

# Genetic improvement of indigenous cattle breeds in Zimbabwe: A case study of the Mashona Group Breeding Scheme

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## Background

The Mashona cattle breed is widely distributed in East and Central Zimbabwe and is the most numerous breed of cattle. The territory of the cattle extends westwards to 29°30' E (area covering Gokwe, Lupane and Tjolutjo), and eastwards as far as the border of Mozambique and over into Tete (Mason and Maule 1960). They occur in various areas of Matebeleland particularly the Matopo Hills. They are similar to other neck-humped cattle like the Tonga and Barotse, and the chest-humped types like the Angoni and the Nyasa Zebu that are found through out Southern Africa (Mason and Maule 1960). They are typically Sanga that originated from the crossbreeding of zebu and taurine cattle (Meyer, 1984; Frisch, et al. 1997). More recent evidence show that the Mashona and its Sanga relatives are closely related to other Sanga cattle like Nkone, Tuli and Nguni, which have African taurine blood in them (Rege and Tawah 1999a; 1999b; Hanotte and Rege 2000).

They are small cattle with cows weighing 275 to 350 kg. Black is the commonest colour followed by red. Other colours are brown with a yellow muzzle, brownish black with a lighter back stripe, dun, yellow cream, black and white, and red and white. The tail is long and touches the ground (Plate 1). The majority of Mashona are horned, but natural polled individuals are also common. Most commercial and research station herds are dehorned.



**Plate 1.** Mashona cows.

Commercial and research station herds numbering 3860 animals form the majority of recorded Mashona cattle, but there is no reliable estimate of the numbers in the smallholder farming sector. Nevertheless, the population of Mashona cattle in the smallholder farming sector has been estimated at 22 thousand adult animals by the Mashona Cattle Society (Indibreed 1996) and at half a million by Moyo et al. (1994).

The value of the Mashona breed as a suitable maternal line for crossbreeding programmes in commercial beef production and as adapted fertile breeds suitable for use in smallholder farms, is well established (Tawonezvi 1984; Moyo 1990; Tawonezvi 1993). Under smallholder management systems the Mashona is the breed of choice because of its ability to remain productive (draft power, manure, milk and meat) under adverse environmental and low management regimes. However the population of pure-bred Mashona cattle is dwindling. Smallholder farmers owning the majority of unrecorded Mashona cattle are not always eager to sell excess livestock, since they perform several functions (like economic security, draft, manure and ceremonial roles) other than the provision of beef. This trend has led national herd rebuilding programmes (e.g. Heifer Project International, cow-calf loan schemes, cow finance loan schemes and government herd rebuilding programmes to purchase large parcels of unadapted exotic-crossbred cull stock from commercial farms to use for restocking smallholder farms. Impacts of these brought-in exotic animals on the indigenous gene pool of cattle in smallholder farms are unknown, but needs urgent quantification.

The carcass grading system in current use in Zimbabwe is biased against the small-framed Mashona cattle and other small-framed indigenous breeds. This is because the grading system uses the fleshing index (ratio of carcass weight to length), a measure which increases with size of animals and tends to discriminate against small-framed breeds (Tawonezvi and Khombe 1995). Mashona cattle in Zimbabwe are therefore threatened by the insatiable quest to improve on their conformation and size by crossbreeding with the larger exotic breeds (Khombe et al. 1994). The Mashona Cattle Society and research stations have initiated selection programmes to increase the size of the Mashona in an attempt to avoid the substitution of the breed by faster growing cross-bred cattle.

## **Mashona herds in the smallholder-farming sector**

The Mashona comprises the majority of genotypes in the estimated 3.5 million indigenous herds in the smallholder-farming sector (Holness 1992). Almost all cattle in this sector are not performance-recorded because of the many functions that they perform (draft, manure, social security, rituals, milk and meat). This breed has not been selected for growth and fertility, which are the selection criteria of breeding programmes being pursued by commercial beef producers. The socio-economic functions that indigenous livestock perform provide a big incentive for the rearing of these animals. Normally, exotic breeds and their obvious crosses are not preferred as substitutes. Although this national pool of indigenous cattle (of smallholder cattle) has been diluted and contaminated by introduction of exotic genotypes, there still remain many areas where relatively pure herds of these cattle can still be found. Conservation strategies need to be put in place urgently to protect this genetic pool from further contamination by indiscriminate crossbreeding.

