Farmer Preferences and Market Values of Cattle Breeds of West and Central Africa

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Abstract

World agriculture is based on a small number of animal species and a decreasing number of breeds within each species. Several breeds of West African shorthorn cattle (*Bos taurus brachyceros)* are now at high risk of extinction due to interbreeding. The West African shorthorn breeds are particularly important resources because of their superior abilities to resist diseases, particularly trypanosomiases, and be productive under high humidity, heat stress, water restriction and with poor quality feed. A study was undertaken in the derived savanna area of southwest Nigeria to determine the prospects for conservation through use and possible improvement of the Muturu, a West African shorthorn breed known to be in decline throughout southern Nigeria. An analysis of farmers' breeding practices and breed preferences confirmed a strong trend away from Muturu, and identified the traits farmers find least desirable about the Muturu relative to other breeds. An analysis of cattle market prices found small, but significant, price differences by breed. The best hopes for increased utilization likely in other areas of West Africa, such as southeast Nigeria, where the Muturu is better suited to the farming systems and there is a large market for this breed to provide incentives.

Key words: cattle breeds, market prices, genetic resources, conservation

INTRODUCTION

The world's animal agriculture is dependent upon less than 20 species of mammals and birds. Within this small number of species, however, there is a great pool of genetic diversity. As domesticated animal agriculture spread across the planet during the last 10,000 to 12, 000 years, sheep, goats, cattle, pigs, horses and donkeys were exposed to a wide range of environmental conditions. Many of the specialized and adapted strains that consequently develop0ed within each species have become extinct or are now in danger of extinction. Hall and Ruane (1993) suggest that 618 breeds of domestic animals have already become extinct. In Europe one third of the surviving 737 distinct breeds of livestock are in danger of extinction (Cunningham, 1992).

Increased concern about the potential long-term costs of genetic diversity loss has focused global attention on the need to conserve plant genetic resources. Animal genetic resources have, until now, received much less attention. Particular interest in the genetic basis of animal agriculture has resulted in an Action Programme for Sustainable Development of Animal Genetic Resources' led by the Food and Agriculture Organization. Important components of this Action Programme are: (i) a global inventory of animal genetic resources and a World Watch List of breeds at risk (e.g. Loftus and Scherf, 1993); (ii) strategies for breed conservation and breed improvement that avoid inappropriate breed replacement or dilution (Cunningham, 1992).

The subhumid and humid zones of West and Central Africa are home to several cattle populations at high risk of extinction. At very high risk are several breeds/strains of West African shorthorn taurine cattle (*Bos taurus brachyceros*) now found in pockets across the humid and sub-humid zones of West and Central Africa. In the centuries since the predecessors of these breeds were introduced into West and Central Africa, the *Bos taurus* breeds (both the West African shorthorn breeds and the longhorn N'Dama) have developed the ability to survive and be productive in areas of low to moderate trypanosomiasis risk without the aid of drugs. Such breeds are therefore known as trypanotolerant. The *Bos taurus* breeds are also reported to have superior levels of resistance to other diseases (streptothricosis, ticks and tick-borne diseases, helminthiasis) as well as abilities to be productive under high humidity, heat stress, water restriction and poor quality feed (Murray *et al.*, 1990; d'Ieteren, 1994; Rege *et al.*, 1994). These superior adaptive abilities make these breeds valuable for further livestock development in West and Central Africa and other harsh environments around the world. Loftus and Scherf (1993) report that five West Africa shorthorn breeds have already become extinct. Rege *et al*. (1994) indicate that the following breeds, with estimates of current population shown in brackets, are currently in the greatest danger of extinction: Bakweri (800-1,300 head), Bakosi (1,000 - 1,300), Kapsiki (3,000 - 5,000), Doayo (5,000 - 7,500) and Liberian Dwarf (5,000 - 12,000).

The main threat of extinction for these breeds is interbreeding, especially with the humped *Bos indicus* breeds that have moved into the sub-humid and humid regions of West and Central Africa during the last 30 years. High population pressure and periodic droughts in the arid and semi-arid areas have prompted the owners of zebu cattle to extend their seasonal transhumance and relocate their permanent settlements further south. Besides facilitating interbreeding, these movements have resulted in long-term changes in agro-ecological conditions that in turn have made the environment less hospitable for the tsetse

flies (*Glossina* spp.) that transmit trypanosomiasis.

Ultimately both the rate of interbreeding and the success of any conservation or improvement strategy depends upon the actions of the farmers who own and utilize those animals. *Ex ante* assessment of farmers' breeding strategies and breed preferences can assist breed conservation and improvement efforts in several ways. First, it can help to assess current stocks of different breeds held by farmers, the geographic distribution of those stocks, and the likely future trends in those stocks. Interbreeding is more likely among animals raised in close proximity and is almost ensured when different breeds are raised in the same herd. Second, farmers' knowledge about specific attributes of different breeds under village conditions can help to focus scientific research on particular traits and identify needs for extension and farmer education. Third, information about farmers' breeding practices and breed preferences can help to identify the likely market for existing or improved breeds. Fourth, it can help to determine the incentives that might be required by farmers for the conservation of threatened or endangered breeds.

