WHITE FULANI CATTLE OF WEST AND CENTRAL AFRICA

C.L. Tawah' and J.E.O. Rege[2]
'Centre for Animal and Veterinary Research. P.O. Box 65, Ngaoundere, Adamawa Province, CAMEROON
[2]International Livestock Research Institute, P.O. Box 5689, Addis Ababa, ETHIOPIA

SUMMARY

The paper reviews information on the White Fulani cattle under the headings: origin, classification, distribution, population statistics, ecological settings, utility, husbandry practices, physical characteristics, special genetic characteristics, adaptive attributes and performance characteristics. It was concluded that the breed is economically important for several local communities in many West and Central African countries. The population of the breed is substantial. However, introgression from exotic cattle breeds as well as interbreeding with local breeds represent the major threat to the breed. The review identified a lack of programmes to develop the breed as being inimical to its long-term existence.

RESUME

L'article repasse l'information sur la race White Fulani du point de vue: origine, classement, distribution, statistique de population, contexte écologique, utilité, pratiques de conduites, caractéristiques physiques, caractéristiques génétiques spéciales, adaptabilité, et performances. On conclu que la race est importante du point de vue économique pour diverses communautés rurales dans la plupart des régions orientales et centrale de l'Afrique. Le nombre total de cette race est important; cependant, l'introduction de races exotiques, ainsi que le croisement avec des races locales représente le risque le plus important pour cette race. Cet article souligne également le fait que le manque de programmes de développement à long terme représente un risque important pour la conservation de cette race.

1.0 INTRODUCTION

The White Fulani are the most numerous of the Nigerian cattle breeds and have socioeconomic importance and wide distribution in several West African countries. This breed is currently threatened by persistent interbreeding with other cattle breeds (e.g. Muturu, Gudali). At the same time, very little effort has been made to ensure that they are characterized and documented, despite their invaluable qualities.

The Fulani cattle are mainly owned by the nomadic Fulani people who occupy the belt between the Sahara and the Rainforest from the west of the River Senegal to the east of Lake Chad, including parts of western Senegal, southern Mauritania, in and around the flood plains of Niger, Chad, northern Nigeria and Cameroon.

2.0 ORIGIN AND CLASSIFICATION

The origin of the Fula_ni c_attle, is quite controversial. Loftus et ul. (1994) have observed that the origins and history of African cattle are complex because of the often emerging varieties due to the intricate web of nomadic movements and pastoralist migrations. Moreover, the introduction of exotic genes into these populations may have changed their constitution over time this malcing it difficult to trace their time origins. Several theories have been postulated to trace the origin of the White Fulani.

One school of thought is of the opinion that the Fulani cattle are truly longhorned zebus that first arrived into the East African coast between the neolithic era of the Duccan and the latest pre-historic (2500-1500 BC) period (Fricke, 1979). The longhorned zebus are believed to have been introduced into West Africa by the Arab invaders during the seventh century, AD (Joshi et al., 1957), roughly about the same time that the shorthorned zebus arrived into East Africa. The appearance of a distinct hump in a newborn calf, especially in the bull calf, and the characteristic nature of the skull and thoracic vertebrae (Olaloku, 1972) point to the Fulani as a longhorned zebu.

Another school of thought (e.g. Curson and Thornton, 1936; Stewart, 1937; Gates, 1952; Faulkner and Epstein, 1957; Joshi et al., I957; Epstein, 1971; Mason, 1987) contends that these cattle originated from the Horn of Africa, present-day Ethiopia and Somalia, and that interbreeding between the shorthorned zebu (which arrived in the Horn around the first millennium BC) and the ancient Hamitic Longhorn and/or Brachyceros Shorthorn (which had arrived much earlier) occurred in the Horn about 2000-1500 BC. The subsequent successive introductions of zebu cattle (the shorthorned zebu) are believed to have displaced most of these sanga cattle into Southern Africa (Mason, 1987). During this period, which was characterized by constant movements of people and animals within Africa, some of these sanga cattle probably intermixed with the shorthorned thoracic-humped cattle to produee the so-called thoracic-humped sanga. The latter may have migrated, most probably along with the spread ot lslam, westerly to constitute what is today the lyre-horned cattle of West and Central Africa, including the Fulani cattle.

The characteristic cranial (primigenius) character (Faulkner and Epstein, 1957) and the giant lyre-horns (Curson and Thornton, 1936), coupled with the apparent tolerance of this breed to trypanosomiasis (Stewart, 1937), have lent support to the thesis that the Fulani has *l3os taurus* breeding. These large horns were, most probably, derived from an intermingling of the thoracic-humped shorthorned zebu (on its westerly passage) with either the humpless Longhorn x cervico-thoracic-humped zebu or the humpless Longhorn x thoracic-humped zebu. The latter sanga types were probably bred in either Darfur and Wadai in the Sudan or Lake Chad region. Payne (1964, 1970) has also described the westerly passage of a zebu breed similar to the White Fulani from Darfur and Wadai in Sudan to Lake Chad, Bornu and Kano in West Africa in the fifteenth century. This is supported by the presence today of some Fellata and Habani cattle in Sudan, considered similar to the Fulani cattle of West Africa. These animals were introduced by Arab traders, who apparently encountered, on arrival, the taurine Kuri and N'Dama cattle (Payne, 1970). Kennedy (1958) has reported evidence of the passage of the Hamitic Longhorns on rock paintings in Birnin Kudu on the Bauchi Plateau in Nigeria, areas where only zebu or sanga cattle are present

today. None of these authors has, however, explicitly referred to the White Fulani as a sanga.

Evidence supporting the contention that the Fulani cattle have taurine genes has come from studies of allele frequencies controlling adult haemoglobin in cattle which have suggested that the White Fulani has allele frequencies which are intermediate between that of the Ankole (sanga) and the Nganda (zebu x sanga) types (Epstein, 1971). Additionally, an analysis of the haemoglobin gene frequencies (Petit, 1968; Queval et al. , 1971) has shown that Hb^A is more abundant (0.62-0.70 vs 0.38-0.58) in the Fulani cattle (the Gobra, Red Fulani and Sudanese Fulani) than in the typical zebu cattle (Brahman, Madagascar Zebu and Arab Zebu). Conversely, Hb^B is more abundant (0.42-0.62 vs 0.30-0.38) in the latter than in the former group. The low frequency of Hb^B in both Fulani and taurine breeds (Petit, 1968) is indicative of probable common heritage in evolutionary history.

The Fulani cattle form a group of their own. They are different from the typical zebu of Western and Eastern Africa by the presence of long horns. They differ from the cervico-thoracic-humped sanga of Eastern and Southern Africa by the presence of a thoracic or sometimes intermediate hump. The Fulani cattle have been classified into two subgroups. The lyre-horned subgroup is comprised of the Senegalese Fulani (or the Gobra), the Sudanese Fulani and the White Fulani (Doutressoulle, 1947; Payne, 1970; Mason, 1988). The long lyreliviimed subgroup is represented mainly by the Red Fulani or Rahaji (Payne, 1970; Mason, 1988). The Senegalese and White Fulani are much larger than the Sudanese Fulani. The coat of the Senegalese and White Fulani is predominantly white whereas that of the Sudanese Fulani is quite variable, usually with a spotted light grey (Mason, 1951; Payne, 1970).

3.0 POPULATION STATISTIC'S AND DISTRIBUTION

Estimates of the population of White Fulani (table 1) clearly show that this breed is not in any danger of disappearing. The White Fulani are the most numerous and widespread of all the Nigerian cattle breeds; representing about 37.2% of the national cattle population (RIM, 1.992). In Cameroon, they represent approximately 33% of the national cattle population and are only second to the Rahaji population. Population statistics of the White Fulani are not available in the ILCA data base (ILCA, 1992) for Ghana, Sudan and Niger. Lamorde and Franti (1975) have presented approximate distributions of the White Fulani herds in northern Nigeria as follows: Benue Plateau (247 herds), Kano (241), North Western (71), North Central (45) and North Eastern (223). Despite the relatively large populations of the White Fulani in the region, introgression of other cattle breeds into this breed (e.g. Muturu or Gudali) should be cause for concern. A recent survey in the Adamawa region of the Cameroon has shown that most White Fulani breeders tend to cross their animals with the Gudali in order to readily sell them (IRZ/GTZ, 1989).

4.0 ECOLOGICAL SETTINGS

The climatic environment in the areas in which the White Fulani are predominantly found is tropical and characterized by two well-defined seasons - the wet and dry seasons and two prevailing wind systems - the south-west rain-bearing wind from the Gulf of Guinea and the dry north-easterly dust-laden wind (the harmattan).

The vegetation varies from closed forest in Derived savannah to light forest and open woodlands in the Guinea savannah. Most trees in the Guinea savannah are fire-tolerant and inchide *Daniellia oliver·i* and *I.s·oberlinia spp.* The major grass species have been described by Tawah and Rege (1994), with *Hypar·rhenia* spp. being the most common. Luxuriant growth of many tall grasses, such as Gamba grass *(Andropogon tectorum* and A. *gayanus)* and Guinea grass *(Panicum maximum),* is characteristic of the Derived and Guinea savannah zones.

The distribution of the tsetse fly is quite variable. *Glossina longipalpis* is found mainly in the heavy woodlands of the southern Guinea savannah, while the riverine species of *Glos·sina taclzinoides* is tound along the riverbanks, especially during the wet season. The semi-arid zones and the Adamawa and Bauchi Plateaux are permanently free of tsetse flies. Thus, some of these

cattle are located in tsetse-free areas, while others are in tsetse-infested areas. This factor has significant influence on both the distribution pattern of the White Fulani in the region and the management practices adopted by their owners.

5.0 UTILITY, HUSBANDRY PRACTICES AND PRODUCTION SYSTEMS

White Fulani cattle are triple-purposed - milk, meat and draught - animals, but are kept mainly for milk by their traditional owners (Payne, 1970; Olutogun, 1976). Its dairy potential is better than that of most zebus in the region (Oyenuga, 1967), but is comparable to that of the Kenana in the Sudan (Osman, 1984). The White Fulani is also a good draught animal by virtue of its docility, tractability, conformation and body size (Mason, 1951; Gates, 1952; Faulkner and Epstein, 1957; Payne, 1970). However, it is slow and sluggish. It is a good beef animal which fattens quite well in feedlots (Olayiwole et al., 1981) and on natural pastures (Faulkner and Epstein, 1957).

Herd sizes and herd structures of the White Fulani vary considerably (Otchere, 1986a; IRZ/ GTZ, 1989; Rege et al., 1993a). Herd sizes have ranged from 13 to 135 head per owner and herd composition has averaged 54.6% adult females, 13.5% adult males, 8.0% young bulls, 13.0% heifers and 11.1% calves (Rege et al., 1993a) in the subhumid zone of Nigeria. Breeding is usually not controlled - thus cows are bred throughout the year. Moreover, unwanted bulls are generally not. castrated - unless they are troublesome - and, in any case, castration is only done when bulls are at least two years of age.

6.0 PHYSICAL CHARACTERISTICS

6.1 Body size and conformation

Estimates of mature (adult) live weights and body measurements are presented in table 3. There was complete lack of information in the literature reviewed on bulls in village herds. Available figures indicate substantial variations in mature live weight and body rzzeasurements in the male and female populations.

The White Fulani is generally taller and narrower-bodied than most European cattle breeds (Hall, 1991). They are fairly medium to large size, with a well-balanced body of good depth and width. The barrel is well sprung and of good capacity. The topline is strong but slopes gently from the hump to a somewhat high sacrum. The back is generally of good width with reasonably satisfactory muscular development. The rump is of good length but has a marked slope from hook to pinbones, which tend to be narrow in some animals. The general shallowness of the body and lack of width give the animal a "leggy" appearance. This characteristic of the breed has been described as an adaptation to long distance trekking (Oyenuga, 1967; Capitaine, 1972). The tail is thin and long, the brush (tail switch) almost reaching the ground. The limbs are of moderate length; the front limbs being well placed with the shoulders which are smoothly covered but not unduly prominent. The hindlimbs are reasonably well-developed, with upper thighs being of fair breadth and fullness. Its bones are clean, light but hard and of good quality.

The hump is well developed, moreso in the males than in the females. It sometimes tends to hang over at the back in the males like in the Gudali. The hump is musculo-fatty (Mason, 1951; Gates, 1992; Ogunsiji, 1974). As alluded to, its placement on the vertebral column is either thoracic or cervico-thoracic. The dewlap is well-developed and fairly large, espPsially in the bulls. It commences at the throat and is carried well between the front legs. Folding of the dewlap is commonly seen. Umbilical (navel flap) and sheath folds are welldeveloped.

The head is long and of good proportion, being wide across the forehead and having fairly prominent orbital arches, unlike in the shorthorned zebus (Payne, 1970). In profile, the head is straight or slightly dished (concave). The neck is strong and deep, providing an upright carriage for the head. The horns are medium to long in length in contrast to the very long horns of the Red Fulani. The horns are slender, well proportioned and carried high on the head. They are also round in cross-section and curve outwards and upwards soon after leaving the head. Most animals

have horns with an outward twist at the tips, giving the characteristic lyre shape. The horns vary in length from about 81 to 107 cm, with pointed tips (Faulkner and Epstein, 1957). The ears are of medium size, erect and set horizontally, showing the inner parts with the'black points to the front. The udder of the White Fulani is fairly well-developed, is of good shape and is strongly attached. The teats are well positioned and are of medium to reasonably large size.

