions than any other livestock species, due to their body structure and low dry matter intake requirements, which minimizes their water and maintenance needs in arid and semi-arid areas, due to their ability to survive on poor quality minimally supplemented feeds (Deng *et al*., 2021). Donkeys continue to play a significant role in power-required activities in both rural and urban areas of developing countries, where donkeys are commonly employed for transportation of goods and movement of individuals from one location to another at extremely low prices (Koko and Shuiep, 2016).

1.2 Problem statement

Donkeys have a wide range of economic advantages that have yet to be completely explored (Geiger *et al*., 2020). Donkey milk is utilized for human consumption and the manufacture of cosmetic goods in several parts of the world (Camillo *et al*., 2018). Polidori *et al*. (2008) discovered that donkey meat has minimal fat, cholesterol levels, a high protein content, and a high potassium content.

According to Zewdie *et al*. (2015), the current state of information on breed level characterisation documented data is insufficient, resulting in a low degree of study interest in donkey genetic resource conservation. There has been a challenge in underdeveloped nations in building genetic improvement programs that can efficiently coordinate breeding systems that incorporate farmers at the village level (Wurzinger *et al*., 2014).

Morphological characterisation of farm animals is the first step to sustaining the use of a genetic resource; characterization of genetic resources is dependent on knowledge about morphological characteristic variation (Birhanje *et al*., 2019). To create long-term genetic improvement projects, it is critical to first understand breeding techniques

(Negussie *et al*., 2013). After learning about breeding procedures, it is simple to create a breeding strategy (Onzima *et al*., 2018).

1.3 Rationale

Donkeys have been seen as less valuable by society because the governments throughout africa have not actively marketed them in comparison to other livestock animals (Hassan *et al*., 2013). Other livestock species, such as goats (Abraham *et al*., 2018; Onzima *et al*., 2018; Hagos *et al*., 2018), cattle (Godadaw *et al*., 2014; Carvalho and Bittencourt, 2015), sheep (Nigussie *et al*., 2013; Dossa *et al*., 2015), and chickens, have had extensive research on breeding practices and morphological characteristics (Dana *et al.,* 2010; Fitsum, 2017). As a result, the donkey has distinct advantages over other livestock species for transportation and use in times of increasingly unpredictable rainfall and desertification (Kimura *et al*., 2013). A loss of livestock genetic diversity as a result of ineffective breeding programs in developing countries will seriously jeopardize efforts to achieve food security and poverty reduction (Zewdie e*t al*., 2015).

In South Africa, there are very few published documents on donkeys. This study attempted to make use of the data on donkey farming that would be collected by first recording it. So that other researchers and policymakers can access the research data on South African donkeys. This information may change people's perceptions of this livestock species in the future. The information obtained from farmers will be carefully evaluated to aid in the formulation of a well-constructed advice plan on how farmers in the selected villages can construct a breeding program, which will improve the farmer's selection of the required breeding trait that will inform the breeding process of donkeys in the Municipality. The study will also assist donkey farmers in fully understanding the many features of donkeys that exist in the area, as well as distinguishing the various morphological traits of their donkeys.

1.4 Aim

The study sought to determine donkey farmers' breeding practices and donkey morphological characterization in three communities in the Blouberg Local Municipality, Limpopo, South Africa.

1.5 Objectives

The objectives of the study were:

i. To identify selection criteria, and mating strategies used by donkey farmers in three selected villages (Thorne, Archibalt, and Genau), within the Blouberg Municipality in the Limpopo Province.

ii. To identify the preferred breed and traits of donkeys utilised in three selected villages (Thorne, Archibalt, and Genau) within the Blouberg Municipality in the Limpopo Province.

iii. To determine the morphological characteristics of the donkey breeds that exist within the three selected villages (Thorne, Archibalt, and Genau) of the Blouberg Municipality in the Limpopo Province.

1.6. Hypotheses

i. Donkey farmers have no selection criteria, mating strategies, culling criteria and breeding season in the three selected villages (Thorne, Archibalt, and Genau) in Blouberg Municipality.

ii. Donkey farmers prefer no breed and no trait in the donkeys utilised in the three selected villages (Thorne, Archibalt, and Genau) of the Blouberg Municipality.

iii. The existing donkey breeds found in the villages have no record of morphological characterisation in all three selected villages (Thorne, Archibalt, and Genau) within the Blouberg Municipality.

CHAPTER TWO

LITERATURE REVIEW

2.0 LITERATURE REVIEW

2.1 Introduction

The donkey, like the horse, mule, and zebra, belongs to the equine family, and for many years, donkeys have been utilized by humans for a variety of purposes aimed at meeting human requirements (Yilmaz *et al*., 2012). Varying parts of the world, with different geographic configurations and climatic conditions, have resulted in the development of several types of donkeys that speak to the characteristics of the various places (Buneveski *et al*., 2018). According to Carneiro *et al*. (2018), the original ancestor of donkeys is thought to be *Equus asinus africanus*, a resident of Africa's North Eastern region, and *Equus asinus europeans*, which is known to originate from the Mediterranean basin. Donkeys have a wide range of economic advantages that have yet to be completely explored (Geiger *et al*., 2020). According to Bennet and Pfuderer (2020), Chinese medicine uses gelatin, which is contained in donkey hides, to treat human ill-health. Donkey milk, on the other hand, is utilized for human consumption and the manufacture of cosmetic goods in several regions of the world (Camillo *et al*., 2018). While Polidori *et al*. (2008) went a step further and determined that donkey meat is low in fat and cholesterol, high in protein, and high in potassium. Donkeys also serve an important role in providing transportation, creating cash through animal traction, and ensuring food security for many marginalized households in Africa's rural and semi-urban areas (Geiger *et al*., 2020). Several studies have been conducted on various donkey breeds, including the Amiata donkey breed (Sargentini *et al*., 2018), the Eastern Algeria donkey breed (Hannani *et al*., 2020), the Central highland Kenya donkey breed (Gishure *et al*., 2020), the Balgaria donkey breed (Vlaeva *et al.,* 2016), the D/Kudu district breed (Khaleel *et al*., 2020). However, to the best of our knowledge, no review has been published outlining the breeding practices of donkey farmers and morphological diversity of donkey breeds. As a result, the current review's goal is to identify breeding practices utilised in donkeys and to characterize the morphological differentiation between different donkey breeds. This research will aid donkey farmers, extension staff, and researchers in understanding the morphological differences between donkey breeds.

2.2 Origin of donkey breeds

The Amiata donkey breed is found in Tuscany as an endangered breed and originates from Mount Amiata, which is located in the provinces of Siena and Grosseto in southern Tuscany, Italy (Sargentini *et al*., 2018). The morphological qualities of the Amiata donkey forebears (the *Equus asinus africanus* and the Equus asinus somaliensis) are shared by the Amiata donkey breed (Sargentini *et al*., 2018). While the Algeria donkey is predominantly found in northern Algeria (Ayad *et al*., 2019). Hannani *et al*. (2020) discovered that the Algerian donkey descended from the African Wild ass donkey through genetic analysis. The Nubian wild ass is thought to be the ancestor of the central highland Kenya donkey (Mitchell, 2017). According to Vlaeva *et al*. (2017), the current Bulgarian donkey breed descended from the Nubiana wild ass and the Somali wild ass. The D/Kudu donkey is prominent in Kano State, which is located in northern Nigeria (Khaleel *et al*., 2020). Both the Balkan and Banat donkeys are indigenous breeds of Serbian donkeys, according to Stanii *et al*. (2015 and 2020). While the origin of the Czech Republic donkey is unknown, it has been traced back to *Equus asinus somaliensis* and *Equus asinus africanus*, as well as several European donkey breeds (Kosuková *et al*., 2015).

2.3 Breeding practices of donkey farmers

Throughout the world donkeys are mainly bred for working power (Kim *et al*., 2021). Research conducted by Navas *et al*. (2017) noted that the selection method used in selecting donkeys for breeding mainly looked at morphological and phenotypical standards. In most cases the breeding rate of donkeys is low due to lack of well-established breeding practices (Quaresma *et al*., 2014). There are limited studies focusing on breeding practices of donkey farmers.

