Research Application Summary

Morphological characteristics of indigenous cattle in Eritrea

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Abstract

Indigenous cattle are the main livestock reared among African communities. Indigenous cattle have some distinguishing characteristics that can be used for attribution and grouping. A total of 243 indigenous cattle from 27 populations spread out in three major agro-ecological zones in Eritrea were utilised in this study. A total of 14 morphological measurements comprising of seven reproductive indices and seven production performance indicators were used to characterise the indigenous cattle. Cluster analysis based on single-linkage agglomerative hierarchical and non-overlapping (SAHN) technique was used to form homogenous groups. Discriminant function analysis was performed to ascertain the accuracy of the classification. The sampled population clustered around two groupings which were cattle populations found in the highlands and eastern coasts (cluster Arado) and those found in western lowland (cluster Barka). The analysis revealed that the Arado cluster mean linear measurements were low for wither height (114.4±0.8 cm), body length (111.75±2.1 cm) and heart girth (134.65±0.9 cm) than the Barka cluster which were 125.3±0.6, 126.8±0.7, and 156.4±0.7 respectively. The squared Mahalanobis distance was highest (5.1) between cattle population in central highlands and eastern lowlands, and lowest (1.93) between populations in central highlands and western lowlands. There was wide variation in morphology, reproductive performance, and productivity within and between cattle populations. This information is useful in a breeding program which utilizes the available variation within and between breeds in enhancing productivity of indigenous cattle populations in Eritrea.

Key words: Agro-ecology, cluster analysis, Eriteria, indigenous cattle, morphology, phenotype

Résumé

Les bovins indigènes représentent le bétail principal élevé parmi les communautés africaines. Les bovins autochtones ont des caractéristiques distinctives qui peuvent être utilisées pour une attribution et une catégorisation. Un total de 243 bovins indigènes provenant de 27 populations dans trois grandes zones agro-écologiques en Érythrée ont été utilisés dans cette étude. Un total de 14 mesures morphologiques comprenant de 7 indices de reproduction et 7 indicateurs de performance productive ont été utilisés pour caractériser les bovins indigènes. Une classification numérique basée sur la technique de

groupement hiérarchique agglomératif basé sur un seul lien et le non-chevauchement a été effectuée pour former des groupes homogènes. Une analyse discriminante a été réalisée pour vérifier l'exactitude de la classification. La population échantillonnée a été regroupée en deux groupes qui consistaient des populations de bovins trouvés dans les montagnes et les côtes orientales (groupe Arado) et ceux trouvés dans les plaines de l'ouest (groupe Barka). L'analyse a révélé que des mesures linéaires moyennes pour le groupe Arado étaient plus basses pour la hauteur au garrot (114,4 ± 0,8), la longueur du corps (111,75 ± 2,1) et la circonférence de la poitrine (134,65 ± 0,9) que le groupe Barka dont les mesures moyennes étaient de 125,3 ± 0,6, 126,8 ± 0,7, et 156,4 ± 0,7, respectivement. La distance de Mahalanobis au carré entre les populations de bovins était la plus élevée (5,1) entre les bovins des montagnes centrales et ceux des plaines orientales, et la plus basse (1,93) entre les bovins des montagnes centrales et ceux des plaines occidentales. Il y avait une grande variation dans la morphologie, la performance reproductive, et la productivité au sein et entre les populations de bovins élevés en Érythrée. Cette information est utile dans la conception d'un programme d''amélioration génétique qui utilise les pour variations disponibles au sein et entre les races dans le cadre d'amélioration de la productivité et la rentabilité des populations bovines indigènes en Erythrée. Dans le cas où des races exotiques devraient être importées dans le pays pour améliorer les races bovines locales, il serait souhaitable que l'utilisation de ces ressources génétiques étrangères soit structurée de sorte que la diversité génétique des races locales ne soit pas compromise.

Mot Clés: Agro-écologie, l'analyse typologique, Erythrée, les bovins indigènes, la morphologie, le phénotype

Background

Eritrea is a relatively young country having gained its independence in the last two decades. Reconstruction and rehabilitation of its infrastructure and the promotion of both public and private investment in the strategic sectors of the economy has been prioritised. Agriculture was identified as the top priority given that about 80% of her population lives in the rural areas where subsistence agriculture is practiced. There has been a notable decline in the contribution realised from agriculture to the Gross Domestic Product from 25% in 1993 to less than 12% in 2005. This decline and/or slower potential growth in the agricultural sector needs to be investigated and the necessary steps taken to increase productivity. Much of the land in Eritrea is arid and semi-arid (ASAL) which is suitable for livestock production. Even where crop production is practiced mixed livestock-crop production system is common as animals are able to utilise the crop residue to satisfy their nutritional needs in addition to grazing. Livestock production therefore forms a very important component of the country's economy. Despite the importance attached to the sector little or no efforts have been made to carry out morphological and genetic characterisation of the animals so as to develop sustainable conservation and utilisation programmes.

Most of Eritrea's animal production occurs in the smallholder production systems (NLDP, 2007). It is estimated that there are 1.9 million head of cattle, 2.1 million sheep, 4.6 million goats, 2.5 million birds and 0.1 million camels. These have been gradually increasing. Smallholder livestock production in Eritrea is characterised by different farming systems but is mainly dominated by pastoral and agro-pastoral systems. Much of the production is practiced to satisfy subsistence needs with little emphasis in commercial production (MOA, 2012). The production is mainly practiced in semi-arid areas and the main breeds kept are indigenous animals which are well adapted to the nutritional and environmental conditions.

