

The multiplication of Africa's indigenous cattle breeds internationally: the story of the Tuli and Boran breeds

Ntombizakhe Mpfu (2002)

ZaBelo Livestock Consultancy, P.O. Box 911, Bulawayo, Zimbabwe

History of the breeds

The Tuli

The Tuli breed was developed from cattle indigenous to south-western Zimbabwe and eastern Botswana. In 1942, while working in the Lowveld area south of Gwanda, Zimbabwe, a land development officer, Mr Len Harvey, noticed that there appeared to be a distinct type of yellow Sanga cattle among the mixed native stock. These cattle seemed to be better adapted to local conditions and were superior to other stock. It was decided to purchase some of these cattle from the smallholder farmers and study them to determine if the type could be improved and whether or not they would breed true. In November 1945, 3000 acres were set aside in Guyu near Gwanda for the establishment of the Tuli Breeding Station. The founding herd had twenty cows and one bull. The idea was to breed bulls to assist in improving smallholder stock, but the commercial farmers also showed interest in the breed and started buying bulls from the station. A breed society was formed in 1961. Because of security problems associated with the liberation war, the Tuli herd was moved to Matopos Research Station in 1979. The selection programme is still in progress. The breed is now used in many commercial herds throughout Zimbabwe and there are seven stud breeders in the country. The improved Tuli has been distributed to several countries in Africa, especially in neighbouring Botswana and South Africa. It has also been used in forming a synthetic breed called the Okouma in Gabon and has been exported to Australia, Canada and the USA.

The Boran

The Boran is thought to have originated from south-west Asia. The breed was developed by the Borana people of southern Ethiopia. Within Ethiopia, the nomads from the south moved northwards and settled with their cattle in the areas west and south of Lake Tana where the cattle became known as Tanaland Boran. The Boran also spread to Somalia and is found on the Ethiopian-Somalia border; in these areas, it is called the Somalia Boran or Awai. The nomads of southern Ethiopia and Somalia migrated with their Boran cattle to Kenya. In Kenya, the Boran influence reached Masai territory. The breed also spread to south-eastern Ethiopia. In the 1920s, European ranchers in Kenya purchased Tanaland Boran cattle and through selection developed a breed called the Improved Boran or Kenya Boran. In 1947, the Boran was introduced into Zambia from Kenya, with additional importations in subsequent years. The breed also proved popular in Tanzania, Uganda and the DRC. Recently, the breed has been distributed to South Africa, Brazil, Mexico, the USA and Australia.

Characterisation of the Tuli and Boran in Africa

Early European settlers in Africa imported cattle from Europe, as they regarded breeds indigenous to the continent as inferior. However, the imported breeds did not tolerate local production conditions and survival rates were lower than those of indigenous breeds. This realisation led to the initiation of evaluation trials on indigenous breeds. Breed improvement programmes were set up for breeds that proved to be productive and characterisation work continued on all indigenous breeds. Breed societies were formed and they started various breed promotion exercises.

Hetzel (1988) summarised the findings of studies carried out in Zimbabwe (Tawonezvi et al. 1988a and 1988b, ; Tawonezvi and Ward 1989), Botswana (Trail et al. 1977; Light et al. 1982; Trail 1984), Uganda (Gregory et al. 1985), Kenya (Gregory et al. 1984; Trail 1984) and Zambia (Thorpe et al. 1979, 1980a and b, , Thorpe et al. 1981) in order to compare the Tuli and the Boran with other breeds. In high-input environments, the Tuli ranked high for fertility, post weaning growth and productivity per cow. When input levels were lower, Mashona, Angoni and Boran outperformed the Tuli in terms of cow productivity. The relative performance of breeds in low- and high-input environments is a measure of the extent of breed by environment interactions. The Mashona, followed by the Boran, was the most adaptable to environmental change. The Tuli performed poorly in the low-input environment. This breed was developed in the sweet-veld area in Matebeleland, Zimbabwe where beef cattle production conditions are good. The Boran, on the other hand, evolved in the semi-arid areas of southern Ethiopia and Somalia and, more recently, in the more favourable environments of the Laikipia ranching district in Kenya.

