Phenotypic characterisation of indigenous goats in Chiredzi resettlement areas

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Abstract

A survey was conducted to phenotypically characterise goats and their production environment in Chiredzi resettlement areas. Purposive sampling was done to select farmers with at least 10 goats. A pre tested structured questionnaire was administered to 60 farmers to characterise production environment within the selected four wards. Breed descriptor and characterisation manual were used for phenotypic characterisation. Qualitative and quantitative traits were recorded on 400 goats based on age. Data was analysed using SPSS version 16 software. Under goat production environment household heads were mainly males and the major reason for goat keeping was for meat (78%). Seasonal variations in feed availability were noticed with major shortage from June to August. Mortality was mainly due to disease and predators (38%) and was high in the wet season. Uncontrolled breeding with minimum selection was the most practised breeding method. Goats showed diverse phenotypic features including adaptive features to hot climates like small hair size (<5cm) (65%), horns (85%), small body size average body length with height 59.95 cm ± 4. Special features present were toggles mainly common in female goats (21.8%) and muzzles in 30.8% of the sampled goat population. A convex facial profile was common in male goats and concave facial profile in females. Multivariate analysis of variance showed significant difference in linear body measurements among wards except for withers height ($p < 0.05$). Survey concludes that goats in Chiredzi resettlement areas were mainly short eared small horn breeds and are adapted to harsh conditions due to the presence of adaptive phenotypic features. However, propose for molecular characterisation to quantify on breed type and genetic erosion status.

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Keywords: Chiredzi resettlement areas, goats, phenotypic characteristics, production, environment

Introduction

Phenotypic characterisation of agricultural genetic resources is a process of identifying distinct breed populations and describing their external and production characteristics (FAO, 2012). Goat production in Zimbabwe is one of the major livestock activities in communal areas. Zimbabwe has a goat population of 4 million (FAOSTAT, 2020). The estimated number of goat breeds used for food and agriculture in the world is about 320 (Rege & Okeyo, 2006) of which 89 (16%) are found in Africa (Shrestha & Fahmy, 2005).

The major indigenous goat breeds in Zimbabwe are the ecotypes of Small East African and Matebele goats. The Small East African goats are phenotypically a small breed (Sikhosana & Senda, 2007) whereas the Matebele goat is much larger (Kusina, 2000). Most of the indigenous breeds are highly distributed in the agro ecological zones 4 and 5 compared to other parts of the country (Masunda, 2001). Exotic breeds also present include the Boer, Pafuri, Saanen and Angora goats. These are mainly found within commercial farming areas for meat and milk and production (Kusina, 2000). At least 90% of goats are raised in communal areas (Shabalala & Mosina 2002). In Zimbabwe the majority of goats are owned by females and flock sizes range from 6 to 10 per household. Goats are mainly kept for meat, milk, manure and sales in times of financial constraints (Gwaze, Chimonyo & Dzama, 2009).

Goat production systems in Zimbabwe are based on utilisation of natural rangeland as a feed resource, kraals for housing, uncontrolled breeding (van Rooyen & Homann, 2008). However with increased intensification and change in climate, it makes uncertain the current status of Zimbabwean goat genetic resources. The aim of the study was to characterise production environment and phenotype of goats in Chiredzi resettlement areas.

Materials and methods

Study site

A survey was conducted in northern resettlement areas of Chiredzi areas, Chiredzi district. The soils are derived from the siliceous gneisses group (CRDC, 2012). The resettlements

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have a warm dry climate with mean temperature ranging from 21 -37˚C and average rainfall of 400mm or less. Rainfall is unreliable resulting in the farming of drought resistant crops like millet, sorghum, cotton and cowpea (EMA, 2002). Livestock production activities include small ruminants, poultry production, cattle ranching and wildlife management.

Sampling procedure

Purposive sampling was initially carried out followed by snowballing to identify wards with the highest goat population within the resettlement areas and farmers with at least ten adult goats per household. Four wards were randomly selected from which households with goats were purposively selected. Snowballing was then adopted to include a lot more goat owners until a sufficient sample was generated to include a total of 400 goats. Sixty questionnaires were administered randomly to the selected farmers and Livestock Production and Development department (LPD) workers to assess the production environment.

