Genetic characterization of indigenous cattle breeds in Zambia – which way forward?

Introduction
Zambia is endowed with a variety of indigenous livestock species that not only provide meat, milk and eggs to meet household protein needs, but are also used for a wide range of economic activities. In recent years, however, the country has been losing many of these indigenous livestock breeds as a result of farmers’ preference for exotic breeds that are perceived to be more productive. Farmers in rural areas believe that they will make more money through livestock rearing by simply shifting from low-producing indigenous breeds to exotic ones. This however, has not worked very well for most small scale farmers as most exotic breeds fail to thrive in their new environments. Thus, for small scale farmers, keeping of indigenous livestock may be advantageous over the exotic ones in that they are adapted to local conditions and will give some level of production even under adverse conditions such as limited supply of feed and water, prevalence of pests and parasites and disease outbreaks. Keeping of indigenous breeds also assists in maintaining local biodiversity and conservation of indigenous farm animal genetic resources. To improve productivity of indigenous breeds, farmers have been crossing them with exotic breeds from the western world. This has had mixed results as it has either resulted in replacement of local breeds by exotic ones or the upgrading efforts did not work due to farmers’ inability to meet management requirements for crossbred offspring and/or their exotic parents. Additionally, in most cases, crossbreeding between exotic and indigenous breeds has been rather random because there have never been any attempts to try and improve the productivity of local breeds through for example, selective breeding. Thus, the low productivity and continued loss of local breed biodiversity calls for genetic improvement and conservation of indigenous farm animal genetic resources. In response to this call, the International Atomic Energy Agency (IAEA) has been supporting a research project aimed at improving production of meat and milk in Palabana and Njolwe dairy tenant schemes through increased utilization of locally available resources including indigenous livestock breeds and locally adapted feed crops.

Review of past animal breeding activities in Zambia
The project started with a desk review of past animal breeding activities in Zambia to consider options for the future. Results from the review showed that most of the indigenous livestock species in the country including cattle, goats, sheep, pigs and a wide range of poultry species are yet to be classified into breeds. They are instead classified according to geographical locations and named according to areas in which they are found. For example, cattle are classified into three major groups based on geographical locations and physical appearances i.e. Tonga, Barotse and Angoni of Southern, Western and Eastern Provinces, respectively. There is still debate on the fourth, the Baila of the Kafue flood plains in Southern province whether it is a separate breed or just a cross between the neighbouring Tonga and Barotse breeds. Other cattle types from other parts of the country are yet to be classified. Most of the earlier work on animal breeding in Zambia, concentrated on phenotypic and performance characterization of cattle breeds for comparison with exotic breeds introduced in the country. Research efforts at the time were aimed at improving productivity of indigenous cattle through crossbreeding with high performing exotic breeds. However, this did not work very well because there was no provision for continuous supply and management of the exotic breeds and their crosses. Only limited research was conducted on the breeding and performance of
other livestock species. This review highlights the need for genetic characterization of indigenous farm animal species to establish their genetic relatedness and possibly to facilitate selected breeding among indigenous breeds. Genetic characterization would also enable registration of local breeds with the Herd Book Society of Zambia and also be instrumental for identifying breeds or strains that may be in danger of extinction to warrant development of remedial measures.

**Phenotypic characterization of indigenous cattle**

Based on the results of the survey, the next stage was to carry out phenotypic characterization of indigenous farm animals found in different parts of the country. Due to limited resources, it was decided to start with indigenous cattle breeds as cattle are the most important of the livestock species in the country. Additionally, instead of covering the whole country to look at the entire cattle population, the team decided to concentrate on areas where specific local breeds are known to exist. Since productive and reproductive performance parameters of indigenous cattle breeds were established in the early 1970s and late 1980s (Table 1), current efforts concentrated on evaluating phenotypic variability and utility characteristics of the breeds. The study also evaluated current and perceived threats to continued existence of specific cattle breeds. The breeds covered in the study included Barotse, Tonga and Angoni of Western, Southern and Eastern provinces, respectively. Within each breed, animals from selected districts were sampled to determine within-breed diversity. During characterization, blood from two to three animals from each kraal was sampled for DNA analysis and subsequent genotyping. The number of samples collected to date total about 300.