## **The Mashona Group Breeding Scheme**

### ***Purpose***

The establishment of this breeding scheme was motivated by the following factors:

- Commercial breeders recognised that they were making very little progress in selecting for growth and fertility using within-herd selection since their individual herds were very small (200–700 cows/herd). The limited exchange of unrelated breeding stock across breeding herds (especially large groups of cows) is suspected to have resulted in high rates

of inbreeding within commercial herds. Low fertility and high pre-weaning mortalities recorded in some of these herds, in a breed renowned for high fertility and survival, were attributed to inbreeding depression. However, the extent of inbreeding has not been quantified.

- The need to establish a nucleus herd from which improvement of growth, food conversion efficiency and fertility could be attained through within-herd selection from a larger base population and use performance records.
- The need to establish a facility that could be used for screening Mashona cattle from smallholder farms and other sources.

### ***Business arrangement***

The Mashona Group Breeding Scheme is a joint venture between nine permanent members of the Mashona Cattle Society and a private investor (registered as Apex Holdings Pvt Ltd). Its main business is to produce bulls for use by the co-operating breeders and make a profit by selling excess bulls and cows to both commercial and smallholder farmers. Recently, the co-operative has engaged in the export of live animals, embryos and semen.

The nine co-operating breeders secured a property, later called *Nyombi Farm*, in Chartsworthy/Mvuma under Agro-ecological Region IV, which is characterised by 'miombo woodland', infertile granitic sands and a low annual precipitation of 600mm. The co-operators contributed a total of 300 cows with high performance indices (as determined by the *Beef Performance Testing Scheme*<sup>1</sup> (BPTS)). They also loaned the scheme their best bulls for one mating season. To date the breeding scheme manages a 400 cow + heifer herd that is mated to 12 to 15 bulls in single sire randomised herds. This nucleus herd is targeted to stabilise at 400 cows and 25 bulls.

### ***Management system***

The animals are managed using the same management system that is practiced by the participating commercial farmers. Animals grazed free range during the wet season (November to May), at this time they are offered phosphorus supplements. During the dry season (June to October), they are offered protein and energy supplements. All the animals are neither penned nor herded, but are run in paddocks where they are offered an *ad-libitum* supply of clean drinking water. Strategic supplementary feeding is applied. Pregnant cows and cows that are nursing calves are given high priority while dry cows and old animals are given low priority. All animals are dipped to control ticks (weekly during the wet-season and fortnightly during the dry season). They are vaccinated annually against quarter black quarter, contagious abortion and anthrax. They are also dosed against both roundworms and flatworms, including liver flukes, at the beginning and end of the wet-season.

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<sup>1</sup>. The BPTS utilises a contemporary comparison type method to determine the breeding values of cattle within a herd, after adjusting for the fixed effects of sex and age of cow (Machaya and Tawonezvi 1992). The 205-day index is used as a measure of calf growth up to weaning and is used for dam selection, while 550-day weight is the selection criterion for replacement stock.

### ***Selection process***

The Group Breeding Scheme utilised a three-tier selection index (Indibreed 1996). Bulls are selected on an index that utilises 30% of their 205-day BPTS index; 30% of summer gain index and 40% of winter feed gain (feedlot testing) and on-range performance tests. The top 5% of the bulls are retained for use within the nucleus and member herds. Surplus bulls are sold to other breeders and butchers. Heifers are selected on an index that utilises 40% of their 205-day BPTS index and 30% of summer gain index and 30% of maternal productivity index (ratio of calf weaning weight on cow post-weaning weight). The top 20% of the heifers is retained, but the rest are sold to commercial and smallholder farmers.

