EVALUATION OF THE PERFORMANCE OF MUTURU CATTLE UNDER THE TRADITIONAL VILLAGE MANAGEMENT SYSTEM IN THE SOUTHERN GUINEA SAVANNA OF BENUE STATE, NIGERIA

B y

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Thesis

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The Department of Animal Science
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May, 1995.

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CERTIFICATION

This thesis entitled "EVALUATION OF THE PERFORMANCE OF MUTURU CATTLE UNDER THE TRADITIONAL VILLAGE MANAGEMENT SYSTEM IN THE SOUTHERN GUINEA SAVANNA OF BENUE STATE, NIGERIA" by DANIEL VERISHIMA UZA, meets the regulations governing the degree of DOCTOR OF PHILOSOPHY of Ahmadu Bello University, Zaria and is approved for its contribution to scientific knowledge and literary presentation.

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DEDICATION

THIS THESIS IS DEDICATED TO MY BOSOM FRIEND THE LATE DR. JOHN NANCAN BINCAN WHO UNTIL HIS DEATH WAS THE DIRECTOR, FEDERAL DEPARTMENT OF LIVESTOCK AND PEST CONTROL SERVICES OF THE FEDERAL REPUBLIC OF NIGERIA. DR. BINCAN READ ONLY PARTS OF THIS WORK BEFORE HE ANSWERED THE CALL TO THE HANDS OF THE ALMIGHTY GOD.

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A B S T R A C T

A study was conducted to evaluate the performance of the trypanotolerant Muturu Cattle kept under traditional village management system in the trypanosomiasis endemic southern guinea savanna of Benue State.

In the first study, surveys were conducted during the rainy season months of May - July 1990 to obtain base line data on systems of management, reproductive performance, disease, marketing and constraints affecting productivity in 362 herds made up of 2,490 head of cattle. Under the traditional village management conditions, more than half of the farmers (57%) kept only a small herd size of 1 - 5 animals mainly for commercial purpose i.e. to generate income. The most popular system of management was semi-intensive (55%). During both dry and rainy season, Muturu cattle obtained their feed from grazing (71.4 and 85.3% respectively) and supplementary feed was hardly fed (3.6% in the rainy season and 8% in the dry season) because many farmers (43.9%) never even heard of it. Age at first service was less than 2 years (46.4%) while age at first calving was 2 - 3 years (49.2%) in these traditionally managed cattle. Abortion rate (14.6%), calf mortality (10.8%) and incidence of disease, diarrhoea (27.1%) were low. Most farmers (76.4%) did not vaccinate their animals. Those farmers who treated their animals (44.2%) and those who did not treat (45.0%) were about the same. Those who treated, used traditional

methods i.e. herbs (81.2%). Most farmers sold their animals life (73.5%) for reasons of family support (34.0%). Lack of feed and water were the biggest management problems facing most farmers (40.8%) while lack of veterinary services, lack of capital and lack of grazing land were the other problems faced by Muturu cattle farmers. Most farmers (56.8%) said that granting of loans to them would improve the numbers and management of their Muturu herd.

Investigations conducted on Raav Livestock Investigation and Breeding Centre (L.I.B.C.), the only institutional farm in Benue State where Muturu cattle are kept, revealed that age at first service was 18 - 30 months while age at first calving ranged from 27 - 39 months. Calving rate was 57%, calf mortality 5%, weaning rate 80 - 90% and culling rate of 1% mainly from cryptorchid bulls. The average birth weight of calves was 14kg., average weaning weight at 6 - 8 months was 48kg while average weight of cows at mating was 143kg.

It appears from these results that Muturu cattle in Raav LIBC did not perform better than those under traditional village management condition. This may have been due to lack of adequate supplementary feeding as funds for procuring them were always insufficient.

It was concluded that Muturu cattle were hardy animals and that under the traditional village management conditions,

it appeared disease was not a constraint militating against production. Probably all that needs to be done now was to explore and take advantage of these unique characteristics and effect increased productivity through improved management.

In the second study, surveys were conducted during the dry season months of November, 1990 - February, 1991 to assess the integration of Muturu into mixed farming system of the people and address constraints of husbandry/management under the traditional village production system. Results from 394 respondents involving 2,336 Muturu cattle revealed that an overwhelming majority of Muturu farmers (90.9%) kept other livestock (such as goats, pigs, sheep and poultry) apart from Muturu cattle but 86.0% considered rearing of Muturu cattle more important than keeping other livestock for reasons of profitability (79.3%). All Muturu cattle farmers (100%) cultivated crops mainly yams (84.6%) and that crop farming was more important (82.1%) than raising Muturu or other livestock. Majority of Muturu farmers (66.1%) fed crop residues to their Muturu cattle mainly yam and cassava peels (38.5 and 19.8% respectively) while feeding of cereal crop residues such as guinea corn (sorghum) stover, maize stover and rice straw was low. Nearly all Muturu cattle farmers owned land (97.7%) through inheritance (95.4%) and more of this land was set aside for cropping (81.2%) rather than raising Muturu cattle (16.0%). During the dry season, grazing natural grass (92.9%) rather than improved pasture (6.9%) was the rule. While an overwhelming majority of Muturu

cattle farmers (82.6%) allowed their cattle to roam freely during the dry season, only 13.5% confined their cattle mainly through tethering (79.4%) during the rainy season (49.5%). Majority of Muturu farmers (80.2%) reported problems of crop damage by free-roaming cattle while those who did not experience this problem were very few (5.1%). While a majority of Muturu cattle farmers (74.5%) did not apply cattle manure on crop farms, 25.3% did. An overwhelming majority of Muturu farmers (87.6%) did not use Muturu cattle for traction while 3.0% said they did.

It appears from these findings that the rearing of Muturu cattle is not properly integrated in the mixed farming system in Benue State. However, the popular practice of grazing natural pasture and feeding crop residues during the dry season calls for an urgent need to determine and assess the nutritional value of these feed resources in meeting the demands for improved productivity of Muturu cattle under the traditional village management system.

In a third study, a one - year two season study of the prevalence of trypanosomiasis and its effect on rectal temperature and some blood parameters in 247 Muturu cattle was carried out between September 1991 and July 1992. The studies were conducted during the rainy season months of September 1991, May and July 1992 and the dry season months of November 1991, January and March 1992 in five (5) randomly selected L.G.As of the former Benue State namely; Gboko, Gwer, Katsina-Ala, Kwande and Ushongo.

Analysis of data showed that the prevalence of trypanosomiasis in Muturu cattle as determined by the parasitological method of thick smear examination, was low (8.9%). T. vivax was most prevalent followed by T. brucei while T. congolense could not be detected by this method. More cattle had trypanosomiasis in the rainy season (5.7%) than in the dry season (3.8%). Gwer L.G.A. had the highest prevalence rate of 19.6% during the rainy season.

Investigations using Antibody ELISA technique however showed a higher prevalence rate of infection (66.8%) than the conventional parasitological techniques (8.9%). The Antibody ELISA also discriminated between infected and non-infected cattle and differentiated between the different Trypanosome Species in cases of mixed infection.

The results of the study suggested that the Antibody ELISA was a more useful technique for epidemiological assessment of bovine trypanosomiasis in Nigeria than the conventional parasitological techniques.

The prevalence of other blood parasites was very low (1.2% for babesiosis).

Analysis of blood parameters in 247 Muturu cattle grazing natural pasture and crop residues under the traditional village management system revealed that the animals maintained normal rectal temperatures, Haemoglobin (Hb), Packed Cell Volume (PCV), Magnesium (Mg), Calcium (Ca) and

Phosphorus (P) during the period of the study. Total Protein (TP) in the blood of all these animals were, however, consistently low.

Trypanosomiasis had no significant effect (P>.05) on rectal temperature and blood variables examined in this study. However, serum Mg levels in Muturu cattle from Gwer, Kwande and Ushongo LGAs were significantly (P<.01) higher than those from Gboko and Katsina-Ala LGAs. Serum Hb, PCV, TP, and Ca were significantly (P<.001) higher in the rainy season than in the dry season, while serum TP in female animals were significantly (P<.001) higher than those in male animals. Age did not have any significant effect on rectal temperature and the other blood variables studied.

Correlation between the variables studied revealed that there were many more correlations in the females than in the males. In the male animals, only Hb was significantly (P <.05) correlated to TP (r = .295), whereas in the female animals, Hb (r = .224), and PCV (r = .413) were highly correlated to TP at (P < .01) and (P <.001) respectively. PCV was however negatively correlated (r = - .402) with rectal temperature, and highly significant (P < .001). Ca and P were also highly correlated to Mg (r = .295 and .315 respectively). These correlations were highly significant, (P < .001 and P < .01 respectively). The higher correlation in the females may have been due to higher numbers of females (185) than males (68) used in the study. These differences may also have been due to the complex physiological processes in the female arising

from pregnancy, formation of skeleton of the foetus and lactation.

In the fourth study, the nutritive value of natural pastures and crop residues which were the commonly used feed resources for feeding Muturu cattle, were determined and assessed for their sufficiency or insufficiency in protein and mineral in meeting requirements for the dry and wet seasons.