Data collection

Production environment

Data for the production environment was collected using a pretested structured questionnaire. This was developed and pretested in Chiredzi resettlement areas before administration. Farmers who took part in pretesting were not included in the actual survey and 60 questionnaires were administered, 20 farmers took part in pretesting.

Phenotypic characterisation

Phenotypic characterisation was done through measuring facial and conformational traits. Discrete and qualitative data was collected on horn presence, horn shape and orientation, ear orientation, facial profile and beard. This was achieved using a breed descriptor adopted from FAO (1986), to help define different shapes and orientation. Quantitative data collected included body length, height at withers, horn length, ear length and heart girth and measurements were taken using measuring tapes and sliding rules. Measuring procedures were adopted from the characterisation manual by FAO (2012).

Data analysis and presentation

Data was analysed using SPSS version 16 for frequencies, descriptive statistics, graphs and charts. Bonferroni test was done for comparison of means after analysis of variance for

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quantitative data. Multivariate analysis of variance to differentiate goat populations in various wards on linear body measurements was done using the following model:

$Y_{ij} = \mu + w_i + e_{ij}$

Where Y_{ij} is observed phenotypic value

μ is overall mean due to condition common to all animals

w is the effect of i^{th} ward (i=1, 2, 3, 4)

e_{ij} are random residuals

Results and Discussion

Household demographics

Chiredzi resettlement area is characterised by majority of male headed households (58.3%) with age ranges of 41-55. Age groups 25-40 and 56-70 had 20% of the total respondents respectively however 1.7% for 71 and above. About 21.7% of the household heads were widowed, 5% were single and the majority (73, 3%) were married. Male headed households had larger flock sizes than female headed households. Goat herds ranged from 10-18 however some even had more than 30. It was also observed that all the respondents obtained formal education however education levels were diverse with the majority (63.3%) having attained secondary level and 31.7 % primary level. Education did not have a direct relationship to flock size. This agreed with (vanRooyen, 2007) that goat production was done to alleviate poverty within the poor members of society in communal areas.

Socio economic factors

Majority (58.3%) of the goats were owned by household heads, 26.3% by male household heads and spouses, and 8.3% by spouses. Argued with (van Rooyen & Homann, 2008) that goat keeping has a strong gender component as most of the goats belonged to males than females however there were multiple ownerships of goats. Respondent's major source of income was crop farming (40%) mainly cotton production. About 28.3% of the families relied on employment as the resettlement areas are sandwiched by sugar cane estates. This agrees with van Rooyen (2007) 60% of Zimbabweans engage in agriculture and is their major source of income and 27% find employment in the agricultural sector, 6.7% had home

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industry as a form of income and these included grinding mills and grocery tuck shops however the reminder relied on remittances from family and friends.

About 48% of the farmers had goat keeping experience ranging from 6-10 years whilst 1.7% had 21-25 experience. Goats were kept for meat (78%); income (13.3%) farmers sold goats at between $25 and $30 for family upkeep and emergency. This agrees with Assan (2013) that a limited number of farmers use goats as a major source of income. In contrast, Homann, van Rooyen, Moyo & Nengomasha (2007) ranked income most important, meat, milk, manure and traditional rituals. In terms of goat routine and daily managerial operations fathers dominated 43.3% and 33.3% herdsmen. Household information showed that 15 % of females took part in goat managerial operations and 9% of the management operations were done by children.

Goat production environment

Majority (96.7%) of the farmers practiced uncontrolled breeding and a major contributing factor was use of the same grazing areas and breeding was based on no selection criteria for most farmers only 8% selected on the basis of size. About 66.7% of the farmers castrated goats and the majority used the open knife method at ages ranging from 3 to 4 months, 20 % used the rubber ring and was done within the first few days of life 5 up to 14 days. Major reason for castrating goats was to improve meat quality. The major type of housing common to farmers was open kraal 53.3% and 41.7% used closed kraal and the remainder had raised floor kraal. It was realised that where open kraals were used mortality due to diseases and predators was high (Homann, 2008) unlike where closed and raised kraals were used.