6.2 Coat and skin colour

The coat of the White Fulani is commonly white on a black skin with black ears, eyes, muzzle, hooves, horn tips and tip of tail. There are a few cases with black coats mixed with dark fl cckings, or red-and-white coats (Payne, 1970). Black fleckings on the sides and Iimbs are fairly common and red markings are frequent. Where variations exist in coat colour, there are many possible combinations of black and white on a black skin or red and white on a white skin (Mason, 1951; Gates, 1952; Faulkner and Epstein, 1957; Ogunsiji, 1974). The skin is loose and pigmented and the hair is soft (Payne, 1970).

7.0 ADAPTIVE CHARACTERISTICS

Estimates of cumulative mortality rate of White Fulani cattle at one year of age, both on-farm and on-station, are presented in table 4. The White Fulani is less tolerant to trypanosomiasis than the N'Dama (Roberts and Gray, 1973b; Hill and Esuruoso, 1976) but is more tolerant than the Gudali and other zebu types (Faulkner and Brown, 1953; Faulkner and Epstein, 1957). Ross et al. (1959) have suggested the existence of a genetic basis for the resistance of White Fulani cattle to intestinal helminths as well. The White Fulani cattle have also been reported to be more resistant to dermatophilosis than the Muturu and N'Dama breeds (Amakiri, 1974; Nwufoh and Amakiri, 1981).

Studies of anatomical and physiological features related to heat tolerance mechanisms (table 5) show that the White Fulani is more heat tolerant than the N'Dama and the Gudali in Nigeria (e.g. Amakiri and Mordi, 1975). This is reflected in their low respiration rate and heat tolerance index. The White Fulani also exhibited less panting and salivation under heat stress (Buvanendran et al., 1992). The White Fulani have a.tendency to sweat much more profusely than the Gudali, N'Dama, the Muturu and Holstein Friesians when exposed to similar high ambient temperatures (e.g. Amakiri and Mordi, 1975; Amakiri and Onwuka, 1980). Indeed, the White Fulani has been reported to be the least stressed breed in the hot climates of Nigeria (Igono and Aliu, 1982).

White Fulani herd

8.0 PRODUCTION CHARACTERISTICS

8.1 Growth and liveweights

Lstimates of liveweights from birth to weaning (table 6) and postweaning (table î) suggest substantial variation in the growth of the White Fulani. Feedlot studies have shown that the White Fulani cattle are able to achieve growth performance of up to 1 kg per day (Harbers et al., 1972; Olaloku, 1980; Olayiwole and Fulani, 1979; Olayiwole et al., 1975, 198I, 1986; Ngere, 1985a).

8.2 Carcass characteristics

Several studies have reported on carcass weight of the White Fulani (Clotte, 1972; Harbers et al.,1972; Johnson and Bell,1978; Olaloku,1980; Buvanendran et al.,1983; Ngere, 1985a) but hardly any reports were available on carcass quality. Harbers et al. (1972), Buvanendran et al. (1983) and Ngere (1985a) have reported a range of 310-445 kg for slaughter weight and of 165-250 lcg for carcass weight in well finished young bulls. Johnson and Bell (1978) have reported slaughter weights of 325 kg and carcass weights of 166 kg in well finished steers. Carcasses have yielded dressing-out percentages of between 50 and 60% (Gates, 1952; Payne, 1970; Olayiwole and Fulani, 1979; Buvanendran et al., 1983; Ngere, 1985a).

8.3 Reproductive characteristics

8.3.1 Male reproduction

Puberty, defined as the age at which ejaculated semen contains at least 5×10^7 spermatozoa with a minimum of 10% motility (Rekwot et al., 1987), is a major determinant of optimum reproductive efficiency. Age at puberty has ranged from as early as IS months under a high protein diet (Rekwot et al., 1987) to as late as 17 months under range conditions (Oyedipe et al., 1981). Age at first service in the White Fulani bulls has ranged from 36 to 54 months under station conditions in Nigeria (Faulkner and Epstein, 1957; Foster, 1960; Oyenuga, 1967).

8.3.2 Female reproduction

The reproductive performance of White Fulani females is presented in table 8. Age at first calving as low as 25.4 months (e.g. Knudsen and Sohael, 1970; Roberts and Gray, 1973a) and calving interval as short as 360 days (e.g. Knudsen and Sohael, 1970; Pullan, 1979) have been reported on station. In contrast, extreme figures of 73 months and 810 days, respectively, have been reported by Pullan (1979, 1980), among others, under traditional management. Supplementation has been shown to reduce age at first calving from 73 months to about 40 months in village herds (Pullan, 1979; Synge, 1980; Otchere, 1986a). Calving rate, which has been defined as a percentage of the number of calves dropped to the number of cows mated in a year, ranged from 53% to 90% under statiori conditions. In coiztrast, calving rate which was inuch lower in village herds ranged from 38o/o in unsupplemented t:ûditioinal systems to 72% in supplemented village systems (e.g. Synge, 1980; Otchere, 1986a).

8.4 Milk production characteristics

Estimates of lactation milk yield of the White Fulani cows maintained under various management systems are presented in table 9. Few studies have reported on the constituents of the White Fulani milk. Some of these studies (table 2) point to a wide range in milk butterfat percent and solids-not-fat (SNF).

9.0 REFERENCES

Adamu A.M., Eduvie L.O., Lufadeju E.A., Ehoche W.O., Okaiyeto P.O., Olorunju S.A.S., Hena S.W. and Tanko R.J. 1990a. Wet season nitrogen, phosphorus and sodium supplementation of Bunaji heifers grazing native pastures. NAPRI Annual Report, 1990, Shika-Zaria, Nigeria. p.107-111.

Adamu A.M., Eduvie L.O., Lufadeju E.A., Ehoche W.O., Okaiyeto P.O., Olorunju S.A.S., Hena S.W. and Tanko R.J. 1990b. Urea/molasses supplementation of Bunaji heifers grazing cereal residues and native pastures. NAPRI Annual Report, 1990, Shika-Zaria, Nigeria. p.102-106.

Adeyemo O. 1986. Serum progesterone levels in monitoring ovarian activity in White Fulani (Zebu) dairy cattle after parturition. Proceedings of a symposium, jointly organized by IAEA and FAO in Vienna, Austria, 17-21 March. In: Nuclear and related Techniques in Animal Production and Health. p.597-601

Aganga A.A., Oyejola B.A., Aganga A.O. and Yaakugh I.D.I. 1986. Reproductive performance of White Fulani cows. Thai J. Agric. Sci. 19:225-229.

Amakiri S.F. 1974. Sweat gland measurements in some tropical and temperate breeds of cattle in Nigeria. Anim. Prod. 18:285-291.

Amakiri S.F. and Funsho O.N.1979. Studies of rectal temperature, respiratory rates and heat tolerance in cattle in the humid tropics. Anim. Prod. 28:329-335.

Amakiri S.F. and Mordi R. 1975. The rate of cutaneous evaporation in some tropical and temperate breeds of cattle in Nigeria. Anim. Prod. 20:63-68.

Amakiri S.F. and Onwuka S.K. 1980. Quantitative studies of sweating rate in some cattle breeds in a humid tropical environment. Anim. Prod. 30:383-388.

Buvanendran V., Adamu A.M. and Abubakar B.Y. 1992. Heat tolerance of Zebu and Friesian-Zebu crosses in the Guinea Savanna Zone of Nigeria. Trop. Agric. (Trinidad) 69(4):394-396.

Buvanendran V., Ikhatua U.J., Abubakar B.Y. and Olayiwole M.B. 1983. Carcass characteristics of indigenous breeds of cattle in Nigeria. J. Agric. Sci. (Cambridge) 100:407-411.

Capitaine P. 1972. Projet de Développement de l'Elevage au Ghana. Etudes de factibilité de quatre ranches. Etude Zootechnique, IEMVT, France, 103pp.

Clotte St. J. 1972. Comparative evaluation of carcass and offal traits of tropical and temperate cattle. Trop. Agric. (Trinidad) 49:9-I3.

Curson H.H. and Thornton R.W. 1936. A contribution to the study of African Native cattle. Onderstepoort J. Vet. Sci. Anim. Industry 7(2):613-739.

Dawuda P.M., Eduvie L.O., Esievo K.A.N. and Molokwu E.C.I. 1988a. Interval between calving and first observable oestrus in postpartum Bunaji cows. Br. Vet. J. 144:258261.

Dawuda P.M., Oyedipe E.O., Pathiraja N. and Voh A.A. Jr. 1988b. Serum progesterone concentrations during the postpartum period of indigenous Nigerian Zebu cows. Br. Vet. J. 144:253-257.

,Dawuda P.M., Eduvie L.O., Esievo K.A.N. and Molokwu E.C.I. 1987. Factors affecting the intervals between calving and resumption of ovarian activities in indigenous cattle: interval between calving and first observable oestrus in postpartum Bunaji cows. NAPRI Annual Report, 1987 Shika-Zaria, Nigeria. p.93-95.

Dettmers A. and Williams T.A. 1978. Some genetic parameters in White Fulani (Bunaji) cows. Nigerian J. Genetics 2:45-52.

Doutressoulle G.1947. L'Elevage en Afrique Occidentale Française. Paris, Editions Larousse, 298pp.

Eduvie L.O. 1985. Factors affecting postpartum ovarian activity and uterine involution in Zebu cattle indigenous to Nigeria. Anim. Reprod. Sci. (The Netherlands) 8:123-128.

Eduvie L.O. and Dawuda P.M.1986. Effect of suckling on reproductive activities of Bunaji cows during the postpartum period. J. Agric. Sci. (Cambridge) 107:235-238.

Eduvie L.O., Njoku C.O., Addo P.B., Molokwu E.C.I. and Osori D.I.K. 1984. Gross and histological changes in the reproductive tract of suckled and non-suckled postpartum cows. J. Anim. Prod. Res. (Nigeria) 4(1):21-41.

Epstein H. 1971. The Origin of the Domestic Animals of Africa. Volume I. Africana Publishing Corporation, London. p.498-505.

Falua E.K. 1976. A study of reproductive efficiency of White Fulani cows as observed in Old Dairy of Teaching and Research Farm, Univ. Ibadan. DVM Dissertation, Univ. Ibadan, Nigeria, l9pp.

Faulkner D.E. and Brown J.D. 1953. The improvement of cattle in British Colonial Territories in Africa. Colonial Advisory Council of Agriculture, Ânimal Health and Forestry. HMSO, London. Publication No. 3, 144pp.

Faulkner D.E. and Epstein H. 1957. The indigenous cattle of British dependent territories in Africa. Colonial Advisory Council of Agriculture, Animal Health and Forestry. HiMSO, Lorndon. Publication No. 5, 186pp.

Foster W.H. 1960. The breeding of White Fulani cattle at Shika, Nigeria. Institute for Agricultural Research, Ahmadu Bello Univ., Samaru, Zaria, Nigeria. Samaru Res. Bull. No. 2, 31 pp.

Fricke W.1979. Cattle Husbandry in Nigeria: A study of its ecological conditions and socialgeographical differentiations. Heidelberger Geographische Arbeiten, Germany, 330pp.

Gates G.M. 1952. Breeds of cattle found in Nigeria. Farm and Forest (Nigeria) 11:19-43. Hall S.J.G. 1991. Body dimensions of Nigerian cattle, sheep and goats. Anim. Prod. 53:61-69. Harbers L.H., Schalles R.R., Okoye B.I.C. and Zemmelink G. 1972. Comparative study of

White Fulani, Friesian and White Fulani-Friesian bulls for meat production. Trop. Agric. (Trinidad) 49:1-8.

Hartley K. and Baker D.W.H. 1935. An unsual variation in the butterfat content of milk. J. Dairy Res. 6:353.

Hïll D.tl. 1tJS6. lObservations on the performance of a dairy herd of White Fulani (Bunaji) cattle at University College, Ibadan, under conditions of moderate exposure to infection from trypanosomes. Inter-African Bureau for Epizootic Diseases Technical Report No. 12, 25pp.

Hill D.H. and Esuruoso G.O. 1976. Trypanosomiasis in N'Dama and White Fulani heifers exposed to natural infection on a ranch in Western Nigeria. Bull. Anim. Hlth Prod. Afr. 24(2):117-124.

IAR. 1976. Report to the Board of Governors on the Institute's work in 1974-1975, Livestock Improvement Programme. Ahmadu Bello University, Zaria, Nigeria, 54pp.

Igono M.O. and Aliu Y.O. 1982. Adaptive thermal responses of the Zebu, half and threequarter Friesian-Zebu crosses to the hot-dry and Ilot-humid seasons. Bull. Anim. Hlth Prod. Afr. 30(4):329-333.

ILCA. 1992. Livestoclc Population Statistics for Sub-Saharan Africa: A Computerized Data Base. International Livestock Centre for Africa (ILCA), Addis Ababa, Ethiopia.