### **Shortfalls of the scheme**

- The scheme relies on the BPTS to identify bulls and cows of high genetic merit. This method of selection has serious shortcomings that have been highlighted by Machaya and Tawonezvi (1992) and Khombe and Tawonezvi (1995). First, the method does not correct for individual birth-weight when calculating the weaning weight index. Secondly, it utilises correction factors for fixed effects that are derived from the United States Department of Agriculture. Thirdly, it does not account for the existing relationships among the animals that are being evaluated.
- The lack of performance recording among animals in the smallholder farming sector, limits the accuracy with which high performing animals can be identified from this genetic pool. Moreover, it is risky to utilise animals identified from this genetic pool in registered herds since their genotypes and pedigrees are unknown. The challenge facing animal breeders in Zimbabwe is to develop methods through which animals of high genetic merit can be identified from the smallholder gene pool without compromising the genetic gains that have already been attained in the commercial herds (Khombe et al. 1994).
- The selection environment and management system/regime for the nucleus herd. Require appropriate definition. Mashona cattle are adapted to produce under conditions of low levels of nutrition, high loads of both internal and external parasites and low water availability. It is not known how this adaptability changes when the animals are reared under high levels of management, as is the practice in the group-breeding scheme in Nyombi Farm. It can, however, be argued that Mashona cattle should be selected under the stressful environments from which they evolved.

### ***The way ahead***

It is important that an advanced recording and genetic evaluation scheme is established for the Mashona breed in general and the Group Breeding Scheme in particular. The methods of selection need to be revised in light of the new animal-model based evaluation methods that are now the methods of choice. The infrastructure of sire evaluation that currently exists in Zimbabwe can be modified easily to use Mixed Model Equations and provide Best Linear Unbiased Prediction (BLUP) breeding values.

A strategy needs to be developed to facilitate the transfer of improved genes back to the smallholder farming sector. The availability of faster growing Mashona cattle will reduce the uncontrolled crossbreeding of indigenous cattle with exotic cattle in the smallholder farming sector.

## **Knowledge gaps**

While the three known breeds of indigenous cattle in Zimbabwe (namely the Mashona, Tuli and Nkone) have received regional and international acclaim, there is paucity of information about these indigenous breeds and this limits their full exploitation in commercial agricultural systems. The gaps in knowledge include the following:

- Only three breeds have been identified from the multitude of livestock genotypes that comprise the indigenous gene pool in the smallholder farming areas. Despite the lack of information on the genotypes that comprise the smallholder cattle population and their potential uses in the current production systems, there is proliferation of uncontrolled crossbreeding with imported exotic breeds. There is an urgent need to characterise the genotypes of cattle that play an important function in the livelihoods of smallholder farmers in Zimbabwe before they are 'lost'.
- The few known breeds have a large variation that indicates scope for future breed improvement. To date, information that has been accumulated about these breeds is inadequate to allow their full exploitation.
- The genetic pool of indigenous cattle that is currently utilised in commercial livestock production is very small and is derived from a small base population. The future development of breeding programmes to improve the utilisation of indigenous genotypes in commercial agriculture will rely on the infusion of new genotypes from smallholder agriculture. However to-date no meaningful and sustainable system has been developed to facilitate the identification of productive (growth and fertility) genotypes from the large unrecorded gene-pool of indigenous cattle in the smallholder farming areas. There is an urgent need to develop an appropriate performance-recording scheme for indigenous cattle in smallholder farms.
- There is currently on-going controversy on the environment and management system in which to rear nucleus herds of indigenous livestock. There is concern that rearing and selecting these animals under high management regimes (winter supplementary feeding, appropriate stocking rates, regular control of parasites and diseases) may lead to loss of the genes for hardiness, survival and fertility. There is need to establish the genetic correlation between growth and these fitness traits. Moreover, the existence/or absence of genotype-environment interaction that is possible between nucleus and research station environments with the production environments of both smallholder and commercial farms require quantification.
- The Beef Performance Testing Scheme (BTS) has been in use for more than 25 years, but its impacts on the traits of interest (growth and fertility) have not been established. The effectiveness of this method of selection needs to be established and its impacts on the beef herd in Zimbabwe needs to be quantified.

