

Herders' Perceptions on Ruminant Livestock Breeds and Breeding Management in Southwestern Niger

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Abstract This study documents indigenous knowledge of breeds of cattle, sheep and goats in southwestern Niger, and includes both pastoralists and agropastoralists. Our study included sheep and goats in view of the increasing importance of small ruminants in livestock production systems in the Sahel since the drought of the 1970s and 1980s. This study was carried out under the Desert Margins Program (DMP) project on arresting land degradation and the conservation of biodiversity in desert margins of sub-Saharan Africa, partly funded by the Global Environment Facility (GEF).

Key words Indigenous knowledge · ruminant · pastoralist · semi-arid · zebu

Introduction

Almost all the ruminants in the West African Sahel are indigenous breeds (Blench, 1999). In the fragile and drought prone Sahelian environments, local livestock breeds are critical to sustainable rural livelihoods as they provide a wide range of outputs while requiring relatively low levels of input with regard to feed, management and health care (Köhler-Rollefson, 2000). In addition to sustaining rural livelihoods, these local breeds often form the basis for the cultural identity of many of the local communities (Bonfiglioli, 1982; McCorkle, 1999; Schareika, 2001). This realization by policymakers, researchers and development workers led to a shift in the nature of livestock projects (Blench, 1999) whereby ranch, farm, and other intensive models were largely dropped in favor of working with traditional organizations such as pastoral associations and community based organizations.

This study documents indigenous knowledge of breeds of cattle, sheep and goats in southwestern Niger, and includes both pastoralists and agropastoralists (Turner and Hiernaux, 2002). Past studies in Niger of indigenous livestock breeds have focused mainly on accounts from WooDabe pastoralists in the arid north of the country, and on cattle in particular (Bonfiglioli, 1982; Swift, 1984; Schareika, 2001), and included social processes involved in animal husbandry and pastoral economy. In view of significant changes over the past two decades it is appropriate to revisit some of issues, such as sedentarization of pastoralists, restricted animal mobility, and a shift in livestock ownership pattern towards sedentary livestock keepers. Our study included sheep and goats in view of the increasing importance of small ruminants in livestock production systems in the Sahel since the drought of the 1970s and 1980s (Turner and Hiernaux, 2002).

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This study was carried out under the Desert Margins Program (DMP) project on arresting land degradation and the conservation of biodiversity in desert margins of sub-Saharan Africa, partly funded by the Global Environment Facility (GEF). The objectives were as follows: (I) to document herders' perceptions of livestock breeds and their breeding strategies; (II) to compare and contrast herders' characterization of livestock breeds with those of livestock researchers and identify gaps between the two approaches; (III) to demonstrate the importance of indigenous knowledge in management of livestock diversity.

Increasing appreciation of the value of local livestock breeds among scientists, development workers, and policy-makers, and of the need for systematic documentation of indigenous knowledge about them (Köhler-Rollefson, 2000) has been driven by many factors. First is the widely acknowledged loss of animal breeds and the need for biodiversity conservation. According to the FAO global database of domestic animal diversity (200), about one-third of more than 7,000 registered breeds (including poultry) are threatened by extinction. Second is the recognition that local breeds carry genes that are of importance for conservation due to their present value (for example, resistance to certain diseases) and perceived future use (Köhler-Rollefson, 1997; Rege and Tawah, 1999). And third is the extinction of most of the wild ancestors of domesticated animal species, which necessitates conserving and exploiting genetic diversity within local breeds (Köhler-Rollefson, 2000). Thus, maintaining diversity can be viewed as insurance against future threats such as famine, drought and epidemics. Furthermore, it allows farmers and pastoralists ready access to genetic reserves from where they can select stocks or develop new breeds in response to environmental change, diseases, and changing consumer demands (McCorkle, 1999). The growing number of comparative studies indicating that within their local environments and resource-constrained production systems, local livestock breeds can perform better than exotic breeds has also contributed to the revival of interest in local breeds (Kebede, 2000; McCorkle, 1999), as has the cultural and aesthetic value of local breeds (McCorkle, 1999).

Although Doutressoulle (1947), Mason and Maule (1960), and Epstein (1971) provide considerable information on local livestock breeds in Africa, there is hardly any information about the role of different species and breeds within the farming systems (Blench, 1999), only scanty data on productivity based on results from research stations, and no information on indigenous knowledge of local breeds. The rich knowledge of pastoralists and agropastoralists on animal husbandry and genetics is widely acknowledged (Köhler-Rollefson, 1993; McCorkle, 1999) and needs to be an integral part of developing a good understanding of local livestock breeds. Many pastoral and agropastoral people keep detailed mental records of their animals' ancestry, even

up to seven generations (Köhler-Rollefson, 2000). However, there is growing concern about loss of traditional knowledge among the pastoralists and agropastoralists in the West African Sahel, especially as young people, due to sociopolitical, demographic, and economic pressures, move to nontraditional livelihood strategies (Blench, 1999; McCorkle, 1999; Turner, 1999).

The breeding goals of livestock keepers are often multifaceted (Bebe *et al.*, 2003; Köhler-Rollefson, 2000; Rege *et al.*, 2001) and go well beyond high animal productivity. Survival under local ecological conditions is often a primary goal (Köhler-Rollefson, 2000) with risk avoidance often being of paramount importance. Breeding goals are also influenced by sociocultural norms, aesthetic preferences (for example, color and color distribution), religious considerations (white sheep are preferred for the Muslim festival of Tabaski), and behavioral traits such as docility, good maternal ability, the ability to walk long distances, tolerance to water scarcity, and loyalty to the owner (Blench, 1999; McCorkle, 1999; Rege *et al.*, 2001). Even religion can influence breeding objectives. McCorkle (1999) cites the case of Bodi agropastoralists of Ethiopia who carefully breed cattle of many coat colors for certain rituals. However, it is important to stress that the breeding goals and strategies of pastoralists are not static but generally evolve in response to changes in local ecological conditions, production systems, pastoralists' preferences, local knowledge, and market opportunities (Bebe *et al.*, 2003; McCorkle, 1999).