Information from the market can help to complete the story begun by farmers. Market information that reveals buyer preferences for different breeds and attributes can be useful in the design of breed improvement schemes. Livestock owners who have specialized in the production and sale of animals will be particularly concerned with the way different breeds are regarded by the market. Even multipurpose milk and meat producers will be interested in the likely market value of animals that might be culled or sold to meet cash needs.

This paper describes a study of livestock owners' breeding practices and breed preferences undertaken in south-western Nigeria in 1993 and 1994. The primary objective was to improve understanding of farmers' breeding practices and breed preferences in order to help target private and public programs of breed conservation and improvement. A secondary objective was to evaluate participatory and quantitative techniques for assessing livestock owners' breed preferences and the signals sent to farmers by livestock markets.

2. RESEARCH DESIGN

2.1 The Study Area

Figure 1 illustrates the geographical distribution of cattle breeds in West and Central Africa as of the mid-1970s. The 7 million *Bos taurus* cattle, including the 4.8 million N'Dama and the 2.2 million West African shorthorns, were most numerous in the more humid southern region, the trypanosusceptible *Bos indicus* breeds were most numerous in the drier northern region, and most of the three million cross-breeds were found in the boundary area between the two regions (ILCA/FAO/UNEP, 1979). The present study focused on a boundary area for 3 reasons: interbreeding and genetic introgression is most likely in those areas; farmers in those areas are more likely to have the option of bringing different breeds into their herds; and farmers in those areas are more likely to have information about the advantages and disadvantages of different breeds. The particular boundary area chosen for this study is in the derived savanna ecozone - a transition zone between humid and subhumid zones - of Oyo State, southwest Nigeria, where most of the cattle in southern Nigeria are located. Cattle breeds commonly found in southern Nigeria are: Muturu -- a trypanotolerant *Bos taurus*; White Fulani -- a trypanosusceptible *Bos indicus*; Keteku -- a stabilized cross

between Muturu and White Fulani; and N'Dama -- a trypanotolerant *Bos taurus* introduced into southern Nigeria through breed improvement programs undertaken during the last 20 years.

As of 1959 there were about 65,000 cattle in southern Nigeria, most of which were Muturu and Keteku. Since that time the number of cattle in southern Nigeria has increased rapidly as large numbers of White Fulani cattle have been moved into the region by Fulbe pastoralists (Blench, 1994). The cattle population increased to 100,000 in 1974/75, to 140,000 in 1984 (ILCA, 1992) and to 234,000 in 1990 (RIM, 1992). At the same time the number of trypanotolerant animals in the region, particularly Muturu and Keteku, have decreased. The number of Muturu in all of Nigeria has decreased from about 200,000 in 1938 to between 60,000 - 115,000 at the present time (Hoste *et al.*, 1992; Akinwumi and Ikpi, 1985; RIM, 1992).

Between 1980 and 1983, 5,000 N'Dama were imported from the Gambia to Nigeria as breeding stock. These were multiplied and disseminated from five government ranches in southern Nigeria. The total number of N'Dama in the country increased from 14,800 in 1975 to 24,800 in 1984 (ILCA/FAO/UNEP, 1979; Hoste *et al.*, 1992). Although N'Dama are raised as multi-purpose animals in The Gambia, early adopters of the N'Dama in southern Nigeria raised them primarily for beef (Jabbar *et al.*, 1995).

2.2 Collection of Household and Matrix-rating Data

A survey of cattle-holding households in the derived savanna ecozone of Oyo state was conducted between January and June 1994. Oyo state is divided into four administrative zones for agricultural extension purposes - Ibadan, Oyo, Ogbomosho and Shaki. Of these, Ibadan falls primarily in the forest zone, has a small number of Muturu cattle, but very few cattle of any other breed. The study therefore focused on Oyo, Oghomosho and Shaki zones where a combination of breeds were known to be raised. Each zone is divided into a number of blocks each containing 50-80 villages and 5,000-10,000 households. Based on information provided by the Ministry of Agriculture, previous surveys and key informants, two blocks were purposively selected from each of the three zones to represent the different agroclimatic situations within the derived savanna ecozone of Oyo state.

In the 6 sample blocks there were 377 villages and 41,321 households of which 292 (less than 1%) were described as settled cattle farmers, i.e. farmers engaged in both livestock and crop production with a semi-permanent or permanent dwelling. All other households were principally crop farmers with some small ruminants but no cattle. Of the 292 households, 66 had cattle when they settled but for a variety of reasons had no cattle at the time of the survey. Individual interviews were conducted with the 226 households who held cattle at the time of the survey. Among them 210 belong to the Fulbe ethnic group who migrated from the north and 16 belong to the local Yoruba ethnic group. Data were collected on settlement, breed and sex composition of cattle herds, and sources of cattle currently in the herd. Respondents were also asked open-ended questions about the main advantages and disadvantages of 5 breeds with which they might be familiar - White Fulani, Keteku, Muturu, N'Dama and crosses of White Fulani and N'Dama.