## **Study questions**

- The Mashona Group Breeding Scheme selects breeding animals under high management regimes (both feeding and veterinary care) while their offspring are expected to perform under low management regimes and stressful environments. What possible problems could result from such selection and what improvements can be made (to the selection method)?

- The selection criteria for the Mashona Group Breeding Scheme places emphasis on growth, food conversion efficiency and fertility. Should indigenous animals be selected only on these three traits? What other traits could be included and how are their inclusion likely to affect progress in the improvement of growth, food conversion efficiency and fertility?
- The largest population of indigenous cattle is in smallholder farms. The utilisation of this genetic pool in commercial agriculture has been frustrated by the lack of a performance recording scheme. Why has it been difficult to establish a performance recording scheme for cattle in the smallholder farming sector? If performance recording of smallholder cattle were made possible, how would such animals be utilised by breed improvement programmes such as the Mashona Group Breeding Scheme?
- The existence of purebred indigenous cattle in smallholder farming areas is threatened by the increase in uncontrolled crossbreeding with the faster growing and 'popular' exotic genotypes. Why is crossbreeding a popular practice among smallholder and commercial farmers? Why is it important to maintain pure-breeding herds of indigenous breeds in smallholder farming areas? What could be done to control or avoid uncontrolled crossbreeding?

## References

- Frisch J.E., D. Drinkwater B. Harrison and S. Johnson. 1997. Classification of the southern African Sanga and East African Shorthorned Zebu. *Animal Genetics* 28:77–83.
- Hanotte O. and Rege J.E.O. 2000. Origins, history and relationships of indigenous African cattle. In: *Proceedings of the third all Africa conference on animal agriculture, Alexandria, Egypt, 2–9 November 2000*. Egypt Society of Animal Production, Cairo, Egypt (in press).
- Holness D.H. 1992. *Mashona cattle of Zimbabwe*. The Mashona Cattle Society, Harare, Zimbabwe. 61 pp.
- Indibreed (Pvt) Ltd. 1996. Description of the Mashona Group Breeding Scheme. Five page manuscript written and presented by Dr. R.D. Smith at a seminar entitled '*practical applications of group breeding concepts to Indigenous cattle*', held on 30th November 1996 at Matopos Research Station, Zimbabwe. Mashona Cattle Society, Harare, Zimbabwe.
- Khombe C.T. and Tawonezvi H.P.R. 1995. Beef performance recording in Zimbabwe: The way forward. In: Dzama K, Ngwerume F.N. and Bhebhe E. (EDS), *Proceedings of the international symposium on livestock production through animal breeding and genetics* held at the University of Zimbabwe, Harare, Zimbabwe, 10–11 May 1995. University of Zimbabwe, Harare, Zimbabwe. pp. 135–138.
- Khombe C.T., Hayes, J.F., Tawonezvi H.P.R, and Mabel Khombe. 1994. Estimation of genetic differences between Mashona bulls from different production systems using an animal model. *Journal of Agricultural Science* (Cambridge). 122:459–463
- Machaya A. C. and Tawonezvi H.P.R. 1992. Beef performance testing in Zimbabwe. *Zimbabwe Journal of Agricultural Research* 30:13–20.
- Mason F.L. and Maule J.P. 1960. *The indigenous livestock of eastern and southern Africa*. Technical Communication 14 of the Commonwealth Bureau of Animal Breeding and Genetics, Edinburgh, UK. 5 pp.
- Meyer E.H.H. 1984. Chromosomal and biochemical markers of cattle breeds in southern Africa. Meyer, E.H.H. (1984). Chromosomal and biochemical markers of cattle breeds in southern Africa. In: Barton R.A. and Smith W.C. (eds), *Proceedings of the 2nd world congress on sheep and beef Cattle Breeding* 2:328–339.