Respondents also highlighted free ranging as the major source of feed (van Rooyen & Homann, 2008) and were most abundant from December to February. However, 20% of the farmers relied on both free-range and supplementation where there was mainly use of crop residues 31.7% and 10% used stock feeds. It contradicted with Homann, *et al*. (2007) that 83% of farmers use crop residues to supplement. Chiredzi farmers experience crop failure at every early stage of life. However, supplementation proved to help maintain the body condition when feed is scarce from June to August.

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Source of water however differed with geological positioning. Rivers were the main source of water as some areas contained perennial rivers Mutirikwi, Runde and Chiredzi however for respondents far from water sources boreholes and dams were the major source of water.

The major cause of mortality was diseases and predators 38%. The highest disease incidence was in February with 35.5% however the least disease incidence percentage was in October. Major diseases that affected the farmers included foot rot, orf and heart water. External parasites (ticks) had the highest levels of incidence. However most (90%) of the respondents never vaccinated their goats and only 6.7% vaccinated occasionally however the remaining vaccinated regularly. Majority (78.8%) of the farmers did not dip goats and the major reason was lack of infrastructure hence leading to high incidence of tick borne diseases. Most of the farmers had no excess to extension and veterinary supply from the government making them resort to veterinary drug suppliers like Agrivet.

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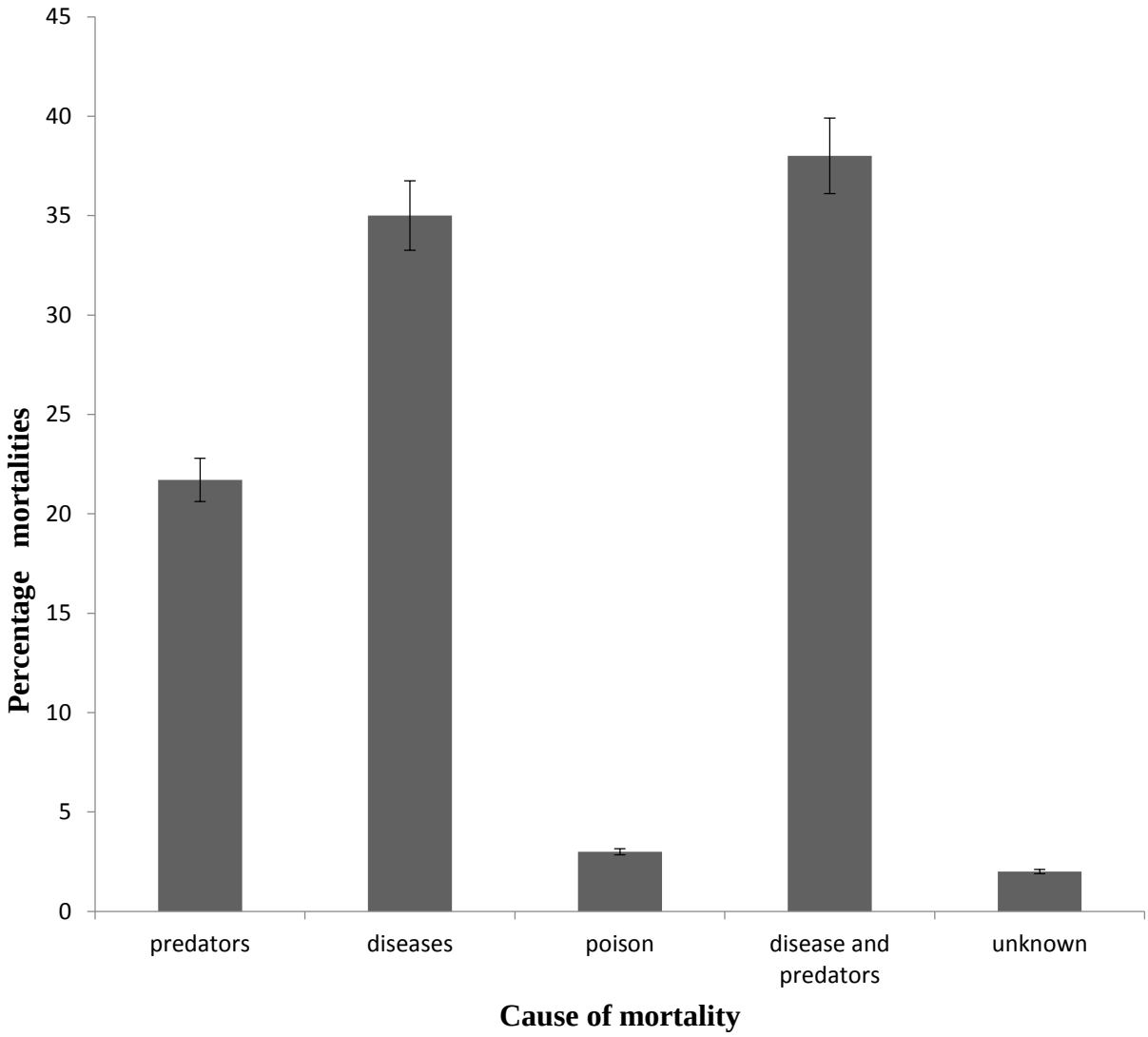