Respondents were asked to rate the 5 breeds according to the criteria that had emerged as most important from previous studies (e.g. Mohammed, 1990; Jabbar *et al.*, 1995) and through key informant interviews with cattle farmers. The matrix rating, or repertory grid, method was used to generate a matrix of breed ratings for each respondent. The matrix rating method was originally developed by cognitive psychologists and has been applied to market research, urban geography, and agricultural technologies such as crop and tree varieties (e.g. Ashby *et al.*, 1989; Asfaw Negassa *et al.*, 1991). Variants of the matrix rating method have been used in pastoral systems for investigating people's understanding and perceptions of the importance of different animal diseases and feed sources (Waters- Bayer and Bayer, 1994).

In this case, a board was prepared with 5 breeds on the vertical axis, each breed identified with a photograph, and descriptions of 9 evaluation criteria on the horizontal axis. The criteria were: milk yield, disease resistance, size of animal, ease of handling, market value, marketability (ease of finding buyers), ability to graze diverse species of grasses, need for moving long distances for grazing, and overall desirability. An animal with higher grazing diversity would have less need for moving long distances for grazing. The meaning of each row, column and cell in the matrix was explained to each respondent during the household interview. Each breed could be rated between 1 (poorest or lowest) and 10 (best or highest) for each criterion, so the respondent was asked to consider the first criteria and put between one and 10 bean seeds in the cell corresponding to each breed. The respondent was then asked to consider the remaining 8 criteria in the same way.

Of the 226 interviews that were conducted with sedentary cattle farmers, 204 (90 percent) produced complete data regarding breeding practices and breed preferences. The 22 who produced incomplete data were all cattle owners who did not rear the cattle themselves but instead gave their animals to one or more Fulbe cattle keepers for caretaking. Those caretakers were included in the sample. Some of the 22 owners gave information on the number of animals they owned and nothing else, others provided partial information about their animals, others could not be reached during the survey because they were not full-time farmers or full-time residents in the villages where their animals were kept. None of the Yoruba cattle owners provided complete data.

2.3 Logit Analysis of Relation Between Breed Preferences and Breeding Practices

The data on breed preferences and breeding practices from the household survey were combined in an analysis of factors affecting the breeds of cattle that farmers actually kept at the time of the survey. The primary interest was to investigate factors affecting the holding of trypanotolerant cattle, including Keteku, N'Dama, and N'Dama x White Fulani crosses. Logit models were fitted to the data and the following hypotheses tested:

(i) Households involved in caretaking arrangements were more likely to keep trypanotolerant breeds. This hypothesis is supported by the results of an earlier survey of 56 peri-urban agropastoralists in Oyo State (Mohammed, 1990).

(ii) Households settled longer in their present location were more likely to keep trypanotolerant breeds. This hypothesis is supported by the results of an earlier survey of 66 sedentary Fulani cattle keepers in five southwest Nigeria states (Jabbar *et al.*,1995).

(iii)   Households reporting cattle keeping as their main occupation were less likely to keep trypanotolerant breed(s).

(iv)   Households that gave high ratings to the trypantolerant breeds were more likely to keep those breeds. Adesina and Zinnah (1993) found that the perceptions of West African farmers' of available technologies affect their adoption of those technologies.

2.4 Collection of Market Data

A rapid appraisal of cattle markets in southwest Nigeria was undertaken to characterize patterns of trade and breeds of animals transacted at each market. The Shaki market was chosen for indepth study since the greatest variety of breeds were exchanged there. The Shaki market is located in the northwest of Oyo state, about 10 kilometers from the border between Nigeria and the Republic of Benin. Data were collected for 2,688 cattle transactions conducted on 49 market days between November 1993 and June 1994. Data were collected more frequently when more animals were exchanged such as before festivals. All data were collected on Mondays, Wednesdays and Fridays. Five breeds of cattle were transacted during those 49 market days: Muturu, Keteku, N'Dama, White Fulani and Sokoto Gudali (another zebu breed).