### Table 1: Productive and performance characteristics of indigenous cattle breeds

<table>
<thead>
<tr>
<th>Cattle Breed</th>
<th>Angoni</th>
<th>Tonga</th>
<th>Barotse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calving percentage (%)</td>
<td>82.5</td>
<td>74.4</td>
<td>78.1</td>
</tr>
<tr>
<td>Birth weight (kg)</td>
<td>22.9</td>
<td>25.7</td>
<td>19.8</td>
</tr>
<tr>
<td>Weaning weight (kg)</td>
<td>147.3</td>
<td>140.8</td>
<td>167.0</td>
</tr>
<tr>
<td>Calf mortality (%)</td>
<td>2.7</td>
<td>4.6</td>
<td>5.3</td>
</tr>
<tr>
<td>Weight at 18 months (kg)</td>
<td>207.7</td>
<td>200.0</td>
<td>235.0</td>
</tr>
<tr>
<td>Weight at 3 years (kg)</td>
<td>238.3</td>
<td>210.3</td>
<td>255.3</td>
</tr>
<tr>
<td>Dress weight (kg)</td>
<td>182.4</td>
<td>145.7</td>
<td>185.5</td>
</tr>
<tr>
<td>Milk yield/lactation (kg)</td>
<td>990</td>
<td>850</td>
<td>1160</td>
</tr>
</tbody>
</table>


**Phenotypic and utility characteristics of Barotse cattle**

The *Barotse* breed is a group of cattle found exclusively in Western Province and surrounding areas of the Kalahari and Namib Deserts in neighbouring Angola, Namibia and Botswana. In Zambia, the *Barotse* is kept by Lozi people living on the Zambezi flood plain. The main distinguishing features of *Barotse* cattle include the large but relatively slender body framework with long horns that spread and curve backwards (Figure 1).
Fig. 1. The *Barotse* cattle are characteristic of a large body frame with long horns that spread from the head and curve backwards (photo: Dr. J. Simbaya).

The breed is normally multi-coloured although commonly black with white or brown patches on the sides and under the belly. Despite the large body frame, it is rare to see a fat, well rounded *Barotse* animal, which may be attributed to the environment the animal lives in. The animals are either wading in flood waters during the rainy season when they are faced with water-borne disease challenges while in the dry season they are usually grazing on burnt plains and there are feed shortages. There are a number of differences among the eco-populations of the Barotse from various districts; the Shang’ombo breed seems to be relatively larger than the Kalabo and Lukulu types. This observation remains to be ascertained with actual physical body measurements. The Shang’ombo breed also seems to be more closely related with Angola breed that tends to be more robust and bulky (Figure 2). The animals in Sesheke and Kaoma Districts tend to be more related with the Tonga and Baila breeds found in neighbouring Districts of Southern province. However, there is need to verify this relatedness with genetic data through DNA analysis.

Fig. 2. The animals from across the border tend to be bigger and robust and ideal for crossbreeding to make draught animals (photo: Dr. J. Simbaya).

Barotse cattle are mostly kept for meat and milk production as demonstrated by trading in animals between cattle keepers and meat processing companies including ZAMBEEF. The sour milk made from Barotse animals (Muzilili) is known for its special taste and flavour. The breed is also used in arable farming as a source of draught power and manure which is usually distributed in cropping fields by shifting kraals every three to four days across an entire planting area (Figure 3). Because of
frequent shifting of kraals, housing of Barotse cattle is relatively simple to allow for ease of dismantling and construction of kraals within a short period of time (Figure 4). The nature of housing for Barotse cattle demonstrates how tame or docile the breed is for easy handling and management.

Fig. 3. Housing for Barotse cattle is relatively simple to allow for easy shifting of the kraal and spreading of manure for crop farming (photo: Dr. J. Simbaya).

Phenotypic and Utility characteristics of the Tonga Breed
The Tonga breed is found in Southern Province particularly on the Zambezi Plateau and valley areas surrounding Lake Kariba. The breed is made up of mixture of various eco-types found in different districts of the Province. Because of this variation, the Tonga is yet to be registered as a distinct breed with the Herd book Society of Zambia. Generally, Tonga cattle have a small body size framework with medium sized horns that tend to spread outwards from the head (Figure 4). The breed is multi-coloured ranging from pure black to white, although brown tend to dominate in most herds especially those found on the plateau areas of Sinazongwe and Maamba. The eco-types found in the valleys tend to be relatively larger than those found on plateau, which may be due to differences in the availability and quality of feeds. One particular distinct eco-type is the one found on the shores of Lake Kariba in Kalomo District locally referred as the Mazambezi that is considerably larger than the upland animal types.