Materials and Methods

Study Site

This study was conducted from May to August 2004 in three agropastoral territories, Banizoumbou, Tigo Tegui, and Kodey in the Fakara region of southwestern Niger (Kollo District) that lies between the confluent valleys of the Niger River to the west and the fossil valley of the Dallol Bosso to the east (13° 20'–13° 35' N; 2° 35'–2° 52' E). The study site has been described in detail by Turner and Hiernaux (2002). The climate of Fakara is a typical inland semiarid tropical climate with an average annual rainfall of 560 mm (1905 to 1989; Lebel *et al.*, 1997). Fakara is part of central Sahel bioclimatic zone. Rainfall distribution is strictly monomodal mostly between July and October. The study site covered 500 km² and is populated mainly by the Djerma ethnic group, who are historically land cultivators. Fakara also harbors a significant number of Fulani, who are pastoralists but are increasingly engaged in farming. The Fulani have generally settled outside of Djerma villages on plots of land loaned to them by Djerma landowners (Turner and Hiernaux, 2002). In 1998, the population of the study

site was 6,000 (Hiernaux and Ayantunde, 2004). The three agropastoral territories are experiencing different land use pressures, with Kodey having a high proportion of land cropped (65% in 1996) compared to 25% and 39% for Banizoumbou and Tigo Tegui, respectively (Turner and Hiernaux, 2002).

Survey on Herders' Perceptions

A total of 95 herders from different households were interviewed individually using a semistructured questionnaire on breeds of cattle, herd size, species and breed preferences, the adaptive, productive and behavioral traits of different breeds of cattle, sheep and goats in their herds, and breeding management. In a stratified random sampling, herders were selected in each village from two ethnic groups (Djerma and Fulani) from 169 households managing herds in all the villages. Thirty-one herders were interviewed in both Banizoumbou and Kodey, while 33 were interviewed in Tigo Tegui. Two-thirds of the herders interviewed in each village were Fulani while the rest were Djerma. The proportion of Fulani interviewed reflects the dominance in animal husbandry in the study site. All herders interviewed were men. Caution should be exercised in relation to the herd size of the pastoralists reported in this study because they usually underreport their animal numbers to limit taxation (Pouillon, 1988). The number of animals reported often depends on who is asking and how. In addition, there are strongly held taboos that discourage counting of the animals. Two enumerators who were fluent in the languages of the interviewees (Fulfulde and Djerma) administered the questionnaire.

Analysis of Survey Data

Data analysis was performed with SAS (1987) using frequency procedure for the description of the data and to analyze the relationships among various variables for each village. MEANS procedure in SAS was used to analyze data on age of the herders interviewed, herd size, mode of acquisition of animals in the herd, reproductive performance (age at sexual maturity and at first calving), and breeding management.

Results and Discussion

Ethnic Composition and Age of the Herders Interviewed

The average age of herders interviewed was 51 (SE = 2.4), 52 (SE = 2.4) and 56 (SE = 2.2) years for Banizoumbou, Kodey and Tigo Tegui, respectively (Fig. 1). Generally, the average age of the Fulani herders was lower than that of the

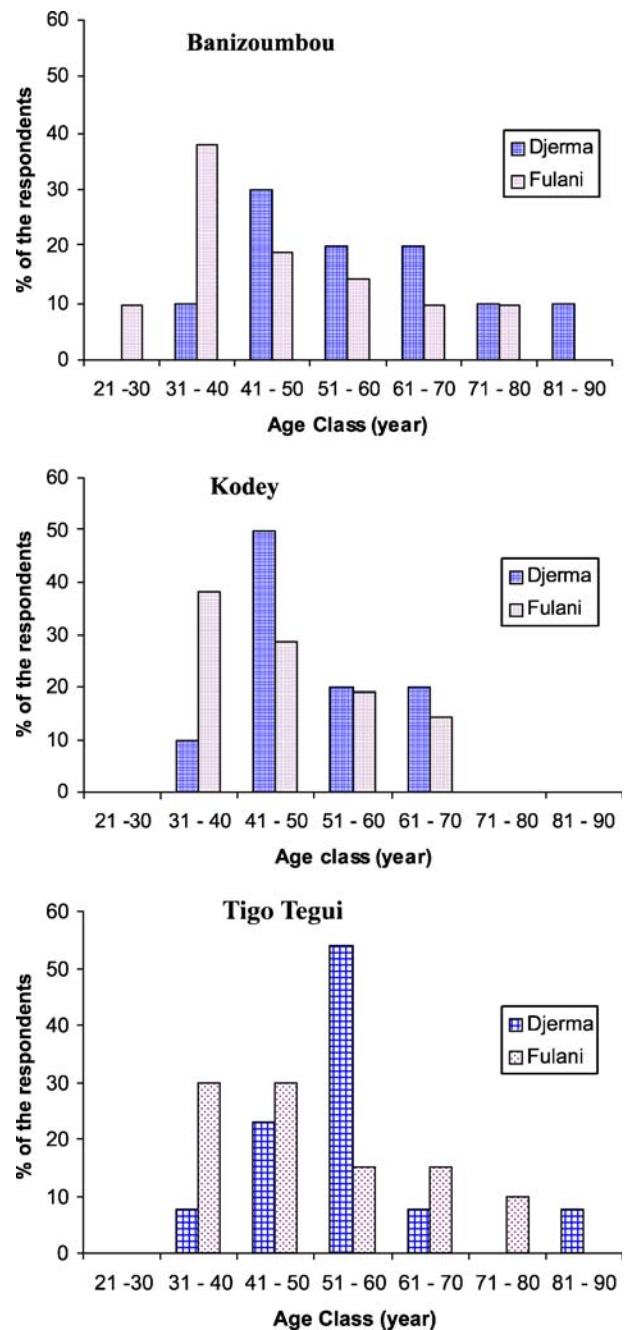


Fig. 1 Age class of the herders interviewed per ethnic group and village, in southwestern Niger (means±standard error for Djerma herders were 57±5, 53±3 and 59±3 years for Banizoumbou, Kodey and Tigo Tegui, respectively. For Fulani herders, means±standard error were 46±3, 49±3 and 53±3 years for Banizoumbou, Kodey and Tigo Tegui, respectively).