Figure 1. Major causes of mortality among Chiredzi resettlement areas

Phenotypic characteristics of goats

Table 1. Descriptive statistics for quantitative data of goats

Variables (cm)	Mean	Maximum	Minimum	SD	Variance

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Body length	66.36	89	59	5.832	34.011
Wither height	59.95	87	47	4.885	23.864
Heart girth	74.51	96	54.04	6.907	47.709
Ear size	13.55	25	10	1.843	3.396
Horn size	9.65	36	0	5.447	29.672

N=400, SD-standard deviation.

Table 1 summarises descriptive statistics of quantitative body measurements of goats in Chiredzi resettlement areas. Linear body measurement on goats showed that the majority of goats were small. This agreed with Devendra & Burns (1983) that goats with 51-65cm height at wither are classified as small. Small goats are also known to cope with high temperatures as it increases surface area for heat loss through evaporation. However maximum (87cm) and minimum (47cm) values on wither height showed presence of dwarf and large goats as any goat with >65 cm and <51 cm are regarded as large and dwarf respectively (Devendra & Burns, 1983). Average horn size of 9.65±5 showed that the majority of the goats in resettlement areas had small horns <15cm (FAO, 1986). According to Mason (1981) goats with small horns fall under the breed class short eared small horns.

Majority of the goats 56.5% had patched body hair coat patterns and 36.5% were plain. According to Yakubu, Salako & Imumorin (2010) similar coat patterns were present for other local African breeds. Toggles were present in 21.8 % of the goats and were highly present in females which contain a plain body hair coat pattern. Low presence of toggles agreed with Hassenet al., (2012) that toggles are common only in dairy breeds and pygmy goat types. However, 30.8% of the goats had pigmented muzzles and none contained wattles. Most of the female goats had a concave facial profile and males were convex. About (48.8%) female goats had medium sized udders and 38% had small udders. Large sized udders were not a major characteristic of the goats. However, the majority of the males had medium sized testis with the large bucks having large testis.

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Majority of the goats showed adaptive features to the high temperatures within the resettlement areas. Figure 2 shows summary of hair length for goats in Chiredzi resettlement areas Most of the goats (65%) had small hair (<5cm) that was glossy. This was a major adaptation feature to an advantage as the resettlement areas fall in natural region 5 with high temperatures. About 7.8% had long hair and was mainly more common in males than females. Most (59.5%) contained glossy hair. Majority of the goats (85 %) were horned and polled goats were only seen in females. This was also to an advantage as it considered a control mechanism for thermal homeostasis (Robertshaw, 2006). Moreover, horn presence improved on reproductive performance (Kridli, Sawalha & Amashe 2004). A total of 66.8% of the horns were backward oriented, 17.5% curved and they were mostly in males. Majority of the goats had lateral ears and 27% had dropping ears.

Table 2 summarises linear body measurements amongst wards in Chiredzi resettlement areas. Multivariate analysis of variance showed variation in body length, heart girth, ear size and horn size among wards except wither height. Phenotypic features showed significant difference at $p<0.05$ for all wards however ward 26 had goats with the largest heart girth. Wither height of ward 29 and 26 did not differ at $p<0.05$. Overly it showed that the means were in range 51-65 and concluded that goats in the area were small according to Devendra & Burns (1983). This variation in linear body measurements can be attributed to breeding strategies that minimise selection depriving production of a uniform crop (FAO, 2012).