The Tonga is mostly kept for meat although the Tonga people will rarely slaughter an animal for food or sale unless there is a funeral or wedding in the family. Because of its small body stature, the Tonga breed is not well adapted as a work animal although nearly all farmsteads have a set of working animals that are used for cultivation of crops and transportation of produce to and from markets. The breed is also used in cultural celebrations. Due to its adaptability to local environment, the breed is widely used in crossbreeding with exotic breeds to produce crossbred beef and milk animals.
Fig. 4. The Tonga has a small body framework with medium sized horns and is mostly use as a work animal (photo: Dr. J. Simbaya).

**Phenotypic characteristics of the Angoni Breed**

*Angoni* cattle are mostly found in Eastern Province and some parts neighbouring Isoka District in Northern Province. The breed is also found in surrounding areas of neighbouring countries including Malawi, Tanzania and Mozambique. Apart from a few commercial farmers keeping the breed in Lusaka and Copperbelt Provinces, the Angoni has been restricted to Eastern Province due to the ban that restricts movement of cattle across the Luangwa River. The Angoni is the only indigenous breed that has been registered with the Herd Book Society of Zambia as a distinct breed. The Angoni has a compact body framework that is generally larger than the Tonga but smaller than the Barotse. They vary considerably in colour ranging from black to roan-brown with a mixture of all colours in between (Figure 6). They have relatively short horns when compared with other cattle breeds. The eco-types found in various districts tend to vary considerably in appearance and size. There are close similarities in cattle from Petauke, Katete and Chadiza, while those in Lundazi and Chama tend to bigger. The cattle of Lundazi, Chama and Muyombe tend to be bigger and males have a characteristic hump that is often tilted on one side of the body (Figure 8). The large size of males and the large compact body frame work make them ideal for draught power. The females have characteristic large udders that make the breed ideal for crossing with exotic breeds for dairying. Historically, Chama as a district never had any cattle and all the animals currently found in the District are a recent acquisition from surrounding districts including Isoka, Lundazi and across the border in Malawi.
The Angoni breed is mostly kept for cultural activities during religious and traditional ceremonies such as the Ncwala ceremony. The animals are also a form of social status symbol for the local people. The breed is also used for arable farming mostly as a draught animal. Nearly all the males and in some instances even females are used as work animals. Rarely do people of Eastern Province use manure for crop improvement. The animals are also used for transportation of agricultural produce to markets and sick people to clinics and hospitals. The cattle are rarely slaughtered for meat or for sale to generate income. Locals only slaughter animals for sale or consumption when faced with a family problem such as a funeral, wedding or to raise money for school fees.

Survival threats for the different breeds

In terms of survival threats, the Barotse breed is currently threatened by the constant outbreak of Contagious Bovine Pleural Pneumonia (BBPP) that affects cattle of Western Province. However, the restricted movement of live animals from Western Province to the rest of the country, which is currently scheduled to remain in force up to 2014, is a welcome move that may assist with the conservation of the breed. The Tonga breed is no longer exclusively limited to the Southern Province as it has continued to migrate northwards as the Tonga people move in search of new farming areas. This has become a major threat for the breed as animals tend to interbreed with other cattle found in their new locations, the prevalence of East Coast Fever in the Province and the rampant commercialization of cattle farming by the Tonga people is also a threat for the breed as more and more people acquire high producing exotic bulls at the expense of local Tonga bulls that are deemed inferior. The crossbreeding threat is exacerbated by the breed being surrounded by large-scale commercial farmers who mostly own exotic breeds, which local people would like to cross with their local cows. However, efforts are currently underway to conserve the breed through on-station establishment of breeding herds such as the ones at Mazabuka Research Station and the National Institute for Scientific and Industrial Research (NISIR) in Chilanga. The Angoni is relatively stable in terms of natural threats to its existence. The only potential threat to the Angoni is the continued outbreaks of East Coast Fever although the disease is currently kept under check through dipping and vaccination of animals. In terms of breed contamination, the Angoni is protected by the government ban that restricts animal movement from either side crossing the Luangwa River.