Value of the breeds in crossbreeding was also evaluated (Thorpe et al. 1980a and b; Thorpe et al. 1981; Tawonezvi et al. 1988a; Tawonezvi and Ward 1989; Moyo 1995). Crosses of the local breeds were compared with local breeds × exotic beef breeds, and with purebred indigenous and exotic breeds. The general findings were that crossing the Tuli or Boran with other indigenous breeds (e.g. Tswana, Barotse or Ankole) had little or no advantage; the crosses were generally no better than the best purebreds. However, the results of these comparative studies were used to pick up promising breeds for further evaluation in Australia and the USA; the breeds selected were the Boran and the Tuli.

Characterisation of the Tuli and Boran breeds internationally

Both Australia and the USA have tropical regions and are also major beef producing countries. The breed that is popular in the Australian and American tropical areas is the Brahman, which is a *Bos indicus* breed developed in the USA from Indian breeds. The breed is adapted to tropical conditions—it is tolerant to heat, ticks and tick-borne diseases and has been selected for high meat yields. Compared with British (*Bos taurus*) breeds, it has relatively low reproductive potential and meat quality characteristics, particularly tenderness. Various studies have shown that beef from *B. taurus* breeds finished under favourable conditions in feedlots or temperate pastures is generally more tender than beef from *B. indicus* breeds. However, even though European *B. taurus* breeds produce good quality meat, they are not adapted to tropical environments. Improvement in productivity of such breeds in tropical regions can be realised by increasing resistance to environmental stresses while maintaining or improving the levels of productive traits. However, improvements through selection are slow compared with the response that can be achieved through crossbreeding. With crossbreeding or synthetic breed formation, qualities of various breeds can be combined and advantage taken of heterosis.

The Tuli and Boran had shown good production characteristics under conditions found in eastern and southern Africa. Since they were developed in tropical environments, they were recognised as a unique genetic material that could be used for both tropical and subtropical cattle production in other tropical areas of the world, e.g. in tropical Australia and America. Production environments in tropical areas are diverse and harsh. Moreover, the different environments and markets require breeds of different mature sizes and maturity patterns. A decision was taken to import the Tuli and the Boran breeds in order to evaluate them for suitability to the diverse production environments and market outlets available to Australian and American farmers operating in tropical areas. The Tuli breed was introduced into Australia in 1990 when 269 embryos were imported from Zimbabwe and implanted into recipient cows in the Cocos Island in the Pacific Ocean. The Tuli calves born in isolation were transferred to the Australian continent. The Boran was similarly introduced from Zambia in 1990. Due to health restrictions, the USA could not import livestock, embryos or semen from Africa. The Tuli and Boran were, therefore, introduced into the USA from Australia in 1991. Experiments were set up to evaluate the African breeds for crossbreeding over a range of breeding, rearing and finishing environments, comparing them with various breeds of European and Indian origin.

Genetic classification

In the past, African breeds were classified as *B. indicus*. However, classification studies done by Frisch et al. (1997), using molecular techniques, showed that southern African sangas (which include the Tuli breed) were not *B. indicus* but *B. taurus*. Moreover, the Boran was subsequently classified as *B. taurindicus*, rather than *B. indicus*. The incorrect classification of the African breeds was likely to prejudice against their acceptance in production systems that favour a high *B. taurus* content. It could also have hindered their use in crossbreeding programmes aimed at maximising the benefits of heterosis while minimising the loss of tropical adaptation that occurs when European *B. taurus* breeds are used for crossbreeding.