During both seasons Andropogon spp appeared to be the most common native grass grazed by the animals. Other grasses included Imperata cylindrica, Hyparrhenia sp. Penicum sp and Pennisetum pedicellatum. Chemical composition values did not differ among the Local Government Areas (LGAs). Only the DM, Ash and Ca were significantly influenced by season. DM of grasses consumed during the dry season was significantly ($P< 0.001$) higher (96.3 ± 1.18%) than those consumed in the wet season (30.2 ± 1.40%). Ash content in the wet season (25.2 ± 2.36%) was higher ($P< 0.01$) than those in the dry season (7.9 ± 2.00%). The Ca content of grasses consumed in the dry season (0.69 ± 0.053%) was significantly ($P< 0.01$) higher than that found in the grasses consumed in the wet season (0.34 + 0.063%).

The chemical composition of crop residues (yam peels, cassava peels, sorghum stover, maize stover and rice straw) revealed that the DM, CP and Ca contents of the residues were not statistically different ($P> 0.05$). On the other hand NDF, ADF and P differed significantly ($P< 0.01$) among the various

residues. Similarly, Ash and Mg contents differed (P< 0.05) among the various crop residues. NDF of yam peels (81.6 + 3.98%) differed significantly (P< 0.001) from those of cassava (30.0 ± 3.98%). The P content of sorghum stover (0.25 ± 0.024%) was significantly (P< 0.05) higher than that of maize stover (0.05 ± 0.024%). Similarly, the P and Mg contents of sorghum stover was significantly (P< 0.01) higher than that for rice straw. Ash contents of rice straw was significantly (P< 0.001) higher than that of maize stover while Mg contents of maize stover was significantly (P< 0.05) higher than the corresponding value for rice straw. When the tuber peels were compared with the cereal stovers/straw, the NDF, ADF and Ash contents were all significantly (P< 0.05) higher for the stovers than the peels.

On the whole, the native grasses and crop residues were highly fibrous, low in protein and deficient in P and Mg during the wet and dry seasons. It was concluded that protein, phosphorus and magnesium were limiting in the diets of these traditionally managed Muturu cattle in Benue State. It was suggested that supplementation with protein, phosphorus and magnesium be encouraged.

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INTRODUCTION

The livestock genetic pool of Africa is as immense as it is diverse. Apart from swine, the continent possesses a high concentration of livestock species, relative to the rest of the world. In Africa can be found 14.5, 17.1, 32.2, 7.8, 74.8, 9.1 and 29.5% respectively of the world's cattle, sheep, goats, horses, camels, mules and donkeys (F.A.O., 1989).

Inspite of the indiscriminate mating as well as other substandard management techniques that support these large number of livestock, it is still possible to clearly define several breeds within many of the species. The major cause of animal protein shortage in several areas of Africa appears to be the low off-take rates for the continent. In cattle, for example, off-take rate for Africa was 12.5%, compared to the world average of 18.5% (F.A.O., 1989). In addition, the total volume of meat output is low for Africa due to low animal weights.

Environmental hazards also limit animal production in Africa (Stewart, 1951; Murray et al., 1990; Payne, 1991). Apart from climatic stress in virtually all the regions, there are a host of diseases and parasites which plague animals. Only a small proportion of Africa is suitable for animal rearing. The vector of the disease, trypanosomiasis, the tsetse fly occupies about 40% of the continent (FAO/WHO/OIE, 1982). The infested area coincides with good forage growth and availability of water. Since most animal species succumb to

the disease, this area cannot be used extensively for livestock farming. No suitable vaccine against trypanosomiasis has been developed (Stewart, 1951; Murray et al., 1990). The disease causes losses in animal resources amounting, conservatively to US $5 billion annually (Murray and Gray, 1984). The threat of the tsetse fly/trypanosomiasis by far remains the greatest limitation to the development of Africa's livestock industry.

The most effective way around the threat is found in the exploitation of livestock breeds that are tolerant to trypanosomiasis. Several strains of trypanosomes have been observed to resist many of the available trypanocidal drugs (Murray et al., 1990; Neate, 1992) and little effort has been directed towards the development of new drugs. Breeds of sheep, goats and cattle known to resist trypanosomiasis abound in the tsetse-infested areas of Africa. Not much is known about the productivity of these breeds, neither is much done to develop them. Many of the animals face extinction except something is done soon enough to preserve them (Osinowo, 1977; Orji et al., 1984). Their extinction will rob Africa of one of the ways forward in the development of her livestock industry.

The Muturu cattle is among the breeds of cattle that are trypanotolerant. It also appears to be the only 'purebreed' among the trypanotolerant class indigenous to Nigeria. The same animal and its relatives exist in other countries of Africa and go by such synonyms as the West African Dwarf

Shorthorn, Lagoon, Forest, Pagan, Somba, Kirdi and Dwarf Agbosome (Mason, 1951; Faulkner and Epstein, 1957; Payne, 1991). The breed is believed to be a member of the Bos brachyceros species (Doutressoule, 1947; Jeffreys, 1951) although Faulkner and Epstein (1957) considered it a degenerate of the larger type, Bos namadicus falconeri. The Channel Island breeds, the Guernsey, Jersey and Kerry have been identified as the European relatives of Muturu (Curson and Thornton, 1936).

Recent livestock census puts Nigeria's cattle population at 13.9 million (RIM, 1992) made up of Bos indicus (zebu) and Bos taurus breeds. The Bos indicus breed represent over 90% of the cattle population and most of them are kept in the northern states within the Guinea, Sudan and Sahel savanna zones. The Bos taurus specie i.e Muturu, N'dama and the hybrid Keteku are few but are important because they survive in the Forest, Derived and Guinea savanna zones on account of their tolerance to trypanosomiasis which is inimical to the zebu breeds.

The popoulation of the Muturu in Nigeria was estimated at 177,000 (RIM, 1992). The number of Muturu however keeps on the decline; the reasons for the dwindling population are not clear. Among guesses are that the breed is a slow grower, that its production is being hampered by poor traditional management practices and/or disease problems. There is little knowledge of the performance and actual contribution of Muturu cattle to Nigeria's beef industry because research

reports on it are very scanty (Roberts and Gray, 1973a; Orji et al., 1984). Little is known about their productivity and there are yet unknown factors that limit the productivity. Because the Muturu has been little studied, the constraints to its production and improvement are also poorly understood. It is felt that more could be done towards improvement of Muturu than is currently being done. However, before any meaningful intervention can be imposed in improving the productivity of the existing herd, a knowledge of the basic data under the present traditional management systems is considered an essential step. Such data would act as pedestal on which further research could rest.

The broad objectives of this study therefore, are to:

(a) obtain baseline data on the performance of Muturu cattle under existing traditional management system in Benue State;

(b) assess the role and constraints of Muturu cattle in the farming system of Benue State;

(c) determine the prevalence of trypanosome organism and its effect on certain blood metabolites such as packed cell volume (PCV), Haemoglobin (Hb), protein, magnesium, phosphorus and calcium, and

(d) assess the nutritional value of traditional feedstuffs for Muturu cattle under village management condition.

LITERATURE REVIEW

BREED CHARACTERISTICS

Classification

The taurine (humpless) cattle has two subgroups: Longhorns (Bos taurus longifrons) and Shorthorns (Bos taurus brachyceros) both of which are restricted to West and Central Africa. While the Longhorns are represented by two breeds only: the N'dama and the Kuri, the Shorthorn subgroup has numerous representatives that go by such synonyms as the West African Dwarf Shorthorn (Muturu), Lagoon, Forest, Pagan, Somba, Kirdi and Dwarf Agbosome (Mason, 1951; Faulkner and Epstein, 1957; Payne, 1991). The name Muturu is a Hausa word for humpless cattle. The name Kirdi - a general term used by the Fulani for non-moslem pagans (ILCA/FAO, 1980), is sometimes used for Muturu. Ghanaian and Liberian Dwarf Muturu also exist as well as Ghana Shorthorns.

In French-speaking countries, the Savanna Shorthorns are called Baoule and the Dwarf - type, Lagune. Dwarf Muturu are found in Cameroun and known locally as Bakweri. Cameroun also has three localized subpopulations of the Savanna Shorthorn type: Kapsiki, Doayo and Bakosi.

Physical characteristics

The Muturu is a small well muscled and compact animal with a good beef conformation. Its size varies considerably from

extremely small Dwarf (Forest) Muturu (<89 cm tall at withers) to small Savanna Muturu (>89 cm tall at withers) so it appears to be smaller than other Shorthorns (Akinwumi and Ikpi, 1995). The legs are thin and short, with height to chest ranging from 37 to 49 cm. Sexual dimorphism is quite pronounced. Contrary to all expectations, however, the males are generally smaller than the females, although they have well developed and robust hind legs. The hump is absent and the dewlap extremely small, typical of the Shorthorns. The Muturu head is long and relatively large compared to its body. The face is triangular in profile and slightly concave, with a flat and wide forehead. The nose is straight and the muzzle large and black.