Irfam M. 1967. Improvement of cattle in Ghana. The Ghana Farmer 11 (2):53-57.

IRZ/GTZ. 1989. Livestoclc Farming Systems in Adamawa. Research Report No l. Institute of Animal Research (IRZ), Wakwa, Cameroon.

Jagun A.G. 1980. Calf mortality in Shika farm during 1975-1979. NAPRI Seminars 2:100110.

Johnson A.O. and Bell T.D. I978. Comparative performance of calves from Bunaji (White Fulani) dams and Charolais, three-quarter Friesian and Bunaji sires. J. Agric. Sci. (Cambridge) 91:305-308.

Johnson A.O. and Gambo A. 1979. Oestrus behaviour in Bunaji (White Fulani) heifers. J. Agric. Sci. (Cambridge) 92:689-694.

Joshi N.R., McLaughlin E.A. and Phillips R.W. 1957. Types and breeds of African cattle. FAO Agric. Studies No. 37, Rome, Italy.

Kennedy R.A. 1958. History Today 8:646.

Knudsen P.B. and Sohael A.S. 1970. The Vom herd: A study of the performance of mixed FriesiannZebu herds in a tropical environment. Trop. Agric. (Trinidad) 47:189-203.

Kumaresan A., Naharajan G. and Singh A. 1983. Serum thyroxine and trüodothyronine concentrations in three breeds of cattle in Nigeria. J. Anim. Prod. Res. (Nigeria) 3(l):57-62.

Lamorde A.G. and Franti C.E. 1975. Nomadism and cattle production in Nigeria. Proceed. Ist Annual Conf. Nigerian Soc. Anim. Prod., Enugu, 14-17 July. p.l4-17.

Loftus R.T., MacHugh D.E., Bradley D.G., Sharp P.M. and Cunningham E.P. 1994. Evidence for two independent domestications of cattle. Proc. Natl. Acad. Sci (USA) 91:2757-2761.

Mason, I.L. 1988. A World Dictionary of Livestock Breeds, Types and Varieties. (3rd edition). CAB International, The Cambrian News Ltd (UK), 348pp.

Mason, I.L. 1987. Domestication and breed formation in cattle. Wld Rev. Anim. Prod. 23(3):71-76.

Mason I.L. 1951. The Classification of West African Livestock. Commonwealth Bureau of Animal Breeding and Genetics. Commonwealth Agric. Bureau, Farnham Royal, England. Tech. Comm. No. 7, p.l-10.

Maximuangu J.C. and Chaloux L.1978. Extension programme of the Bambui dairy project. IRZ Bambui Station, l4pp.

Miller T.B. 1961. Studies on the nutrition of Zebu cattle in N. Nigeria. I. Energy intake and milk production. Emp. J. Exper. Agric. 29:230-242.

Miller T.B. and Thorpe R.J. 1962. Potential production of White Fulani cattle under Shika System of Management. Samaru Agric. Newsletter No. 49, Samaru, Nigeria.

Mrode R.A. 1988. Lactation performance of the White Fulani cattle in Southern Nigeria. Trop. Anim. Hlth Prod. 20:149-154.

Ngere L.O. I985a. The White Fulani (Bunaji) of Nigeria. In: Animal Genetic Resources in Africa: High Potential and Endangered Livestock Proceed. 2nd OAU Expert Committee Meeting oNovember 24-28, 1983, Bulawayo, Zimbabwe. p.67-77.

Ngere L.O. 1985b. The Gudali of Nigeria - Review. In: Animal Genetic Resources in Africa: High Potential and Endangered Livestock Proceed. 2nd OAU Expert Committee Meeting November 24-28, 1983, Bulawayo, Zimbabwe. p.77-81.

Ngere L.O. 1975. The im.provement of livestoclc production in Nigeria through breeding. Nigerian J. Anim. Prod. 2(1):36-43.

Nwufoh K.J. and Amakiri S.K. 1981. The normal skin bacterial flora of some cattle breeds iri Nigeria. Bull. Anim. Hlth Prod. Afr. 29:103-105.

Ogunsiji O. 1974. Length and level of preparum feeding on the milk of W. Fulani cows in Ibadan. Ph.D. Thesis, Univ. Ibadan, Nigeria, 356pp.

Olaloku E.A. 1980. Problems of intensive beef production in the derived and Southern Guinea vegetation zones of Nigeria. Premier Colloque International: Recherches sur l'Eleva e Bovin en Zone Tro icale Humide, 18-22 avril, Bouaké, Côte d Ivoire. p.671682.

Olaloku E.A. 1972. The effect of the level of feed, nutrient intake and stage of lactation on the milk of White Fulani cows at Ibadan. Ph.D. Thesis, Univ. Ibadan, Nigeria.

Olaloku E.A., Hill D.H. and Oyenuga V.A. 1971. Observations on the White Fulani (Bunaji) Zebu cattle of Northern Nigeria in a Southern Nigeria environment. I. Factors influencing the birth weight of calves at lbadan. Trop. Agric. (Trinidad) 48:209-216.

Olaloku E.A. and Oyenuga V.A. 1979. Observations on the White Fulani (Bunaji) Zebu cattle of Northern Nigeria in a Southern environment. VII. Dietary energy and protein utilization during lactation at Ibadan. East African Agric. Forestry J. 42:296-303.

Olaloku E.A. and Oyenuga V.A. 1976. Feed intake and milk yield of White Fulani (Bunaji) Zebu cattle as influenced by the stage of lactation. J. Assoc. Adv. Agric. Sci. Afr. 3(1):20-26.

Olaloku E.A. and Oyenuga V.A. 1974. Feed intake, yield and composition of millc of cows fed supplementary concentrate at pasture. East African Agric. Forestry J. 40:103-110.

Olaloku E.A. and Oyenuga V.A. 1973. Studies on the White Fulani (Bunaji) Zebu cattle: The effect of stage of lactation, age of cow and seasons of the year on milk yield, butterfat and solids-not-fat content of White Fulani eattle at Ibadan. J. Assoc. Adv. Agric. Sci. Afr. (Suppl.l):20-31.

Olayiwole M.B., Ahmed M.B. and Bell T.D. 1975. Feedlot performance and carcass characteristics of steers fed high energy rations. Nigerian J. Anim. Prod. 2(2):270-276.

Olayiwole M.B., Buvanendran V. Fulani I.J. and Ikhatua J.U. 1981. Intensive fattening of indigenous breeds of cattle in Nigeria. Wld Rev. Anim. Prod. 17(2):71-77.

Olayiwole M.B. and Fulani I.J. 1979. Economics of commercial beef production under feedlot system of management. NAPRI Seminars, Zaria. l:l67-177.

Olayiwole M.B., Olorunju S.A.S., Kera B.S., Agishi E.C., and Adesipe Y.M. 1986. Economics of feedlot technology. NAPRI Annual Report, 1986. Shika, Nigeria. p.l31-132.

Olutogun O. l 976. Reproductive performance and growth of N'Dama and Keteku cattle under ranching conditions in the Guinea Savannah of Nigeria. Ph.D. Thesis, Univ. Ibadan, Nigeria, 126pp.

Osman A.H. 1984. Sudanese indigenous cattle breeds and the strategy for their conservatïon and improvement. FAO Anim. Prod. Hlth Paper 44(l):58-66.

Otchere E.O. 1986a. Traditional cattle production in the subhumid zone of Nigeria. In: von Kaufmann, R., S. Chater and R. Bench (eds). Livestock Systems Research in Nigeria's Subhumid Zone. Proceed. 2nd ILCA/NAPRI Symposium, Kaduna, Nigeria, October 29-November 2,1984. International Livestock Centre for Africa (ILCA), Addis Ababa, Ethiopia, p.110-140.

Otchere E.O. 1983. The productivity of Bunaji (White Fulnai) cattle in pastoralist herds on the Kaduna plains of Nigeria. International Livestoclc Centre for Africa (ILCA) Subhumid Programme Kaduna. Internal Comm. No. 46. 27pp.

Oyedipe E.O., Kumi-Diaka J. and Osori D.I.K. 198I. Determination of onset of puberty in Zebu bulls under tropical conditions of Northern Nigeria. Theriogenology 16:419-43l.

Oyedipe E.O., Pathiraja N., Voh Jr. A.A., Eduvie L.O. and Marire B.N. 1987. The effect of Human Chorionic Gonadotrophin (HCG) on corpus luteum function in Zebuu cattle. NAPRI Annual Report, Shika-Zaria, Nigeria, p.91-92.

Oyenuga V.A. 1967. Agriculture in Nigeria: An Introduction. FAO, Rome, Italy, p.240-253. Payne W.J.A. 1970. Cattle Production in the Tropics. Volume I. Tropical Agricultural Series,

Longman Group Ltd, Western Printing Services Ltd, Bristol, Great Britain, 336pp. Payne W.J.A. 1964. The origin of domestic cattle in Africa. Empire J. Exp. Agric. 32:97-113. Petit J.P. 1968. Détermination de nature des hémoglobines chez 982 bovins africains et

malgaches (taurins et zébus) par électrophorè se sur acétate de cellulose. Rev. Elev. Méd. vét. Pays trop. 21(3):405-413.

Puilan N.B. ï980. Productivity of White Fulani cattle on the Jos Plateau, Nigeria. I1. Nutritional factors. Trop. Anim. Hlth Prod. 12:17-24.

Pullan N.B. 1979. Productivity of White Fulani cattle on the Jos Plateau, Nigeria. I. IHerd structures and reproductive performance. Trop. Anim. Hlth Prod. 11:231-238.

Pullan N.B. and Grindle R.J. 1980. Productivity of White Fulani cattle on the Jos Plateau. Nigeria. IV. Economic factors. Trop. Anim. Hlth Prod. 12:16I-I70.

Queval R., Petit J.P. and Hascoet M.C. 1971. Analyse des hémoglobines du Zébu arabe (Bos indicus). Rev. Elev. Méd. vét. Pays trop. 24 (1):47-51.

Rekwot P.I., Oyedipe E.O., Akerejola O.O., Kumi-Diaka J. and Umoh J.E. 1987. The effect of protein intake on the onset of puberty in Bunaji and Friesian x Bunaji crossbred bulls in Nigeria. Theriogenology 28(4):427-434.

Rege J.E.O., von Kaufmann R.R. and Mani R.I. 1993a. On-farm performance of Bunaji (White Fulani) cattle l. Herd stru.ctures and cattle disposal. Anim. Prod. 57:I99-209.

Rege J.E.O., von Kaufmann R.R., Mwenya W.N.M., Otchere E.O. and Mani R.I. 1993b. On-farm performance of Bunaji (White Fulani) cattle 2. Growth, reproductive performance, millc offtake and mortality. Anim. Prod. 57:211-220.

kIM. 1992. Nigerian Livestoclc Resources (6 vols). Report by Resource Inventory and

Management Limited (RIM) to FDLPCS, Abuja, Nigeria.

Roberts G.J. and Gray A.R. 1973a. Studies on Trypanosome-resistant cattle. I. The breeding and growth performance of N'Dama, Muturu and Zebu cattle maintained under the same conditions of husbandry. Trop. Anim. Hlth Prod. 5:211-219.

Roberts G.J. and Gray A.R. 1973b. Studies on Trypanosome-resistant cattle. II. The effect of trypanosomiasis on N'Dama, Muturu and Zebu cattle. Trop. Anim. Hlth Prod. 5:220-233.

Ross J.G., Lee R.P. and Armour J. 1959. Haemonchosis in Nigerian Zebu cattle. The influence of genetic factors in resistance. Vet. Rec. 71:27-31.

Ruthenberg H.1974. Artificial pastures and their utilization in the Southern Guinea Savannah and the Derived Savannah of West Africa. Tour d'horizon of an agricultural economist. Beef production on artificial pastures. Handbuch der Landwirtschaft u. Ernährung. In: cden W. Entw iclclungslä ndem 13:312-330.

SARS. 1972. Shilca Agricultural Research Station Annual Report (1971). Institute for Agricultural Research, Samaru, Ahmadu Bello Univ., Zaria, Nigeria, 39pp.

Stewart J.L. 1937. The cattle of the Gold Coast. Vet. Rec. 49(41):1289-1297.

Synge B.A. 1980. Factors limiting cattle productivity in highland areas of Nigeria II. Centre for Tropical Veterinary Medicine, Easter Bush, Roslin, Midlothian, Scotland, 50pp.

Tawah C.L. and Mbah D.A. 1989. Cattle Breed Evaluation and Improvement in Cameroon: A review of the situation. Institute of Animal Research (IRZ), Wakwa, Cameroon, 29pp.

Tawah, C.L. and Rege, J.E.O. 1994. Gudali cattle of West and Central Africa. Animal Genetic Resources Information, No. 17, FAO, Rome, Italy.

Umoh J.U. 1982. Relative survival of calves in a University herd in Zaria, Nigeria. Br. Vet. J. 138:507-514.

Umoh J.E. and Koch B.A. 1971. Consumption of salt and mineral mixtures, Shika Agricultural Research Station Annual Report, Zaria, Nigeria, p.21-22.