The rapid appraisal indicated that relatively few trypanotolerant cattle were exchanged compared to the trypanosuceptible breeds. In order to ensure adequate samples of all breeds, data were collected for all transactions involving N'Dama, Keteku and Muturu and a random sample of transactions involving White Fulani and Sokoto Gudali. For each transaction, data were collected on price (Nigerian Naira per head) and various factors hypothesized to affect price: attributes of the animal (breed, type, sex, colour, size, condition score), attributes of the seller (occupation, ethnicity, sex, residential location, reason for sale, distance travelled, mode of transport) and attributes of the buyer (occupation, ethnicity, sex, location/destination, distance to travel, mode of transport, reason for buying). Since animals are not weighed at the Shaki market, data were collected on other measures of size that were observable to buyers and sellers. A Bovine Weighing Tape (manufactured by WASCO, Fort Atkinson, Wisconsin, USA) was used to measure height at the withers, length and girth circumference.[1]

2.5 Implicit Price Analysis

An implicit or hedonic price function was estimated to relate the price per animal to its various attributes and characteristics. The maintained hypothesis of implicit price analysis is that products have attributes that confer utility and that the values of those attributes contribute to the price of the product. The observed product price is therefore a composite of the implicit prices of the product's attributes (Rosen, 1974) . In this analysis the focus was on the importance of breed relative to other attributes likely to affect the price of cattle. The hypothesis that was tested was as follows: everything else equal, there were no differences in price per animal due solely to breed.

In a competitive market an implicit price will be a function of the product attributes alone, and not of individual consumer or supplier attributes (Ockowski, 1994). However, most studies have found that price is also related to attributes of the buyers and sellers, implying some non-competitiveness in the market (e.g. Andargachew and Brokken, 1993; Francis, 1990; Oczkowski, 1994; Rodriguez *et al*., 1995).

The general form of the implicit price function is given in equation (1):

$$P = F(Q,C) + e \qquad (1)$$

where P is the observed price of the product, **Q** is a set of qualitative (discrete) variables, **C** is a set of quantitative variables, and **e** is an error term. Interaction variables may also be incorporated. The partial derivative of the estimated function with respect to a quantitative variable is the implicit marginal value of the attribute. We tested for quadratic relationships between price and the continuous quantitative variables by including both the variables and their squares. Qualitative attributes are represented by dummy variables so the estimated parameters measure the impact of the presence or absence of the attribute. The SPSS Analysis of Covariance procedure was used to estimate the model. Bonferroni confidence intervals were used in the hypothesis tests in order to reduce the likelihood of false rejection of null hypotheses (Norusis, 1993).

3. RESULTS OF HOUSEHOLD SURVEY ANALYSIS

3.1 Farmers' Present and Past Breeding Practices

Among the 204 sample herds, 69% contained only White Fulani, 24% contained White Fulani and Keteku, 4% contained mixtures including White Fulani, Keteku and N'Dama, and 3% contained only Keteku. None of the herds contained Muturu. The 55 households that were caretakers of animals had been settled in their current location longer than other households (average of 40 years compared to 27 years) and were less likely to hold pure White Fulani herds (47% compared to 77%). Average herd size did not differ significantly between the groups by herd composition (p>0.05).

Table 1 shows how the breed composition of the farmers' cattle holdings changed over time. Overall there was a large shift away from the indigenous *Bos indicus* breeds, Muturu and Keteku, to White Fulani. In the past i.e. any time before the survey, 55% of the 204 households reared Muturu or Keteku, at the time of the survey 31% reared Keteku and none reared Muturu. While 44% of the households that had only White Fulani in the past had some Keteku at the time of the survey, 63% of the households that had only Muturu or Keteku in the past had only White Fulani at the time of the survey. Of the 113 farmers who gave reasons for giving up Muturu or Keteku, 75% mentioned poor market value, 66% mentioned low milk yield, 43% mentioned small size, and 27% mentioned wild temperament or difficulty in management or handling. Of the 43 farmers who gave reasons for adding trypanotolerant breeds to their herds, 51% mentioned disease resistance, 26% mentioned ability to graze a variety of grasses, 21% mentioned less need for travelling long distances for grazing, 14% mentioned better quality of milk, and 12% mentioned shorter calving interval.

Data on sources of cattle in the respondents' herds at the time of the survey are presented in Table 2. Those data suggest that caretaking arrangements and interbreeding are the main ways that farmer exercise discretion over the breeds of animals in their herds. Overall 80% of the cattle held by the respondents were inherited or born to animals that were inherited, 14% originated through caretaking arrangements, and just 5% were purchased. Inheritance was the most important source for all breeds of cattle; caretaking was a much more important source for Keteku than for White Fulani.

3.2 Farmers' breed preferences

The information about the reasons why farmers adopted or eliminated certain breeds from their herds, presented above, provided some insight into farmers' breed preferences. Additional information was obtained by asking farmers' opinions about the advantages and disadvantages of different breeds and their ratings of different breeds according to a set of pre-selected criteria. Here we report only the results from the matrix rating. The advantages and disadvantages listed by the respondents confirms both the list of criteria used in the matrix rating and the general results of the matrix rating.