The horns of the Muturu are small and short, especially in the female and thick at the base in the males. They can attain lengths of about 7.8 cm, with a basal girth of 16.6 cm and a basal core circumstance of 13.2 cm (Gates, 1952). The horns are oriented outwards and forwards and laterally to the exterior, forming a "C" in the females. Rudimentary horns also exist. Even though polled animals are common, the extent of their occurrence is unknown. The ears are small and laterally attached below the horns. The neck is of average length, flabby and thus apparently wider longitudinally. It is thin in the females and sturdy in the males. The chest is wide and deep, and the back is well muscled. The top line is inclined slightly forward in the females and is horizontal in the males. The udders in the cows are poorly developed.

The Muturu's coat has a multiplicity of colours, with plain black and black-and-white being the most common and typical of the Shorthorns. However, coats with brownish black or dark brown with white markings have also been reported (Olutogun, 1976). It has been observed that black or darker shade coats are common among the Forest type, while black-and-white or lighter shade coats are typical of the Savanna type (Epstein, 1971).

There are controversies surrounding the classification of the dwarf cattle found along the coast of West and Central Africa. Stewart (1951) asserted that these cattle are genetically heterogeneous and classified them collectively as the West African Shorthorn, due to similarities to European cattle of the Celtic era. Jeffrey (1956) however, was of the opinion that these cattle breed true to type as far as size is concerned.

It is generally agreed that these cattle are dwarfs (Gates, 1946; Jeffreys, 1951; Stewart, 1951). Gates' (1946) explanation was that the dwarfism in these cattle is ateleiotic, a phenomenon in which growth ceases in early age or childhood. Montsma (1959) however, was of the view that growth in the West African dwarf cattle starts at a low level and continues at a decreasing rate for a long period, with a considerable proportion of their development taking place in later stages when growth rate is very low. Following these findings, Montsma (1959) concluded that dwarfism in these

cattle was neither ateleiotic nor purely achondroplastic even though they resemble the achondroplastic Dexter cattle of Ireland. Rouse (1959) attributed their dwarfism to natural selection and low nutrition. Stewart (1951) had observed that the presence of large individuals within the same zone ruled out poor nutrition per se as cause of stunted growth in these cattle.

The West African dwarf cattle, including the Muturu are low at the withers, prompting Montsma (1959) to believe that they represent the smallest cattle breeds in the world.

The Muturu and the other West African shorthorns are humpless and withstand varying degrees of trypanosomiasis (Stewart, 1951). ILCA/FAO, (1980) reported on the existence of two types of Muturu - the Forest Muturu, a more uniformly black type and the Savanna Muturu which is more commonly white. Payne (1991) stated that pied individuals also occur, with colours extra to black and white. Polledness is also a common feature of the breed. The Muturu are docile under village conditions but are rather wild on the ranches (ILCA/FAO, 1980).

The West African shorthorns exhibit marked path - forming behaviour when grazing on improved pastures, which may indicate adaptation to forest environment rather than to the open savanna and this makes them suitable to village herding (Ferguson, 1966).

Both the Muturu and the N'dama have been found to possess principally haemoglobin A in their blood, with values at 75.6 and 82.7% respectively (Vohradsky and Mozzanti, 1971). The breed also exhibits high heat tolerance (Wright, 1955) although no relationship has been found between haemoglobin type and heat tolerance (Silva, 1973).

Adaptive characteristics

Heat Tolerance

The ability of trypanotolerant cattle to withstand heat has been attributed to their relatively small size and, therefore, large surface area: body weight (Wright, 1955). However, the West African Shorthorns have been found to be susceptible to direct solar radiation which was evidenced by elevated rectal temperature when deprived of shade (Ferguson, 1967). Individuals that inhabit the more northern parts of the Guinea savanna tend to possess characteristics that enable them to graze longer into periods of high solar radiation (Ferguson, 1966; Pagot, 1974).

The N'dama, another trypanotolerant breed has been observed to withstand higher levels of humidity than the zebu (Pagot, 1974). The same may be expected of the Muturu since it occupies the same ecological zone as the N'dama. This may suggest the absence of rigid homeothermy, a feature that is commonly observed in desert species, notably the camel (Wilson, 1984).

Amakiri (1974) had observed higher density of sweat glands in the Muturu than the N'dama (Bos taurus), White Fulani (Bos indicus) or German Friesian cattle in the humid zone. The Muturu was expected to sweat more profusely than the other breeds studied, which would enable it withstand higher temperatures. Its small size confers on it lower maintenance requirements and therefore less heat production. However, Jenkison and Nay (1973) attributed the better heat tolerance of the indigenous zebu than their exotic Bos taurus counterparts to the lower maintenance requirements and heat production of the former. Mean gland volume and length: diameter ratio were also higher in the Muturu than in either N'dama or German Fresian (Amakiri, 1974). The low tolerance of the Muturu to solar radiation may be due to its less glossy coat which often is dark. Payne (1991) has noted that animals with glossy coat and highly pigmented skin fare better in areas of high solar radiation.

Tolerance to Trypanosomiasis and Other Diseases

Perhaps, the tolerance of the Muturu to trypanosomiasis is one of its most outstanding assets. It has been stated that the humid forests to the coast of West and Central Africa as well as parts of East Africa are heavily infested with tsetse flies which serve as vectors of trypanosomiasis. The ability of certain breeds of cattle, among them the Muturu, to remain productive in the tsetse-infested areas without treatment has long been recognized (Stewart, 1951; Roelants, 1986). Murray et al., (1990) observed that trypanotolerant cattle would

play significant role in livestock development in the forests due to the unlikelihood of developing a vaccine in the foreseeable future.

Trypanotolerance is measured by at least three main characteristics (Murray, 1987). These are the animals' ability to control parasitaemia, its ability to develop an effective immune response, and the ability to resist anaemia. Anaemia is a well recognized and inevitable consequence of trypanosome infection in domestic animals (Stewart, 1951; Murray, 1974; Morrison et al., 1981; Murray and Dexter, 1988). Following on this knowledge, it has now been established that the measurement of anaemia gives a reliable indication of the disease status (Murray, 1979; Trail et al., 1991) and productive performance (ILRAD, 1986; ILCA/ILRAD, 1986a,b) of tryponosome infected cattle. The critical packed cell volume (PCV) has been estimated at 15% and infected animals with values at or below this level have to be treated with trypanocidal drugs, to prevent death (Murray et al., 1990).

With regard to regulation of parasitaemia, Murray (1987) observed different patterns with different strains of trypanosomes. Trypanosoma brucei is controlled by the animal's ability to regulate parasite growth, followed by the induction of the immune response. In T. vivax infections, the ability to mount an immune response is the important path of control. In the N'dama, Paling et al, (1987) found no relationships between control of parasitaemia and anaemia

although both controls were observed (Murray and Dexter, 1988) during infection.

The Muturu possess all three typanotolerant characteristics listed above (Stewart,, 1951; Murray et al., 1990). Calves less than one year are more resistant than adults to the effects of trypanosomiasis (Fiennes, 1970; Maxie and Valli, 1979; Wellde et al., 1981; Murray et al., 1982): The former appear to have a superior erythropoetic response.

The level of trypanotolerance of the West African Shorthorns has been examined by Stewart (1951). Of 1113 cattle, only 171 became infected, with 62 showing clinical signs during periods of four outbreaks. Eleven of the cattle eventually died. A more severe test was the trekking of the cattle from Ghana to Nigeria, over hundreds of kilometres of tsetse-infested zone. None of the animals fell to trypanosomiasis. In natural infections, these cattle were observed to recover spontaneously, although the rapidity of recovery depended on nutritional status (Stewart, 1951).

Murray et al., (1990) have extensively reviewed the control of trypanosomiasis and highlighted the limitations of individual methods. The development of a vaccine against the disease seems far away. Trypanosomes exhibit a complexity of multiple antigen types during a single infection. Furthermore, van Meirvenne et al. (1977) reported that trypanosome species individually comprise of unknown number of different strains or serodemes, all capable of elaborating

a different repertoire of variable antigen types. There is, therefore, a strong need to exploit the breeds most suited to the environment, not only for the reasons of poor nutrition (Vercoe, 1974; Frisch and Vercoe, 1978) but most especially for the fact of trypanosomiasis and other diseases.

Both the N'dama and West African Dwarf Shorthorn (Muturu) appear to be more resistant to tickborne diseases, including heartwater, anaplasmosis, endemic piroplasmosis and babesiosis (Epstein, 1971; Ilemobade, 1984). On the other hand, the dwarf shorthorns are reported to be much more susceptible to rinderpest than the zebu breeds (Stewart, 1937, 1951; Cornell and Evans, 1937; Ferguson, 1967). van Hoeve (1972) also noted the low resistance of the Muturu to footrot.