Umoh J.U. and Jagun A.G. 1981. A case-control study of calf mortality in Zaria. Nigerian VVet. J. 10:31-39.

van Raay J.G.T. 1975. Rural Planning in a Savannah Region (northern Nigeria). Rotterdam University Press, Rotterdam (The Netherlands), 183pp.

Wheat J.D. and Broadhurst J. 1968. Analysis of data on Bunaji cattle in Birnin Kudu and Kabomo, Northern Nigeria. Institute for Agricultural Research, Ahmadu Bello Univ., Samaru, Zaria, Nigeria. Samaru Miscellaneous Paper No. 25, l3pp.

Wheat J.D., de Leeuw P.N. and Koch B.A. 1972. Bunaji cattle at the Shika Research Station, North Central State, Nigeria. Institute for Agricultural Research, Ahmadu Bello Univ., Samaru, Zaria, Nigeria. Samaru Miscellaneous Paper No. 41, l2pp.

Zakari A.Y., Molokwu E.C.I. and Osori D.I.K. 1981. Effect of season on the oestrous cycle of rows *(I3os indicus)* indigenous to Northern Nigeria. Vet. Rec. 12:213-215.

TABLE 1:
Distribution and population statistics of the White Fulani cattle

Country	Synonym	Number	Year	Source	Habitat
Nigeria	Bunaji (Hausa)[a], Yakanaji (Fulani), White Kano	4335000 7670850 5118547	1985 1992 1992	Ngere, (1985b) ILCA (1992) RIM (1992)	Northern Nigeria: Kano, Katsino, Bauchi, Sokoto, Zaria, Bornu Plateau, Adamawa, Benue Southern Nigeria: (recent introducion) Ibadan, Lagos
Cameroon	Aku (Fulani), Akou (French), White Fulani, White M'Bororo	845688 1373615	1989 1992	Tawah & Mbah (1989) ILCA (1992)	North West (Bamenda Highlands) Adamawa North Far North
Central African Republic	Akou	600000	1992	ILCA (1992)	North, Northwest and Central Regions
Sudan	Fulbe, Tulus, Umbororo, White Fellata	250000	1994	Mohammed (unpub.)	Southern Sudan
Ghana	White Fulani	NA[b]			NA

[a]*Names in parentheses refer to the origin. of the synonym*
[b]*NA = not available*

TABLE 2:
Composition of White Fulani milk (%)

Milk constituents	Mean	Standard deviation
Butterfat	4.10-7.50	0.28
Solids-not-fat (SNF)	8.39-9.12	0.13-0.15
Proteins	3.73-3.99	0.09-0.14
Lactose	4.24-4.24	0.09-0.11
Minerals	0.67-0.68	0.02-0.05
Total. Solids	12.51	0.38

Adapted from: Hartley & Baker, 1935; Hill, 1956; Miller, 1961; Irfam, 1967; Oyenuga, 1967; Payne, I970; Ogunsiji, 1974; Ngere, 1975; Olaloku and Oyenuga, 1973, 1974, 1976

Table 3: *Mature weight and adult linear body measurements in the White Fulani*

	Husbandry system		
	"Improved"		Village
Trait	**Bull**	**Cow**	**Cow**
Mature weight, kg	425-665 (14)[a]	250-380 (191)	270-310 (50-395)
Height at withers, cm	130-152	118-137	-
Body length, cm	152	117-137	-
Heart girth, cm	193 (7)	145-161 (141)	155 (50)
Width at hips, cm	45	40-41 (27)	-
Hip height, cm	-	122 (110)	-
Rump length, cm		39-42 (27-110)	

[a]Number of animals sampled

Adapted from:

Mason, 1951; Gates, 1952; Faulkner & Epstein, 1957; Joshi et al., 1957; Foster, 1960; Oyenuga, 1967; Wheat & Broadhurst, 1968; Payne, 1970; Olaloku et al., 1971; Capitaine, 1972; Wheat et al., 1972; Roberts & Gray, 1973a; Ogunsiji, 1974; Ruthenberg, 1974; Olutogun, 1976; Buvanendran et al., 1980; Synge, 1980; Hall, 1991

Table 4: *Mortality rates in the White Fulani by location and management system*

Station/Country	Management System	Mortality (%)		Perinatal mortality rate (%)		Source
		Calf (≤1 yr.)	Adult	Abortion	Stillbirth	
Shika, Nigeria	Station	3.0-11.2	-	4.2	2.6	Jagun (1980); Umoh & Jagun (1981); Umoh (1982); Aganga *et al.* (1986)
Ibadan, Nigeria	Station	12.4	-	8.0	-	Falua (1976)
Bambui, Cameroon	Station	15.4	0.9	-	-	Tawah & Mbah (1989)
Jos Plateau, Nigeria	Village (supplemented)	2.9-3.3	-	-	-	Synge (1980)
Jos Plateau, Nigeria	Village	10.7-11.7	4.1	-	-	Pullan (1980); Synge (1980)
Kaduna, Nigeria	Village	12.5-22.4	-	-	-	Otchere (1986a); Rege *et al.* (1993b)

Table 5: *Heat tolerance characteristics of White Fulani cattle*

Trait	Mean ± se[a]	Source
Sweat gland measurements:		
Length, µm	354.0 ± 32.00	Amakiri (1974);
Diameter, µm	105.0 ± 3.00	Amakiri & Mordi (1975);
Shape (length/diameter), units	3.2 ± 0.34	Igono & Aliu (1982)
Volume, $\mu m^3 \times 10^6$	3.1 ± 0.45	Amakiri (1974);
Density, number/cm^2	1 584.0 ± 336.0	Amakiri & Mordi (1975);
	1 520.0 ± 212.0	Igono & Aliu (1982)
Sweating rate, $gm/m^2/hr$	1 209.6 ± 180	Amakiri & Onwuka (1980);
	105.8-161.3 ± 18.8	Igono & Aliu, 1982;
	77.5 - 172.0	Buvanendran *et al.* (1992)
Moisture loss/gland, $x10^{-6}$ g/hr	7.0 - 10.6	Igono & Aliu (1982)
Rectal temperature (RT),°C	38.3 - 38.9	Amakiri & Funsho (1979); Igono & Aliu (1982);
Respiratory rate (RR), flank movements/minute	15-30	Buvanendran *et al.* (1992)
Coefficient of adaptability[b] (CA, heat tolerance index)	2.0 - 2.3	Amakiri & Funsho (1979); Igono & Aliu (1982);
Heat tolerance coefficient (HTC)[c]	90.7	Buvanendran *et al.* (1992)

[a]Standard error
[b]CA = RT/38.33 + RR/23.0
[c]HTC = 100 - 10[RT_1 - RT_2], where RT_1 = rectal temperature at 16.00 hr and RT_2 = rectal temperature at 07.00 hr

Table 6: *Pre-weaning weights (±standard deviations) of White Fulani cattle by location and management system*

Location/Country	Management system	Birth weight (kg)		3 mo. weight (kg)		6 mo. weight (kg)		9 mo. weight (kg)		Source
		n[a]	Mean ± sd	n	Mean ± sd	n	Mean ± sd	n	Mean ± sd	
Shika, Nigeria	Station	3464	22.3 ± 1.1 (21.7-27.0)[b]	732	63.2±1.6 (62.5-66.9)	918	101.7 ± 13.4 (77.0-132.6)	580	126.5 ± 24.1	Faulkner & Epstein (1957); Foster (1960); Miller & Thorpe (1962); Oyenuga (1967); Umoh & Koch (1971); Wheat *et al.* (1972); IAR (1976); Johnson & Bell (1978); Oni *et al.* (1988).
Kabomo, Nigeria	Station	84	23.0 ± 4.6	70	81.5 ± 11.7	44	130.2 ± 23.2		-	Wheat & Broadhurst (1968)
Birnin Kudu, Nigeria	Station	118	21.7 ± 4.3	77	64.7 ± 13.2	77	130.8 ± 24.6		-	Wheat & Broadhurst (1968)
Vom, Nigeria	Station		24.2		-		129.4		-	Roberts & Gray (1973a)
Bambui, Cameroon	Station	120	23.1 ± 1.8	24	60.2 ± 3.6	19	88.7 ± 6.1	4	98.5 ± 9.8	Tawah & Mbah (1989)
Idon, Nigeria	Ranching	128	19.8		-	20	76.3 ± 15.2	3	99.7 ± 11.2	Otchere (1983)
Mando, Nigeria	Ranching	148	20.1		-	50	97.8 ± 25.5	51	128.7 ± 27.8	Otchere (1983)
Abet, Nigeria	Village	389	20.2 ± 8.3		-	250	61.6 ± 14.3	244	76.9 ± 23.4	Otchere (1986a); Rege *et al.* (1993b)
Kurmin Biri, Nigeria	Village	731	20.0 ± 11.1		-	163	74.1 ± 14.4	387	77.9 ± 33.4	Otchere (1983); Rege *et al.* (1993b)
Ganawuri, Nigeria	Village	277	19.9 ± 7.5		-		-	129	85.3 ± 26.1	Rege *et al.* (1993b)
Madauchi, Nigeria	Village	399	18.2 ± 9.4		-		-	129	67.0 ± 29.5	Rege *et al.* (1993b)

[a]Number of observations
[b]Figures in parentheses are ranges

Table 7: *Post-weaning weights (±standard errors) of White Fulani cattle by location and management system*

Location/Country	Management system	12mo. weight (kg)		18mo. weight (kg)		24mo. weight (kg)		30mo. weight (kg)		36mo. weight (kg)		48mo. weight (kg)		Source
		n*	Mean ± se	n	Mean ± se	n	Mean ± se	n	Mean ± se	n	Mean ± se	n	Mean ± se	
Shika, Nigeria	Station	658	145.1±0.4	392	188.8±0.9	345	226.8±1.5	313	267.0±2.2	256	302.4±2.2	138	336.5±4.1	Wheat *et al.* (1972); Oni *et al.* (1988)
Kabonzo, Nigeria	Station	22	214.2±6.2	9	255.6±8.0	8	333.9±8.1		-		-		-	Wheat & Broadhurst (1968)
Birnin Kudu, Nigeria	Station	69	180.5±3.2	62	236.5±4.1	42	278.1±5.3	30	300.0±9.4	26	322.0±9.4	11	335.2±12.9	Wheat & Broadhurst (1968)
Abet, Nigeria	Village	213	92.5±1.9	213	113.4±1.6		-		-		-		-	Otchere (1983); Rege *et al.* (1993b)
Kurmin Biri, Nigeria	Village	317	96.5±2.2	317	114.3±1.6		-		-		-		-	Otchere (1983); Rege *et al.* (1993b)
Ganawuri, Nigeria	Village	98	97.5±2.8		-		-		-		-		-	Rege *et al.* (1993b)
Madauchi, Nigeria	Village	109	82.1±3.4		-		-		-		-		-	Rege *et al.* (1993b)
Mando, Nigeria	Ranching	53	136.0±4.2	53	174.8±5.6		-		-		-		-	Otchere (1983)

*Number of observations

TABLE 8:
Reproductive characteristics (± standard deviations) of White Fulani females

Truits	n[a]	Mean ± sd	Source
Age at first service, months		26.2 ± 4.9	Aganga et al. (1986)
Length of productive life, no. of lactations (no. of years)		5.0 - 5.8 (9-10 yrs)	Payne (1970); Ngere (1975)v
Length of oestrus cycle, days	130	20.8 ± 2.0 (18.0 - 22.9)[b]	Johnson & Gambo (1979); Zakari et al. (1981); Oyedipe et al. (1987); Adamu et al. (1990a,b).
Duration of oestrus, hours	3	8.3 ± 4.6 (3.1 - 12.0)	Payne (1970); Johnson & Gambo (1979); Zakari et al. (1981)
Intensity of oestrus		4.12 ± 0.03	Zakari et al. (1981)
Interval from parturition to first oestrus, days	148	74.0 ± 51.3 (15.0 - 137.6)	Adayemo (1986); Dawuda et al. (1987); Dawuda et al. (1988a,b); Adamu et al. (1990a,b).
Interval from parturition to conception, days		43.8 ± 15.2 (146.7 ± 80.7)	Adayemo (1986); Eduvie & Dawuda (1986)
Interval from parturition to complete uterine involution, days	74	26.0 ± 1.1 (25.9 - 35.5)	Eduvie (1985); Dawuda et al. (1988b)
Interval postpartum to detection of first follicles, days	38	44.9	Eduvie (1985)
Interval pospartum to first ovulation, days	68	65.8	Eduvie (1985)
Interval from first follicle to first ovulation, days	36	43.3	Eduvie (1985)
Number of ovulations	82	1.7 ± 0.5	Adamu et al. (1990a,b)
Conception rate between 60 and 90 days postpartum, %	41	48.8 ± 26.1	Eduvie & Dawuda (1986)
Interval from parturition to first elevation of serum progesterone, days	6	37.0 ± 8.7	Adayemo (1986)
Initiation and completion of caruncular re-epithelialization postpartum, dayss		10-21	Eduvie et al. (1984)

[a]*Number of observations*
[b]*Figures in parentheses are ranges*

Table 9: *Lactation milk performance (±standard deviation) of White Fulani cattle*