2.4 Visibility variations among donkey breeds

Amaita donkeys: is known to have grey coat, with dark shoulder stripes, less visible leg stripes, dovetail, collar buttons and healthy dark hoof (Sargentini *et al*., 2018). **Eastern Algeria donkey**: Hannani *et al*. (2020) noted to have a variation of back stripes and zebra marks with coat that is bay colour with shades of light, dark and burnt, others were light to dark grey and head muzzle, eye contour that was grey. **Central highland Kenya donkeys**: donkeys are said to have grey – dun coat colour, with some that have chocolate brown colour, while all the donkeys have equine stripes

in the backline, with shoulder stripes and the muzzle together with the nostrils area was white in colour (Gichure *et al*., 2020). **Regions of Bulgaria donkey**: The notifiable dominant colours are grey and brown, which had a dark cross on the back, while a few animals were observed to be black and roam (Vlaeva *et al*. 2016). **D/Kudu:** district donkeys have variation of colours, white grey and light brown being the most dominant colours, while others are dark grey and dark brown (Khaleel *et al*. 2020). **The Banat and Balkan**: donkeys have closely related similarities which local donkey farmers usually confuse the exact separation of the two breeds, the breeds have grey to chocolate in coat colour and differ on the black stripe on legs, silver bright coat pigmentation on the chest area and around the nose and eyes (Stanišić *et al*., 2015; 2020). **Czech donkeys**: have been difficult to identify as no donkey originates from the republic, they are coming from across other parts of Europe and resemble those donkeys (Kosťuková *et al*., 2015).

2.4 Definition of morphological traits measurements in donkeys

Morphological measures are taken as follows, according to Vlaeva *et al*. (2016), Sargentini *et al*. (2018), and Ayad *et al*. (2019): Chest circumference: the circumference around the chest right behind the paws and behind the withers. Withers height: the distance between the tallest point at the withers and the ground. Body length is defined as the distance between the tip of the shoulder and the ischium. Ear length is measured from the point where the ear joins the head to the tip of the ear; Head length is measured between the top of the occipital region and the tip of the nose, and Neck length is measured between the cranium and the border of the atlas wings, as well as the apex of the scapula and the length of the left and right ears.

2.5 Chest circumference variations among different donkey breeds

Different donkey breeds' chest circumferences have been measured (Table 2.1). Hannani *et al*. (2020) measured the chest circumference of Eastern Algeria donkeys aged 3 to 16 years and found it to range between 112.97 and 116.85 centimetres (cm). Central Highland Kenya donkeys found in Kenya measured 113.7 cm for females and males under 3 years of age and above 3 years of age, respectively (Gichure *et al*., 2020). Vlaeva *et al*. (2016) discovered measures for parts of Bulgaria donkeys to be about 126.78 – 138.31 cm for the geldings found, which included one jennet, in the country of Bulgaria. According to the findings of Khaleel *et al*. (2020), male D/Kudu

area donkeys in Nigeria aged 2 years and above measured 113.2 cm. Banat donkeys observed in Serbia aged 3 to 8 years with measurements ranging from 114.5 cm to 138.5 cm for males and females (Stanii *et al*., 2020). Donkeys found in the Czech Republic in Czechia were measured by Kosuková *et al*. (2015) to be between 127 – 132.9 cm for male and females between the ages of 2 and 5 years. Stanišić *et al*. (2015) also noted that Balkan donkeys in the country of Serbia had measurements of 119.6 – 114 cm for male and female around ages of 3 years and above.

Table 2. 1 Chest circumference variations among different donkey breeds

Length (cm)	N	breed	Age	Sex	Country	Author
112.97-116.85	65	Eastern Algeria donkey	3 to 16 years	Male and Female	Algeria	Hannani *et al*., 2020
113.7	360	Central Highlands Kenya donkey	Below 3 years and above 3 years	Male and Female	Kenya	Gichure *et al*., 2020
126.78 - 138.3	96	Regions of Bulgaria donkeys	-	-	Bulgaria	Vlaeva *et al*., 2016
113.2	144	D/Kudu	2 years and above	Male	Nigeria	Khaleel *et al*., 2020
114.5 - 138.5	53	Banat Donkey (Central Balkans)	3 to 8 years	Male and Female	Serbia	Stanišić *et al*., 2020
127 -132.9	70	Czech Republic donkey	3 to 5 years	Male and Female	Czechia	Kosťuková *et al*., 2015
119.6 -114	74	Balkan Donkey	Below 3 years and above 3 years	Male and Female	Serbia	Stanišić *et al*., 2015

n = sample size

2.6 Withers height variations among different donkey breeds

The variations in withers height among donkey breeds are shown in Table 2.2. Amiata donkeys found in various parts of Italy that were merely jennets were measured to be 123.2 – 130.7 cm tall (Sargentini *et al*., 2018). Hannani *et al*. (2020) measured 112.67 – 107.55 cm for Eastern Algeria donkeys, which were determined to be between the ages of 3 and 16 in Algeria for both males and females. In Kenya, Central Highlands donkeys under and over the age of three years, including both sexes, were measured at 99.67 percent (Gichure *et al*., 2020). According to Vlaeva *et al*. (2016), the Bulgaria donkey observed in examined locations of Bulgaria has a height at birth of 112.94 – 126.09 cm. Khaleel *et al*. (2020) measured 102.4 cm for male 2-year-old animals located in Nigeria's D/Kudu area. Kosuková *et al*. (2015) measured both sexes between the ages of 3 and 5 years in the Czech Republic and found measurements ranging from 106.0 to 109.9 cm. Stanišić *et al*. (2015) recorded 103.3 – 104.9 cm for Balkan Donkeys in Serbia, these donkeys were below and above age of 3 years for both male and female.

Table 2. 2 Withers height variations among donkey breeds

Length (cm)	n	Breed	Age	Sex	Country	Author
123.2-130.7	32	Amiata donkey		Female	Italy	Sargentini *et al*., 2018
112.67-107.6	65	Eastern Algeria Donkey	3 to 16 years	Male and Female	Algeria	Hannani *et al*., 2020
99.67	360	Central Highlands Kenya donkey	Below 3 years and above 3 years	Male and Female	Kenya	Gichure *et al*., 2020
112.94-126.09	96	Regions of Balgaria donkeys			Bulgaria	Vlaeva *et al*., 2016
102.4	144	D/Kudu	2 years and above	Male	Nigeria	Khaleel *et al*., 2020
106.0-109.9	70	Czech Republic donkey	3 to 5 years	Male and Female	Czechia	Kosťuková *et al*., 2015
103.3-104.9	74	Balkan Donkey	Below 3 years and above 3 years	Male and Female	Serbia	Stanišić *et al*., 2015

n = sample size

2.7 Body length variations among different donkey breeds

The size of the body varies amongst donkey breeds, as seen in Table 2.3. Sargentini *et al*. (2018) discovered significant variance in body length between identical breeds of the same sex but from various locations within Italy, with results ranging from 47.3 to 55.3 cm. In Eastern Algeria, male donkeys ranged in size from 3 to 16 years old, with measurements ranging from 114.64 to 116 cm (Hannani *et al*., 2020). This comprised both male and female donkeys, which had a longer body length than Italy breeds. According to Gichure *et al*. (2020), male and female donkeys in Kenya's central highlands had an accurate measurement of 113.2 cm, which is less than the

findings of Vlaeva *et al*. (2016), who recorded 117.06 – 133.09 cm for Donkeys found in Algerian Regions. The donkeys in D/Kudu district that were 2 years old and older, mostly males, measured 64 cm (Khaleel *et al*., 2020). Which was very low when compared to Banat donkeys, which measured 113 – 132 cm in an age range of 3 to 18 years, according to Stanii *et al*. (2020). Kosťuková *et al.* (2015) measured body length of Czech Republic donkeys to be 115.5 – 116.1 cm and their age was around 3 – 5 years. The Measurement for Balkan donkey was just by a centimetre to the Czech Republic donkey, Stanišić *et al*. (2015) measured them to be 110 – 117 cm.

Table 2. 3 Body length variations among different donkey breeds

Length (cm)	n	Breed	Age	Sex	Country	Author
47.3-55.3	32	Amiata Donkey		Females	Italy	Sargentini *et al*., 2018
114.64-116.9	65	Eastern Algeria donkey	3 to 16 years	Male and Female	Algeria	Hannani *et al*., 2020
113.2	360	Central Highlands kenya	Below 3 years and above 3 years	Male and female	Kenya	Gichure *et al*., 2020
117.06-133.1	96	Regions of Bulgaria			Bulgaria	Vlaeva *et al*. 2016
64.0	144	D/Kudu	2 years and above	Male	Nigeria	Khaleel *et al*., 2020
113-132.0	53	Banat Donkey (Central Balkans)	3 to 8 years	Male and female	Serbia	Stanišić *et al*., 2020
111.5-116.1	70	Czech Republic donkey	3 to 5 years	Male and Female	Czechia	Kosťuková *et al*., 2015
110-117.2	74	Balkan Donkey	Below 3 years and above 3 years	Male and Female	Serbia	Stanišić *et al*., 2015

2.8 Ear Length variations among different donkey breeds

Several studies have found that ear length varies between donkey breeds (Table 2.4). The ear length of Amiata donkeys in Italy ranged between 28.0 and 29.9 cm (Sargentini *et al*., 2018). Which was greater than Eastern Algeria, D/Kudu, and Balkan donkeys, which had measures ranging from 25 to 26 cm (Stanišić *et al*., 2015; Hannani *et al*., 2020; Khaleel *et al*., 2020).