Djerma in all the villages. The lowest age recorded during the survey was 26 years for a Fulani herder while the oldest herder, a Djerma, was 85 years old. Age structure of the herders (Fig. 1) showed that the modal age class for Fulani herders was 31 to 40 years in all the villages, whereas for Djerma herders it was 41 to 50 years in Banizoumbou and

Kodey, and 51 to 60 years in Tigo Tegui. Though information on age given by the herders should be taken with caution, the trend of Fulani herders being younger than Djerma herders is plausible in view of the herding tradition of the former. There are many reports of the Fulani starting to take care of the household animals as early as boyhood (Ayantunde *et al.*, 2000; de Verdière, 1994; McCorkle, 1999). Fulani boys often handle the herds in the dry season while adult men are responsible for herd management during the wet season when grazing control is critical to avoid damage to crops (Ayantunde *et al.*, 2000). The older age of Djerma herders could be attributed to their crop farming background and consequently the need for more time to acquire animal husbandry skills, mainly through association with the pastoralists. Another reason is the seasonal migration of young Djerma men, mostly between 20 and 45 years of age, to coastal countries in West Africa such as Benin, Togo, Ghana, and Nigeria (Faulkingham and Thorbahn, 1975), thus leaving the older population for agricultural activities.

Herd Size and Mode of Acquisition

In all the villages, the Fulani had higher numbers of cattle, sheep, and goats than the Djerma (Fig. 2). Except for Tigo Tegui, Fulani herders had at least twice the number of cattle, sheep, and goats compared to Djerma herders. At least 70% of Fulani herders interviewed had more than ten head of cattle whereas only 30% of the Djerma had more than ten cattle (Fig. 2). Given the high climatic fluctuation and spatiotemporal variability in feed resources in the West African Sahel, the traditional pastoral strategy has been to

keep herd numbers, especially females, as high as possible. For all animal species and ethnic groups, herd composition was heavily dominated by females (65% to 95% of the herd). A major reason for the high proportion of the females in the herd is the sale of male animals that are not needed for breeding, especially in the dry season to buy grains for household consumption (Blench, 1999; Swift and Maliki, 1984). In our study, males accounted for at least 33% of cattle herds of Djerma, whereas they accounted only for about 20% of Fulani herds. This could be attributed to the Djerma need for draught animals for cropping activities and transportation.

Cattle breeds found were Bororo, Azawak, and Djelli, while Bali-Bali and Tuareg were sheep breeds reported by the herders (Table I). Only one breed of goat, Sahel, was kept by the herders in the study. Bororo and Bali-Bali were the commonest cattle and sheep breeds, respectively. The number of Bororo in Fulani herds was twice the number of Azawak, whereas the reverse was the case for Djerma herds (Table I). Bororo is commonly considered the most prestigious zebu cattle breed among most Fulani clans (Blench, 1999). This breed is found mainly in the east of Niger, in the extreme north of Nigeria, in Chad, and the north of Cameroon (Epstein, 1971). Azawak cattle are found mainly in the Azawak valley in Niger and Mali, but also in central Niger, eastern and southern Burkina Faso, and on the northern border of Nigeria (Payne, 1970). Azawak has been reported to produce more milk than all other cattle breeds in Niger (Achard and Chanono, 1995). Milk yield could be up to four liters per day in the wet season when forage is abundant. Djelli breed is found in southwestern Niger in the Niger

Fig. 2 Distribution of herd size of cattle, sheep and goats of the herders interviewed in southwestern Niger.

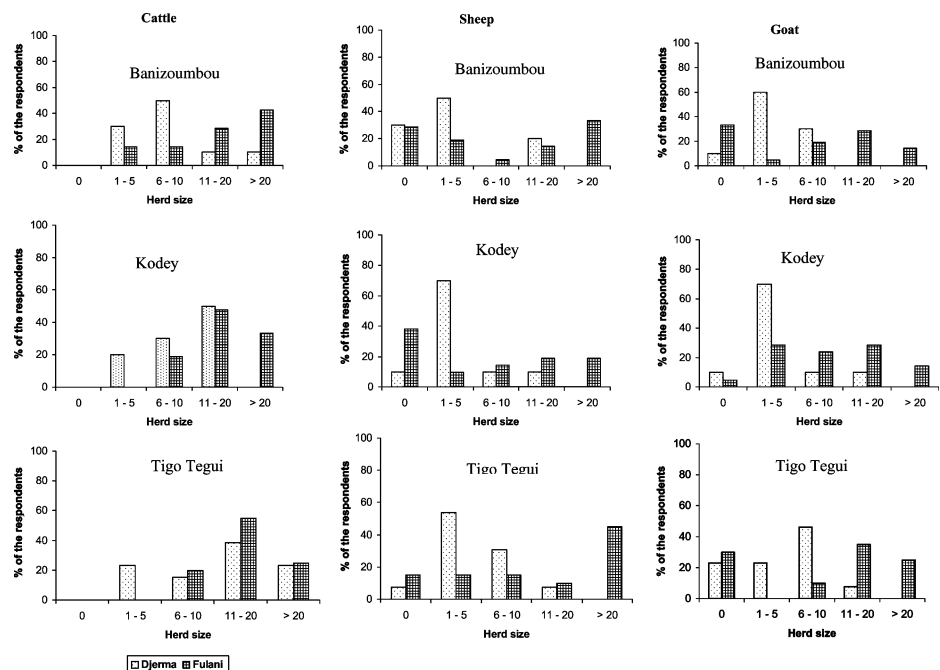


Table 1 Herd Size of Cattle and Sheep of the Herders Interviewed per Breed and Ethnic Group (mean±standard error)