Location/Country	Management system	Milking system	Lactation yield (kg)		Lactation length (days)		Butterfat percent	Daily milk yield (kg)	Source
			n[a]	Mean ± sd	n	Mean ± sd			
Shika, Nigeria	Station	Hand & Machine	3704	992.6 ± 118.3 (720-2240)[b]	3203	249.5 ± 9.2 (196-365)	7.5	4.2±0.07	Faulkner & Brown (1953); Faulkner & Epstein (1957); Foster (1960); Miller (1961); Oyenuga (1967); SARS (1972); IAR (1976)
Vom, Nigeria	Station	Machine	389	835 ± 343 (635-1130)	347	246.0 (241-246)	-	3.4	Knudsen & Sohael (1970)
Ibadan, Nigeria	Station	Hand	1085	932.5 ± 115.9 (855-2950)	1085	244.7 ± 10.0 (239-427)	4.5	3.8	Hill (1956); Joshi *et al.* (1957); Dettmers & Williams (1978); Ngere (1985a); Mrode (1988)
Ibadan, Nigeria	Station	Hand	94	1328.3 ± 16.8[c] (1310-1345)	38	240.0	5.6	5.5	Olaloku & Oyenuga (1973)
Accra, Ghana	Station	Most probably milked	498	623.2 ± 10.5	440	194 ± 64 (240-300)	-	3.7±0.5 (2.3-3.7)	Faulkner & Epstein (1957); Ngere (1985a)
Bambui, Cameroon	Station (supplemented)	Hand	-	465-555	-	173-200	-	-	Maximuangu & Chaloux (1978)
Bambui, Cameroon	Station	Hand	8	536.5 ± 114.3	8	175.5 ± 38.6	-	3.2±0.13	Tawah & Mbah (1989)
Jos Plateau, Nigeria	Village	Hand	-	-	-	-	4.5-5.9	0.27-0.87	Pullan (1979); Pullan & Grindle (1980); Synge (1980)
Jos Plateau, Nigeria	Village (supplemented)	Hand	-	-	-	-	-	0.87-1.06	Pullan (1979); Pullan & Grindle (1980); Synge (1980)
Kaduna, Nigeria	Village	Hand	-	-	-	-	-	0.34-0.42	Otchere (1983)
Kaduna, Nigeria	Village (supplemented)	Hand	-	-	-	-	-	0.54-0.75	Otchere (1983)
Zaria, Nigeria	Village (supplemented)	Hand	-	-	-	-	-	0.50-1.07	van Raay (1975)

[a]Number of observations
[b]Figures in parentheses are ranges
[c]Fat-corrected milk yield

GUDALI CATTLE OF WEST AND CENTRAL AFRICA

[1]C.L. Tawah and J.E.O. Rege[2]
[1]Centre for Animal and Veterinary Research. P.O. Box 65, Ngaoundere, Adamawa Province, CAMEROON
[2]International Livestock Research Institute, P.O. Box 5689, Addis Ababa, ETHIOPIA

SUMMARY

The objective of this paper was to compile the available information in the conventional and non-conventional literature on the origin, distribution, ecological settings, utility, husbandry practices and production systems of the Gudali, a West and Central African shorthorned zebu which is similar in conformation, size and origin to the East African shorthorned zebu. These animals are reputed not only for their beef and dairy qualities · but also for their hardiness to the harsh northerly environments. Under the prevailing circumstances in the pastoral systems, natural selection is the primary force affecting any genetic change and, as a result, animals tend to perform relatively poorly. Most of the documented studies have been limited in scope and applicability. Therefore, further studies are needed to adequately characterize these animals under their different production systems.

RESUME

L' objectif de cet article est de recueillir l' information disponible dans la littérature conventionnelle et non-conventionnelle au sujet de l'origine, la distribution, le contexte écologique, l'utilité, les pratiques de conduites et les systèmes de production de la race Gudali, zébu à courtes cornes de l'Afrique orientale et centrale, semblable du point de vue de la conformation, l'origine et la taille au zébu à courtes cornes de l'Afrique de l'est. Ces animaux sont réputés non seulement pour leur viande et leur qualité laitière, mais aussi pour leur résistance aux dures conditions environnementales du nord. Dans les conditions de systèmes pastoraux, la sélection naturelle est la force principale qui influence n'importe quel changement génétique et les animaux présentent des performances très limitées. La plupart des études réalisées ont eu un objectif très limité et peu d'applicabilité. Il est donc nécessaire de réaliser d'autres études afm de caractériser ces animaux sous les différents systèmes de production.

1.0 INTRODUCTION

The African indigenous livestock populations are not only in danger of complete dilution by imported exotics or complete extinction, they are also poorly characterized and not systematically classified. Halting the persistent decimation of potentially invaluable indigenous African animal germplasm and standardizing their classifications will require a "comprehensive" knowledge of not only their physical, biological and adaptive characteristics but also of the ecoclimatic environments in which they have survived and reproduced for several millennia. This is necessary to facilitate the development of strategies for the conservation and improvement of those breeds with high genetic potentials. In addition, it will facilitate the identification of genetic markers of adaptive traits for incorporation into breed improvement schemes. The objective of this paper is to compile available information in the conventional and non-conventional literature with the aim of identifying information gaps that will need to be filled to adequately characterize these populations.

2.0 ORIGIN AND CLASSIFICATION

Three ancestral bovine types which migrated into Africa from western Asia several centu:ies ago (Curson and Thorntorn, 1936; Faulkner and Epstein, 1957; Williamson arnd Payne, 1974; Payne, 1990) are believed to have contributed significantly to the present-day cattle types in the continent (Stewart, 1937; Williamson and Payne, 1974). These are the Hamitic or Egyptian Longhorns *(Bos taurus longifrons)* and the Brachyceros Shorthorns *(Bos taurus brachyceros)* which are both considered as the ancestral *Bos taurus* types, and the humped (Bos *indicus)* or zebu type (Payne, 1964). The latter have two recognized sub-types, namely, the lateral-horned cervico-thoracic-humped (the first humped type to arrive into Africa) and the thoracic-humped. The thoracic-humped (or zebu) sub-type is a comparative newcomer which is believed to have entered into Africa only about 1500 (Epstein and Mason, 1984) to 2500 years ago from India.

The precise centre of domestication of the zebu is unknown. However, it is believed that humped cattle, like their humpless counterparts, were first domesticated in western Asia, about 5000-6000 years ago (Payne, 1970) and that they migrated with Arab and Indian traders from the Indian sub-Continent in successive waves (Payne, 1964) into Africa via the Horn of Africa, i.e., present-day Ethiopia and Somalia (Epstein and Mason, 1984; Mason, 1987). From the Horn these animals subsequently dispersed northward into lower Egypt (Faulkner and Epstein, 1957) and, comparatively recently, westward into the West and Central African region (Curson and Thornton, 1936; Epstein, 1971; Payne, 1990). The zebu probably reached the semi-arid West Africa before 1000 AD (Epstein, 1971). The westerly migration followed the rouLe soutri of the Sahara and north of the great rainforest belt (Payne, 1964) in an attempt to avoid tsetse-infested humid coastal zones. Another wave of migration into western Asia probably toolc place and might account for the presence of zebu cattle in Iraq and Iran (Payne, 1990).

The two major cattle groups in West and Central Africa today are the "humpless" (Bos *taurus)* or taurine and "humped" *(Bos indicus)* or zebu cattle, including their derivatives. Mason (1951) has classified the zebu into short- and lyre-horned sub-groups. Whereas the former have similar origin, physical appearance and conformation to the East African and Indo-Pakistan shorthorned zebus (Irfam,1967; Payne,1970), the latter apparently have evolved from an intermixture of the shorthorned zebu and the Hamitic longhorned cattle. Amongst the shorthorned zebus of West and Central Africa are the Gudali which are found mainly in Nigeria and Cameroon. Also included are the Maure of Senegal, Mali and Mauritania, the Tuareg of Mali, the Djelli of Niger, the Azawak of Mali, Niger and Nigeria and the Shuwa of Nigeria, Chad and Cameroon (Epstein, 1971; ILCA, 1992a). They probably have a common ancestry *(Gates,* 1952).

Gudali is a Hausa v:word which means for shorthorned and short-legged cattle. It is generally used to embrace a large group of shorthorned zebus which is collectively known as the Fulbe or Peuhl zebu in West and Central Africa. There are two major sub-types of the Gudali. These are

the Sokoto and the Adamawa Gudali. The latter is comprised of three strains, namely, the Ngaundere, Banyo and Yola Gudali. Whereas all three strains have been found in Cameroon, only the latter two exist in Nigeria (RIM, 1992).

The Adamawa Gudali has inhabited the Adamawa mountain ranges stretching from Nigeria to Cameroon, hence its name. Indeed, the various names (Mason, 1988) used to designate these cattle populations are primarily based either on place of origin (e.g. Sokoto Gudali, Adamawa Gudali, Ngaundere Gudali, Banyo Gudali, Yola Gudali), or name of owning tribe (e.g. Fulbe Gudali, Peul, Poulfoulo, Fulani Gudali), or, in some cases, predominant colour markings (e.g. Tattabareji, which is a Fulani word for speckled coat colour, is used as synonym for Yola Gudali).

3.0 POPULATION STATISTICS AND DISTRIBUTION

Accurate estimates of the Gudali population are not available, mainly because of the constant movement of these animals with their pastoral owners inside and outside their ecological zones and the overlap in the distribution of the different sub-types. In view of the overlap in breed boundaries, available figures (table 1) are likely to be overestimates of the G uûûli population.

4.0 ECOLOGICAL SETTINGS

The climate in the zone occupied by the Gudali is marked by a dry and a wet season. The north-south rainfall gradient is considerable, with the northern region receiving substantially less rainfall and having a much shorter wet season compared to the forest belt and coastal area in the south.

The rainfall gradient, the relative humidity and the length of the dry season tend to influence the vegetation of the zone. The natural vegetation is dry grassland in the north interspersed with montane grasslands on the Jos and Mambila Plateaux and open woodland on the Adamawa Plateau. The common grasses are *Pennisetum* spp., *Paspalum* spp., *Hyparrhenia* spp., *Brachiaria* spp., *Panicum phragmitoides*, *Loudetia arundinacea* and *Andropogon gayahus.*

The Plateaux are relatively free of major animal diseases (Faulkner and Epstein, 1957), although blaclcquarter and foot-and-mouth diseases are still endemic. Tsetse are not found in the northern arid zone and have been eradicated from most of northeastern Nigeria (RIM, 1992). However, savannah tsetse. like *Glossina morsitans* and the riverine species like *G. tachinoide.s* and *G. palpalis* are found in the subhumid zone. Indeed, the pattern of cattle distribution in the region is mainly determined by the tsetse distribution (Rege et al., 1994). Dermatophilosis which is a skin disease caused *by Dermatophila congolense* is also common in the zone. Tick-borne diseases such as cowdriosis and babesiosis are equally widely spread (Tawah and Mbah, 1989), as are endoparasites.

5.0 UTILITY, HUSBANDRY PRACTICES AND PRODUCTION SYSTEMS

Gudali cattle are primarily used for milk and meat. However, they are also exploited for draft purposes, particularly ploughing and, to a lesser extent, carting in some areas, for the Gudali is a sturdy and docile animal (Gates, 1952; Oyenuga, 1967; Payne, 1970; Domingo, 1976). Despite their sturdy and docile nature, characteristics which make the Gudali suitable for draught, they are slow and sluggish. The bullocks are usually put to work at about three to four years of age (Payne,1970). Gudali cattle respond reasonably to intensive feeding (Lhoste and Dumas, 1972; Olayiwole et al., 1981) and are believed to be amongst the most promising beef breeds in the region (Leclercq, 1976; Olutogun, 1976; Pagot, 1985).

About 90% of Gudali cattle are traditionally kept by Fulani and Hausa pastoralists (Ngere, 1985a). The most significant feature of the traditional husbandry system is the communal ownership and use of grazing lands. At the approach of the dry season herders undertake a short distance transhumance, particularly into the flood valleys *(yaérés)* of the tributaries of river Benoue (Pagot, 1992) in northern Nigeria and Cameroon. The dry season movements involve

long treks from the homestead usually southwards. When the rains return, there is a reverse movement, with cautious efforts to avoid tsetse-infested and flooded areas. During transhumance, suckling or lactating cows stay in the village (Faulkner and Epstein, 1957). However, most herds tend to be sedentary most of the year. The Sokoto Gudali is reputed to be specialized in eating browse and the herders are commonly seen lopping trees towards the end of every dry season (RIM, 1992). Breeding is not controlled, although castration of unwanted bulls is often practised.

6.0 PHYSICAL CHARACTERISTICS

6.1 Body size

The substantial variation as reflected in the range in mature (adult) body measurements (table 2), especially in the mature weight of the Gudali, is most probably associated with the wide range in "mature age" arising partly from the differences in the defmition of maturity at farm level.