Table 2. 4 Ear Length differentiation of different donkey breeds

Length (cm)	N	Breed	Age	Sex	Country	Author
28.0-29.9	32	Amiata Donkey		Females	Italy	Sargentini *et al*., 2018
25.38-26.36	65	Eastern Algeria donkey	3 to 16 years	Male and females	Algeria	Hannani *et al*., 2020
26.7	144	D/Kudu	2 years and above	Male	Nigeria	Khaleel *et al*., 2020
25.6-26.1	74	Balkan Donkey	Below 3 years and above 3 years	Male and Female	Serbia	Stanišić *et al*., 2015

n = sample size

2.9 Head length variations among different donkey breeds

Head length was measured in various research and shown to vary between donkey breeds (Table 2.5). Stanišić *et al*. (2015) obtained the highest measurement, measuring head length to be around 47.6 – 49.6 cm for both male and female (with males displaying a slightly higher value) at the ages of 3 years and above. Then came donkeys from the Czech Republic, whose measurements were 42.8 – 45.2 cm for male and female between the ages of 3 and 5 years, according to Kosuková *et al.* (2015). D/Kudu district donkeys in Nigeria had accurate measurements of 44.0 cm for males aged 2 years and up (Khaleel *et al*., 2020). The head length measures in the D/Kudu district donkey were greater than those in the Eastern Algeria donkey, which had a measurement of 40.23 – 41.33 cm for 3 to 16-year-old males and females, according to Hannani *et al*. (2020).

Table 2. 5 Head length variations among different donkey breeds

Length (cm)	N	Breed	Age	Sex	Country	Author
40.23-41.3	65	Eastern Algeria donkey	3 to 16 years	Male and Female	Algeria	Hannani *et al*., 2020
44.0	144	D/Kudu district donkeys	2 years and above	Male	Nigeria	Khaleel *et al*., 2020
43.8-45.2	70	Czech Republic donkey	3 to 5 years	Male and Female	Czechia	Kosťuková *et al.*, 2015
47.6-49.6	74	Balkan Donkey	Below 3 years and above 3 years	Male and Female	Serbia	Stanišić *et al*., 2015

n = sample size

2.10 Neck length variations among different donkey breeds

Table 2.6 depicts the differences in neck length between donkey breeds. Sargentini *et al.* (2018) discovered the longest neck length for Amiata donkeys, measuring 57.2 – 62.0 cm in females, which was more than the findings for Eastern Algerian donkeys, which measured 38.75 – 40.45 cm (Hannani *et al*., 2020). D/Kudu district donkeys, which were mostly males, measured the shortest at 31.1 cm (Khaleel *et al*., 2020).

Table 2. 6 Neck length variations among different donkey breeds

Length (cm)	N	breed	Age	Sex	Country	Author
57.2-62.0	32	Amiata donkey		Female	Italy	Sargentini *et al*., 2018
38.75-40.5	65	Eastern Algeria	3 to 16 years	Male and Female	Algeria	Hannani *et al*., 2020
31.1	144	D/Kudu district donkeys	2 years and above	Male	Nigeria	Khaleel *et al*., 2020

n = sample size

2.11 Conclusion

Donkeys unlike other farm animals do not have a clear well developed breeding practices, it depends on what a particular farmer wants. This review explored donkey breeding practices utilised throughout the globe and the morphological differences of donkey breeds and found that morphological diversity of donkey breeds existed, first within animals living in the same country but in different areas. This review also discovered minor differences across animals from the same region of the same country. The observed donkeys displayed noticeable coat colour variation and a diversity of coat mark traits. Donkeys were identified in the following colours: grey, chocolate brown, black, and roan. While grey appears to be the most prominent colour, which type of grey is dominant remains a study subject. Evolutionary science formerly stated that an animal's coat colour adapts to its environment, allowing it to survive predators by blending in seamlessly with the environment. Because donkeys have a genesis that can be traced back to the wild, evolution science can be accepted. Another difficulty with colour is uniformity or variation during breeding seasons; if the area has a different colour, there will be colour variation; if not, there will be consistency. An indicator that variety exists within species of the same sex, as well as variance within the same breed with different sexes. Males in the collected literature had higher measurements than females in some regions, but there was no discernible difference between males and females in others. This could be because the genetic makeup of those donkey breeds in the same places is the same, with no changes in morphological dimensions, or because they respond to the environment in the same way.

CHAPTER THREE

METHODOLOGY AND ANALYTICAL PROCEDURES

3.0 METHODOLOGY AND ANALYTICAL PROCEDURES

3.1 Study site

The research was carried out in the Blouberg Local Municipality, which is part of the Capricorn District Municipality in Limpopo province. The Area Office of Agriculture and Agrarian Reform conducted a campaign to increase donkey production in the district in three villages in Blouberg Municipality, namely Thorne, Archibalt, and Genau (Figure 3.1). According to the Blouberg Municipality growth and development strategy, Vision, (2040) the municipality is home to 175 753 people and 41 416 homes, accounting for 13.2 percent of the district's population. The municipality is known for its warm winters, which are typically frost-free, and it's extremely hot, often dry summers. The area receives approximately 455mm of yearly rainfall, which mostly comes in the form of afternoon thunderstorms between November and March. The average high temperature is 26.02°C, while the average low temperature is 12.10°C.

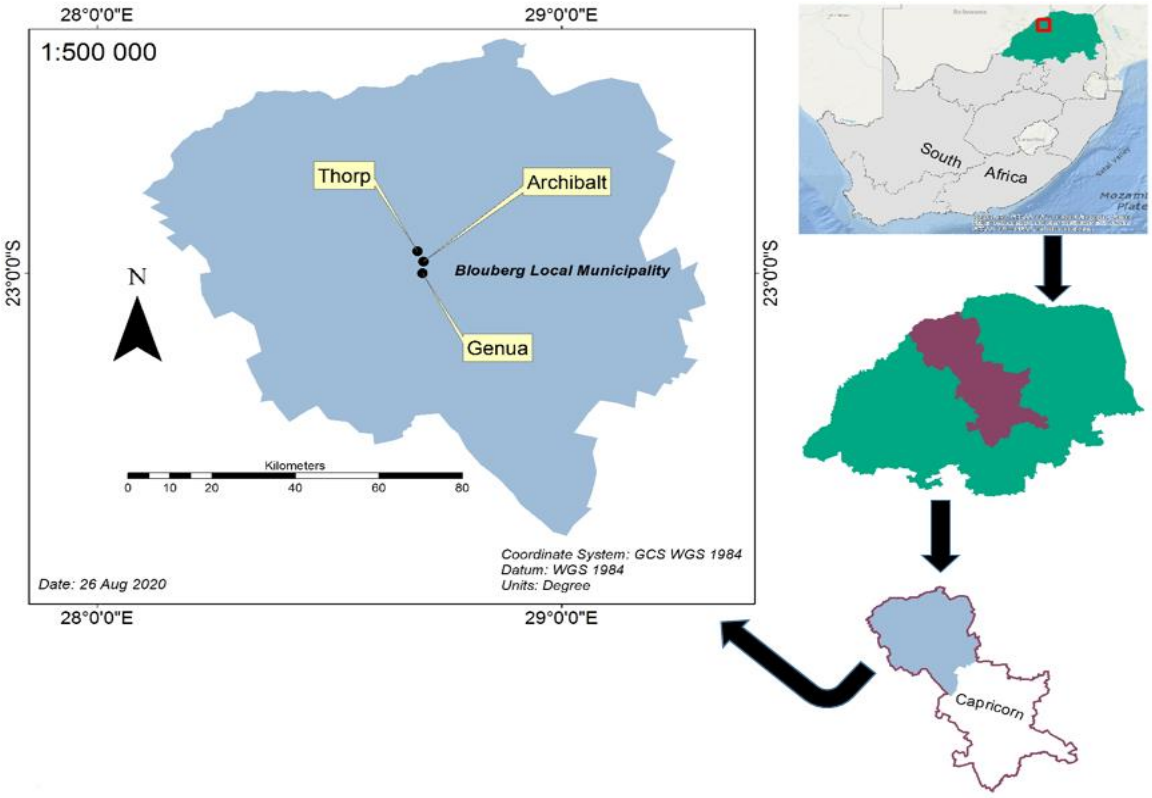

Figure 3. 1 Blouberg local municipality map showing the study area

3.2 Sampling procedure of the study

Blouberg Local Municipality and three villages such as Thorne, Archibalt, and Genau, were sampled selectively using information obtained from the Provincial Department of Agriculture. Purposive sampling, according to Saunders *et al*. (2009), allows judgment to be used to select situations that allow study objectives to be addressed. The town and villages were chosen based on the availability of donkey farmers in Capricorn District who collaborate with the Department of Agriculture. Snowball sampling was used to choose donkey farmers. According to Saunders *et al*. (2009), the snowball sampling approach is used to identify individuals of the intended population when the population size is uncertain. The idea behind snowball sampling is that after the investigator has interviewed the first donkey farmers, a chain of respondents will be established in which the first respondents will provide information for the next respondents, who will then provide information for the third respondent, and so on (Vogt,1999). Because the population size of donkey farmers was unknown, the snowball sampling approach was utilized to choose them. The study intended to interview a minimum of 30 donkey farmers, but only 21 were willing to be interviewed based on the recommendations of the authors (Louangrath and Sutanapong, 2019) about breeding goals, breed and trait preferences, selection criteria, mating strategies, breeding practices, and donkey breeding age. Simple random sampling was employed to select 74 donkeys from each of the three settlements. Stanišić *et al*. (2015) and Khaleel *et al*. (2020) proposed a sample size of 70 and 144 donkeys, respectively, in their investigations. The simple random sampling technique is a sampling strategy in which every individual in the population has an equal chance and possibility of being chosen for the sample (Saunders *et al*., 2012). Total population sampling is employed when the population of interest is relatively tiny, according to Saunders *et al*. (2012).