Breed	Banizoumbou		Kodey		Tigo Tegui	
	Djerma (<i>n</i> = 10)	Fulani (<i>n</i> = 21)	Djerma (<i>n</i> = 10)	Fulani (<i>n</i> = 21)	Djerma (<i>n</i> = 13)	Fulani (<i>n</i> = 20)
Cattle						
Azawak	3.1±0.7	6.6±2.4	4.6±0.8	2.7±0.6	8.9±2.9	1.8±0.6
Bororo	4.4±2.5	10.9±1.6	2.3±1.0	10.7±2.4	2.4±1.6	14.5±2.9
Djelli	0.5±0.1	1.0±0.9	1.3±0.5	2.7±0.1	0	0.5±0.1
Crossbred ^a	0.9±0.6	2.9±2.2	2.3±0.3	4.3±0.9	3.2±1.4	1.9±0.5
Total	8.9±2.4	21.4±3.2	10.5±1.4	20.4±3.2	14.5±2.6	18.7±2.8
Sheep						
Bali-Bali	4.3±1.1	11.3±4.5	3.5±1.0	9.4±1.9	5.2±1.3	25.1±7.4
Tuareg	0	6.1±2.3	0.1±0.1	0.5±0.1	0	0
Total	4.3±1.1	17.4±5.2	3.6±1.1	9.9±2.0	5.2±1.3	25.1±7.8
Goat						
Sahel	4.4±0.8	15.8±6.9	3.8±1.0	16.4±4.8	5.8±1.6	18.8±4.6

^a Crossbred found in the study site are mostly crosses between Azawak and Bororo.

River valley and in the southern part of Sokoto in Nigeria. It is reported to be a good beef but poor dairy animal, and is often used for work (Epstein, 1971). Other cattle breeds in Niger, though not found in the study site, are Sokoto Gudali and Kuri. Kuri is a taurine breed found in the region of Lake Chad and along its shores. The breed is unique for its ability to thrive in semiaquatic conditions. Blench (1999) has reported that Kuri cattle can stay afloat and swim long distances. Bali-Bali is a Fulani sheep breed and commonly found in Niger, Mali and northern part of Nigeria, Tuareg sheep are found in central Niger and northeastern Mali (Wilson, 1992). Both sheep breeds are adapted to long distance transhumance. Only two breeds of goat are common in Niger, Sahel (also referred to as West African Long-Legged) and “Chevre Rousse de Maradi.” In our study site only the Sahel breed was found. It is reported to be a very hardy and can survive for two days without drinking (Blench, 1999). The Sahel breed is generally preferred by the pastoralists and is widely distributed from Senegal to Sudan (Blench, 1999). Though “Chevre Rousse de Maradi” goats are found in many parts of Niger, they are mainly concentrated in Maradi department in southern Niger. The breed is known for its suitability for fine leather (Blench, 1999).

For all species (cattle, sheep, and goats) and across ethnic groups, the major source of animals was through birth in the household herds (Table II). On average, herd births accounted for about 75% of the Djerma cattle herds compared to 60% for Fulani. Other modes of acquisition of animals reported by the herders interviewed were inheritance, purchase, caretaking arrangements, and animals from absentee owners. Such acquisition from outside the household will influence the gene pool available for selection of desired traits and genetic variability in the herd. For all species and in all the three villages, only Fulani herders reported of animals from absentee owners in their herd. The

number of animals from absentee owners was particularly high in Banizoumbou, which could be partly explained by the availability of a higher proportion of grazing areas (range and fallow) compared to Kodey and Tigo Tegui (Turner and Hiernaux, 2002). Loaning animals is a common practice among the pastoralists in the West African Sahel (McCorkle, 1999; Swift and Maliki, 1984; Turner, 1999) called “habanai” in Fulfulde, and is a caretaking arrangement whereby the first two calves of a loaned cow become the property of the caretaker, who is often a relation of the owner. The caretaker also benefits from the milk of the loaned cow. This traditional credit facility serves to strengthen family ties and trust in the community, provides capital base in building a cattle herd and a means of meeting emergency cash needs, and enhances family dietary status through the consumption of milk from the loaned cow. Similar loan arrangements called “namanya” among the Sebei in Uganda and “mafisa” in western Zambia have been reported (Köhler-Rollefson, 2000; McCorkle, 1999).

Local Concepts of Breeds

The herders interviewed defined breed as a population of livestock with distinct physical and behavioral characteristics, and cultural separation from similar groups. According to the herders, key features in classifying a population of livestock as a breed include physical shape, body size, coat color, absence or presence of horn and horn shape, ease of handling, behavior towards owners and strangers, productive performance, resistance to harsh conditions (drought, lack of forage, diseases), roles in sociocultural life of the community, and origin of the breeding materials. Clearly, the set of traits that pastoralists and agropastoralists use to identify a “breed” may be complex and are always deeply

Table II Mode of Acquisition of Herd of Cattle, Sheep and Goats of the Herders Interviewed per Ethnic Group (mean±standard error)