6.2 Conformation

Despite differences in conformation and other physical features (table 3), the Gudali is generally a long, well balanced and relatively compactly built animal, with a deep and wide body and well-sprung ribs. They are deeper-bodied than the White Fulani (Faulkner and Epstein, 1957; Oyenuga, 1967), with a close-to-the-ground appearance. They closely resemble the East African Boran in conformation, size and type (Payne, 1970; Domingo, 1976), to a large extent, and the Sudanese Kenana (Faulkner and Epstein, 1957), to a lesser extent.

6.3 Coat colour

Gudali cattle have multiple coat colour markings (table 3).

7.0 ADAPTIVE CHARACTERISTICS

Rectal temperatures (RT) of 38.0-39.0 and 38.5-39.l^{o}C and respiration rates (RR) of 19.9-38.3 and 24.9-42.6 flank movements per minute, respectively in the cool and hot seasons in Nigeria have been reported for Sokoto Gudali (Buvanendran et al., 1992). Based on these values, corresponding coefficients of adaptability (CA) for the breed of 1.77-2.69 and 2.092.87 have been estimated using the formula: (RT/38.33) + (RR/23.0) - a higher value of which indicates poor adaptability. A corresponding sweating rate of 54.7-93.3 and 170.8224.1 g/m^2/hr has also been recorded. These results suggest that the Sokoto Gudali compared to the White Fulani are less adapted to the Guinea savannah (e.g. Ngere, 1985a; Buvanendran ct al., 1992). This may partly account for their limited dispersion beyond their present habitat. It has also been suggested that the Sokoto Gudali have relatively less tolerance to trypanosomiasis than the White Fulani (Stewart, 1937; Faulkner and Epstein, 1957) and the "humpless" Shorthorns and Longhorns in the region.

Cumulative mortality rates at one year of age in Ngaundere Gudali have ranged from 3.5% at Wakwa station to 10.9% at Bambui station in Cameroon (Tawah and Mbah, 1989). In Solcoto Gudali, they have varied from 6.2% at the research station in Ghana (ILCA, 1992b) to 24.6% at Obudu ranch in Nigeria (Iloeje, 1985). The figures indicate substantial variation most probably due to between-environment differences. The differences in calf mortality rates point to the inability of the Gudali to survive outside their traditional niches. Adult mortality rate has ranged from 1.6 to 3.6% for Ngaundere Gudali on-station in Cameroon (Tawah and Mbah, 1989).

8.0 PERFORMANCE CHARACTERISTICS

8.1 Growth and live weights

The growth performance of the Gudali is presented in table 4. These results point to the possible superior mothering ability of Banyo Gudali cows as compared to Ngaundere Gudali cows. The growth performance of Gudali seems to be inferior to that of most European beef cattle breeds and their crosses with zebus under similar management conditions in the tropics.

Banyo Gudali bull

Ngaundere Gudali cow

8.2 Carcass characteristics

Carcass performance under different feeding regimes for the Gudali are presented in table 5. The increase in carcass weights under improved conditions has not been translated into improved dressing-out percentages in the Gudali. A similar trend has been observed with the White Fulani in the region (Tawah and Rege, 1994). Carcass yields of the Gudali are lower than those of the White Fulani (Buvanendran et al., 1983), but the hides of the Gudali are much heavier than those of the White Fulani.

8.3 Reproductive characteristics

The reproductive performance of the Gudali is presented in table 6. Age at first calving and calving interval have manifested substantial variations both within and across breed types. It was evident that Gudali cattle attain sexual maturity at a much later age than the "humpless" West African Shorthorns under similar conditions (Rege et al. , 1994). The long calving interval may be attributed to the postpartum period of ovarian inactivity (aroestrus) in the Gudali (Eduvie, 1985). The length of the interval betwcen successive calvings indicates that, on average, Gudali cows calve every other year.

Perinatal mortality, including abortions and stillbirths, in Ngaundere Gudali has ranged from 4.7 to 5.9% under station conditions (Tawah and Mbah, 1989; Mbah et al.,1991). These figures may partly account for the low fertility rate obtained for the Gudali. Annual weaning rate - percentage calf crop weaned to number of calves born per year - has ranged from 49 to 53o/o in Ngaundere Gudali (Lhoste, 1980; Tawah and Mbah, 1989) and 55% in Sokoto Gudali (Osmanu, 1979) under station conditions, a reflection of high calf losses from birth to weaning in the Gudali. Such losses tend to slow down efforts at genetic improvement of the breed (Tawah et al., 1994). RIM (1992) has reported a 32% mortality rate in less-than-tenmonths-old Gudali calves under traditional pastoral management. No recent estimates of length of productive life of Sokoto Gudali exist. However, available figures have averaged about 10 years (Faulkner and Epstein, 1957; Irfam, 1967; Oyenuga, 1967).

There was a general absence of information in the literature reviewed on male reproductive performance. However, age at first service in Sokoto Gudali bulls has been estimated at 36 months under improved grazing in Ghana (Irfam, 1967).

8.4 Milk production

The range in milk yield and lactation length of the Gudali (table 7) indicates substantial variation in these traits. These figures point to the opportunity for genetic improvement of milk traits through stringent selection. It is apparent from the limited data that the dairy qualities of Adamawa Gudali are inferior to those of Sokoto Gudali and that, in general, the Gudali is a relatively poor milker compared to the White Fulani and the other important zebu breeds in the region.

Information was generally lacking on the milk composition of the Gudali. The only available figures for milk butterfat for the Sokoto Gudali was in the range of 5.4 to 6.5o/o (Faulkner and Epstein, 1957; Payne, 1970; Epstein, 1971; Ngere, 1985a).

9.0 SPECIAL GENETIC CHARACTERISTICS

Studies by Braend and Khanna (1968), Braend (1971) and Queval (1982) on haemoglobin and transferrin polymorphisms of zebu and taurine cattle of Western and Eastern Africa have pointed to the possibility that the Gudali may share the same evolutionary path with the zebus of India, Pakistan and Eastern Africa. There is also evidence that zebu cattle are distinct from the "humpless" Shorthorns and Longhorns of West and Central Africa. For example, haemoglobin (Hb) gene frequencies are similar in the zebus, with a substantial presence of both Hb^A (0.52-0.60) and Hb^B (0.32-0.44) compared to the taurine with a predominance of Hb" (0.72-0.99). There is a complete absence of Hb^D in the zebu and of Hb^B and Hb^C in the Mu.uturu, a taurine breed.

Transferrin (Tf) allele frequencies are similar in the zebus, with TfA (at a frequency of 0.17-0.24), Tf^S (0.03-0.21), Tf^D (0.14-0.23), Tf^E (0.23-0.25) and Tf^F (0.25) alleles being present in the Gudali. Alleles Tf^S and Tf^F are completely absent in the Muturu, N'Dama and the European taurine breeds (Queval, 1982). Whereas the Y chromosomes are acrocentric in the zebus, they are sub-metacentric in the West African taurine breeds Baoulé and N'Dama as well as the European taurine breeds (Popescu, 1980). The blood factor Z' is common in the Gudali and Fulani zebus but absent in the Muturu and N'Dama (Braend and Khanna, 1968).

The âforementioned polymorphic systems may be useful as markers in the investigation of genetic relationships amongst these populations and for studying the purity of these breeds. They may also contribute in the tracing of the micro-evolutionary histories of the Gudali populations. Thus, they may be useful in the development of strategies for the enhancement, utilization and conservation of the Gudali. There is hardly any DNA work published on these breeds. So, as part of breed characterization, there is a need for genetic distance studies to determine the relationships between the various breeds, strains or populations of the Gudali.

10.0 REFERENCES

Braend M.1971. Haemoglobin variants in cattle. Anim. Blood Groups and Biochem. Genetics 2:15-21.

Braend M. and Khanna N.D. 1968. Haemoglobin and transferrin types of some West African cattle. Anim. Prod. 10(2):129-134.

Buvanendran V., Adamu A.M. and Abubakar B.Y. 1992. Heat tolerance of Zebu and Friesian-Zebu crosses in the Guinea Savanna Zone of Nigeria. Trop. Agric. (Trinidad) 69(4):394-396.
'

Buvanendran V., Ikhatua U.J., Abubakar B.Y. and Olayiwole M.B. 1983. Carcass characteristics of indigenous breeds of cattle in Nigeria. J. Agric. Sci. (Cambridge) 100:407-411.

Buvanendran V., Umoh J.E. and Abubakar B.Y. 1980. An evaluation of body size as related to weight of three West African breeds of cattle in Nigeria. J. Agric. Sci. (Cambridge) 95:219-224.

Capitaine P. 1972. Projet de Développement de l'Elevage au Ghana. Etudes de factibilité de quatre ranches. Etude Zootechnique, IEMVT, France, 103pp.

CRZW. I974. Rapport d'activités trimestrielles, 1973/74. Centre de Recherches Zootechniques de Wakwa, Cameroon.

Curson H.H. and Thornton R.W. 1936. A contribution to the study of African native cattle. Onderstepoort J. Vet. Sci. Anim. Industry 7(2):613-739.

Domingo, M.A. 1976. Contribution à l'Etude de la Population Bovine des Etats du Golfe du Bénin. Agence de Coopération Culturelle et Technique, France, 143pp.

Dumas R. and Lhoste P.1966. Variations du poids vifs et du rendement en viande de boeufs Zébus de l'Adamaoua au cours de la saison séche. Rev. Elev. Méd. vét. Pays trop. 19(4):573-579.

Eduvie L.O. 1985. Factors affecting postpartum ovarian activity and uterine involution in Zebu cattle indigenous to Nigeria. Anim. Reprod. Sci. (The Netherlands) 8:123-128.

Epstein H. 1971. The Origin of the Domestic Animals of Africa. Volume I. Africana Publishing Corporation, New York (USA), p.327-556.

Epstein H. and Mason I.L. 1984. Cattle. p. 6-27. In: Evolution of domesticated animals. Mason, I.L. (ed.). Longman Group Ltd, New York (USA), 452pp.

Faulkner D.E. and Epstein H. 1957. The indigenous Cattle of the British Dependent Territories in Africa. Colonial Advisory Council of Agriculture, Animal Health and Forestry. HMSO Publication No. 5, 186pp.

Gates G.M. 1952. Breeds of cattle found in Nigeria. Farm and Forest 11:19-43

Hall S.J.G. 1991. Body dimensions of Nigerian cattle, sheep and goats. Anim. Prod. 53:61-69.
Huebl K. 1973. L'embouche intensive des Zébus Gudali à Mokwa (Nigéria). Actes du Colloque sur l'Embouche intensive des Bovins en Pays Tropicaux, 4-8 décembre, Dakar, Sénégal, p.295-296.
ILCA. 1992a. Livestoclc Population Statistics for Sub-Saharan Africa: A Computerized Data Base. International Livestock Centre for Africa, Addis Ababa, Ethiopia.
ILCA. 1992b. Trypanotolerant Livestock in West and Central Africa Volume 3 - A Decade's Results. ILCA Monograph 2, 1 l6pp.
Iloeje M.U. 1985. Heterosis from crosses among Zebu and South Devon beef cattle in South Eastern Nigeria. 1. Fertility and calf performance to weaning. J. Anim. Prod. Res. (Nigeria) 5 (2):151-158.
Irfam M. 1967. Improvement of cattle in Ghana. The Ghana Farmer 11(2):53-57.
Johnson A.O., Buvanendran V. and Dim N.I. 1986. Evaluation of dairy potential of Bunaji and Sokoto Gudali breeds. National Animal Production Research Institute (NAPRI), Shilca-Zaria, Nigeria, Annual Report, 1986, p.23-28.
Johnson A.O., Buvanendran V. and Oyejola B.A. 1984. Dairy potential of Bunaji (White Fulani) and Bôkoloji (Sokoto Gudali) breeds. Trop. Agric. (Trinidad) 61 (4):267-268.
Joshi N.R., McLaughlin E.A. and Phillips R.W. 1957. Types and breeds of African cattle. FAO Agricultural Studies No. 37. Rome, Italy.
Lamorde A.G. and Franti C.E. 1975. Nomadism and cattle production in Nigeria. Proceed. lst Annual Conf. Nigerian Soc. Anim. Prod., Enugu, 14-17 July, p.l4-17.
Leclercq P. 1976. Principales races d'animaux domestiques des zones tropicales. Institut d'Elevage et de Médecine vetérinaire des Pays tropicaux (IEMVT), France, ENS/II-35, p.35-36.
Lhoste P. 1.g80. L'amélioration génétique des Zébus de l'Adamaoua (Cameroun) pour la production de la viande. Premier Colloague International: Recherches sur l'Elevage Bovin en Zone Tropicale Humide, 18-22 Avril, Bouaké, Côte d Ivoire .761-769.
Lhoste P. 1973. Essai de finition de boeufs Zébus avec utilisation maximale de mélasse. Acts du Colloque sur l'Embouche Intensive des Bovins en Pays Tropicaux, 4-8 décembre, Dakar, Sénégal, p.l39-147.
Lhoste P. I968. Comportement saisonnier du bétail Zébu en Adamaoua Camerounais. II. La croissance avant sevrage pour les veaux de race locale et les métis demi-sang Brahma. Rev. Elev. Méd. vét. Pays trop. 21 (4):499-517.
Lhoste P.1967. Comportement saisonnier du bétail Zébu en Adamaoua Camerounais. I Etude des femelles adultes: Comparaison de la race locale aux métis demi-sang Brahma. Rev. Elev. Méd. vét. Pays trop. 20(2):329-342.
Lhoste F. and Dumas R. 1972. Embouche intensive des Zébus de l'Adamaoua. I. Comparaisons de différents systémes d'alimentation (1970). Rev. Elev. Méd. vét. Pays trop. 25(2):259-280.
Lhoste P., Dumas R. and Haon P.1972. Embouche intensive des Zébus de l'Adamaoua, II. Influence de la durée de la période d'embouche (1971). Rev. Elev. Méd. vét. Pays trop. 25 (2):281-293.
Lhoste P. and Pierson J. 1973. Embouche intensive de jeunes mâles: Comparaison de taurillons et bouvillons de trois races. Actes du Colloque sur l'Embouche Intensive des Bovins en Pays Tropicaux, 4-8 décembre, Dakar, Sénégal, p.233-236.
Lhoste P., Pierson J., Atekwana J. and Munji M. 1976. Expérimentation de l'alimentation intensive des bovins au Cameroun. Rapport de Synthèse. Centres de Recherches Zootechniques de Wakwa et de Bambui, Cameroun, 21 pp.
Mandon A. 1957. Le Zébu Brahma au Cameroun: Premiers résultats de son introduction en Adamaoua. Rev. Elev. Méd. vét. Pays trop. 10:129-145.
Mason I.L. 1987. Domestication and breed formation in cattle. Wld Rev. Anim. Prod. 23(3):71-76.