Evaluation of the African breeds in Australia

In Australia, the breeds were evaluated for various production, reproduction and health traits on pasture. Calving rates of purebred Adaptaur and Belmont Red cows were compared with those of F₁s sired by Brahman, Boran or Tuli bulls. All F₁ crossbreds had higher calving rates than the straightbreds – compared with straightbred cows, fewer F₁ cows need to be maintained to produce the same number of calves. The F₁ Boran and F₁ Tuli crossbreds had higher calving rates than their F₁ Brahman counterparts. Survival to the age of 18 months was higher for crossbreds than for the straightbreds. The incidence of dystocia (difficulty giving birth) was higher in zebu (Brahman and Boran)-sired progeny (20%) than in Tuli-sired progeny (6%); figures for the Tuli breed were similar to those for straightbreds. The Tuli breed, therefore, offers a way of capturing the benefits of heterosis without increasing the incidence of dystocia. The relatively high incidence of dystocia among Boran sired progeny was, however, contrary to observations among Kenya Boran populations where much lower rates has been observed and the breed is renowned for its ability to deliver smaller calves which nevertheless have very fast preweaning growth rates (BCBS (Boran Cattle Breeders Society) 1987).

Higher calving and calf survival rates from crossbreds gave extra 10-25 calves for every 100 cows bred without added inputs. Cow productivity was calculated by combining calving rates, calf survival rates and growth rates of progeny. Crossbred cows were more productive than straightbred cows. Although Boran and Tuli crosses had progeny with lower mature live

weights than Brahman-sired cows, they were consistently more productive than the larger Brahman crosses. The animals were also evaluated for tolerance to environmental stresses such as tick challenge, heat and gastrointestinal nematodes. The ranking of the sire breeds for tick resistance was Brahman > Boran > Belmont Red, Adaptaur and Tuli > Charolais. For resistance to gastrointestinal nematode infestation the ranking was Brahman > Boran, Belmont BX > Belmont Red, Charolais, Adaptaur and Tuli.

Other evaluations included feedlot performance and carcass quality. Crossbreds were superior or equal to the corresponding straightbreds. Brahman- and Boran-sired progeny had similar levels of heterosis (both *B. taurus* × *B. indicus*). However, Brahman progeny had a higher mature size than Boran progeny. Tuli and Boran are of similar size, but there was more heterosis in Boran × Adaptaur crosses (*B. indicus* × *B. taurus*) than in Tuli × Adaptaur crosses (*B. taurus* × *B. taurus*). Larger breeds grow faster but when genotypes are compared at the same proportion of mature size, differences in efficiencies of feed conversion are small or non-existent. The decision whether to use big or small breeds has to be based on other factors. The important carcass characteristics for markets served by tropical Australia are fatness, lean yield and eating quality attributes such as tenderness. Three general conclusions were made. Firstly, for carcass traits, the Tuli and Boran carcasses were similar to those of Charolais and better than the Brahman. Therefore, the African breeds can be used in crossbreeding programmes without adversely affecting carcass characteristics. Meat from Brahman progeny is tougher, but can be improved by crossing with taurine breeds, i.e. British, continental or sanga *B. taurus* breeds. Therefore, the *B. indicus* content can be reduced while maintaining tropical adaptation by using the African *B. taurus* breeds as a partial substitute for the zebu breeds. Secondly, there was no evidence of heterosis for eating quality characteristics; thus, crosses will always produce meat that has an eating quality in-between those of parent breeds. By using crosses, farmers can benefit from increased productivity and still be assured of improved meat quality. Thirdly, the differences between breed types for carcass characteristics for animals raised on pasture and on feedlot were small. However, performance of the breeds differed depending on the muscle type studied and the harshness of the environment. As environmental conditions became harsher, the better-adapted breeds produced relatively better quality meat than the less well adapted breeds. For example, there was re-ranking on tenderness of meat; the eye round muscle from *B. taurus* was less tender than that for *B. indicus* when animals were raised on pasture, but more tender than that for *B. indicus* for animals on feedlot.

Evaluation of the African breeds in the USA

Experiments began in 1991, with imports of semen from Australia. The experimental locations are in temperate (e.g. Nebraska) and subtropical locations (Texas, Florida, Georgia, Louisiana and Oklahoma). The African breeds were compared with various other breeds. For example, in Texas, three stations bred (a) Angus cows to the Tuli, Brahman and Angus (b) Hereford and Angus cows to the Tuli, Boran and Brahman and (c) Brahman cows to the Tuli, Brahman and Angus (Hill 1993). In Georgia, the dam genotypes included Angus × Hereford and Brahman × British crossbreds while the sire breeds were Tuli, Hereford, Angus and Brahman. The Meat Animal Research Centre (MARC) in Nebraska has a germplasm evaluation programme that includes the Tuli and Boran breeds. Other sire breeds evaluated at that centre are the Hereford, Angus, Brahman, Belgian Blue and Piedmontese (Cundiff et al. 1998).