Table 3 presents the results of the matrix rating. The most consistent and clear-cut results were for White Fulani. White Fulani were rated highest for milk yield, size, ease of handling, market value and marketability, and lowest for disease resistance, ability to graze a diversity of grasses, and need mobility for grazing. All of the average ratings for White Fulani are significantly different from those of other breeds ($p<0.01$). The ratings for Muturu and N'Dama were very similar to each other and almost the polar opposite to White Fulani; Muturu and N'Dama were rated low for every criteria for which White Fulani was rated high, and vice versa. Keteku and White Fulani x N'Dama crosses were generally rated somewhere between White Fulani and Muturu/N'Dama. With only one exception (need mobility for grazing), the average ratings for Keteku were higher than those for White Fulani x N'Dama crosses. In terms of overall desirability, White Fulani were rated highest, followed by Keteku, White Fulani x N'Dama crosses, Muturu and N'Dama.

3.3 Relationships Between Breed Preferences and Breeding Practices

Three logistic regression models were fitted to relate breeding practices -- represented by breed(s) of cattle in the farmers' herds -- to characteristics of the herd and the farmers' ratings of the breed(s). The results of the model in which the dependent variable was whether a household held any trypanotolerant breed at the time of the survey are shown in Table 4. The results indicate:

(i) households that were caretakers of others' animals were significantly more likely to keep trypanotolerant breeds;

(ii) households that had been resident in their present location for longer periods of time were significantly more likely to keep trypanotolerant breed(s);

(iii) the greater the rating given on the need for mobility of N'Dama, the less likely they were to keep trypanotolerant breed(s);

(iv) the greater the rating given on the need for mobility of the Keteku, the more likely they were to keep trypanotolerant breed(s);

(v) the greater the rating for ease of handling of the N'Dama, the more likely they were to keep trypanotolerant breed(s);

(vi) the greater the rating on the disease resistance of the N'Dama, the more likely they were to keep trypanotolerant breed(s); and

(vii) the greater the rating on the market value of the Keteku, the more likely they were to keep trypanotolerant breed(s) [2].

All of these results were consistent with the null hypothesis with the exception of result (iv).

4. RESULTS OF MARKET ANALYSIS

4.1 Marketing Patterns

Table 5 presents data on the origins of the cattle for the 2,688 cattle transactions that were monitored at the Shaki market. Forty-four percent of the monitored cattle came from the Republic of Benin and 18% came from Burkina Faso via Benin. Benin was a particularly important source of Muturu and Keteku: 85% of the Muturu and 75% of the Keteku originated from Benin. Burkina Faso was a particularly important source of White Fulani and Gudali: 35% of all White Fulani and 31% of all Gudali originated from Burkina Faso.

Data on the destination of cattle transacted at the Shaki market show that all of the cattle were destined for consumption, rearing or resale within southern Nigeria. Sixty-three percent of all cattle stayed within Oyo state. The second most important destination was the city of Enugu in southeast Nigeria. Enugu was a particularly important destination for Keteku and Muturu (32% of all purchases of Keteku and 50 % of all purchases of Muturu). Muturu are traditionally reared in southeast Nigeria where they have special value for ceremonies (Akinwumi and Ikpi, 1985). Informal interviews with traders indicate that due to the scarcity of Muturu, Keteku are sometimes used as a substitute.

Sixty-six percent of all cattle traded were males, 29% were cows and 5% were heifers. Sixty-nine percent of the traded animals were sold by traders and 31% were sold by farmers. The main buyers were traders (51%), followed by butchers and caterers (23%), consumers (14%) and farmers (11%). Traders purchased 62% of the Muturu and 56% of the Keteku. Traders mostly purchased males (86%), while butchers mostly purchased females (77%). Farmer purchases included 7% cows, 32% heifers, 23% young males and 38% bulls. All the animals except two were purchased for rearing. Since additional questions were not asked, it could not be established how many were used for breeding and how many for fattening.

5.2 Price Relationships

Table 6 reports the results of the most satisfactory implicit price model that was fitted to the data. Other versions of the model indicated that length of the animal and length squared were not statistically significant, so both variables were excluded from the final model. Also, none of the interaction terms between breed and girth and wither height (or their squares) were significant, so these interaction terms were excluded from the final version. The results indicate that, everything else equal:

(i)   There were significant relationships between price per animal and condition score, girth circumference and height at the withers. The significance of the squared terms supports the hypotheses that the relationships are non-linear. The negative signs on condition score and height, and positive signs on condition square and height square indicate that, everything else equal, price increases at an increasing rate as condition score and height increase.

(ii)   Prices paid for Keteku and Gudali were significantly lower than those paid for White Fulani, while prices paid for N'Dama were significantly higher than for White Fulani. N'Dama prices were also higher than those for other breeds. White Fulani and Muturu prices were not significantly different. Price differences due to breed were less than

differences due to type of animal and month of transaction.

(iii) Cows fetched significantly lower prices than males, while heifers fetched significantly higher prices than cows.

(iv) Traders paid significantly higher prices than either farmers, consumers or butchers/caterers.