Special genetic characteristics

Haemoglobin and transferrin (TF) polymorphisms have been reported in the Muturu. Both the Muturu and the N'dama have been found to possess principally haemoglobin A in their blood which is different from the other Shorthorns, an indication that they may be genetically different from the other breeds (Bangham and Bluemberg, 1958; FAO, 1976; Vohradsky and Mozzanti, 1971). However, no relationship has been found between haemoglobin type and heat tolerance (Wright, 1955; Silva, 1973). Baoule and Muturu cattle however, have similar TF allele which are different from that of the N'dama (Braend and Khanna, 1968). The pressence of

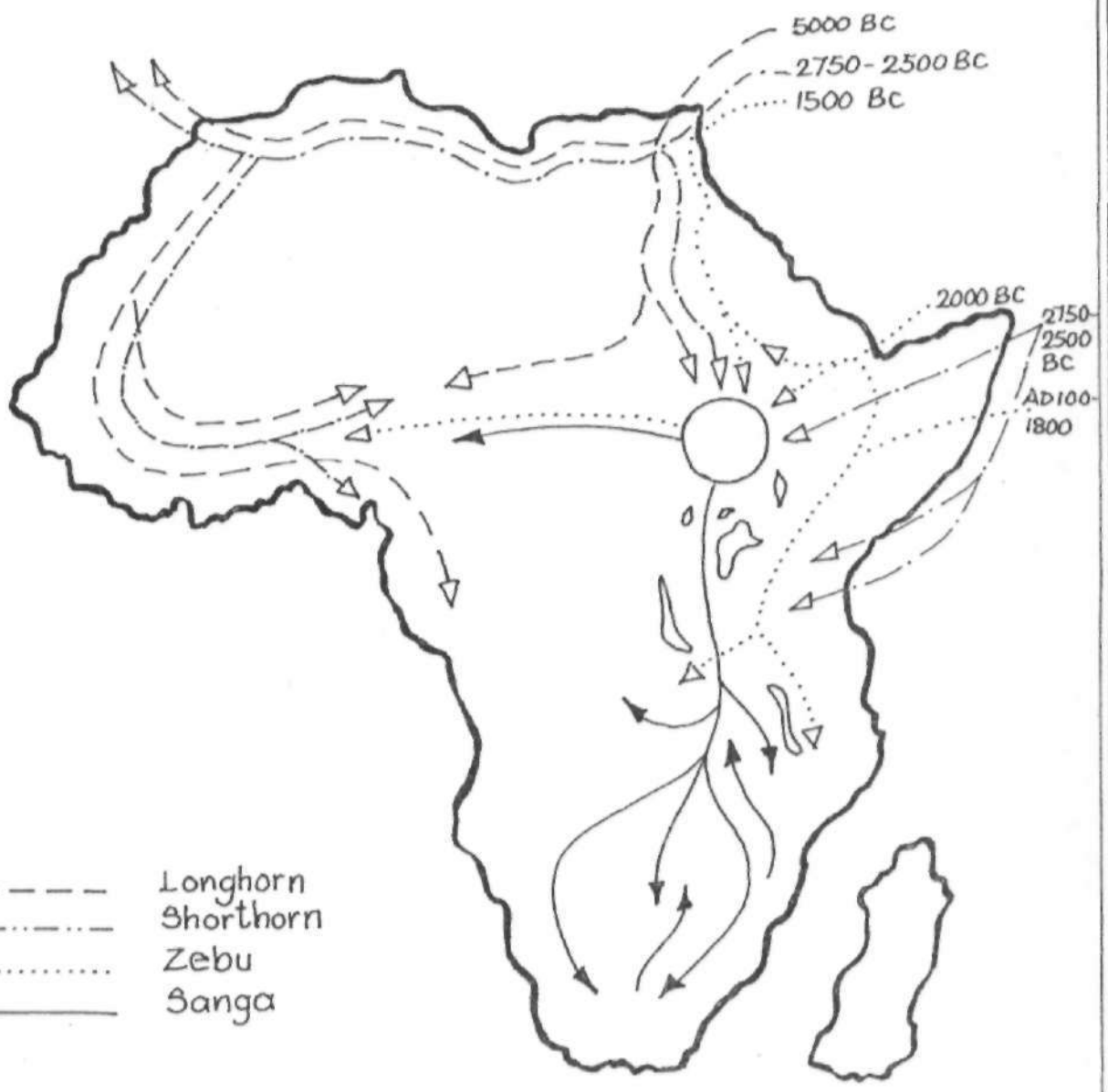
another blood factor Z in the zebu and not the taurine breeds (Muturu and N'dama) is further evidence of different ancestries of these cattle types. These alleles differentiate the humpless Shorthorns and Longhorns from each other as well as from the humped zebu (Mason, 1951, 1958; Joshi et al. 1957).

Trypanotolerance appears to be of genetic origin and is highly heritable. Murray et al. (1990) demonstrated that N'dama embryos carried to term by surrogate Boran cows were born with the trait.

ORIGIN

The humpless Longhorns and Shorthorns are believed to have been introduced into Africa from centres of domestication in Asia (Epstein, 1957; Faulkner and Epstein, 1957; Payne, 1970; Williams and Payne, 1977; Oliver, 1983). Longhorns arrived about 5000 BC. They were followed by the humpless Shorthorns about 2500 BC and the humped zebu, first around 1500 BC, then in large numbers around 670 AD (Fig.1). After entering Egypt from Asia, B. taurus brachyceros cattle moved southwards along the River Nile thence into western Sudan while others moved from Egypt along the Mediterranean seaboard (Stewart, 1937). It is speculated that increasing aridity at the time of their introduction may have made it impossible for the Shorthorns to follow the southward migration route across the Sahara. This may explain the route taken westward along the North African Mediterranean coast. It is highly likely that, like the Longhorns before them, the Shorthorns split into two

Fig.1 POSSIBLE MIGRATION ROUTES OF DOMESTIC CATTLE IN AFRICA



Source: Oliver, 1983.

routes around Morocco. One stream moved north into present-day France and the British Isles - the Jersey, Guernsey and Kerry breeds are partly derived from this stock; and the other moved south and westward, eventually coming into the rain-forest zone where, through exposure to trypanosomiasis, they became tolerant (Fig. 1). Isolated populations of Shorthorns were also reported in East Africa (Stualmann, 1927). Similar cattle are reportedly found in the Island of Socotra off the Horn of Africa and were also reported in the 1920s on the islands of Pemba and Mafia, off the coast of Tanzania (Payne, 1964) and in Madagascar (Dechambre, 1951). These Shorthorn populations may have resulted from movements further south of the introductions through Egypt and/or from a separate introduction through the Horn of Africa.

Doutressoulle (1947) considered that Shorthorns were brought to West Africa by the Berbers from southern Morocco. From Morocco, the southern-bound Shorthorns supposedly spread between the Sahara and the Atlantic coast, to the Guinea coast and the hinterland of Nigeria (Fig. 1). Cameroun formed the extreme and southern limits of their distribution in the region. Whatever the route might have been, shorthorned humpless cattle are depicted among the prevailing Longhorns in rock paintings on the Bauchi plateau of Nigeria dating from the second half of the first millennium BC. According to Epstein (1971), the Shorthorns were the most common type of cattle in northern Nigeria before the Fulani invasions of about 1820. It is believed that they migrated

from this area to the Atacora mountain chain along Benin, Togo and Ghana, they supposedly populated the north of Togo and Ghana. Migrations of Akan people from Ghana to settle in Cote D'Ivoire (where they became known as the Baoule tribe) brought the Shorthorn to the area. Through further migrations from Benin City, in Nigeria, the Gold Coast was populated by the Shorthorns, eventually evolving to create the present-day local Shorthorn populations.

Elimination of Shorthorns from Chad, the Sudan and Ethiopia probably took place much earlier and was associated with the primary westward expansion of the zebu. Traces of Shorthorns are still found in the east and south of Chad. It is believed that the population of Shorthorns in West and Central Africa owes its existence to its tolerance to trypanosomiasis, a competitive advantage over the zebu. As has been alluded to, the zebus were introduced much later and spread west and south, stopped only by the western rain-forest barrier. (Crossbreeding between the zebu and the taurine types is thought to have formed the sanga types, which are the predominant cattle in the southern African region). Present-day populations of Shorthorns in Central African countries have resulted from imports in recent times, during and after the colonial era.

ECOLOGY AND DISTRIBUTION

Some aspects of the nature of the country inhabited by the Muturu have been raised in discussing the breed characteristics. In West Africa, Stewart (1951) observed that the West African Shorthorns generally live south of the 12th parallel (which is a land strip north of the coast) until Nigeria is reached when that line dips south. The predominant features of the high forest and its adjoining derived savanna are high, though seasonal temperatures, humidity and rainfall vary. These conditions on their own are capable of adversely affecting feed intake and utilization (Payne, 1991). In the high forest, forage supply may be limited. The derived savanna provides the most ideal environment for animal rearing, were it not for its infestation, just like the high forest, with tsetse flies and vectors of other diseases (Hill and Upton, 1964; Adegbola and Amodu, 1972). Rainfall within the derived savanna ranges from 1200 to 1500 mm per annum. Forages of quality abound in the zone, and include species of Hyparrhenia, Cymbopogon, Digitaria, Pennisetum, Setaria, Panicum and Andropogon (Blair - Rains, 1957; de Leeuw, 1977; Mohammed-Saleem, 1986). It is possible to provide grazing for 8 months of the year while water supply is constant.