The African breeds have been characterised for various traits of economic importance. In Georgia, the Brahman, Tuli and Boran breeds were evaluated for live weight, warm carcass weight, rib-eye area, level of kidney, pelvic and heart fat, actual fat thickness, adjusted fat thickness, dressing percentage, marbling score, maturity score, quality grade, yield grade and rib-eye area per unit of body weight (Baker and Williams 1996). At the MARC, traits

measured included age at puberty, gestation length, birth weight, calving ease, scrotal circumference, calving rate, calf survival, weaning weight, cow productivity, slaughter weight, marbling score, eating quality and weight of retail product.

Tuli and Boran crosses were significantly younger at puberty and had higher reproductive rates at two years of age than the Brahman crosses. However, as the females became older, reproductive rates did not differ significantly by breed. The Tuli-sired steers were significantly lighter at slaughter than steers from the other breeds. This ranking was the same as that observed at weaning and reflects a slightly slower rate of gain during the feedlot phase of the study. Tuli-sired cattle had carcass and meat characteristics more similar to those of British breed-sired than to Brahman- or Boran-sired cattle. Tuli-sired steers, therefore, can provide an acceptable alternative to Brahman-sired steers for carcass merit. Information is still being collected on cow productivity of F₁ cows sired by Tuli, Boran and Brahman sires.

Popularity of the African breeds internationally

The Tuli breed

In Zimbabwe, where the Tuli breed was developed, the popularity of the Tuli and other indigenous breeds in the commercial sector, as measured by the number of breeding females, is low. This is despite the results of research done at Matopos Research Station, which showed that indigenous breeds are productive and are suitable for the local production conditions. One of the major reasons given for the low popularity of the breed is that the meat grading system has, for a long time, favoured the long carcasses of exotic breeds. There are only seven Tuli stud breeders in Zimbabwe. In 1992, the estimated total number of Tuli cattle in the national commercial herd was 10 thousand (FAO *DAD-IS*, 2000). The number of Tuli cows in the smallholder sector is not known. A FAO-sponsored breed survey to be carried out late in 2000 is expected to determine the distribution of the Tuli and other breeds in all livestock producing sectors of Zimbabwe.

In the southern African region, the Tuli is found mainly in South Africa with smaller sized populations in Botswana and Namibia. The distribution and number of Tuli cattle found in Botswana is not known. However, the Botswanan Government owned a Tuli breeding cowherd of 60 animals in 1996 and 57 animals in 2000 that was used in breed evaluation studies. The South African Tuli Breed Society has 36 herds (one is a Namibian herd) with about 1883 females that are over two years old. About 43% of the society member herds participated in a national beef testing scheme in 1998, thus allowing evaluation of the breed using field records. In collaborating herds, both production and adaptive traits are measured. Performance testing is encouraged by the society and the society is planning on making it compulsory for its members. The South African Tuli population is closely linked to the one in Zimbabwe, as the cattle were imported from there and exchange of cattle is still continuing. The two breed societies in Zimbabwe and South Africa, therefore, work closely together and have started joint genetic evaluations of the Tuli populations.

As evaluation of the breed continues in Australia and the USA, Tuli cattle have been distributed in the farming community. Breed associations have been formed in Australia (the Tuli Association of Australia, based in tropical Queensland) and in the USA (the North American Tuli Association, based in Texas, but including farmers in the USA and Canada).

The Boran breed

The Boran breed is found in Ethiopia where it is called the Borana. Purebred herds are found at research sites – e.g. where a breed improvement programme has been run for the breed. In Kenya, the commercial sector developed the Improved Boran. Most of the Boran cattle distributed worldwide are Kenyan Borans with breed promotions being carried out mainly by the Kenya Boran Breed Society. The Boran has also become a popular breed in Zambia. The Boran Breed Society in Zambia has the largest number of registered cattle. The distribution and number of cattle in other African countries is not known.