(v) The highest prices were paid in May and June and the lowest prices were paid in November. November prices were significantly lower than all other periods, except January-February. The two peak periods coincided with the Christian festival time of Christmas and New Year and the Muslim festival time of Eid-el-Kabir.

6. DISCUSSION AND CONCLUSIONS

6.1 Discussion

Farmers have four options available for changing the breeds of animals in their herds:

(i)   purchasing more desirable animals, especially bulls of more desirable breeds;

(ii) deliberately breeding cows and heifers with bulls of more desirable breeds in own herd or neighbouring herds;

(iii) bringing animals of more desirable breeds into their herds through sharing or caretaking arrangements;

(iv) culling less desirable animals and disposing of them by sale or home slaughter.

The options are arranged in order of the amount of deliberate discretion that the farmer exercises: option (i) is the most deliberate and rapid way to exercise discretion over breed, option (iv) is the least deliberate and slowest way to exercise discretion over breed. The results of this study indicate that cattle owners in the derived savannah of Oyo State rarely exercise the most deliberate options (i) and (ii); only 5% of all animals entered the farmers' herds through purchase and farmers only purchased 11% of animals exchanged at the Shaki market and it was not clear how many of those purchased animals were actually used for breeding. Instead they rely on the options of less deliberate discretion.

Nonetheless about 75% of the respondents reported that the breed composition of their herd was different at the time of the survey than it was in the past. There is a strong trend away from the *Bos taurus* Muturu and Keteku toward the *Bos indicus* White Fulani. Keteku was developed in the past by farmers as a deliberate choice to combine the disease resistance of Muturu and the larger size and milk yield of White Fulani. However, the decreasing number of Keteku at present indicate that as Muturu have disappeared from farmers' herds, so too may the Keteku. Although farmers acknowledged some clear advantages of the Muturu and Keteku (disease resistance, ability to graze a variety of grasses), those advantages appear to be of relatively little importance compared to the many disadvantages of the Muturu and Keteku relative to the White Fulani. Moreover, where disease challenge particularly that of trypanosomiasis is smaller, there is less incentive to choose Muturu and Keteku against White Fulani.

The movement away from Muturu in the derived savanna areas of Oyo State is consistent with the aggregate trend in south-western Nigeria. The national livestock survey

conducted in the early 1990s (RIM, 1992) found virtually no Muturu in Ogun State where not long ago many farmers held Muturu (Grandin, 1980). The national livestock survey reported 11,623 Muturu among a total of 234,461 cattle in Oyo State (now Oyo and Osun states), but most of those Muturu were located in the forested areas.

The implicit price analysis produced a very satisfactory model of the prices of cattle exchanged at the Shaki market. The measure of goodness-of-fit, $R^2 = 0.73$, is about twice as high as the R^2 for similar models estimated by Rodriguez *et al.* (1995) for sheep and goat prices in Pakistan and Andargachew and Brokken (1993) for sheep prices in Ethiopia. The results show that there are some differences in prices that are solely due to breed, but that most variation in prices is due to continuous variables such as wither height and girth circumference that vary from animal to animal within breed. Although, other things being equal, N'Dama fetched higher price in the market compared to other breeds, farmers rated N'Dama low in terms of value and marketability. This contradiction partly explains why N'Dama population did not expand as rapidly as would be expected after initial introduction by the government funded project. Variation due to type of animal or month of transaction was greater than that due to breed. The significant effect of type of buyer indicates some degree of non-competitiveness or the importance of excluded explanatory variables. The implicit price results indicate that there are important seasonal fluctuations in cattle prices. More results on seasonality would have been generated had data been available over an entire calendar year.

6.2 Implications for conservation through utilization

The strong trend among the farmers against the *Bos taurus* Muturu implies that there is very little scope for conservation of the Muturu in the derived savanna areas of southern Nigeria. If trends from the study area expand into the area of Oyo State that is now forested, the population of 11,000 Muturu that is now reported could be interbred to extinction within 20-30 years. This would mean the loss of important resource for Nigeria and all regions of the world where livestock are raised under the stresses of disease, heat and humidity. The ability to be productive under low to moderate levels of trypanosomiasis make these animals more attractive to farmers. Trypanosomiasis remains a constraint in southern Nigeria[3] and there is evidence from across Africa of resistance to the drugs available for prophylactic and curative treatment of trypanosomiasis (Peregrine *et al.*, 1994).

Research and development agencies should consider the possibility of selecting Muturu bulls with superior production characteristics and promoting them with farmers who now keep Muturu in the forest zone. Everything else equal, conservation efforts might be better directed at locations, such as southeast Nigeria, where the Muturu is better suited to the farming system and where there is a distinct market for Muturu. The market does not otherwise appear to provide farmers with strong motivations for or against particular cattle breeds. The implicit price analysis indicates a small price premium for N'Dama, but the total number of N'Dama is so small that this result must be regarded with caution.