- Moyo S. 1990. Evaluation of the productivity of indigenous cattle and some exotic beef breeds and their crosses in Zimbabwe. ILCA Research Fellowship Report. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. 139 pp.
- Moyo S., Rege J.E.O. and Swanepoel F.J.C. 1994. Evaluation of indigenous, exotic and crossbred cattle for beef production in a semi-arid environment. In: Smith C., Gibson J.S., Benkel B., Chesnais J., Fairfull W., Gibson J.P., Kennedy B.W. and Burnside E.B. (eds), *Proceedings of the 5th world congress on genetics applied to livestock production*, (Guelph, Ontario, Canada) 20:344–347.
- Rege J.E.O. and Tawah C.L. 1999. The state of African cattle genetic resources. I. Sanga, zenga, recent derivatives, threatened and extinct breeds. *Animal Genetic Resources Information* (FAO) 26:1–25.
- Rege J.E.O. and Tawah C.L. 1999. The state of African cattle genetic resources. II. Geographic distribution, characteristics and uses of present day breeds and strains. *Animal Genetic Resources Information* (FAO) 26: 1–25.
- Tawonezvi H.P.R. 1984. Crossbreeding range beef cattle for weaner production in Zimbabwe. PhD Thesis, University of Zimbabwe, Harare, Zimbabwe. 116 pp.
- Tawonezvi H.P.R. 1993. Adaptability of beef cattle. *Journal of the Zimbabwe Society of Animal Production* 5:15–18.
- Tawonezvi H.P.R. and Khombe C.T. 1995. The potential of indigenous breeds to meet market needs. Paper presented at *the Meat Science Symposium. Zimbabwe Society of Animal Production* Harare, Zimbabwe, 5 October 1995. pp 97–100.

### **Additional reading materials**

- Buvanendran V. 1990. Adjustment factors for weaning weights of Mashona cattle in Zimbabwe. *Journal of Agricultural Science* (Cambridge) 114:35–40.
- Chavunduka D.M. 1976. The role of cattle in the traditional African society. In: Smith A.J. (ed), *Beef cattle production in developing countries*. Centre for Tropical Veterinary Medicine, University of Edinburgh, Edinburgh, UK. pp. 398–400.
- Hanotte O., Tawah C.L., Bradley D.C., Okomo M., Verjee Y., Ochieng J and Rege J.E.O. 2000. Geographic distribution and frequency of a taurine *Bos Taurus* and an indicine *Bos indicus* Y-specific allele amongst sub-Saharan African cattle breeds. *Molecular Ecology* 9: 387–396.
- Harvey K. 1987. The history and development of the three indigenous cattle breeds of Zimbabwe: *The indigenous cattle breeds of Zimbabwe* In: Grant J (ed), *Proceedings of a workshop, held at Matopos Research Station, 26–27 February 1987*. Research and Specialist Services, Harare, Zimbabwe. pp. 10–15.
- Jackson J.C. 1989. Exploring livestock incomes in Zimbabwe's communal lands. people, lands and livestock. In: Cousins B (ed), *Proceedings of a workshop on the socio-economic dimensions of livestock production in communal lands of Zimbabwe*. Center for Applied Social Sciences, University of Zimbabwe, Harare, Zimbabwe.
- Khombe C.T. 1995. The conservation and selection of indigenous beef breeds in Zimbabwe. In: Dzama K., Ngwerume F.N. and Bhebhe E. (eds), *Proceedings of the international symposium on livestock production through animal breeding and genetics held at Harare, Zimbabwe, 10–11 May 1995*. University of Zimbabwe, Harare, Zimbabwe. pp. 45–49.
- Khombe C.T., Hayes J.F., Cue R.I. and Wade K.M. 1995. Estimation of direct additive and maternal additive genetic effects for weaning weight in Mashona cattle of Zimbabwe using an individual animal model. *Animal Science* 60:41–48.

- Moyo S. 1996. *The productivity of indigenous and exotic beef breeds and their crosses at Matopos, Zimbabwe*. PhD thesis, University of Pretoria, South Africa. 161 pp.
- Tawonezvi H.P.R., Ward H.K., Trail J.C.M. and Light D. 1988. Evaluation of beef breeds for rangeland weaner production in Zimbabwe. *Animal Production* 47:361–367.