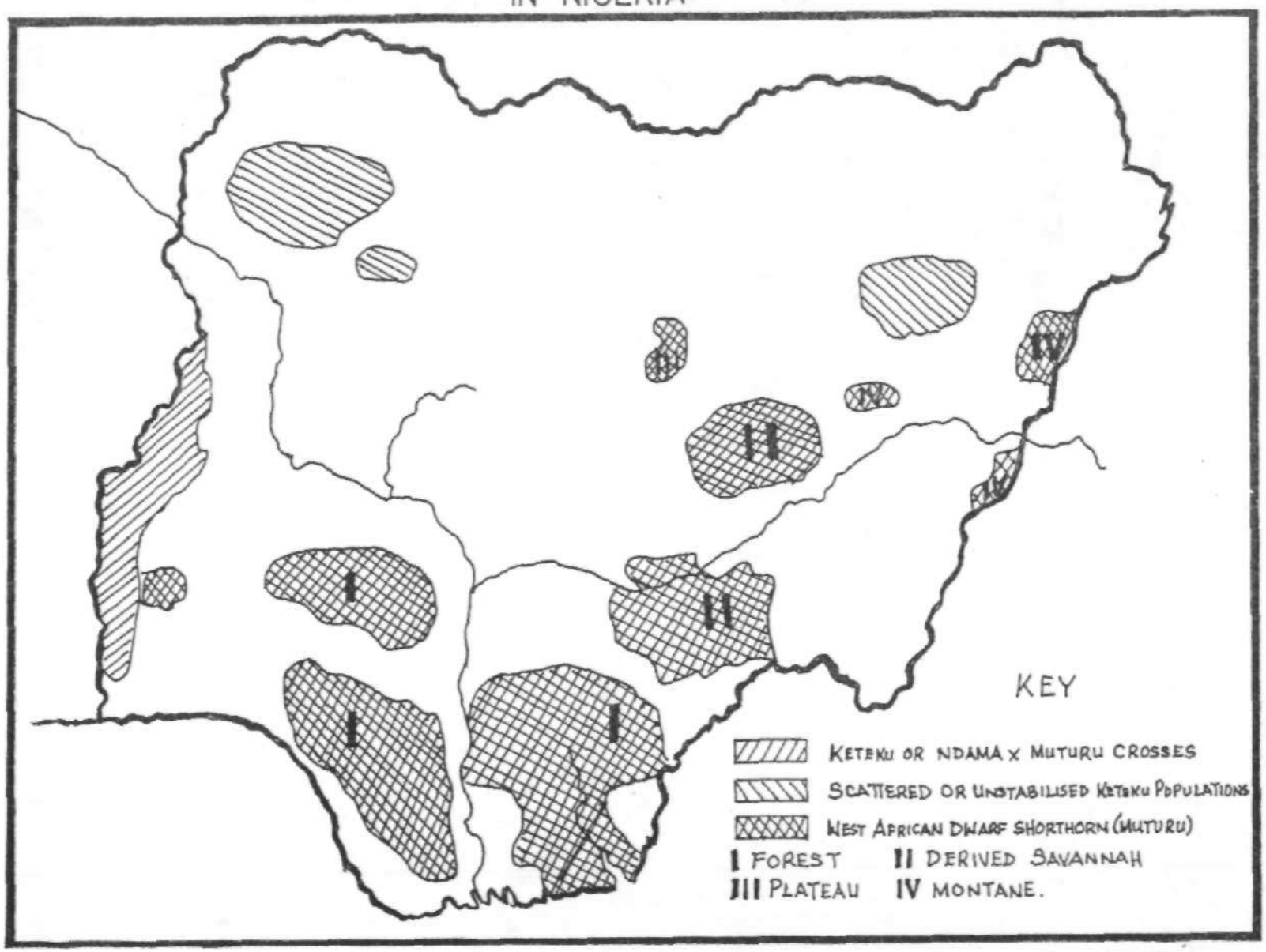
In Nigeria, Algren (1959) reported that the derived savanna covered an area of only 4000 ha, 5% of which was farmed to arable crops and the rest was deemed suitable for livestock farming. The situation must have changed greatly, but

although the human population has risen, so also has the area of the derived savanna, as large areas of the high forest are cleared for farming (Putt et al., 1980).

In Nigeria, the Muturu is largely restricted to the derived savanna and regions of the high forest, south of the rivers Niger and Benue (Bourn et al., 1986) (Fig. 2). Much of the derived savanna is now classified as a subhumid zone, an area between $8^{o}30'$ and $10^{o}30'$N covering 40% of Nigeria's total area of about 942,000 square kilometres (Jahnke, 1982). ILCA/FAO (1980) and Nord (1982) defined this area further as being bounded to the north by the limit of the 180 - day crop growing season and to the south by the interface between the derived savanna and forest vegetation zones. About 20% of the zone is said to be under cultivation (Bourn and Mulligan, 1983). In Africa, the subhumid zone holds only 25% of the continent's population (Adegbola and Amodu, 1972; von Kaufmann, 1986) and these observations point to the fact that a large area of the subhumid zone, of which the derived savanna is part, is left for grazing, other factors permitting. Most of the inhabitants are crop farmers, with a few cattle - keeping individuals (Waters-Bayer and Taylor-Powell, 1986a). The limitation to livestock rearing appears to be the scare of trypanosomiasis.

In the high forest, it has been stated, there might be limitation of forage availability. Under such a regime, only animals with low maintenance energy requirements and added advantage of trypanotolerance would survive (Hill and Upton, 1964; Murray, 1987).

FIG.2 DISTRIBUTION OF WEST AFRICAN DWARF CATTLE IN NIGERIA



Source: RIM 1992

The common factor within the zones inhabited by the Muturu is infestation by tsetse flies (Glossina spp). These flies transmit trypanosomes to animals. In Africa, the major species of trypanosome are Trypanosoma congolense, T. vivax, T. brucei and T. simiae which cause severe loss in production and performance of cattle and water buffalo (Murray et al., 1990). Tsetse infest 37% or 11m km^2 of Africa, spreading through 40 countries (FAO/WHO/OIE, 1982). It is considered that 7m km^2 of this area would be suitable for livestock and mixed agriculture without stress to the environment, if trypanosomiasis could be controlled (Mac Lennan, 1980). Only 30 million of Africa's 140 million cattle are located in the tsetse infested zone. The trypanotolerant cattle that have well been recognized in West and Central Africa represent only 5% or 8 million of the cattle population in countries infested with tsetse (ILCA/FAO, 1980). The trypanotolerant breeds constitute 3% of Nigeria's national herd (ILCA/FAO, 1980). The failure to further expand the horizon for these breeds is attributed to the fact that there are fears of their resistance only to local strains of trypanosome (Murray et al., 1990). Actually, this fear should have been dispelled by the reports of Stewart (1951) who observed the resistance of the West African Shorthorns to the Tanzanian strain of trypanosomes. For certainly, zebu cattle do not survive in this zone for long without dosing with trypanocidal drugs (Stewart, 1951).

POPULATION

Tables 1 and 2 summarize population figures of Muturu cattle in Nigeria over a period of about 55 years. These estimates reveal a general decline in the population of the Muturu over the 55 years period. In 1992 when the livestock census of Nigeria was carried out however, the figure of 177,000 (RIM 1992) was close to that of 176,000 estimated in 1960 by Fricke (1979). Perhaps the Nigeria civil war 1967 - 70 which affected the southern part of the country where most of Muturu cattle is concentrated may have contributed to this dwindling population. Another factor may have been due to increased interbreeding between the zebu cattle and the Muturu. This may be so because over the years, there has been seasonal movement of White Fulani cattle from the drier North to the Muturu habitat of the Subhumid and Humid forest zones in search of pasture and water. With time, this movement has encouraged settlement of the White Fulani cattle in the Muturu zone. Even though the Muturu zone is tsetse infested, increased farming activities have resulted into tree clearing and destruction of tsetse habitat, thus rendering the areas less infested with tsetse flies and creating favourable environment for settlement and increased interbreeding between White Fulani cattle and the Muturu.

MANAGEMENT SYSTEMS

Not much is documented on the management systems under which the Muturu are produced. Information on management systems will go a long way in aiding decisions on changes that ought

Table 1 Estimated population of Muturu cattle in Nigeria before 1938 to 1992.

Year	Population	Source
-	378,000	Oyenuga (1967)
1938	200,000	Fricke (1979)
1960	176,000	Fricke (1979)
-	100,000	Domingo (1976)
1977/7	57,000	ILCA/FAO (1980)
1983	79,000	Shaw and Hoste (1987)
-	59,500	Ngere et al (1975)
1984	37,500	Akinwumi and Ikpi (1985)
-	25,000	Adeniji (1985)
1991	97,600	ILCA (1992)
1992	177,000	RIM (1992)

Table 2 Estimated Population of muturu cattle in Nigeria by State.