Mode of acquisition	Banizoumbou		Kodey		Tigo Tegui	
	Djerma (<i>n</i> = 10)	Fulani (<i>n</i> = 21)	Djerma (<i>n</i> = 10)	Fulani (<i>n</i> = 21)	Djerma (<i>n</i> = 13)	Fulani (<i>n</i> = 20)
Cattle						
Born in the herd	6.2±2.2	10.5±2.2	8.7±1.6	12.0±2.4	11.8±2.5	13.0±2.4
Inherited	0.9±0.2	0.8±0.4	0	3.2±0.8	0	3.0±0.7
Bought	1.8±0.4	0.4±0.2	1.6±0.4	0.8±0.2	2.4±0.3	0.8±0.3
Caretaking ^a	0	1.8±1.0	0.2±0.1	1.4±0.4	0.3±0.1	0.8±0.2
Absentee owner	0	7.9±2.4	0	3.0±1.6	0	1.0±0.3
Sheep						
Born in the herd	3.5±1.2	9.5±4.5	2.7±0.9	6.4±1.8	3.8±1.8	19.2±6.2
Inherited	0	0	0	2.1±0.7	0	3.8±1.5
Bought	0.8±0.3	0.2±0.1	0.9±0.3	0.5±0.1	1.4±0.3	1.2±0.4
Caretaking ^a	0	0.6±0.3	0	0.8±0.3	0	0.8±0.5
Absentee owner	0	7.1±3.4	0	0	0	0
Goat						
Born in the herd	3.5±0.9	4.6±1.3	2.9±0.9	12.4±4.6	4.3±1.2	13.9±3.3
Inherited	0	0	0	2.4±1.2	0	2.4±0.9
Bought	0.9±0.3	0.8±0.2	0.9±0.2	0.8±0.3	1.6±0.4	1.8±0.6
Caretaking ^a	0	1.5±0.4	0	0.9±0.4	0	0.6±0.2
Absentee owner	0	8.9±2.8	0	0	0	0

^a Caretaking refers to animals (often females) given out as loan often to relation but have to be returned to the owner at a specified agreed period.

embedded in the culture and traditions of the community. In Fulfulde, breed is “légno”, while in Djerma it is “doumi”, the same as the word for crop varieties, reflecting their farming tradition. The Fulfulde word applies only to animals reflecting Fulani pastoral tradition and the important role they played in both developing and spreading ruminant livestock breeds in West Africa (Blench, 1999). Though local understanding of breeds can sometimes be confused, conflating biological, cultural, and linguistic differentiation, it generally agreed with Western concepts as both are largely based on visual appraisal of external characteristics.

Here we use the definition of breed given by the FAO (2000) as “either a subspecific group of domestic livestock with definable and identifiable external characteristics that enable it to be separated by visual appraisal from other similarly defined groups within the same species or a group for which geographical and/or cultural separation from phenotypically similar groups has led to acceptance of its separate identity.”

According to the herders, crossbreeding is very common among cattle in the region and largely uncontrolled. When crossbreeding is controlled, it is done for two major reasons: to improve the productive and adaptive performance of a breed, and to spread risk by diversifying the breed. The most popular method of crossbreeding is to introduce males of the new breed directly into a herd. In the study region, herders always prefer crossbreeding between Bororo cows and Azawak bulls for higher milk production and tolerance to harsh conditions. No crossbreeding was

reported by the herders between the two breeds of sheep found in the region.

Breed Characterization by the Herders

Ninety-two percent, 87% and 88% of the herders interviewed in Banizoumbou, Kodey, and Tigo Tegui, respectively, preferred keeping cattle to rearing small ruminants (sheep and goats). Major reasons given for this preference included cultural tradition, milk production, manure for crop fields, draught power, and the use of cattle for transport and as status symbols. In pastoral societies, the number of cattle possessed is a source of prestige. In mixed crop–livestock systems in the West African Sahel, animal manure is very important for soil fertility. In spite of the herders’ preference for cattle, they still keep significant number of sheep and goats in their herds because small ruminants are easy to sell to meet emergency household needs, as well as a way of spreading the risk of animal mortality.

In addition to physical or phenotypic traits (body shape, size, coat color, horn, hump, leg) and productive traits commonly used by researchers to characterize animal breeds, the herders interviewed cited adaptive (especially tolerance to lack of forage and water, and ability to walk long distances), aesthetic (beauty; this was always given as one of the reasons for rearing Bororo cattle), and behavioral traits (docility, ease of handling, loyalty to owner/herder) as important in characterizing breeds (Table III). Generally, herders’ characterizations agreed with information in the

Table III Phenotypic and Behavioral Characterization of Breeds of Cattle, Sheep and Goats by Herders in Southwestern Niger^a

Breed	Phenotypic, adaptive and behavioral traits
Cattle	
Azawak	Medium size, large hump, large stomach, long umbilical cord, variable coat color but commonly dark wheat, short ears, short horns, short legs, docile and easy to handle, and slow in walking long distances.
Bororo	Large size, large stomach, reddish brown coat color, long umbilical cord, long ears, long legs, long horns, robust, beautiful, intelligent, difficult to steal, nervous and only easy to handle by the herder/owner, and tolerant of harsh conditions.
Djelli	Small size, large hump, short horns, large stomach, long tail, shy, variable coat color but commonly white, docile and easy to steal.
Sheep	
Bali-Bali	Large size, long ears, smooth hairs, white or white–black coat color, prolific, beautiful and easy to handle.
Tuareg	Small size, short ears, white and/or black coat color, prolific and docile.
Goat	
Sahel	Large size, long ears, long and thin legs, variable coat color, prolific, stubborn, highly tolerant of harsh conditions and can walk long distance.

^a Responses from both ethnic groups were combined because they were similar.

scientific literature on the breeds (Blench, 1999; Epstein, 1971; Mason, 1984). The herders tended to be more detailed in their description of cattle breeds than sheep and goats, and were able to characterize Bororo cattle better than Azawak and Djelli. This could be attributed to their long experience of managing the breed and cultural affection and bias for Bororo, especially by the Fulani. For example, the herders reported that Bororo were the best dairy cattle in the region but in reality Azawak cows produce significantly more milk (Achard and Chanono, 1995). The herders tended to be more detailed when describing the behavioral aspects of the breeds than the productive traits such as milk production. Bororo cattle were reported to be highly intelligent and difficult to steal because they are always attached to the camp, and would always find their way back. This claim is supported by the story of a WoDaaBe elder in central Niger who reported an incident in his childhood when a Bororo herd was taken away by some soldiers. The owner was calm and simply went to the water point where he used to give them water being confident that the animals would meet him there. As

expected, the animals ran away from the soldiers and returned to the water point. The pastoralist remarked that if they had been Azawak breed, they would have been lost forever (Bonfiglioli, 1988).