3.3 **Experimental animals**

The two donkey strains identified in the study area are the wild and feral donkeys. The age of the animals ranged from two years to ten years. These breeds are distributed all over the world and are believed to live well in dry, rocky locations with temperatures surpassing 50^{o}C (Pearson *et al.*, 1999). In this study, the main uses of donkeys were cart puling and drought power and making money from that. Goulder (2016) discovered that donkeys are used year-round in Africa as a means of transport to

generate additional income through hiring or lending practices by owners, and for ploughing during wet seasons.

3.4 Animal management

The farmers who took part in the survey took exemplary care of their animals; the donkeys were housed in well-built kraals with 24-hour access to water and nutrient supplements like salt leaks. Donkeys that were injured or unwell were not employed in the study. According to Fraser, a makeshift rope halter was employed to restrain the donkeys during data collecting (2010). The best way to restrain donkeys during veterinary procedures is to use a rope halter (Fowler, 2008). Following the attachment of a rope halter, the donkeys remained calm.

3.5 Study design

Questionnaires were used in this cross-sectional observational investigation. Twenty-one individual donkey farmers/owners were interviewed in three villages of the Blouberg Local Municipality in Limpopo Province. Each farmer was interviewed inside the donkey kraals, by one enumerator who explained the questionnaires to the farmer and translated into the indigenous sePedi language (Annexure B).

3.6 Data collection

Ethical approval was granted by the University of Limpopo Animal Research Ethics Committee (ULAREC) with the number AREC/06/2021:PG before the commence of the study. According to Sargentini *et al*. (2018), Ayad *et al.* (2019) and Vlaeva *et al*. (2016), identified morphological characterisation as measuring features such as HL - Head length; EL - Ear length; NL - Neck length; CW - Chest width; Bal - Back length; BoL - Body length; HW - Hips width; UC - Umbilical circumference; BH - Back height; HR - Height at the rump; TC - Thoracic circumference; CD - Chest depth; WH - Withers Height; FLL - Front leg length; CC - Cannon circumference; CL -Cannon length; CH - Cannon height. Head length (HL), Ear length (EL), Neck length (NL), Chest width (CW), Back length (Bal), Body length (BoL), Hips width (HW), Umbilical circumference (UC), Back height (BH), Height at the rump (HR), Thoracic circumference (TC), Chest depth (CD), Withers Height (WH), Front leg length (FLL), Cannon circumference (CC), Cannon length (CL), Cannon height (CH).

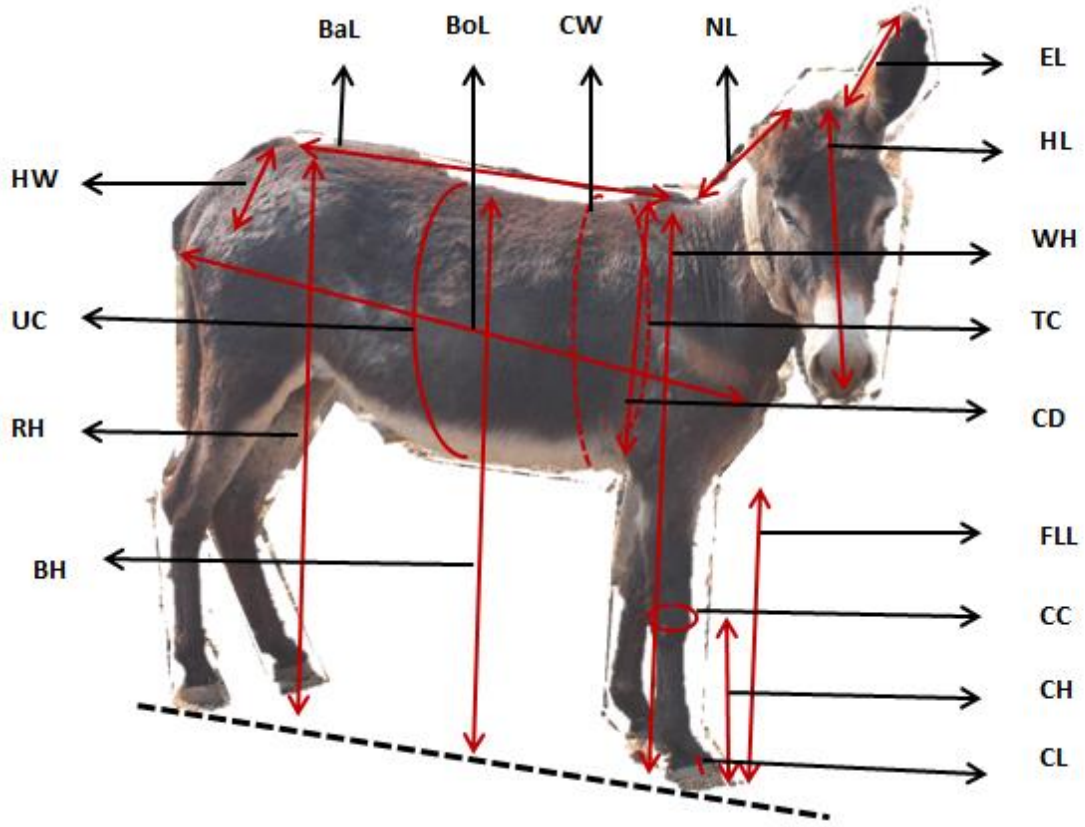

Figure 3. 2 Demonstration of different body measurements performed in donkeys

Identification of selection criteria for breeding stock and trait preferences were done (Annexure B) in a participatory manner as explained by Duguma *et al*. (2011).

3.7. Statistical Analysis

For data analysis, the Statistical Analysis Software version 9.4 (SAS, 2019) program was employed. To fulfil objectives 1 and 2, the frequency process (PROC FREQ) was utilized to calculate frequencies and percentages. For the associations, the Chi-square test was utilized. To fulfil objective 3, the method of means (PROC MEANS) was utilized to construct descriptive statistics of morphological features. During the morphological trait analysis, sex and age were considered. The following are examples: The general linear model (GLM) was employed.

$$Yij = u + Gi + Aj + eij$$

Where;

Yij is an observation of the morphological traits of ith sex and jth age, u is the overall mean, Gi is the fixed effect of ith sex, Aj is the effect of jth age and eij is the residual error. Significance will be observed at $p < 0.05$ and Duncan multiple range tests will be used for significant differences. Trait preferences were computed for the importance of each criterion and estimated by computing the index of ranking as discussed by Zewdu *et al*. (2018). Index = Sum (3 x rank1 + 2 x rank2 + 1 x rank3) for individual trait / Sum (3 x rank1 + 2 x rank2 + 3 x rank1) for overall traits.

CHAPTER FOUR

RESULTS

4.0 RESULTS

4.1 Socio-economic status of donkey farmers

Table 4.1 is a description of the socio-economic status of farmers in the three villages. The obtained results indicated that there was no significant difference (*p>0.05*) in the gender of farmers. The results further showed that marital status of the farmers had no statistical variation (*p>0.05*) among three villages. Education level of the farmers in the three villages was statistically significantly different (*p<0.05*). There was no statistically significant difference (*p>0.05*) in money made from donkeys. Belief system and occupation showed no statistical variation (*p>0.05*) between villages. The age of the farmers in all three villages was not statistically significant different (*p>0.05*) and the overall mean was 63.88±5.04. Genau and Archibalt had almost similar mean average age (63.88±5.04 and 63.83±3.34 years) and Thorp village having a mean average age of 66.43±7.82. Household sizes of the donkey farmers also showed no statistical variation (*p>0.05*), the sizes in Genau and Archibalt villages showed similarities in average household size (7.13±0.90 and 7.00±0.89) and Thorp village showing an average household size of 4.86±1.26. The numbers of years' farmers had into farming with donkeys showed a range average of 17.25±4.77 in Genau village, 17.83±7.15 in Archibalt village and 27.71±7.94 in Thorp village this was not statistically significantly different (*p>0.05*) in all three villages. The donkey numbers owned per farmer ranged from an average of 4.63±0.32 in Genau village, followed by 5.16±0.65 in Archibalt village and 6.43±2.06 in Thorp village, however the donkey numbers in the three different villages were not statistical significantly different (*p>0.05*).