State	1977[1]	1984[2]	1992[3]
Benue	25,000	-	10,000
Anambra	10,000	11,310	15,000
Bendel	5,000	1,574	19,000
Cross River	4,000	2,575	5,000
Imo	3,000	7,412	13,000
Ondo	3,000	3,660	3,000
Oyo	2,000	8,847	73,000
Kwara	2,000	-	11,000
Ogun	2,000	536	-
Lagos	2,000	1,217	-
Rivers	-	399	3,000
Akwa Ibom	-	-	6,000
Bauchi	-	-	1,000
Kaduna	-	-	1,000
Plateau	-	-	17,000
Total	57,000	37,503	177,000

[1] Source: ILCA/FAO, 1980.

[2] Source: Akinwumi and Ikpi, 1985.

[3] Source: RIM, 1992.

to be made. The productivity of an animal depends as strongly on management as on genotype. The productivity of most cattle in the tropics is believed to be below their genetic potentials due to poor management, even under sedentary systems (Otchere, 1986a). The reality is that many cattle are reared under nomadic (extensive) systems. The inhabitants of the area in which the Muturu are kept are mainly sedentary crop farmers (Waters-Bayer and Taylor-Powell, 1986a; von Kaufmann, 1986). Livestock rearing among the latter is a secondary enterprise.

ILCA/FAO (1980) described three distinct herd management systems among rearers of the trypanotolerant cattle in Nigeria. These systems include village husbandry, commercial farming or ranching and transhumance husbandry. Muturu are for the most part kept under the village husbandry system. This consists of free-roaming or confinement overnight and herding in daytime (Ferguson, 1986). Ferguson (1987) further contended that grazing may be for only about 9 hours a day which occurs from about 9 a.m. to dusk. Thereafter, animals are tethered on bare ground. No concise feed supplementation is undertaken. This, the author opined was a major factor responsible for the poor condition and low performance of village herds.

According to the National Agricultural Sample Census (Federal Office of Statistics, Nigeria, 1977), only 0.3% of all rural households in Western and Eastern Nigeria keep cattle, with an average of 4 animals per household and rarely over 10 animals. Cattle herds are generally concentrated in a few

villages, with neighbouring villages owning no cattle at all. A few private herds of 50 - 60 cattle are found in some areas. The herds were observed to be mixtures of Muturu and Muturu x N'dama crossbreds in the Western Nigeria. Cattle are kept together with the trypanotolerant goats and sheep by Ibo, Yoruba, Tiv, Idoma and Egun tribesmen. The survey further revealed that the natives relish meat from these animals and believe that the meat from humpless cattle tasted better than beef from zebu cattle, although the animals are neither kept as regular sources of meat nor of income.

During grazing, animals are herded on roadside grass, natural pasture and fallows, in addition to household wastes and crop residues (ILCA/FAO, 1980). No salt licks are provided, neither are animals castrated nor weaned systematically.

Commercial farms or ranches keep the N'dama or Keteku and serve mainly as breeding and multiplication centres. Short-term fattening is also carried out on ranches (ILCA/FAO, 1980). Hired nomads are used for herding the animals, mainly on natural pastures. Supplements in the form of mineralized concentrates, fodder or crop residues are provided.

Seasonal transhumance is reported to be practised with Keteku cattle in the Guinea savanna zone although such herds are predominantly Bunaji cattle (ILCA/FAO, 1980). The animals are occasionally treated against trypanosomiasis.

The inadequacy of natural grazing in meeting the requirements of Bunaji cattle was demonstrated through a theoretical model by Milligan and von Kaufmann (1979). In spite of benefits derivable from supplementary feeding (Pullan, 1980; Synge, 1981), ILCA/FAO (1980) stated that no supplementary feeding is undertaken with the village-reared Muturu. It is doubtful if any meaningful health management practices are observed in village herds. These substandard practices are capable of lowering the productivity of any animal, including the Muturu.

PRODUCTIVITY AND UTILITY

There is a dearth of literature on the productivity of the Muturu. The scanty reports on trypanolterant breeds cover mainly the N'dama, Keteku and their crosses.

Reproduction in the Muturu

Oyenuga (1982) and Otchere (1986a) observed that Nigerian cattle breeds are generally late in attaining sexual maturity and calf mortality may be as high as 20%. Olutogun (1976) reported an average age at first calving of 47.6 months in the N'dama under local management conditions. Shorter periods have been observed by Akinokun (1976) and Claus (1976) who reported 40.5 and 41 months respectively. Calving intervals of 472 - 570 days have also been reported for the N'dama (Akinokun, 1970; Claus, 1976; Olutogun, 1976). In a tsetse-free environment, Roberts and Gray (1973a) observed a shorter calving interval of 363 days. On government ranches, calving rates varied between 54 and 78% while calf viability to one year was 95% and calf mortality was 2 - 3% (ILCA/FAO, 1980). A conception rate of 72% has been reported for N'dama and Keteku cows in studies spanning ten years (Steinbach and Balogun, 1971). Seasonal variations were noted, with the highest conception rate corresponding to April and lowest values in October in Western Nigeria. These periods represent availability of lush forage and fibrous material respectively. With concentrate supplementation at the rate of 0.9kg/head/day, Montsma (1963) recorded a calving percentage of 92 for the West African Dwarf Shorthorn (Muturu). Thorpe et al., (1988) had attributed the low

reproductive performance of the N'dama to infection with trypanosomes.

In the Keteku, the average age at first calving is 47 months under improved ranching conditions (ILCA/FAO, 1980). The Keteku are reported to be late breeders; while N'dama and Muturu may be culled for reproductive inefficiency at 30 - 39 months, Keteku heifers may be left until they are 48 - 57 months of age. The mean calving interval for the Keteku is between 491 and 673 days (Claus, 1976; Olutogun, 1976). Olutogun (1976) observed a calf mortality rate of 2.2% in herds of Keteku, N'dama and their crosses, in studies spanning 18 years. In the Muturu, Ferguson (1967) recorded 26 months as average age at first calving at a multiplication ranch while Roberts and Gray (1973a) observed 21 months at a tsetse-free station. On both sites, dry season feed supplementation was practised. ILCA/FAO (1980) reported 4 - 5 years as the common age at first calving among village herds.

Age at first calving and calving interval in the Muturu can be as short as 21 months and 11 - 13 months respectively under intensive ranching or research station conditions (Ferguson, 1967; Oyenuga, 1967; Roberts and Gray, 1973a; Olutogun 1976) but is generally 4 - 5 years and 18 - 24 months respectively under village conditions (ILCA/FAO, 1980). Calving occurs throughout the year as in the other trypanotolerant breeds or their crosses. Calving percentage ranges from 57 for village/light tsetse challenge conditions to 96% for station/tsetse-free environments while calf viability to one year is between 85 and 95% (ILCA/FAO, 1980).

The average birth weight of Muturu calves is 13.2 kg, compared to 18.1 and 26.5kg respectively for N'dama and Bunaji calves (Roberts and Gray, 1973a). Ngere and Cameron (1972) reported a birth weight of 14.8kg for Muturu calves and 14.5, 14.3, 23.6 and 22.2kg for N'dama, Muturu x N'dama, Santa Getrudis x Muturu and Red Poll x Muturu respectively.

Basic factors have been searched to explain the seemingly low reproductive performance of the Muturu, outside the large areas of nutrition and infection with trypanosomes. Ezekwe and Orji (1988) observed low total protein in the semen of Muturu and N'dama. There was also a high failure rate in getting the bulls of these breeds to ejaculate a second time. In an earlier study, Orji et al. (1984) recorded low ejaculate volume and high proportion (30%) of morphologically deformed spermatozoa from Muturu and N'dama. The cation and chloride complex was balanced. Studies on the Muturu (Orji et. al., 1984) pointed to the small testicular size as being responsible for the low semen volumes. Ezekwe and Orji (1986) had reported on the lower proportion of the acrosome to whole spermatozoon in the Muturu and N'dama, relative to the normal range, 55 - 60% in other breeds. The midpiece, head length and width of the spermatozoa of the two breeds were similar to values reported for other breeds. The head of the Muturu spermatozoon was observed to be narrower than that of the N'dama. Igboeli et al. (1987) reported the low motility of spermatozoa of the Muturu and attributed this to the absence of fructose in most of the ejaculates.

Unlike the Holstein-Friesian bulls, Muturu and N'dama bulls tended to settle less readily and exhibited fewer intense pre-ejaculate sexual displays during semen collection (Nwakalor et al., 1979). The Muturu bulls were found to be shy and nervous while penile thrusts were weaker in the Muturu and N'dama than in the Holstein-Friesian bulls.

The length of oestrous cycle in the Muturu is 19.5 ± 0.8 days and this was considered to be within the range for beef breeds (Orji and Adeuyi, 1986). However, the cows poorly exhibit oestrus with a high incidence of silent heat (Orji, 1985; Orji and Adeuyi, 1986). These findings generally point to low success rates with both natural and artificial insemination.

The influence of trypanosomes on reproductive efficiency has been studied (Maehl et al., 1988; Trail and d'Ieteren, 1991). It was found that parasitaemia, due to trypanosome infection affected calving intervals and overall productivity. Animals that maintained a high PCV had 11% shorter calving interval, 9% heavier calf weaning weight, and 24% superior cow productivity than those whose PCV were lowered by disease.