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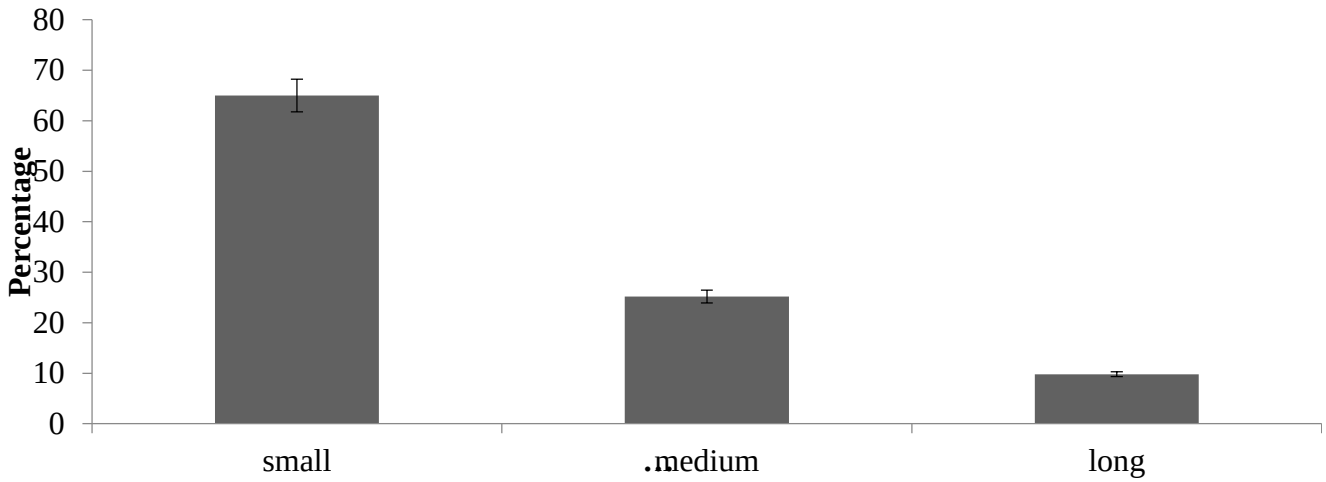

Figure 2. Percentage proportions of various hair lengths of goats in Chiredzi resettlement areas

Table 2. Comparison of mean table amongst wards for linear body measurements

Ward	Mean trait value (cm)									
	Body length	SE	Wither height	SE	Heart girth	SE	Horn size	SE	Ear size	SE
26	67.73^{c}	.548	60.39^{b}	.557	78.27^{c}	.575	10.59^{bc}	.509	13.63^{a}	.132
27	66.09^{b}	.613	59.59^{a}	.404	73.70^{b}	.609	7.93^{a}	.491	13.11^{a}	.143
28	63.92^{a}	.441	59.52^{a}	.444	71.93^{a}	.414	8.98^{b}	.467	13.23 ^{a}	.159
29	67.21^{c}	.644	60.29^{b}	.533	74.12^{bc}	.913	11.09^{c}	.644	14.24^{b}	.256

Values with different superscripts differ significantly at $p < 0.05$; SE, standard error

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Conclusion

Goat production environment and phenotypic features can be characterised and defined by resource constrained farmers, with multiple goat ownership. Seasonal variations in feed availability were highly scarce from June to September. Mortalities were high in the wet season mainly due to disease and predators. There was limited institutional support from government and other stakeholders. The major breed class present was small eared short horn goats with a limited number of dwarf and large breeds. Goats had adaptive features which enabled survival in a harsh environment of limited feed and high temperatures. Production environment had an influence on linear body traits and can be attributed to minimum selection when breeding.

Recommendations

For further studies to recommend molecular characterisation so as to come up with exact breed types and also to make conclusion if genetic resources are being eroded. An advanced phenotypic characterisation of traits that require repeated measures for example birth weight, growth rate, adaptability, carcass weight and meat quality as it will allow selection for the best animals for breeding in line with breeding objectives.

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