Table 4. 1 Socio-economic status of donkey farmers

	Villages				
	Genau	**Archibalt**	**Thorp**		
Characteristic	**N (%)**	**N (%)**	**N (%)**	**Chi – Square**	**P - Value**
Categorical variables					
Gender					
Male	7 (33%)	6 (28.57%)	6 (28.57%)		
Female	1 (4.76%)	0 (0.00 %)	1 (4.76%)	0.90	0.64^{ns}
Marital Status					
Single	2 (9.52%))	0 (0.00%)	1 (4.76%)		
Married	5 (23.8%)	6 (28.56%)	6 (28.56%)		
Widow	1 (4.76%)	0 (0.00%)	0 (0.00%)	3.75	0.44^{ns}
Level of Education					
No Formal	0 (0.00%)	1 (4.76%)	5 (23.8%)		
Primary school	2 (9.52%)	4 (19.04%)	1 (4.76%)		
Secondary school	6 (28.56%)	1 (4.76%)	1 (4.76%)	14.64	0.01*
Money from Donkeys					
Yes	5 (23.8%)	6 (28.56%)	4 (19.04%)		
No	3 (14.28%)	0 (0.00%)	3 (14.28%)	3.41	0.18^{ns}
Belief System					
Christian	6 (28.56%)	4 (19.04%)	6 (28.56%)		
African Tradition	2 (9.52%)	2 (9.52%)	1 (4.76%)	0.6563	0.72^{ns}
Occupation					
Public	7 (33.32%)	6 (28.56%)	4 (19.04%)		
Private	1 (4.76%)	0 (0.00%)	0 (0.00%)		
Pensioner	0 (0.00%)	0 (0.00%)	3 (14.29%)	8.43	0.08^{ns}
Continuous variables					
	Mean±SE	**Mean±SE**	**Mean±SE**	**F-value**	**P-value**
Age	63.88±5.04	63.83±3.34	66.43±7.82	0.06	0.94^{ns}
Household size	7.13±0.90	7.00±0.89	4.86±1.26	1.52	0.25^{ns}
Years farming with donkeys	17.25±4.71	17.83±7.15	27.71±7.94	0.81	0.46^{ns}
Number of donkeys	4.63±0.32	5.16±0.65	6.43±2.06	0.57	0.57^{ns}

* significant at P < 0.05, ^{ns} = not significant, SE: Standard error

4.2 Purpose of keeping donkeys

Table 4.2 depicts the reason why farmers in the three selected communities retain donkeys. There was no statistically significant difference ($p > 0.05$) across the villages in terms of the various motivations for keeping donkeys. However, in Genau and Thorp villages, no farmers kept donkeys for all functions (social status, drought power, and cart hauling).

Table 4. 2 Purpose of keeping donkeys

Donkey keeping purpose	Villages			Chi-Square	P- value
	Genau N (%)	Archibalt N (%)	Thorp N (%)		
Cart pulling	3 (14.28%)	0 (0.00%)	1 (4.76%)		
Drought power and cart pulling	5 (23.8%)	5 (23.8%)	5 (23.8%)		
Social status, drought power and cart pulling	0 (0.00%)	1 (4.76%)	0 (0.00%)		
Milk production, social status, drought power and cart pulling	0 (0.00%)	0 (0.00%)	1 (4.76%)	7.36	0.29^{ns}

^{ns} = not significant

4.3 Types of Donkey breeds kept and breeding practices by donkey farmers

Table 4.3 presents the types of donkey breeds kept and the breeding practices conducted by the donkey famers in the three selected villages. The results indicated that there was no significant difference ($p>0.05$) between the villages on donkey breeds kept. The results further showed no significant difference ($p>0.05$) in the conduction of breeding and in the preferred mating system. The results showed a significant difference ($p<0.05$) in inbreeding knowledge by the farmers amongst the three villages. The obtained results then proved to be no significant difference ($p>0.05$) within characteristics culling practice, culling method, and mating season in the three villages.

Table 4. 3 Types of Donkey breeds kept and breeding practices by donkey farmers

Characteristics	Villages				
	Genau N (%)	Archibalt N (%)	Thorp N (%)	Chi – Square	P – value
Breeds kept					
Wild donkey	6 (28.56%)	2 (9.52%)	5 (23.8%)		
Feral donkey	2 (9.52%)	4 (19.04%)	2 (9.52%)	2.93	0.23^{ns}
Breeding practice conducted					
Yes	1 (4.76)	2 (9.52%)	1 (4.76)		
No	7 (33.33%)	4 (19.04%)	6 (28.57%)	1.12	0.57^{ns}
Breed improvement					
Pure breed	8 (38.10%)	6 (28.57%)	7 (33.33%)		
Mating system					
Controlled	2 (9.52%)	1 (4.76%)	3 (14.29%)		
Uncontrolled	6 (28.57%)	5 (23.81%)	4 (19.04%)	1.17	0.56^{ns}
Inbreeding known					
Yes	8 (38.10%)	6 (28.57%)	3 (14.29)		
No	0 (0.00%)	0 (0.00%0	4 (19.04%)	9.8824	0.01^{*}
Culling practiced					
Yes	1 (4.76%)	2 (9.52%)	5 (23.81%)		
No	7 (33.33%)	4 (19.04%)	2 (9.52%)	5.5781	0.06^{ns}
Reason for culling					
Old age	5 (23.81%)	2 (9.52%)	4 (19.04%)		
Low production	3 (14.29%)	4 (19.04%)	3 (14.29%)	1.2648	0.53^{ns}
Mating season					
Spring	6 (28.57%)	6 (28.57%)	7 (33.33%)		
Autumn	2 (9.52)	0 (0.00%)	0 (0.00%)	3.5921	0.17^{ns}

* = significant at P <0.05, ^{ns} = not significant

4.4 Selection criteria used by the farmers

The selection criteria used by the donkey farmers in the three communities are shown in Table 4.4. The selection criteria utilized by the donkey farmers in the three villages were found to be not significantly different (*p>0.05*), indicating that the farmers used the same selection methods in all three villages.

Table 4. 4 Selection criterion used by the farmers

	Villages				
	Genau	**Archibalt**	**Thorp**		
	N (%)	**N (%)**	**N (%)**		
Selection methods				**Chi - square**	**P - value**
Growth rate	4 (19.04%)	2 (9.52%)	2 (9.52%)		
Skin colour	1 (4.76%)	0 (0.00%)	1 (4.76%)		
Conformation	3 (14.29%)	4 (19.04%)	4 (19.04%)	1.91	0.75^{ns}

^{ns} = not significant

4.5 Rank and indices for trait preferences

Table 4.5 displays the respondents' rating of each essential attribute in the study area. The collected results in Genau village revealed that the farmers' preferences in the selection of male donkeys were body size (0.37), growth rate (0.20), and animal performance (0.20). While in female donkeys, the farmers prioritized twinning ability (0.30), mothering ability (0.30), and foaling ability (0.13). Farmers in Archibalt village valued body size (0.50), animal performance (0.17), growth rate (0.13), and mating ability when selecting male donkeys (0.10). Female donkeys were chosen based on their body size (0.40), twinning ability (0.17), and foaling ability (0.17). In Thorp village, farmers prioritized body size (0.29), growth rate (0.23), and mating ability (0.20) while

selecting male donkeys. In the selection of female donkeys, body size (0.26), twinning ability (0.23), and mothering ability (0.15) were considered. In the three villages, the overall choice for male donkeys was body size (0.39), growth rate (0.19), and performance (0.14), whereas the overall preference for female donkeys was body size (0.26), twinning ability (0.23), and mothering ability (0.14). (0.15).