With the trend towards more White Fulani in the derived savanna, perhaps breed improvement schemes should focus on ways of improving the adaptation traits of the White Fulani through within-breed selection or cross-breeding with breeds such as the N'Dama.

While size, milk yield and disease resistance are breed characteristics that have received considerable research attention (e.g. Rege *et al.*, 1994), the needs for mobility for grazing and ease of handling have received scant research attention. Breed improvement should be considered with caution, however. Currently farmers acquiring cattle through renting and sharing manage breeds for which they may not have highest preference. The low level of deliberate discretion that farmers are exercising to improve or change breeds suggests that there is limited scope for breed improvement that would require farmers to purchase improved animals. Breed improvement would require both the production of improved and adapted genotypes and farmer education. Farmers in this sample had negative opinions about the N'Dama even though few of them actually had any personal experience with the N'Dama. The results of the logit analysis suggest that cattle farmers with higher opinions of the N'Dama were more likely to keep trypanotolerant cattle.

Research of the type reported here could be a useful component of any appraisal of current and future stocks of the genetic resources used in agriculture. Perhaps the most useful information gathered in this study was on farmers' current and past breed portfolios and the sources of animals in their herds. Reliable information for a large area could be collected with a brief questionnaire administered to a large number of households. Governments concerned about animal genetic resources could design agricultural survey or census questionnaires to collect such information. Development projects concerned with breed improvement and dissemination should use the matrix ranking approach to better understand farmers' perceptions of different breeds.

NOTES

[1] Height, length and girth were measured following the procedure described by Buvanendran *et al*. (1980): wither height is the vertical height from the floor to a point just above the spinous processes of the second and third vertebra, length is the distance from the point of the shoulder corresponding to the outer and lateral tuberosity of the left humerus to the left tuber ischii, and girth circumference is the circumference of the body measured perpendicular to the shoulder blade at the 6th-7th rib.

[2] When the dependent variable measured whether or not a farmer kept a specific trypanotolerant breed, fewer factors turned out to be significant. Only four variables were significant in explaining whether a household held Keteku and only one factor was significant in explaining whether a household held N'Dama.

[3] In 1987, in a sample of 1525 zebu cattle in 5 states of southwest Nigeria, a mean rate of trypanosome prevalence of 14.4% was found - 18% in the wet and 10.8% in the dry season (Ikede *et al., 1987*). A repeat survey in slightly wetter and more forested locations in 3 of the same 5 states showed prevalence rates of between 18.5% - 21% in the wet season and 16% in the dry season (ILRI-Ibadan, unpublished data).

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Table 1: Distribution of sample households according to past and present (January - June 1994) breeds of cattle in the herds, southwest Nigeria

	Present breeds					
Past breeds	White Fulani	Keteku	WF + Keteku	WF + Keteku + N'Dama	All herds (n)	All herds (%)
White Fulani	51	4	34	2	91	45
Keteku	21	-	-	1	22	11
Muturu	1	-	12	5	18	9
WF+Muturu	-	3	-	-	3	1
Keteku+Muturu	61	-	2	1	64	31
Mixtures[a]	6	-	-	-	6	3
All herds (n)	140	7	48	9	204	
All herds (%)	69	3	24	4		100

[a]Mixtures of White Fulani, Keteku, N'Dama, White Fulani x N'Dama crosses.

Source: Farm survey

Table 2:   Sources of cattle by breeds in the sample herds, southwest Nigeria

Breeds in herd	% animals by source			
	Inherited	Purchased	Share of caretaking	Caretaking
White Fulani	85.1	4.5	0.2	10.2
Keteku	56.0	6.7	-	37.3
WF+Keteku	84.1	5.1	1.3	9.5
WF	91.2	5.6	0.3	2.8
Keteku	74.0	4.4	2.6	19.0
Mixtures[a]	19.1	5.1	6.4	69.4
WF	56.9	18.5	3.1	21.5
Keteku	15.1	-	7.5	77.4
N'Dama+ WFxN'Dama	-	-	7.7	92.3
All herds	80.9	4.8	0.8	13.5

a. same as in Table 1.

Source: Farm survey

Table 3: Matrix rating of cattle breeds by sample cattle holders, southwest Nigeria (n=204)

	White Fulani	Keteku	W.Fulani x N'Dama	Muturu	N'Dama
Milk yield	9.4 (1.1)	5.5 (1.5)	4.7 (1.4)	2.6 (1.1)	3.1 (1.4)
Disease resistance	2.4 (1.2)	5.9 (1.6)[a]	5.5 (1.4)[a]	8.4 (1.2)[b]	8.6 (1.3)[b]
Size of animal	9.5 (1.0)	5.9 (1.6)	4.8 (1.3)	2.1 (1.2)	3.2 (1.3)
Ease of handling	9.4 (1.0)	5.9 (1.7)	4.0 (1.3)	2.3 (1.1)	1.7 (1.1)
Market value	9.5 (1.0)	6.3 (1.6)	4.4 (1.3)	2.1 (1.1)	2.8 (1.2)
Marketability	9.2 (1.1)	7.1 (1.7)	4.4 (1.4)	2.7 (1.3)[b]	2.7 (1.4)[b]
Graze diverse grasses	2.4 (1.1)	6.0 (1.4)[c]	5.6 (1.4)[c]	8.8 (1.2)[b]	9.1 (1.2)[d]
Need mobility	9.6 (1.1)	4.6 (1.5)	3.8 (1.4)	2.0 (1.3)[b]	2.0 (1.3)[b]
Overall rating	8.7 (1.6)	5.9 (2.1)	4.7 (1.8)	3.1 (1.6)[e]	2.6 (1.5)[e]