Growth and Meat Production

The birthweight of Muturu calves is 13.2 - 14.8kg (Ngere and Cameron, 1972; Roberts and Gray, 1973a). Ngere and Cameron (1972) observed an average daily gain in weight of 0.38kg between birth and 210 days of age when a weight of 108.5kg was attained. In the same trial, the Muturu and its crosses

with the N'dama, Santa Gertrudis and Red Poll had dressing percentages of between 42 and 51. Ferguson (1967) reported slightly higher dressing percentage values, 50 - 53 for the Muturu. Roberts and Gray (1973a) observed an average daily weight gain of 0.33kg for male Muturu calves between birth and weaning and 0.21kg from 6 to 18 months of age on unimproved pasture. Weaning weights were higher in calves that were able to maintain high PCV in the face of tsetse challenge than in individuals whose PCV were low (Trail and d'Ieteren, 1991). It was further observed that the weight gains of the former were about 44% superior to those of the latter. Hill and Upton (1964) were of the view that liveweight gain and mature liveweight were similar for N'dama and Muturu although the former was favoured as a beef animal due to better conformation. The Nigerian Muturu has been observed to possess good beef conformation (Shaw and Colville, 1950; Faulkner and Epstein, 1957).

Montsma (1959) found that the conformation of the West African Dwarf Shorthorn (Muturu) generally compares favourably with that of other beef breeds. Crossbreds were however, observed to possess higher carcass weight and greater uniformity in size than the pure Muturu (Stewart, 1951). Hill and Upton (1964) reported that the N'dama had higher finishing weight than the Muturu x N'dama by about 8kg but were only 4kg heavier than the Keteku at 30 months of age.

Weight gains were highest between early and mid-rains (late March to August) in Western Nigeria in a herd of N'dama, Keteku and their crosses (Hill and Upton, 1964). It was felt that the animals would benefit from improvement in pastures and supplementary feeding during the dry season.

Milk Production

In calling for the development of mixed farming in the humid south of West Africa, Stewart (1951) was of the view that the indigenous trypanotolerant cattle would provide the farmer with among other things, a little milk. However, all available accounts point to the fact that the Muturu and other dwarf shorthorns are poor milk animals (Payne, 1991). The Muturu possess a compact little body, similar to the renowned milk breeds of the world. However, it differs from the latter greatly in dairy potentials. By weigh-suckle-weigh techniques, Montsma (1959) recorded yields no higher than 250kg over the entire lactation period from Muturu that were in above average condition. The average daily yield was 2kg and the highest daily yield was 2.7kg. In a later study, cows supplemented with 1.8kg/head/day of groundnut cake/maize yielded 362kg (Mostsma, 1963). By similar methods, Ngere et al. (1975) obtained a total average yield of 265.5 ± 101kg over 295 days from daily outputs of about 0.9kg. The maximum daily yield from a cow was 9kg and yields were highest between the third and seventh week of lactation. Milk analysis revealed total solid content of 10.6%, butterfat, protein and ash made up 1.3, 3.2 and 0.75% respectively (Ngere et al., 1975). A major problem

encountered by these workers was the inability to stimulate milk letdown in Muturu cows. That led to the use of the calf to extract the milk.

Under ranch conditions, Olaloku (1976) recorded a yield of 421kg over 216 days. Payne (1991) reported that the Muturu generally yield between 120 and 360kg milk over a lactation period of 120 - 180 days. Thus, the Muturu's potentials as a dairy animal appears to be poor.

Draught

Stewart (1951) listed draught power as one of the benefits that could be derived from the development of mixed farming under which trypanolterant cattle would be reared in tsetse-infested regions. Unfortunately, the Nigerian Muturu has not been effectively put to use as a draught animal (ILCA/FAO, 1980). Payne (1991) reported that the Muturu could be used for traction but their capacity is small and the stamina, low. Furthermore, their trypanotolerance easily breaks down through the stress of overwork. The Muturu is considered too small in stature and of poor conformation for traction requirements (Aribisala, 1965). The Ghanaian Muturu were found to be better than their Nigerian counterparts for traction. The former are larger but efforts at further developing their worth through crossbreeding with Zebu was abandoned. Aribisala (1965) felt that the multiplication of the Ghanaian Muturu was a preferred alternative to crossbreeding with zebu.

Generally, large breeds produce more draught power than small breeds. In trials with the American Brahman and two Criollo breeds, Lawrence (1987) found that the distance travelled, work done, speed and power all followed the predictable trends where values were greatest for the Brahman and least for the lighter two Criollo breeds. Ferguson (1988) opined that the farmer would employ whatever animal was available and that the draught efficiency would depend as much on design and quality of harness and other equipment as on breed of cattle used.

Miscellaneous Functions

The Muturu is employed in a variety of other ways outside those described above. As earlier mentioned, Muturu are generally not milked since their yield is just sufficient for their calves. Throughout most of southern Nigeria, however, milk is extracted from Muturu by native doctors for medicinal preparations. The animal would supply manure under mixed farming situations (Stewart, 1951). In its ecological zone, the Muturu is the preferred breed of cattle for use in numerous traditional ceremonies (Orji et al., 1984). The slaughter of a Muturu forms a prominent component of funeral ceremonies for elderly titled men among several tribes of the central and southern Nigeria. When a pagan dies for example, one or more oxen are sacrified and the corpse is rolled up in the hides of the slaughtered animals, while the meat forms part of the ceremonial feast. Muturu are commonly kept as pets or frequently used for prestige or dowry purposes (Ross, 1944; Rouse, 1969).

IMPROVING THE PRODUCTIVITY OF THE MUTURU

The Muturu may be small in size and of low productivity but these could be due to deficiency in management. The low productivity of most of Nigeria's cattle has been highlighted by Oyenuga (1982) and Otchere (1986a). Areas that could be manipulated to improve an animal's performance include improvements in nutrition, health, breeding and farming systems.

Nutrition

Although Jeffreys (1956) suggested that improvement of the environment would fail to alter the absolute size of cattle, Montsma (1959) was uncertain as to whether the relative proportions and in particular, the body weight of dwarf cattle would really remain unaltered under favourable conditions. Roberts (1971) was of the view that most cattle in the tropics are poorly fed and improving their nutrition could immediately increase their reproductive performance. The effects of poor nutrition differ mainly on grounds of whether the major deficiency is energy, protein, minerals or a combination of these factors. Usually, more than one component is deficient under traditional management. In the tropics, there are fluctuations in both the quantity and quality of forage throughout the year (Blair-Rains, 1957; Umunna and Agishi, 1988; Payne, 1991). Animals gain weight during the rainy season and lose some of the weight in the dry season. Ademosun (1973) observed that there existed a wide scope for improvement with supplementary feeding of

byproducts in the dry season when forage supply was limited. Cows of an unspecified breed that received a 75% concentrate diet gained 19kg more than those that received hay plus a protein supplement and these two groups gained more than a third group kept on hay alone over 42 days of receipt for fattening (Lofgreen and Kiesling, 1985).

In the Bunaji cattle, Pullan (1980) pointed to the effect of poor nutrition on the low growth rate of calves and mature individuals. The positive effects of supplementary feeding was demonstrated under pastoral system (Pullan, 1980; Synge, 1981). These workers advocated the use of supplementary feeding in traditionally managed herds. In the same breed, Otchere (1986b) observed significant improvement in the weight of calves at birth and one year of age due to supplementary feeding. The viability of calves was also enhanced but no improvement in calving interval was observed. In the Azaouk zebu, Bartha (1971) found that feeding concentrates advanced puberty and age at first conception by between 4 and 18 months. Restricted feeding, experimentally or by drought delayed puberty and interfered with ovarian activity of cows (Penzhorn, 1975; Post and Reich, 1980; Dindorklar el al. 1982). Penzhorn (1975) observed 80, 93, 87 and 40% conception rates respectively in Africander heifers on high, medium, low and restricted nutrition after a 3-month breeding period. Two out of three oestruses may be silent in underfed animals (Hale, 1974) and such results would adversely affect artificial insemination programmes.

Brahman heifers fed concentrate pre - and post - partum exhibited higher cyclicity and conception rates than cows fed concentrate prepartum or postpartum only (Olivares et al., 1981). It was concluded that cows should be fed well for 22 - 55 days before parturition and, possibly, for 90 days after parturition. King (1968) estimated that a 1% change in body weight would result in a 1% change in conception rate at first service.

ILCA/FAO (1980) had called for a repetition of these works in the subhumid zone but in expectation of shortages in conventional concentrates and rising prices, advocated for use of cheaper agro - industrial by-products, in addition to improvement in pastures. No supplementary feeding is undertaken for Muturu under village condition (ILCA/FAO, 1980). In many nomadic zebu herds, Okoh et al. (1988) observed that farmers did not supplement for reasons of ignorance or lack of the feeds or funds. In the Muturu, the situation may not be different under village husbandry, in which its rearing is regarded as a secondary enterprise. The alternative to scarce concentrates is to utilize improved pastures. Adegbola (1969) reported increments in body weight of between 29 and 114% as a result of application of nitrogen to natural grass. In the N'dama, it was possible to take animals to 300kg at 2 years of age through supplementation with local groundnut meal (Murray et al., 1990). The animals gained as much as 1 kg/day and cows yielded 313 kg of milk over 10 months. Montsma (1963) had observed a milk yield of 362 kg and calving percentage of 92 from N'dama and

non-descript West African Shorthorn through supplementation with 1.8kg groundnut cake/head/day.