Table 4. 5 Ranks and indices for trait preference for male and female donkeys

Traits	**Genau (n = 5)**				**Archibalt (n = 5)**				**Thorp (n = 11)**				
	R1	**R2**	**R3**	**Index**	**R1**	**R2**	**R3**	**Index**	**R1**	**R2**	**R3**	**Index**	**Overall Index**
Male donkey													
Mating Ability	0	0	1	0.03	0	1	1	0.10	3	1	2	0.20	0.11
Body size	3	1	0	0.37	4	1	1	0.50	2	6	1	0.29	0.39
Ear Size	1	0	0	0.10	0	0	0	0.00	1	1	2	0.11	0.07
Coat colour	0	0	1	0.03	0	0	1	0.03	1	0	1	0.06	0.04
Growth rate	0	3	0	0.20	0	2	0	0.13	2	3	3	0.23	0.19
Performance	1	0	3	0.20	1	0	2	0.17	1	0	1	0.06	0.14
Temperament	0	1	0	0.07	0	1	0	0.07	1	0	1	0.06	0.07
Female donkey													
Twinning ability	3	0	0	0.30	1	1	0	0.17	2	3	3	0.23	0.23
Body size	1	0	0	0.10	3	1	1	0.40	6	0	1	0.29	0.26
Mothering ability	1	3	0	0.30	0	1	1	0.10	0	1	1	0.05	0.15
Coat colour	0	0	0	0.00	0	1	0	0.07	0	2	1	0.08	0.05
Age at 1st foaling	0	0	2	0.07	0	0	1	0.03	0	1	2	0.06	0.05
Foaling ability	0	1	2	0.13	1	0	2	0.17	1	1	1	0.09	0.10
Performance	0	1	0	0.07	0	0	0	0.00	1	2	0	0.11	0.06
Temperament	0	0	1	0.03	0	1	0	0.07	1	1	2	0.11	0.07

R1 – R3 = Rank 1 to Rank 3, n = Sample.

4.6 Donkey colour variations

Donkey colour variations were noticed in the investigation on three separate villages, as shown in Table 4.6. The donkey colours in the three communities were not significantly different (*p>0.05*), and the same colours existed in each hamlet.

Table 4. 6 Donkey colour variations

	Villages				
Coat colour	**Genau N (%)**	**Archibalt N (%)**	**Thorp N (%)**	**Chi - Square**	**P - value**
Dark brown	16 (21.62%)	5 (6.76%)	5 (6.76%)		
Light brown	7 (9.46%)	3 (4.05%)	3 (4.05%)		
White	4 (5.41%)	3 (4.05%)	0 (0.00%)		
Grey	13 (17.57%)	7 (9.46%)	7 (9.46%)		
Chuck coal	1 (1.35%)	0 (0.00%)	0 (0.00%)	4.46	0.81^{ns}

^{ns} = not significant

Figure 4. 1 Dark brown donkey

Figure 4. 2 White Donkey

Figure 4. 3 Light brown donkey

Figure 4. 4 Grey donkey

Figure 4. 5 Chuck coal colour

4.7 Effect of village on morphological traits and body weight of donkeys

The results of the effect of village on the morphological features and body weight of the donkeys are shown in Table 4.7. Only four of the eighteen examined variables (BaL, HW, BH, and FLL) exhibited a statistically significant difference (*p<0.05*) between the three villages. BaL and FLL were statistically significant (*p<0.05*) amongst the villages, whereby BaL was higher in donkeys from Archibalt (80.39±084 cm) and Thorp (78.93±1.25 cm) villages. FLL was observed to be higher in Thorp (77.60±1.60 cm) and Genau (74.33±1.11) villages. The current results indicated that donkeys from Thorp village had a higher HW (48.80±5.82 cm) as compare to other villages.

Table 4. 7 Effect of village on morphological traits and body weight of donkeys

	Villages			
	Genau	**Archibalt**	**Thorp**	
Traits	**Mean±SEM**	**Mean±SEM**	**Mean±SEM**	***P-value***
HL (cm)	48.61±0.88	50.29±0.60	50.27±1.01	0.28^{ns}
EL (cm)	25.94±0.90	25.09±0.80	25.73±0.69	0.77^{ns}
NL (cm)	47.30±1.04	48.12±0.96	50.47±1.55	0.26^{ns}
CW (cm)	121.60±1.07	124.44±0.93	124.47±1.16	0.15^{ns}
BaL (cm)	$74.90±1.71^{b}$	$80.39±0.84^{a}$	$78.93±1.25^{a}$	0.01^{*}
BoL (cm)	118.00±1.29	119.90±1.28	121.07±3.33	0.60^{ns}
HW (cm)	$34.83±1.44^{b}$	$40.37±0.86^{b}$	$48.80±5.82^{a}$	0.003**
UC (cm)	75.94±1.67	79.54±0.98	76.93±2.80	0.20^{ns}
BH (cm)	$115.61±1.06^{ab}$	$118.56±0.94^{a}$	$113.73±2.54^{b}$	0.04^{*}
HR (cm)	118.78±1.28	120.88±0.98	121.87±1.05	0.27^{ns}
TC (cm)	25.72±1.11	27.66±0.67	29.20±0.69	0.06^{ns}
CD (cm)	43.94±0.98	44.32±0.85	45.40±0.69	0.65^{ns}
WH (cm)	111.39±1.07	113.07±0.83	113.13±1.31	0.47^{ns}
FLL (cm)	$74.33±1.1^{ab}$	$71.54±1.2^{b}$	$77.60±1.06^{a}$	0.01*
CC (cm)	23.05±0.76	23.51±0.25	24.13±0.45	0.35^{ns}
CL (cm)	34.39±1.36	34.46±0.60	35.40±0.56	0.73^{ns}
CH (cm)	6.67±0.26	6.80±0.20	6.73±0.39	0.93^{ns}
BW (kg)	105.83±2.50	108.93±1.75	109.27±2.68	0.56^{ns}

* = significant at P < 0.05; **Highly significant (p <0.01) ^{ns} = not significant, a, b: means in the same row with different superscripts are significantly (P < 0.05), HL - Head length; EL - Ear length; NL - Neck length; CW - Chest width; Bal - Back length; BoL - Body length; HW - Hip width; UC - Umbilical circumference; BH - Back height; HR - Height at the rump; TC - Thoracic circumference; CD - Chest depth; WH - Withers Height; FLL - Front leg length; CC - Cannon circumference; CL -Cannon length; CH - Cannon height; BW – Body weight.

4.8 Phenotypic correlation between measured traits

Table 4.8 shows the phenotypic correlation of 18 traits measured of female and male donkeys that existed in three villages, the male traits above diagonal and female traits below. BW in male donkeys showed not to be statistically significantly correlated ($p > 0.05$) with HL, EL, NL, BaL, HW, FLL, CC, CH, CL but was positively statistical significant correlated ($p<0.05$) with BoL, UC, TC, CD and positively highly statistical significant correlated ($p<0.01$) with CW, BH, HR, WH.BW in female donkeys was not statistically significant correlated ($p>0.05$) with NL, BaL, TC, CL, however the same trait showed to be positively significant correlated ($p<0.05$) with HL, EL, BoL, HW, UC, FLL and CC and positive highly significant correlated ($p<0.01$) with CW, BH, HR, WH and CH.

Table 4. 8 Phenotypic correlation between measured traits, male above diagonal and female below diagonal

Traits	HL	EL	NL	CW	BaL	BoL	HW	UC	BH	HR	TC	CD	WH	FLL	CC	CL	CH	Bwe
HL		-0.09^{ns}	-0.28^{ns}	0.20^{ns}	0.27^{ns}	-0.12^{ns}	0.20^{ns}	0.01^{ns}	0.14^{ns}	0.28^{ns}	0.28^{ns}	-0.09^{ns}	0.31*	0.13^{ns}	0.37*	0.19^{ns}	0.31^{ns}	0.19^{ns}
EL	0.33^{ns}		-0.18^{ns}	0.22^{ns}	0.17^{ns}	0.09^{ns}	0.17^{ns}	0.04^{ns}	-0.09^{ns}	0.19^{ns}	0.03^{ns}	0.05^{ns}	0.16^{ns}	0.05^{ns}	-0.12^{ns}	-0.00^{ns}	0.03^{ns}	0.15^{ns}
NL	0.17^{ns}	0.05^{ns}		0.20^{ns}	-0.36*	0.33*	0.09	0.22^{ns}	0.04^{ns}	0.23^{ns}	0.50**	-0.04^{ns}	-0.03^{ns}	0.44**	0.16^{ns}	0.08^{ns}	0.08^{ns}	0.19^{ns}
CW	0.47**	0.38*	0.19^{ns}		0.52**	0.35*	0.09^{ns}	0.33*	0.45**	0.63**	0.30^{ns}	0.38*	0.61**	0.25^{ns}	0.35*	0.17^{ns}	0.11^{ns}	0.94**
BaL	0.33^{ns}	0.07^{ns}	-0.16^{ns}	0.49**		0.88^{ns}	0.89^{ns}	0.97^{ns}	0.04^{ns}	0.11^{ns}	0.47^{ns}	0.03^{ns}	0.00^{ns}	0.59^{ns}	0.54^{ns}	0.46^{ns}	0.64^{ns}	0.00^{ns}
BoL	0.41*	0.12^{ns}	0.59**	0.48**	0.04^{ns}		-0.40*	0.59**	0.51**	0.19^{ns}	0.37*	-0.01^{ns}	0.15^{ns}	0.21^{ns}	0.12^{ns}	0.04^{ns}	0.22^{ns}	0.34*
HW	0.30^{ns}	0.10^{ns}	0.21^{ns}	0.51**	0.40*	0.36*		-0.41**	-0.56**	0.29^{ns}	0.37*	-0.03^{ns}	0.07^{ns}	0.22^{ns}	0.20^{ns}	0.10^{ns}	0.04^{ns}	0.14^{ns}
UC	0.53**	0.37*	0.24^{ns}	0.43*	0.18^{ns}	0.35*	0.13^{ns}		0.59**	0.09^{ns}	0.35*	0.07^{ns}	0.16^{ns}	-0.06^{ns}	-0.01^{ns}	-0.41**	-0.03^{ns}	0.35*
BH	0.52**	0.22^{ns}	0.06^{ns}	0.79**	0.50**	0.33^{ns}	0.41*	0.62**		0.36*	0.09^{ns}	0.23^{ns}	0.44**	-0.07^{ns}	0.21^{ns}	-0.04^{ns}	0.11^{ns}	0.41**
HR	0.45**	0.25^{ns}	0.20^{ns}	0.79**	0.30^{ns}	0.57**	0.54**	0.44**	0.79**		0.47**	0.25^{ns}	0.56**	0.49**	0.41**	0.43**	0.16^{ns}	0.60**