Note: Numbers in brackets are standard deviations. Not reported are the standard errors but all of the standard errors for the attribute ratings were between 0.07 and 0.12. The standard errors for the overall ratings varied between 0.10 and 0.15.
All of the rating differences between breeds are significantly different at the 0.1% level of confidence except the following:

[a] Keteku and White Fulani x N'Dama are significantly different at the 5% level.
[b] Muturu and N'Dama are not significantly different
[c] Keteku and White Fulani x N'Dama are significantly different at the 1% level.
[d] Muturu and N'Dama are significantly different at the 5% level.
[e] Muturu and N'Dama are significantly different at the 1% level.

Source: Farm survey

Table 4: Factors affecting the probability of keeping trypanotolerant cattle in the herd, southwest Nigeria

	Full Model			Stepwise		
	Est. Coef.	Asym. St. Err.	Signif.	Est. Coef.	Asym. St. Err.	Signif.
Constant	-12.40	2.58	0.000	-11.08	2.04	0.000
Caretaker (0/1)	1.67	0.47	0.004	1.63	0.43	0.000
Occupation (0/1)	0.38	0.49	0.443			
Years in present location	0.03	0.01	0.003	0.03	0.01	0.04
Ratings for N'Dama						
Need mobility	-0.25	0.20	0.209	-0.36	0.17	0.037
Ability to graze diverse grasses	0.06	0.21	0.767			
Marketability	0.11	0.16	0.488			
Market value	0.15	0.19	0.426			
Ease of handling	0.46	0.19	0.015	0.47	0.16	0.004
Size	-0.31	0.19	0.097			
Disease resistance	0.42	0.19	0.026	0.41	0.16	0.010
Milk yield	0.08	0.17	0.640			
Ratings for Keteku						
Need mobility						
Ability to graze diverse grasses	-0.41	0.18	0.026			
Marketability	0.10	0.15	0.490			
Market value	0.30	0.17	0.072	0.50	0.13	0.000
Ease of handling	0.05	0.15	0.759			
Size of animal	0.29	0.18	0.103			
Disease resistance	0.08	0.14	0.591			
Milk yield	0.16	0.16	0.948			

Table 5: Origin of cattle traded at Shaki market, southwest Nigeria, Nov. 93 - June 94

	Local LGA	Rest of Oyo	Kwara	Benin	Burkina Faso	Total (n)
White Fulani	218	170	158	80	347	973
Gudali	85	58	55	31	104	333
Keteku	137	49	40	721	13	960
Muturu	26	18	10	335	6	395
N'Dama	5	20	-	2	-	27
All (n)	471	315	263	1169	470	2688
All (%)	18	12	10	44	18	100

LGA - Local Government Area, a middle level administrative unit

Source: Market survey

Table 6:   Determinants of cattle prices, Shaki market, Southwest Nigeria (n = 2,688)
(Prices per head)

	Coefficient	St. error
Covariates		
Condition score (2-8)	-313.8**	124.7
Condition score^2	77.4***	12.0
Wither height (inches)	-301.6***	65.0
Wither height^2	4.0***	0.7
Girth (inches)	129.0***	45.1
Girth^2	0.4	0.4
Factors		
Breed:		
White Fulani		
Gudali	-180.5*	83.4
Keteku	-310.9*	71.4
Muturu	-125.3	96.2
N'Dama	601.1*	258.4
Type of animal:		
Male	0.0	
Cow	-1427.9*	77.8
Heifer		
Type of buyer:		
Farmer	0.0	
Trader	458.3*	96.1
Consumer	-141.4	110.8
Butcher/caterer	77.5	110.8
Month of transaction:		
November	0.0	
December	852.8*	71.6
January-February	134.6	83.6
March-April	352.1*	95.1
May	1298.9*	101.8
June	1292.4*	145.2
R^2	0.70	

For coefficients of covariates **,*** indicate t significant respectively at $p < 1\%$ and 0.1%. For coefficient of the factor categories, * indicate the coefficient is significantly different from 0 i.e. the base category within the factor. Here significance is based on 0.95 Bonferroni confidence interval because when joint confidence intervals are constructed, t values are inadequate to determine whether differences are significant (Norusis, 1993).