Mason I.L. 19RB. A World Dictionary of Livestock Breeds, Types and Varieties. (3rd ed.) CAB International, The Cambrian News Ltd, United Kingdom, 348pp.

Mason I.L. 1951. The Classification of West African Livestock. Commonwealth Bureau of Animal Breeding and Genetics. Commonwealth Agricultural Bureau, Farnham Royal, England, Technical Communication No.7, p.l-10.

Mbah D.A., Abassa P.K., Zamba P., Tawah C.L., Messine O. and Oumate H. 1991. F actors affecting the reproductive performance of Zebu cattle on the Adamawa Plateau. Proceed. 2nd Annual Conf. Cameroon Biosci. Soc., 22-29 November, 1990, Dschang University Centre, Cameroon 2:217-225.

McCulloch J. 1951. Livestock Breeding Policy at Jakiri Livestock Breeding Investigation Centre, Nigeria (Unpublished).

Millar D. 1979. Relationships between inbreeding levels and some reproductive performance traits in West African Shorthorn and Sokoto Gudali cows at Agricultural Research Station, Legon, Ghana. BSc Dissertation, University of Ghana, Legon, 52pp.

Miller T.B. I961. Study on the nutrition of Zebu cattle in northern Nigeria. I. Energy intake and millc production. Emp. J. Exp. Agric. 29:230-240.

Ngere L.O. 1985a. The Gudali of Nigeria - Review. In: Animal Genetic Resources in AfricaHigh Potential and Endangered Livestock. Proceed. 2nd OAU Expert Committee Meeting, 24-28 November, 1983, Bulawayo, Zimbabwe, p.77-81.

Ngere L.O. 1985b. The White Fulani (Bunaji) of Nigeria. In: Animal Genetic Resources in Africa -High Potential and Endangered Livestock. Proceed. 2nd OAU Expert Committee Meeting, 24-28 November, 1983, Bulawayo, Zimbabwe, p.67-77.

Olayiwole M.B., Buvanendran V., Fulani J.I. and Ikhatua J.U. 1981. Intensive fattening of indigenous breeds of cattle in Nigeria. Wld Rev. Anim. Prod. 17(2):71-77.

Olayiwole M.B., Olorunju S.A.S., Kera B.S., Agishi E.C. and Adesipe Y.M. 1986. Economics of feedlot technology. NAPRI, Shika-Zaria Annual Report, 1986, p.l31132.

Olutogun O.1976. Reproductive performance and growth of N'Dama and Keteku cattle under ranching conditions in the Guinea savannah of Nigeria. Ph.D. Thesis, University of Ibadan, Nigeria, 126pp.

Oni O.O., Buvanendran V. and Dim N.I.1988. The influence of some environmental factors on growth rate of two Nigerian cattle breeds and the hybrid with the Charolais. J. Anim. Prod. Res. (Nigeria) 8(2):121-131.

Osmanu S.T.1979. Studies on bovine infertility at the Agricultural Research Station (Legon) over half a decade (1972-1977). BSc. Dissertation. University of Ghana, Legon, 82pp.

Oyenuga V.A. 1967. Agriculture in Nigeria: An Introduction. FAO, Rome, Italy, p.240-253.

Pagot J. 1992. Animal Production in the tropics and subtropics (translated by Wilding, J.). The MacMillan Press Ltd, London, p.351-358.

Pagot J. 1985. L'Elevage en Pays Tropicaux. Editions G.P. Maisonneuve et Larousse, Paris, France, p.380-383.

Payne W.J.A. 1990. An Introduction to Animal Husbandry in the Tropics. 4th edition. Tropical Agricultural Series, Longman Group Ltd, New York (USA), 881pp.

Payne W.J.A. 1970. Cattle Production in the Tropics. Volume I. Tropical Agricultural Series, Longman Group Ltd, New York (USA), 336pp.

Payne W.J.A. 1964. The origin of domestic cattle in Africa. Emp. J. Exp. Agric. 32:97-113.

Pierson J.N. 1980. Bilan succinct d'un essai de contrôle de lactation sur des vaches de trois groupes génétiques différents. Premier Colloque International: Recherches sur l'Elevage Bovin en Zone Tropicale Humide, 18-22 Avril, Bouaké, Côte d Ivoire .771-776.

Popescu C.P.1980. Etude cytogénétique d'un lot de bovins Africains. Résultats préliminaires. Premier Colloque International: Recherches sur l'Elevage Bovin en Zone Tropicale Humide, 18-22 Avril, Bouaké, Côte d Ivoire .821-822.

Queval R. 1982. Polymorphismes de la transferrine chez les bovins trypanosensibles et trypanotolérants de l'Afrique de l'Ouest. Répartition et fréquence de leurs allèles. Rev. Elev. Méd. vét. Pays trop. 35 (4):373-380.

Rege J.E.O., Aboagye G.S. and Tawah C.L. 1994. Shorthorn cattle of West and Central Africa II. Ecological settings, utility, management and production systems. World Anim. Rev. 78:14-21.

RIM. I992. Nigerian Livestock Resources (6 vols). Report by Resource Inventory and Management Iimited (RIM) to FDLPCS, Abuja, Nigeria.

Sada I. 1968. The length of the gestation period, calvi.ng interval and service period in indigenous West African cattle: N'Dama, West African Shorthorn and Solcoto Gudale. Ghana J. Agr. Sci. I:91-97.

Stewart J.L. 1937. TThe cattle of the Gold Coast. Vet. Rec. 49(41):1289-1297.

Tawah C.L. 1992. Genetic evaluation of growth performance of Gudali and two-breed synthetic Walcwa beef cattle populations under selection in Cameroon. A Research Fellowship Report. ILCA, Addis Ababa, Ethiopia, lOSpp.

Tawah C.L. and Mbah D.A. 1989. Cattle breed evaluation and improvement in Cameroon: A review of the situation. Institute of Animal Research (IRZ), Walcwa, Cameroon, 29pp.

Tawah C.L. and Rcge J.E.O. 1994. White Fulani cattle of West and Central Africa. Animal Genetic Resources Information, No. 17, FAO, Rome, Italy.

Tawah C.L., Rege J.E.O., Mbah D.A. and Oumate H. 1994. Genetic evaluation of birth and weaning weight of Gudali and two-breed synthetic Wakwa beef cattle populations under selection in Cameroon: genetic and phenotypic trends. Anim. Prod. 58:25-34.

Wheat J.D. and Broadhurst J. 1972. An analysis of data on Solcoto Gudali cattle at Bulassa and Dogondaji, North Western State, Nigeria. Institute for Agricultural Research, Samaru, Ahmadu Bello University, Zaria, Nigeria. Samaru Miscellaneous Paper 39, 11 pp.

Williamson G. and Payne W.J.A. 1974. An Introduction to Animal Husbandry in the Tropics. Tropic Agricultural Series, Longman Group Ltd, 447pp.

Table 1: *Distribution and population figures of Gudali cattle in West and Central Africa*

Breed type	Synonym	Number	Country	Year	Source	Habitat
Sokoto Gudali	Bokoloji, Sokoto	1 000 000	Nigeria	1985	Ngere (1985a)	Found mainly in Nigeria: Sokoto, Mambila and Adamawa regions; Northwestern Nigeria, Northeastern Nigeria, Northcentral Nigeria and Benue Plateau
		1 743 375	Nigeria	1992	ILCA (1992a)	
		4 351 523	Nigeria	1992	RIM (1992)	
		NA	Northern Benin			Northern Benin
		NA	Ghana			Ghana
		NA	Mali			Mali
Adamawa Gudali[1]		1 000 000	Nigeria	1985	Ngere (1985a)	Northeastern Nigeria; Adamawa and Sardauna regions of Nigeria and Gongola State
		1 603 905	Nigeria	1992	ILCA (1992a)	
		263 019	Nigeria	1992	RIM (1992)	
		2 942 000	Nigeria & Cameroon	1985	Pagot (1985)	
Banyo Gudali		NA	Nigeria			Mambila Highlands in the southern fringe of Nigeria
		140 420	Cameroon	1992	ILCA (1992a)	Banyo and Bamenda Highlands of Cameroon
Yola Gudali	Tattabareji	NA	Nigeria			Central and Muri Emirates of Nigeria Tignere of Cameroon
		NA	Cameroon			
Ngaundere Gudali	Peuhl, Fulbe, Poulfoulo, Fulani Gudali, Goudali	550 000	Cameroon	1957	Mandon (1957)	Ngaundere and Bamenda Highlands of Cameroon
		598 980	Cameroon	1992	ILCA (1992a)	
		400 000	Central African Republic	1992	ILCA (1992a)	Central African Republic
		NA	Congo			Congo

NA indicates that population figures are not available

[1]Adamawa Gudali is generally used in Cameroon to refer to the Banyo, Yola and Ngaundere Gudali

Table 2: *Mean ranges of mature weight and body measurements of Gudali cattle*

Trait	Sex/category	Adamawa Gudali			Sokoto Gudali
		Ngaundere	Banyo	Yola	
Mature weight, kg					
	Bulls	400-563	400-408	350-352	499-660
	Cows	330-408	360-363	335-336	241-353
	Oxen	350-499	453	-	509-662
Height at withers, cm					
	Bulls	133-136	-	122	130-137
	Cows	123	-	120	117-131
	Oxen	122-131	-	-	-
Heart (chest) girth, cm					
	Bulls	190-194	-	-	190
	Cows	170	-	-	144-166
	Oxen	170-184	-	-	-
Body length, cm					
	Bulls	158-179	-	88	154
	Cows	145	-	76	124-145
Width at hips, cm					
	Bulls	42-55	-	41	46
	Cows	44	-	40	42-44

Adapted from: McCulloch, 1951; Gates, 1952; Faulkner & Epstein, 1957; Joshi *et al.*, 1957; Dumas & Lhoste, 1966; Lhoste, 1967; Oyenuga, 1967; Payne, 1970; Epstein, 1971; Captaine, 1972; Lhoste *et al.*, 1972; CRZW, 1974; Domingo, 1976; Leclercq, 1976; Olutogun, 1976; Buvanendran *et al.*, 1980; Lhoste, 1980; Ngere, 1985a; Pagot, 1985; Hall, 1991

Table 3: *Physical characteristics of Gudali cattle*

Attribute	Sokoto Gudali	Ngaundere Gudali	Banyo Gudali	Yola Gudali
Conformation	Topline slopes slightly from hump to sacrum; rump is somewhat shorter than that of White Fulani and sloping; body is generally of good capacity, thus, an excellent beef type; head is long and wide between the eyes and across the forehead, with a straight or slightly convex facial profile; head is generally carried very low on a narrow, short and solidly muscled neck, particularly in the bulls; muzzle is of good width.	Rump is less sloping and very well fleshed; flat and broad back, especially over the loins; head is well proportioned and long, averaging 50-62 cm, and narrow below eyes, averaging 21-25 cm in width, with a similar facial profile as in Sokoto Gudali; head is somewhat bigger than that of Banyo Gudali and carried on a narrow, short and solidly muscled neck, particularly in the bulls as in Sokoto Gudali.	Shoulders blend smoothly with the body; topline slopes slightly from hump to sacrum as in Sokoto Gudali; rump is of fair length and sloping; body is of uniform width throughout, with a well developed musculature; head is well proportioned as in Ngaundere Gudali, with a good width between the eyes and at the muzzle	Considerable variation in body conformation, more closely resembling Banyo type than the other types in their constitutional make-up; they are shorter and smaller-bodied than the other subtypes.
Appendages (limbs, tails, ears)	Upper thighs are of fair width, but tend to narrow somewhat lower down; tail is long and well developed, terminating with a switch almost touching the ground; ears are long, large and convex, sometimes pendulous, although not to the same degree as in some of the Indo-Pakistan zebus.	Upper thighs are broad, fairly full and thick; they are well let down to the lower thighs; legs are shorter than those of the White Fulani but well set, with less fine but clean and strong bones.	Upper thighs are broad, fairly full and thick as in Ngaundere Gudali but narrow and lean as they descend; limbs are of moderate length with little impression of leggedness; bone quality is good but tends to be a little too fine for size and weight of body; prominent tail end, with a high setting.	Limbs are much shorter than in the other subtypes.
Hump	Hump is rounded from front to back with a slight fall at the back, firmly placed over the withers (thoracic in position) and musculo-fatty in structure, especially in the bulls.	Hump is very large and pendulous, generally hanging over on one side and having the appearance of being broken; it is thoracic in position and musculo-fatty in structure as in Sokoto and Banyo Gudali; it is shaped like a conical hat (phrygian shaped) in the bulls.	Hump is well developed in both sexes, more so in the males; as in Sokoto & Ngaundere Gudali, it is thoracic in position; it is firm, pyramidal in shape and tending to be upright.	Hump is moderately large and tends to be upright as in Banyo Gudali but smaller than in Ngaundere Gudali; it may be cervico-thoracic in position