TC	0.30^{ns}	-0.06^{ns}	0.45**	0.39*	0.04^{ns}	0.39*	0.27^{ns}	0.15^{ns}	0.33^{ns}	0.45**		-0.20^{ns}	0.18^{ns}	0.47**	0.36*	0.07^{ns}	0.25^{ns}	0.33*
CD	0.53**	0.34*	0.20^{ns}	0.82**	0.47**	0.53**	0.43*	0.45**	0.84**	0.81**	0.39*		0.39*	-0.08^{ns}	0.19^{ns}	-0.06^{ns}	-0.14^{ns}	0.31*
WH	0.14^{ns}	0.04^{ns}	0.57**	0.26^{ns}	-0.29^{ns}	0.59**	0.10^{ns}	0.18^{ns}	0.17^{ns}	0.35*	0.44**	0.03^{ns}		0.29^{ns}	0.30^{ns}	0.21^{ns}	-0.07^{ns}	0.58**
FLL	0.17^{ns}	0.15^{ns}	0.18^{ns}	0.37*	-0.05^{ns}	0.30^{ns}	0.14^{ns}	0.28^{ns}	0.33^{ns}	0.44**	0.70**	0.28^{ns}	0.39*		0.12^{ns}	0.56**	0.14^{ns}	0.27^{ns}
CC	0.30^{ns}	0.16^{ns}	0.45**	0.44**	-0.04^{ns}	0.68**	0.39*	0.34*	0.36*	0.59**	0.06^{ns}	-0.24^{ns}	0.46**	0.30^{ns}		0.09^{ns}	0.19^{ns}	0.30^{ns}
CL	0.30^{ns}	-0.15^{ns}	0.17^{ns}	0.10^{ns}	-0.24^{ns}	0.41*	0.13^{ns}	0.22^{ns}	0.25^{ns}	0.36*	0.27^{ns}	0.18^{ns}	0.27^{ns}	0.30^{ns}	-0.15^{ns}		0.55**	0.18^{ns}
CH	0.29^{ns}	-0.17^{ns}	0.19^{ns}	0.04^{ns}	-0.34^{ns}	0.44*	0.16^{ns}	0.42^{ns}	0.23^{ns}	0.38*	0.26^{ns}	0.15^{ns}	0.24^{ns}	0.29^{ns}	-0.14^{ns}	0.29^{ns}		0.09^{ns}
Bwe	0.43*	0.37*	0.17^{ns}	0.75**	0.27^{ns}	0.36*	0.34*	0.44*	0.65**	0.64**	0.14^{ns}	0.10^{ns}	0.67**	0.43*	0.37*	0.17^{ns}	0.75**	

* = significant at P < 0.05, ** = high significant at P < 0.01, ^{ns} = not significant; HL - Head length; EL - Ear length; NL - Neck length; CW - Chest width; Bal - Back length; BoL - Body length; HW – Hip; * = significant at P < 0.05, ** = high significant at P < 0.01, ^{ns} = not significant; HL - Head length; EL - Ear length; NL - Neck length; CW - Chest width; Bal - Back length; BoL - Body length; HW - Hip width; UC - Umbilical circumference; BH - Back height; HR - Height at the rump; TC - Thoracic circumference; CD - Chest depth; WH - Withers Height; FLL - Front leg length; CC - Cannon circumference; CL -Cannon length; CH - Cannon height and BW – Body Weight

CHAPTER 5

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Discussion

Donkeys play an important part in the rural livelihoods of disadvantaged households by offering labor-related services such as drought power and transportation (Gieger and Hovorka, 2015). The study determined the socioeconomic condition of the farmers, and the study participants had a range of education levels, with some having no formal education, some having only basic school education, and the majority having secondary education. Swai and Bwanga (2008) discovered that donkey farmers' educational levels ranged from no formal schooling to elementary school education to secondary school education in northern Tanzania. Despite the fact that the two surveys had varied numbers at each level, it is clear that donkey farmers have just a basic education that does not extend beyond secondary school. According to Shuiep (2016), the average age of donkey farmers was around 32.8, with farmers having only one donkey, which was utilized to earn income or to be ridden for transportation. This study's findings were slightly different in that the minimum age of donkey farmers participating in the study was 66.88, with no younger farmers. In this study, the minimum number of donkeys kept was four, with a maximum of six, and the donkeys were utilized to produce money by delivering things rather than only for transportation. Gieger *et al*. (2020) discovered that donkeys were used to earn money and that different age groups in society owned donkeys for a variety of reasons, including riding. In this survey, no young farmers owned donkeys, the majority of farmers were in their retirement years, and the farmers did state they made money from donkeys. The economic worth assigned to the animal may range from location to place, as farmers seek to safeguard animals that provide income and so avoid using them for non-beneficial purposes.

The donkey animal is the most efficient agricultural power unit (Nengomasha *et al*., 2000). This study discovered that donkeys were mostly used to assist farmers with drought power, cart pulling, social status, and donkey product consumption, but primarily for drought power and cart pulling. Farmers in a research conducted by Hassen *et al*. (2013) focused on employing donkeys for income-generating activities rather than on drought power. There were parallels with this finding since it was tied to this study, which discovered that farmers utilized donkeys for cart hauling, which would draw buckets of water from a nearby faucet for the donkey owner and other

community members. The cart was also used to transport heavy loads throughout the settlements. Donkeys are kept for a variety of reasons, including milk, meat, production labour, and recreation (Deng *et al*., 2021). None of the farmers in this study kept donkeys for the purpose of eating donkey meat, and only one farmer out of several made a living through milk consumption. Other donkey applications were discovered to be lacking, and the aim of maintaining donkeys was not varied. The wild donkey and the feral donkey were breeds of donkeys kept by farmers, which matched with the conclusions that "at least three different varieties of wild asses are found in Africa" (Kimura *et al*., 2013). In this study, donkeys play an important role in supporting farmers with daily activities that need electricity and contribute significantly to household income. The breed was chosen based on the animal's capacity to execute the essential labour as well as its ability to survive the difficult geographical conditions at the study site.

There has been little research into analysing the influence of different breed types on the complex variety within livestock production systems in underdeveloped countries, and knowledge gaps exist regarding breed change strategies (Martyniuk, 2021). The study's findings revealed that, while farmers were aware of ideas such as inbreeding, there was no breeding program in place to aid in the preservation of particular donkey genetic features required for reproduction and assisting in genetic variability among the villages. Farmers did not manage animal breeding, and most farmers allowed animal culling to nature, while some culled old age animals with low output performance. Visual features such as growth rate, skin colour, and confirmation were used to choose animals for herd stock. The resulting results were not different from those found in small ruminant animals kept by communal farmers, such as sheep and goats, mating was not restricted, and animal selection was based on physical features (Nigussie *et al*., 2013; Dossa *et al*., 2015). Tada *et al*. (2013) discovered that selection of animals to be part of the herd was primarily based on preference for coat colour, body size, and body confirmation in a research on Nguni cattle. The livestock production systems that exist in rural parts of South Africa demonstrate a lack of adequate breeding informed selecting processes. In the current study, donkeys' colours were mostly brown (dark and light), white, grey, and chuck coal. These colours matched the findings of Bunevski *et al*. (2018), who discovered that the colours of Macedonian donkeys were brown, black, and grey. This study's study region was

topographically similar to the Macedonian donkey study side; however, the current study site was hilly with extreme hot temperatures.