According to the herders, ruminant livestock breeds that survive harsh conditions such as forage and water scarcity, harsh climate, and long distances were usually of small size, with large hump in cattle, short ears, long and thin legs, and a big stomach. Small body size is plausible because small livestock breeds have lower feed requirements. The justification for a large hump in cattle was unclear. A large hump means a good body fat reserve and this will enhance survivability in harsh conditions. Perhaps a large hump may also facilitate loss of heat from the body. However, experiments conducted about 50 years ago to test the function of the hump for heat dissipation in zebu cattle found no differences between humped cattle and those from which the hump was removed (Hafez, 1968). The rationale for a big stomach is also unclear. Probably this is associated with the assumption that a big stomach is necessary to store water

Table IV Age (year) at Sexual Maturity and at First Calving of Cattle Breeds from Herders' Perceptions in Southwestern Niger (mean±standard error)

Breed	Banizoumbou		Kodey		Tigo Tegui	
	Djerma (n = 10)	Fulani (n = 21)	Djerma (n = 10)	Fulani (n = 21)	Djerma (n = 13)	Fulani (n = 20)
Age at sexual maturity						
Azawak	1.5±0.2	1.4±0.1	1.7±0.3	1.4±0.1	2.0±0.1	2.0±0.1
Bororo	2.4±0.2	2.3±0.2	2.6±0.3	2.5±0.2	2.7±0.2	2.4±0.1
Djelli	1.4±0.3	2.0±0.6	1.5±0.5	2.0±0.1	1.6±0.2	1.7±0.1
Age at first calving						
Azawak	3.7±0.3	3.9±0.2	4.3±0.3	3.4±0.1	3.8±0.2	3.7±0.2
Bororo	4.5±0.3	4.8±0.2	5.3±0.4	5.0±0.2	4.5±0.2	4.5±0.2
Djelli	3.4±0.2	3.5±0.1	4.0±0.1	3.5±0.2	3.6±0.1	3.7±0.2

as the animals may have to walk for many days before reaching a watering point in the dry season.

Age at sexual maturity of cattle breeds given by the herders was on average 1.5, 2.5, 1.6 years for Azawak, Bororo, and Djelli, respectively (Table IV). Age at first calving was 3.8, 4.8, 3.6 years for Azawak, Bororo and Djelli, respectively. For heifers, age at sexual maturity refers to age at initiation of estrus. For steers, age at sexual maturity refers to age at which it can mate with a heifer or cow. Age at sexual maturity varies with breed, nutrition, live weight, and management practices (Wilson, 1986). The herders' responses on age at sexual maturity and at first calving generally agrees with the available published information (Achard and Chanono, 1995; Wilson, 1986). For example, Wilson reported an average age of 4.1 years as the age at first calving of heifers in Mali, though he did not specify the breed. For Azawak at a ranch in Toukounous in central Niger, Achard and Chanono (1995) reported 1.8 and 3.6 years as age at sexual maturity and at first calving, respectively. The agreement between herders' responses and researchers' results demonstrates the professionalism of

the pastoralists and their sound knowledge of the reproductive behavior of their animals. For small ruminants, the herders confused age at sexual maturity with age at first parturition and therefore the results were left out.

Herders' Breed Preferences

The Fulani tended to prefer Bororo to other cattle breeds. In all the villages surveyed, at least 40% of the Fulani interviewed gave cultural heritage as the reason for keeping Bororo (Fig. 3). Tradition always plays a central role in herd management and the value attached to breeds and individual animals (Blench, 1999). Other reasons given by the Fulani for keeping the breed included loyalty to the herder, physical conformation (beauty and large size), the ownership of a Bororo breeding bull, and loan animals from absentee owners. It was surprising that none of the Fulani herders interviewed mentioned directly the productive performance of Bororo cattle, reconfirming that productivity is often not the primary goal of the pastoralists in cattle husbandry (Köhler-Rollefson, 2000). The major reason