Methodological approach
The qualitative and quantitative phenotypic characters necessary for identification and description of distinct populations, breeds or eco-types were measured. A total of 243 indigenous cattle in 27 populations spread out in three ecological zones in Eritrea were considered. The list of the characters considered in the characterisation was adopted from FAO (1986) which proposed a comprehensive list of animal descriptors relevant in morphological description of breeds. Besides, the survey data, images of adult males and females animals in their natural habitat was used for purposes of identification and differentiation of local animal categories. In this study, the characterisation followed the approach described by Solomon *et al.* (2011) with a total of 27 sampling units from the three ecological zones being selected. Each sampling unit comprised of three sites each from which 9 animals were considered.

A general linear model (GenStat, 2009) procedure was used to analyse body weight and other linear body measurements which included;

Cluster analysis based on hierarchical single linkage algorithm technique (Sneath and Socal, 1973) was used to form homogenous groups of cattle based on their resemblance morphologically (Manly, 1994). This analysis was aimed at distinguishing the different cattle populations in Eritrea into distinct cattle types in different agro-ecological zones. Further, discriminant function analysis was carried out to ascertain the accuracy of the classification of cattle populations. Mahalanobis square distance was also calculated to determine variability among the cattle population found in different agro-ecological zones.

Research application

Two distinct clusters were observed (Fig. 1A and B) and these were the Barka for cattle populations of Western lowlands (Shambuko, Barentu, Tekombia, Awgaro, Golij, Tesenei, Akordet, Tekreret and Keru) and Arado for populations found in the highlands and Eastern Coasts (Cheguaro, Afelba, Maialba, Sheha, Zighib, Serejeka, Shieb-seleba, Hamelmalo, Habero, Dengolo, Shieb-Ghedged, Shieb-Mensheb, Emberemi, Foro, Enghel, Recumbadin and Bada).
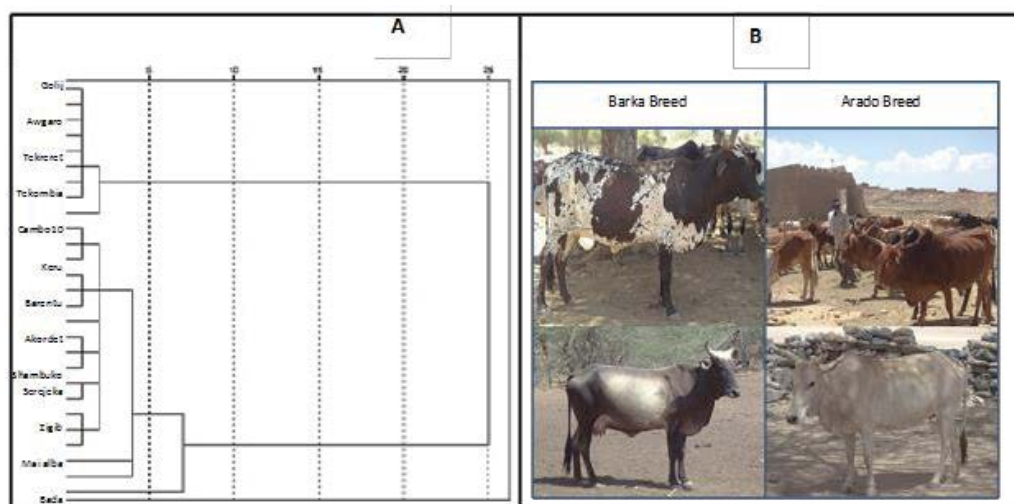
Figure 1. (A) Dendogram using single linkage in classification of cattle populations and (B) Baraka and Arado breeds

There was a high variation within and between clusters amongst the animals implying that there is sufficient genetic diversity that can be utilized in breed improvement. For instance, the mean milk production ranged between 1.98±0.22 to 3.48±0.27 ltrs for the Barka and Arado clusters, respectively. Similarly, lactation length varied between 4.23±0.54cm and 5.64±0.16cm between the two clusters. Here was noticiable variation s in the body length, chest girth, wither height, and dewlap width of indigenous cattle in different agro-ecological zones in Eritrea (Table 1).

Table 1. Morphometry measurements of cattle populations in different agro-ecological zones in Eritrea

Agro-Ecological zone	Body length (cm)	Chest girth (cm)	Wither height (cm)	Dewlap width (cm)
Highland	112.2±2.1	131.7±1.0	110.7±0.8	11.4±1.1
Western lowland	126.8±0.7	156.4±0.7	125.3±0.6	18.7±0.6
Eastern coast	111.3±2.2	137.6±0.8	108.1±0.8	14.3±0.4

The western lowland breed types are superior in all the parameters considered in this study. Based on the finding of this research a breeding programme would exploit on within and/ or between breed type variation for genetic improvement of cattle in Eritrea. Based on the results obtained in this research there is still high genetic diversity in Eritrean indigenous cattle populations. However, phenotypic characterisation alone is not sufficient for breeding purposes, molecular characterisation has to be done to support the phentypic data. Work is still underway to characterise the cattle using molecular techniques.

Conclusion

Eritrea indigenous cattle can be classified into Barka and Arado breeds types. However, there is a notable sub-population from the Shambuko (Barka sub-population) area. In the Arado breed type there were two distinct sub-populations from Chequaro and Foro regions. The former is found near the border of Eritrea and Ethiopia. Based on the descriptor characters it is evident that diversity exists within and between breed types and can be utilized in selecting individuals with higher potential for traits of interest.

Acknowledgments

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