Selecting animal parents who will improve the genetic quality of the future generation is one of the most important aspects of animal breeding (Toghiani, 2011). Abebe *et al*. (2020) discovered that physical visual features such as body size and coat colour were the most important in the selection of breeding animals for small scale farmers. The current study found that body size, growth rate, and mothering skill were among the most highly valued features in the selection of donkeys to be the parents of the future generation, however coat colour was not. In use, the size of the donkey has a significant impact on the task that it will execute. Mekonnen *et al*. (2012) discovered that community farmers ranked drought power and animal outputs in the form of milk highly. In this study, performance was ranked as one of the favoured features, although it did not score highly, and none of the farmers were interested in the animal outputs such as milk or meat; instead, the farmers were interested in the animals' capacity to walk. Body size, development rate, and mothering ability are all critically important features for the famers in this study, so a breeding program will need to be designed to address those traits in order to increase the performance of the next generation.

To fully aid decision making in cattle development and breeding program construction, a thorough understanding of breed traits is required (FAO, 2012). The majority of the morphological features measured in the study did not differ between the tree communities. There was a difference in front leg length, body height, height at withers, and back length; the acquired results differed with modest similarities from a study conducted by Sargatini *et al*. (2018), who discovered a number of variances between features identified in different regions. Furthermore, a study conducted by Vleava *et al*. (2016) yielded data that differed substantially from this study in that different measurements in different places vary greatly. The current study used villages that were quite close to each other and had the same climatic circumstances, therefore there was no variation in the measured attributes because the animals were all from the same location. Negomasha *et al*. (1997) stated unequivocally that there is very little physical variation in African donkeys; however, a study conducted in Kenya by Gishure *et al*. (2020) claimed to have the highest measurement traits (body weight, body length, height at whither, and heart girth); this study had similar measurements

and higher for body length, wither height, and chest width. The link between body measurement attributes (body length, waist height, hip width, and rum height) was demonstrated in this study, comparable to a study conducted by Yilmaz and Ertugrul (2012), who discovered the same traits to be correlated with body weight. The present results for donkey animals in this study show that as the features body length, whither height, hip breadth, and height at rump rise in length, the animal's body weight increases as well.

5.2 Conclusions

Farmers in the study villages did not use a breeding program to develop their stock so that it was entirely fit for the activities that the donkeys were expected to undertake. Farmers did not comprehend breeding techniques, but they did have their own method of picking animals based on physical features, which were highly ranked by farmers in all three communities. Morphological features were detected in all three villages, with very little variance among the donkeys, owing to the fact that identical breeds were kept in all three villages, and the terrain of the places was the same. A few features were discovered to correlate with body weight, which means farmers can use these traits to estimate animal body weight without using weighing scales, and they can also use those traits to select animals for breeding stock to improve the next generation.

5.3 Recommendations

Based on the findings obtained in the study, it is recommended:

1. The Department of Agriculture, Land Reform, and Rural Development must intensify its donkey production promotion program, as well as establish solid relationships with other stakeholders such as institutions of higher education learning and non-governmental organizations, in order to launch an educational program on the importance of keeping and breeding donkeys.
2. More research on the existing donkeys in the Limpopo Province is needed, and information must be adequately documented so that a provincial breeding program may be formed.

CHAPTER 6

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Annexure A

Consent form

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Cell: 073 6968036, Email: maswanamasixole@gmail.com

INFORMED CONSENT FORM FOR PARTICIPATING IN A RESEARCH STUDY

Before taking part in this research, the researcher will talk to you, and will give you this consent form to read, as well as to clarify you where you might need clarity. You are cordially asked to sign the form after you have decided to take part in this project. I, ……. agree to participate in research titled *"*EVALUATION OF BREEDING PRACTICES AND MORPHOLOGICAL CHARACTERISATION OF DONKEYS IN THREE SELECTED VILLAGES OF THE BLOUBERG LOCAL MUNICIPALITY, IN THE LIMPOPO PROVINCE*"* in the Department of Agricultural Economics and Animal Production University of Limpopo.

Furthermore, I understand that:

1. My participation in this research is voluntary, and I will not gain monetary/ financial compensation for my participation. I may withdraw my participation in a case of discomfort, and my withdrawal will not affect my relationship with the researcher.
2. I have the right to not answer certain questions if I am uncomfortable. I understand that this participation is entirely voluntarily. I can withdraw my consent at any time with no penalty.

3. My response to the questions will be recorded at my permission. However, where I am not comfortable about recording my response, the researcher will have to write down my responses by him/herself.
4. Confidentiality and anonymity of records identifying you as a participant will be maintained by me and my learning institution, if necessary.
5. If you have any questions or concerns about participating in the interview or about contributing to this study, you may contact me or my supervisor on the numbers listed above.

_____ _____ _____

Participant Signature Date

(Full name)

I, Masixole Maswana, have clarified the scope of the research to the participant and explained his/ her rights concerning his/ her participation in the study. She/ He agrees to participate in this study.

Kind regards,

_____ _____ _____

Researcher Signature Date

Annexure B

Department of Agricultural Economics and Animal Production,

University of Limpopo,

Private Bag X1106, Sovenga 0727,

South Africa

Questionnaire: Evaluation of breeding practices and morphological characterization of Donkeys in three selected villages of Blouberg Local Municipality

The main aim of this study is to investigate donkey farmers breeding practices and donkey's morphological characterisation in the Blouberg local Municipality, Limpopo South Africa.

QUESTIONNAIRE NUMBER	

NAME OF RESPONDENT	

CONTACT DETAILS	

NAME OF THE VILLAGE	

Please put a tick and fill blank spaces where is appropriate

1.1 Gender of household's head

1. Male		2.Female	

1.2 Age of the respondents…….

1.3 Marital status

1. Single		2.Married		3.Widow		4.Divorced	

1.4 Household size……..

1.5 Level of education

1. No formal Education		2. Primary		3.Secondary		4. Tertiary	

1.6 How long have you farmed with Donkeys ?.....

Do you make money from donkeys and what do you use them for to make money

……..

……..

1.7 Animal breeding experience in years…….

1.7.1 Do you have a source of income?

1. Yes		2. No	

1.7.2 If yes, what is your source of income?

1. Salaries or Wages		2. Pension fund		3. Social grant		4. Business profit		5.Other	

1.7.3 If other, specify…….

1.8 What is your monthly household income?

<1000		1000-5000		5000-10000		>10000	

1. Christian		2.Muslim		3. African tradition		4.Other	

If other please specify ……

1.10 Occupation

1. Public		2. Private		3. Pensioner		4. Other	

If other please specify ……..

1.11 Work status

1. Part-time		2. Full-time		3. Permanent		4. Other	

If other please specify ……

2. SECTION B: Breeding practices and donkey usage

Breeding

2.1 Donkey breed type

1. Wild Donkey		2. Feral donkey		3. Istrain Donkey		4. Other	

If others please specify ……

2.2 What is the purpose of keeping Donkeys?

1. Meat Consumption		2. Milk production		3. Social Status		4.Drought Power		5. Cart Pulling	

2.3 How many Donkeys do you farm with? …….

2.4 Do you practice breeding?

1. Yes		2. No	

2.5 What are the kinds of breeding practices you use?

1. Importing exotic		2.Improving indigenous	

Any other ? …….

2.6 Which ways do you use to improve your breeds?

1. Cross breeding		2. Pure breeding	

If any other please specify ……

2.7 Which mating system do you practice?

1. Controlled		2. Uncontrolled	

Specify any other if it exist ……

2.8 If controlled mating, by what technique?

1. Culling unproductive		2. Culling disabled	

Any other method please specify ……

2.9 Do you know the inbreeding concept?

1. Yes		2. No	

Management of breeding

2.10 Do you practice culling?

1. Yes		2. No	

If No specify ……

2.11 Reasons for culling

1. Old age		2. Low production		3. Others	

2.12 To identify selection criteria, mating strategies and culling practices used by farmers in three villages, within the Blouberg Municipality in the Limpopo to breed and rear donkeys.

3. SECTION C: Selection criterion used for selecting breeding stock

3.1 Which criteria do you use to select your male and female donkey for breeding?

1. Growth rate		2. Skin colour		3. Conformation		4. Others	

3.2 If others, specify……

3.3 Season to breed

Breeding season	Response
Spring	
Autumn	

3.4 Traits preferred in male donkeys

Trait	Response (Rank)
Mating ability	
Body size	
Ear size	
Coat colour	
Growth rate	
Temperament	
Other (specify)	

3.5 Traits preferred in female donkeys

Traits	Response (Rank)
Twinning ability	
Body size	
Mothering ability	
Temperament	
Age at 1st foaling	
Coat colour	
Foaling ability	
Other (specify)	