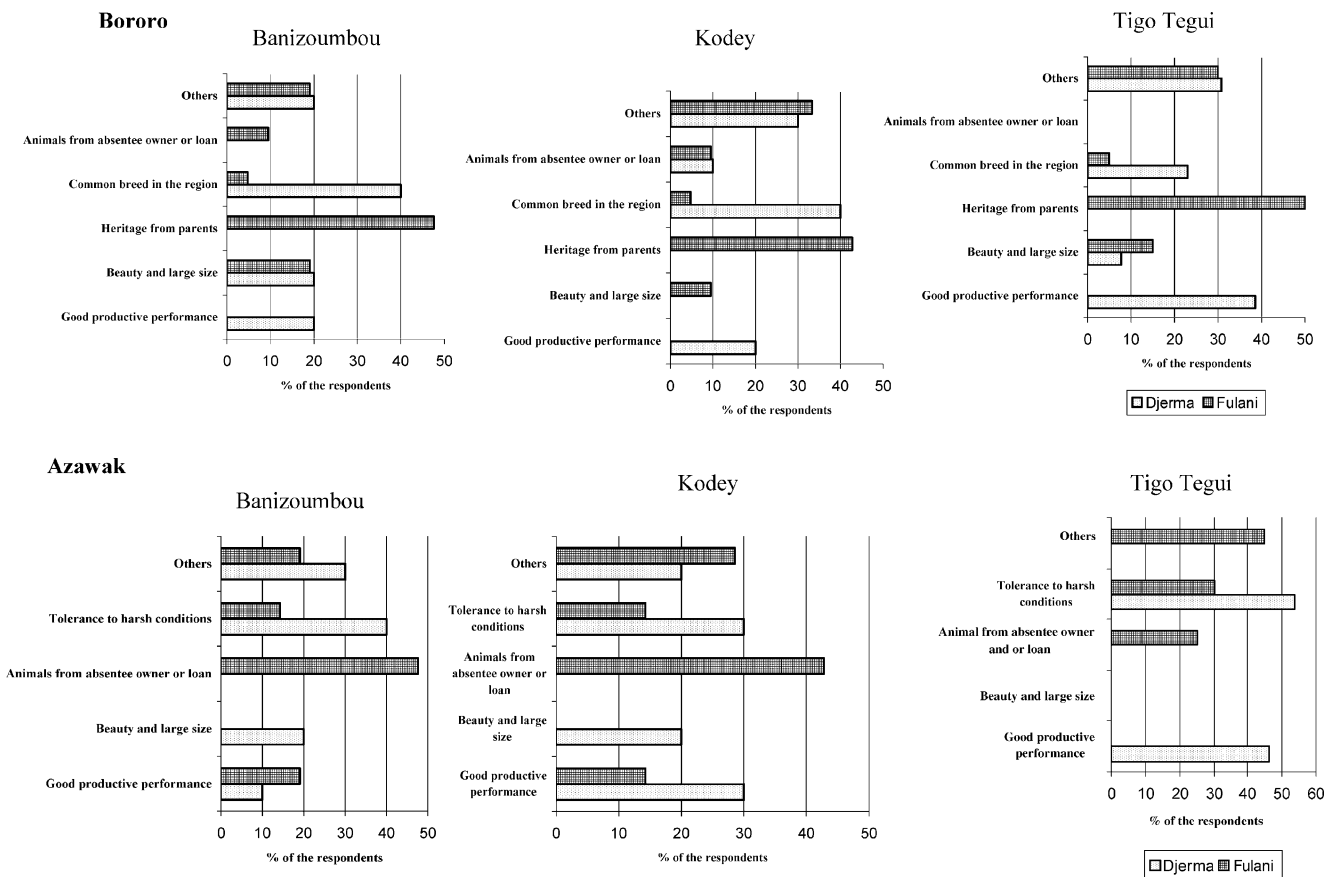
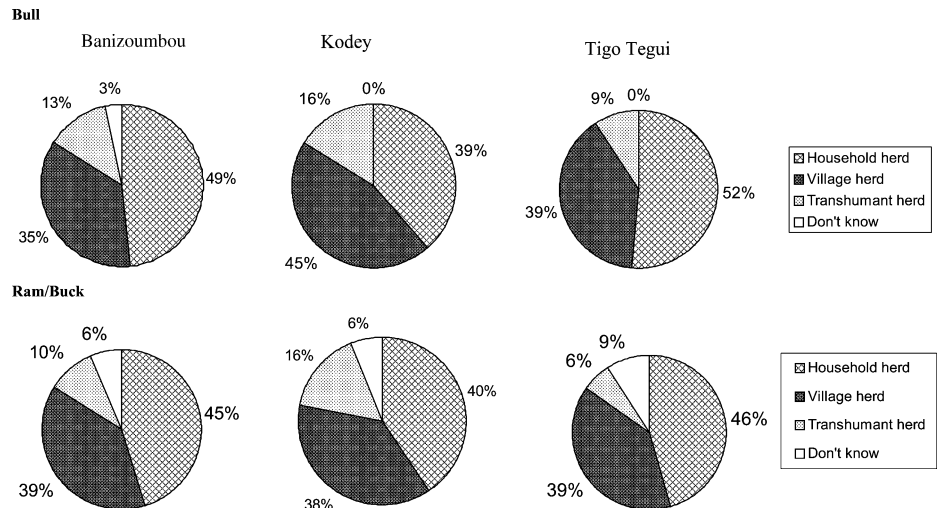


Fig. 3 Reasons for keeping different breeds (Bororo and Azawak) of cattle by the herders interviewed per ethnic group in South-western Niger. Values are percentage of the respondents per village and ethnic group. Across the villages, the Fulani herders gave only one reason for keeping Djelli breed, which was animals from absentee owners while

the Djjerma gave tolerance to harsh conditions as reason for keeping the breed. For Bororo and Azawak breeds presented in the figure, “others” refer to easy to handle and loyalty to herder, diversification of the herd and saving against emergency.

Fig. 4 Origin of the breeding male (bull, ram/buck) according to herders' perceptions in southwestern Niger.



given by Djerma herders for keeping Bororo cattle was, pragmatically, that it was the most common breed in the region. Other reasons were good productive performance, especially milk, marketability, physical conformation (beauty and large size), and loyalty to owner. For Azawak cattle, the first reason given by Fulani for keeping the breed was that the animals belonged to absentee owners or were on loan. Other major reasons were tolerance of harsh conditions, good productive performance, and lack of means to acquire preferred Bororo. The Djerma gave similar reasons for rearing Azawak. In all villages, Fulani herders gave only one reason for keeping Djelli, which was that all Djelli cattle in their herd belonged to absentee owners. The significant number of animals from absentee owners can be a potential resource for the creation of genetic variability in the herds of the pastoralists. For sheep, major reasons given for keeping Bali-Bali and Tuareg were good reproductive performance (especially the incidence of multiple births), physical conformation, marketability, as savings against emergencies, and their tolerance of harsh conditions. In addition, some Fulani respondents gave cultural heritage as a reason for keeping Bali-Bali, and lack of means to acquire the preferred breed as a reason for keeping Tuareg sheep.

Selection for Desired Traits and Breeding Practices

Between 85% and 95% of herders interviewed in both ethnic groups responded that they had made effort to select for desired traits in their cattle herds, whereas only between 15% and 26% had made similar efforts for sheep and goats. According to the herders, their main breeding strategy was to control the bull that mated their cows or heifers. This response was in agreement with the observation (Köhler-Rollefson, 2000) that most pastoralists' selec-

tion efforts focus on male animals, which are usually chosen on the basis of their female relatives' performance, their vigor, and their phenotypic characteristics. Where the breeding bull of interest is in another herd, a herder can borrow the bull, free of charge, to stay in his herd for up to three months or more. Alternatively, the herder can place his cows in the bull's herd for mating. In our survey, about 40% of respondents reported that the breeding bulls for mating their cows come from another herd in the village (Fig. 4). The practice of using a bull from another herd to mate cows or heifers will prevent inbreeding, and it is often done in the expectation that the cows will be served by a better bull. In view of this expectation, the Fulani take great care to ensure that bulls brought into their herd are of known quality (Blench, 1999), whereas they do not often control breeding in sheep and goats. Not only do herder's control the quality of the breeding bull, they also time the mating in order to ensure that the cows calve during the season of maximum grazing resources.