3 (continued)

Attribute	Sokoto Gudali	Ngaundere Gudali	Banyo Gudali	Yola Gudali
Horns	Horns are shorter than in Ngaundere Gudali; they are especially shorter in the bulls than in the cows; they are sometimes extremely short, with little curvature; generally, horns project in a lateral and upward direction from the head; they may be totally absent or polled; they are round but can sometimes be flattish or oval in cross-section, with blunt rather than sharp pointed tips	Horns are short to medium in length and crescent-shaped; they are not thick; they project outwards, upwards and slightly forwards; some animals have downward hanging horns; horns can be short and massive in the bulls but fine and less developed in the cows	Horns are short to medium in length as in Ngaundere Gudali; they may be thin or moderately thick; they project outwards and upwards and slightly forwards, with the tips sometimes curving backwards, they may at times have only a slight curvature; they are more developed than in Ngaundere Gudali and similar in cross-section to that of Sokoto Gudali	Similar to those of Banyo & Ngaundere Gudali, being short to medium in length, moderate in size or thickness and projecting outwards, upwards and slightly forwards as in Banyo & Ngaundere Gudali
Skin folds	Dewlap, sheath (prepuce) and umbilical folds are prominent; dewlap is very well developed and large, averaging 35-40 cm in length, with pendulous neck folds often running into the large umbilical and sheath folds in the bulls	Dewlap, sheath and umbilical folds are poorly to moderately well developed and not unduly pendulous; they are little more developed than in Banyo Gudali	Dewlap is moderately developed but not unduly pendulous; umbilical and sheath folds are usually obvious but not pendulous	Dewlap, sheath and umbilical folds vary from being small & poorly developed to moderately well developed
Coat colour	Pure forms have white, grey-white, cream or fawn colours, with dark grey areas over the shoulders and hump extending forward to the neck in the bulls; they are often white or cream in the females and light grey or cream with a light grey, light blue tinge or dark grey patches over the head, neck, shoulders, hump and tail in the males; the different shades of colour vary in intensity; occasionally, dark patches are seen around the eyes, often with minute dark spots on the legs, just above the hooves and blue-grey shaded dun coats; the skin, hooves, muzzle and tail-switch are generally black, but red skin is sometimes seen under the tail and in the ears; hair is short and loose; skin is medium-thick and pigmented	Mainly red, white-and-red, reddish brown or solid white; they are far more whitish and broken than Banyo Gudali; brindle and roan animals are also frequent as are spotted red animals in white-and-brown coats	White and deep bright red; usual colour pattern consists of a white face similar to that of the Hereford, except that there is always colour around the eyes and muzzle, with white running down the dewlap, along the abdomen up between the thighs and on the legs; rest of body is red; there are cases where red may extend over the entire face while white may be present in splashes over the back or on the flanks; the two colours are clearly demarcated though the division may take the form of a broken or a clean line	Mixtures of red, black, blue, dun, brown, blue-roan and white are seen, with the white either in patches or speckles; it is this speckled pattern that has given rise to its Fulani name Tattahareji (or speckled cattle)

Table 4: *Means (± standard error) of pre- and post-weaning liveweights of Gudali cattle*

Station	Country	Breed*	Birth weight (kg)	3mo. weight (kg)	6mo. weight (kg)	8mo. weight (kg)	12mo. weight (kg)	18mo. weight (kg)	24mo. weight	30mo. weight (kg)	36mo. weight (kg)	Source
Wakwa & Bambui	Cameroon	NG	24.2±0.03 (1263)†	72.9±0.35 (561)	123.3±0.16 (566)	143.1±0.64 (199)	162.2±0.73 (132)	194.4±0.91 (129)	228.6±1.59 (71)	-	307.4±2.64 (21)	Tawah & Mbah (1989)
Wakwa	Cameroon	NG	24.2±0.06 (2211)	79.7±0.06 (211)	124.2±0.28 (202)	148.7±0.80 (1413)	-	-	-	-	-	Lhoste (1968); Tawah (1992)
Bambui	Cameroon	MBG	24.5±0.05 (399)	55.6±0.57 (302)	80.7 ± 0.96 (251)	203.0 (12)	153.7±2.03 (32)	183.2±2.30 (26)	218.2±4.79 (17)	-	-	Faulkner & Epstein (1957); Tawah & Mbah (1989)
Dogondaji	Nigeria	SG	22.0±0.30 (171)	76.0±2.00 (94)	114.0±2.70 (57)		144.0±2.70 (57)	199.0±5.20 (49)	241.0±4.30 (5)	301.0±10.1 (7)	358.0±4.60 (11)	Wheat & Broadhurst (1972)
Shika	Nigeria	SG	23.7 (92)	74.0 (67)	87.4 (90)	-	120.5 (68)	-	-	-	-	Cni *et al* (1988)

*NG = Ngaundere Gudali; MBG = Mixed Banyo Gudali (i.e. a mixed population of pure Banyo Gudali and crosses between Banyo Gudali, Sokoto Gudali and White Fulani); SG = Sokoto Gudali
†Figures in parentheses are number of observations

Table 5: *Feedlot performance and carcass characteristics of Gudali cattle under different feeding regimes*

			Weight gain (kg)		Daily gain (g/d)		Slaughter weight (kg)				Carcass weight (kg)				Dressing percentage			
							Before fasting		After fasting		Hot		Chilled		Gross		Net[c]	
Sex	Age (mo.)	Feeding regime	n[a]	mean±sd[b]	n	mean±sd	n	mean±sd	n	mean±sd	n	mean±sd	n	mean±sd	n	mean±sd	n	mean±sd
Ngaundere Gudali																		
Bull	12-24	Intensive	5	130.1	25	501.7±117.3 (778-1084.4)	10	417.5		-	20	190.2±40.2 (151.0-229.4)		-	38	54.1±1.1 (52.4-55.0)		-
Steer	36-48	Intensive	82	42.6±15.1 (17.2-64.2)[d]	132	719.2±325.3 (147.0-1270.0)	70	411.0±23.0 (381.0-441.3)	60	387.1±23.0 (360.4-420.9)	70	219.9±13.2 (203.2-247.0)	65	214.8±11.1 (200.7-229.3)	120	52.6±1.7 (51.0-56.6)	60	59.8±2.0 (55.8-62.0)
Steer	36-48	Semi-intensive	15	29.7±13.3 (20.6-47.9)	15	333.3±149.8 (231.0-538.0)	7	414.7±7.5 (410.3-425.7)	7	388.1±4.3 (385.6-394.5)	7	222.0±8.9 (216.8-235.0)	7	219.0±8.2 (214.2-231.0)	7	53.5±1.2 (52.8-55.2)	7	57.2±1.7 (56.2-59.6)
Steer	36-48	Extensive	8	-27.6±10.6	8	-310.0±120.0	8	363.9±21.8 (348.1-390.3)	8	344.1±19.2 (330.2-367.3)	8	187.1±7.4 (181.7-196.0)	8	184.6±7.8 (178.9-194.0)	8	51.4±1.1 (50.1-52.2)	8	54.4±0.9 (53.3-55.0)
Sokoto Gudali																		
Bull	-	Intensive	-	29.5-93.5	-	300.0-920.0	-	295.0-353.0	11	308.9±14.7	-	156.0-317.0	-	-	-	44.8-54.4	-	-

[a]Number of animals

[b]Standard deviation

[c]Net dressing percentage = gross dressing percentage adjusted for weight of digestive content

[d]Figures in parentheses are ranges

Adapted from: Lhoste *et al.*, 1972; Lhoste and Dumas, 1972; Lhoste and Pierson, 1973; Lhoste, 1973; Lhoste *et al.*, 1976; Lhoste, 1980 Huebl, 1973; Domingo, 1976; Olayiwole *et al.*, 1981, 1986; Buvanendran *et al.*, 1983

Table 6: *Means (± standard deviations) of reproductive parameters of Gudali cattle*

			Age at first calving (months)		Calving interval (days)		Calving rate (%)	
Station	Country	Breed[a]	n[b]	Mean±sd	n	Mean±sd	Mean±sd	Source
Bambui	Cameroon	NG	-	48.0	-	511.5±101.2	54.0±3.6	Tawah & Mbah (1989)
Wakwa	Cameroon	NG	-	53.0±8.5	-	536.0±14.7	57-63	Lhoste (1980); Tawah & Mbah (1989)
Wakwa	Cameroon	NG	-	49.5±0.6	-	536.9±17.3	-	Mbah *et al.* (1991)
Bambui	Cameroon	MBG	-	48.0	-	511.6±123.5	75.0±6.0	Tawah & Mbah (1989)
Bambui	Cameroon	MBG	-	-	122	424.5±41.5 (340-483)[c]	-	Faulkner & Epstein (1957)
Bambui	Cameroon	PBG	-	-	-	502 (402-728)	-	Faulkner & Epstein (1957)
Kofare	Nigeria	YG	-	-	-	431	-	Faulkner & Epstein (1957)
Bulassa	Nigeria	SG	34	43.4±7.7	85	496.0±147.5 (442-510)	-	Wheat & Broadhurst (1972)
Dogondaji	Nigeria	SG	75	40.8±9.8	132	439.0±126.4 (378-458)	74.2±1.5[d]	Wheat & Broadhurst (1972); Iloeje (1985)
Shika	Nigeria	SG	11	40-47.0	270	378.4±23.6 (366-423)	-	Faulkner & Epstein (1957); Johnson *et al.* (1984)
Legon	Ghana	SG	24	43.0±7.9	24	459.0±84.0	33-76	Millar (1979); Osmaru (1979); ILCA (1992b)
Nungua	Ghana	SG	23	38.6±26.4	60	465.2±17.0	-	Sada (1968)

[a]NG = Ngaundere Gudali; MBG = Mixed Banyo Gudali (i.e. mixed herd of pure Banyo Gudali and crosses between Banyo Gudali Sokoto Gudali and White Fulani); PBG = Pure Banyo Gudali; YG = Yola Gudali; SG = Sokoto Gudali

[b]Number of observations

[c]Figures in parentheses are ranges

[d]Estimate from Obudu ranch with a standard error

Table 7: *Means (± standard deviations) of lactation milk performance of Gudali cattle*

Station	Country	Breed[a]	Milking system	Lactation yield (kg)		Lactation length (days)		Source
				n[b]	Mean±sd	n	Mean±sd	
Shika	Nigeria	SG	Hand & Machine	1 319	1 101.3±104.9 (1 055-1 526)[c]	1394	244.8±14.1 (236-279)	Faulkner & Epstein (1957); Miller (1951); Johnson *et al.* (1984, 1986)
Wakwa	Cameroon	NG	Hand, restricted suckling	14	374±183.3 (374-1 047)	14	140±8.6 (140-270)	CRZW (1974), Leclercq (1976); Pierson (1980); Pagot (1985); Tawah & Mbah (1989)
Banbui	Cameroon	MBG	Hand	122	619±53 (549-834)	122	221±21 (204-242)	Faulkner & Epsein (1957)
Jakiri	Cameroon	PBG	Hand	23	1249±170 (423-1 818)	217	-	Faulkner & Epstein (1957)
Bambui	Cameroon	PBG	Hand	3[d]	1322 (1 174-1 614)	-	-	Faulkner & Epstein (1957)
Yola,	Nigeria	YG	Most probably hand	14[d]	884-1247	-	-	Faulkner & Epstein (1957)
Kofare	Nigeria	YG	Most probably hand		964-1227		216-305	Gates (1952); Faulkner & Epstein (1957)

[a]SG = Sokoto Gudali; NG = Ngaundere Gudali; MBG = Mixed Banyo Gudali (i.e. a mixed population of pure Banyo Gudali and crosses between Banyo Gudali, Sokoto Gudali and White Fulani); PBG = Pure Banyo Gudali; YG = Yola Gudali

[b]n = number of observations

[c]Figures in parentheses are ranges

[d]Number of lactations