The Boran Association of Australia is based in Queensland; the first batch of Australian Borans was imported from Zambia. The Boran is also found in significant numbers in South America. However, its popularity in North America has not grown as fast as that of the Tuli, possibly because of its similarity to the Brahman breed. Since the Brahman performs better than the Boran for many traits, farmers in North America have tended to use the Brahman instead.

Conclusions

The Tuli-Boran story provides three major lessons. First, it shows the importance of characterisation of breeds. The international community is benefiting from characterisation work, which started in Africa and showed that indigenous cattle breeds are more productive than other breeds under certain production conditions. More characterisation studies (both on-farm and on-station) are being carried out in the importing countries—Australia and the USA. On their website, the Tuli Breed Association in South Africa notes that there is more research being done on the Tuli breed in the USA than in the whole of southern Africa, with over 20 people so far having done a research degree in the USA using Tuli data. Molecular genetics studies have been used to correctly classify the breeds, thus allowing their targeted use in beef production. Secondly, it gives two examples of successful breed improvement programmes for indigenous breeds. The breed improvement work carried out in Zimbabwe, at the Tuli Breeding Station and later at the Matopos Research Station, produced the Tuli that has been distributed internationally. Similarly, the work done in Kenya produced the Improved Boran. The importing countries have advanced testing schemes which collect information that can be used in selection and hence genetic improvement of the breeds. This gives breeders in the importing countries a competitive advantage over farmers in the exporting countries, e.g. Ethiopia, Kenya or Zimbabwe. The third issue that emerges from the Tuli-Boran story is that of rights to benefits for the communities or countries that initially developed the breeds. With the breeds now distributed widely in many countries, purchases of Tuli cattle, for example, need not be made only from Zimbabwe. This issue is a problem not for African breeds only—an alternative example being the European breeds (e.g. the Holstein, Hereford and Charolais), which are now distributed all over the world with most of the genetic material for these breeds no longer being sourced entirely from Europe. The Tuli-Boran story also presents situations for joint breed improvement and promotion programmes across countries. For example, in North America there is one Tuli breed society covering Canada and the USA, whilst Tuli breeders in Zimbabwe and South Africa, and Namibia and South Africa work closely together. The high level of exchange of Tuli animals between Zimbabwe, South Africa, Botswana and Namibia makes it possible for joint evaluation programmes to be beneficial. Similar joint programmes can be investigated for the Kenyan, Ethiopian and Zambian Boran cattle populations.

Knowledge gaps

Research on these breeds is still going on both inside and outside of Africa. Most of the studies going on outside of Africa have been evaluations of the breeds for crossbreeding. For a crossbreeding project to be sustainable there has to be a supply of purebred animals. Selection within breed is possible given that stud herds now exist in the importing populations. However, the following questions still need to be addressed:

- What traits should the stud breeders aim to improve?
- How are the traits related to each other and can selecting for improvement in some traits result in the breeds losing their adaptive and other special characteristics?
- What genes control these special characteristics and what is the nature of their inheritance?

Discussion questions

- The Tuli cattle found in Australia and the USA were founded on 269 embryos imported from Zimbabwe in 1990.
 - Should there be concern about inbreeding?
 - Southern Africa has a large genetic pool of Tuli cattle both in the commercial and smallholder sectors. Should Africa supply her competitors with genetic material when they start having problems with inbreeding – at what price and with what conditions? Exports from southern Africa are still going on, mainly to Canada, South America and the USA.
- Does the Tuli-Boran story lend itself to property rights issues?
- What other African livestock breeds have been distributed and evaluated internationally?

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Related websites

1. <http://leaky.rock.tap.csiro.au/breeds/tuli/tuli.html>
2. <http://leaky.rock.tap.csiro.au/breeds/boran/boran.html>
3. <http://leaky.rock.tap.csiro.au/facts/crossbr-boran.html>
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