When asked about their selection criteria for breeding bulls, the herders mentioned parentage and history of progeny with good productive and reproductive performance, beautiful appearance, vigor, large body frame, preferred breed, and ease of handling. Both ethnic groups gave similar criteria for selecting breeding bulls (see Table V.). Though they do not keep written records, the pastoralists keep detailed mental records of their animals (McCorkle, 1999). After identifying the breeding bulls with desired characteristics, those that are not needed for breeding are usually castrated and later sold. Some herders, especially those that cultivate land, keep about two bulls for traction and or transport. Castrating male animals that are not suitable for breeding is an important mechanism for maintaining or improving desired qualities. However, Blench (1999) argued that castration is often done not for the primary goal of improving genetic quality but rather to

Table V Selection Criteria for a Breeding Bull According to Herders Interviewed per Ethnic Group in Southwestern Niger (% of the Respondents)

Criteria	Banizoumbou		Kodey		Tigo Tegui	
	Djerma (<i>n</i> = 10)	Fulani (<i>n</i> = 21)	Djerma (<i>n</i> = 10)	Fulani (<i>n</i> = 21)	Djerma (<i>n</i> = 13)	Fulani (<i>n</i> = 20)
History of parent and progeny with good milk production and reproductive performance	20.0	28.6	10.0	28.6	15.4	15.0
Beautiful appearance	10.0	19.0	20.0	14.3	23.1	10.0
Young, fat and strong	20.0	14.3	0	14.3	7.7	5.0
Good and well appreciated breed	10.0	4.8	10.0	4.8	23.1	25.0
Large body frame	20.0	9.5	0	14.3	15.4	20.0
Good health	0	4.8	0	4.8	0	5.0
Aggressiveness and persistence in mating cows (strong libido)	0	4.8	10.0	4.8	0	5.0
Resistance to harsh conditions	0	4.8	20.0	9.5	7.7	5.0
Easy to handle	0	4.8	10.0	4.8	0	5.0
No response	20.0	4.8	20.0	0	7.7	5.0

control animals of unsuitable temperament. Sale of male animals not needed for breeding has been widely reported among pastoralists (Blench, 1999; Swift and Maliki, 1984), especially to buy grains in the dry season. According to Swift and Maliki (1984), poor households often sell their animals at one or two years of age, well before the optimal age for sale. Male sheep (rams) are always in high demand during the Islamic festival of Tabaski and some herders sell their animals to take advantage of the good price. White rams are greatly preferred for the festival and do attract higher prices. In addition, small ruminants are often sold to meet emergency cash needs.

Breeding males are normally replaced when they get old and their performance declines. Other reasons given for replacing breeding males were marked decline in strength and poor performance, emergency financial need, availability of a better performing breeding male, and wild behavior. Some of these reasons are similar to criteria often used in intensive cattle production systems in temperate countries where there is systematic evaluation of the breeding soundness of the bulls. However, pastoralists always keep breeding males, if healthy, for quite a long time (Köhler-Rollefson, 2000). In this study, herders reported replacing bulls between seven and eleven years, while rams/bucks were replaced between three and five years. When asked about reasons for replacing cows, the herders mentioned old age, ill health, and low milk yield.

Conclusions: Implications for Management of Animal Genetic Resources and Livestock Diversity

Results from this study reaffirm that the breeding decisions of pastoralists and agropastoralists are designed to meet multiple objectives. Therefore, there is need for a holistic

approach towards management of animal genetic resources and conservation of domestic animal diversity, especially by the research community. Participation of pastoralists from the planning stage of a breeding and conservation program through to implementation and evaluation should be given top priority by researchers, development agencies, and policymakers. Though there is a better interaction now between the research/development community and pastoral associations than a decade ago, pastoralists are still largely ignored in the design and implementation of many livestock-related projects in the West African Sahel. For example, *Projet Azawak*, is designed to improve milk production of Azawak cattle in Azawak valley of Niger, is run by a development agency and local Non-Governmental Organizations (NGO). Cows of pastoralists and agropastoralists are being mated by selected Azawak bulls from government ranch without considering the breeding objectives and selection criteria of the owners (Les Echos du Sahel, 2004). Building on traditional breeding institutions such as community bulls, stock exchanges or loan schemes, castration and ritual protection is a practical approach to advance community-based management of animal genetic resources (Köhler-Rollefson, 2000). The overriding goal of community-based animal genetic resources management and conservation should be the empowerment of the local people to manage their resources.

The characterization of local breeds of cattle, sheep, and goats by herders interviewed demonstrates the importance of indigenous knowledge in management and conservation of livestock breeds. Therefore, understanding and systematic documentation of indigenous knowledge of local breeds should be the starting point of livestock breeding and conservation programs (Rege *et al.*, 2001). The ethnic-specific preferences for cattle breeds in the study suggest that adoption of animal-related technologies may be

influenced by such preferences. In addition to cultural preferences for local breeds, mode of acquisition of animal into the herd, livestock mobility, and increasing sedentarization of the pastoralists to cultivate land are important factors to be considered in developing livestock breeding strategies and conservation. For instance, animals from absentee owners and transhumant herders may enhance the genetic variation of a herd but may also lead to genetic erosion if the breeding bull is inferior to the one in the herd. Breeding programs that provide practical guidelines on judging breeding soundness of bulls based on a blend of local knowledge and scientific results will aid herders in deciding to accept animals from outside. Efforts to develop local breeds should always take into consideration the multiple breeding goals of the pastoralists and should fully respect cultural preferences of the people.

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