Adequate feeding is also a prerequisite to the maintenance or even improvement in trypanotolerance (Stewart, 1951; Murray et al., 1990; Payne, 1991). Stewart (1951) observed that spontaneous recovery from trypanosome infection was more common during early rains, with the appearance of young grass than at other periods. Payne (1991) reported that under - nutrition constitutes a stress factor that could derail the trypanotolerance of the Muturu.

Although comparative research reports do not adequately cover the Muturu, due largely to its local rearing setting, it is believed (Montsma, 1959) that its productivity could be improved through improved nutrition.

Breeding

A sound breeding programme would, perhaps, be the primary point at which practical attempts at improving the Muturu should commence. Nwakalor et al. (1979) initiated series of studies to characterize the sexual behaviour of the Muturu, results of some of which were reviewed above. It was believed (Orji et al., 1984) that such line of research would save the breed from extinction.

Attempts at improving the West African Shorthorns by selection within themselves proved unsatisfactory because of the ready transmissibility of dwarfism (Stewart, 1951;

Jeffrey, 1956). It was also reported that crossbreeding with European breeds was ineffective due to the presence of local enzootic diseases and generally unsuitable environment (Stewart, 1951). More success was achieved through crossbreeding with indigenous zebu breeds. Apart from achieving improvement in body weight, some level of trypanotolerance was maintained in crossbreds from zebu. Crossbreds from European bulls and dwarf shorthorn cows were less hardy (Stewart, 1951; Murray et al., 1990).

The Muturu has been bred to other West African Shorthorn breeds in a bid to increase their size and retain a high level of trypanotolerance (Stewart, 1951; Ngere and Cameron, 1972; Murray et al., 1990). N'dama bulls have been the preferred animals in such programmes which are generally supported by the government (Stewart, 1951; Hill and Upton, 1964). Such a programme is also aided by the fact that trypanotolerance is not strain-specific or localized to a single environment (Stewart, 1951; Murray at al., 1990). In western Nigeria, it was found that N'dama-Keteku crossbreds were superior to either purebreed in the second and third years of growth (Hill and Upton, 1964). The ideal animal for the market was considered to be the first cross between the two breeds.

The low libido and overall performance of Muturu bulls have been highlighted (Nwakalor et al., 1979). The low levels of ejaculate volume and seminal protein and the virtual absence of fructose in the semen as well as low sperm motility (Orji

et al., 1984; Igboeli et al., 1987; Ezekwe and Orji 1988) are also factors that would retard the progress of an aggressive artificial insemination (AI) programme. Artificial insemination is one of the most rapid tools in use towards breed improvement and development (Payne, 1991). The oestrous characteristic of Muturu cows, however, are in many respects similar to those of other beef cows (Orji and Adeuyi, 1986). There might be other factors such as environmental stress responsible for the poor expression of oestrus reported by these workers. Upgrading the Muturu and other Shorthorns aided beef production but not milk yield (Stewart, 1951). The crossbreds remained disappointingly low milk producers.

Mishra et al., (1974) reported on the presence of a J antigenic factor in individuals of five breeds from Asia and Europe studied. The proportion of the individuals with the factor was highest in the Haryana and lowest in the Sahiwal. Animals that possessed the factor performed better than those without it, within each breed. It would be interesting to establish the proportion of Muturu cattle that possess this factor. That may serve as the way round the transmission of dwarfism, if selected individuals could perform above the breed average. The preservation of the Muturu genotype would be impossible without successes in intrabreed selection and development. ILCA/FAO (1980) found that farmers recognize the Muturu and N'dama heifers as earlier breeders than the Keteku, a Muturu-zebu crossbred. Sadly, there are already more Keteku than the Muturu in Nigeria (ILCA/FAO, 1980).

Health Management

The trypanotolerance of the Muturu is well documented (Stewart, 1937, 1951; Mulligan, 1951; Roberts and Gray, 1973a,b; Hill and Esuruoso, 1976; Murray and Trail, 1984) and reference has been made to these reports. The resistance of the breed and other West African Shorthorns to tickborne diseases (Epstein, 1971; Ilemobade, 1984) has also been highlighted in this review. However, it needs to be restated that the dwarf shorthorns are more susceptible to rinderpest than the zebu (Cornell and Evans, 1937; Stewart, 1951; Ferguson, 1967) and the Muturu has a low tolerance to footrot (van Hoeve, 1972).

The most important cause of death among young Muturu is helminthiasis and there have been losses through sporadic outbreaks of anthrax (Ferguson, 1966).

The Muturu can still fall to trypanosomiasis, especially under poor management or in areas heavily infested with tsetse flies. Miller (1946) was one of the first to insist on the use of the term, tolerance rather than some stronger term in describing the reactions of the forest cattle to trypanosomes. The productivity of the Muturu can be adversely affected by trypanosome infection. That accounts mainly for the differences observed in the productivity of village and ranch reared Muturu. In the latter, measures are taken against the disease (ILCA/FAO, 1980). The Muturu also does better in tsetse-free environments than in infested

areas (Stewart, 1951; Murray et al., 1990). Trail et at., (1991) reported 15% lower reproductive performance in N'dama cows which were highly parasitaemic than in cows without parasitaemia. Similar observations were made by Maehl et al. (1988) who reported depressed calf birthweight, cow weight gains and calf preweaning growth rate and weaning weight in trypanosome-infected N'dama. Herds maintained under zero tsetse risk recorded high calf viability, calf weight and overall productivity relative to herds kept at low, medium or high risk (Trail and D'Ieteren, 1991). In low or no tsetse-risk environments, ILCA/FAO (1980) reported that trypanotolerant cattle could be as productive as the trypanosusceptible breeds.

The facts that emerge from these reports are that the productivity of the Muturu could be enhanced through treatment with trypanocidal drugs. ILCA/FAO (1980) observed the use of such drugs to check weight loss of N'dama cattle on the ranches. The resistance of many strains of trypanosomes to existing drugs (Murray et al., 1990) and the reluctance of pharmaceutical firms to develop new drugs is however, a cause for concern. Moreover, it is feared that the trypanotolerant breeds may lose some of their natural tolerance, which may be of non-genetic origin (Payne, 1991) if prophylaxis becomes a strong component of health management.

Most importantly, it should be realized that the productivity of the Muturu could be substantially improved if it is

vaccinated against diseases to which it has lowered resistance. Stewart (1951) observed that the dwarf Shorthorns required several times the dosage of the rinderpest vaccine due to very high susceptibility. However, the vaccine requires cautious application; certain individuals fell after administration of the live serum. Hoof care and anthelmintic administration would benefit the Muturu.

Modifications to Farming Systems

The Muturu, is a secondary produce within the farming system of its ecological zone (Waters-Bayer and Taylor-Powell, 1986a). Many head of Muturu are reared under the village husbandry system (ILCA/FAO, 1980) which encompasses several substandard practices.

There are problems of land use (Jahnke, 1974) and that of the entire farming system (Ferguson, 1988). The problems afflicting the farming system are in two categories - the fixed (climate, natural resource base and physiological attributes of the breed) and the dynamic (disease risk, management system, effectiveness of extension services, adjustments in land tenure and other socio-economic factors). Ferguson (1987) strongly felt that the system of management of the Muturu provided insufficient grazing time, 9 hours for an animal that depends almost entirely on natural grazing. Waters-Bayer and Taylor-Powell (1986a) also observed incidences of labour constraints in many areas of the subhumid zone, especially during peak periods of arable crop

activity. That would leave little time for a secondary enterprise such as the rearing of Muturu. The zone's long growing season of 180 - 270 days (ILCA/FAO, 1980) creates room for great activity in arable crop farming. Multiple cropping is also practised, in a bid to bring in more returns from limited resources and stabilize income over time (Abalu, 1976).

Agriculture in the subhumid zone is in a transition between shifting and permanent cultivation and the frequency of cropping is increasing to the detriment of fallowing (Ruthenberg, 1980). This is an indication of increasing human pressure on the land and would only limit available land for grazing. It has not been assessed how farmers would react to full intensification of Muturu rearing.

The complete adoption of mixed farming advocated by Mackie (1945) would enhance the status of the Muturu. The breed will be taken into cognisance as changes in the farming systems unfold. Waters-Bayers and Taylor- Powell (1986b) were of the opinion that successive use of land for grazing and cultivation could boost the production potentials of both livestock and crop enterprises during which cattle provide manure for cropping while crop residues provide an important dry season feed reserve. It has been observed (Powell, 1986) that the increased fertility of animals during the harvest season is due to grazing of sorghum, millet, rice and soyabean residues that are higher in crude protein and phosphorus than those found in the natural range during the same period of the year.

Arable crop farmers and nomadic pastoralists are known to co-exist in the derived savannah and some parts of the high forest. The latter may rear some animals for the former while exchanges of fees, grazing land, crop residue and animals occur (McCowan et al., 1979; Waters-Bayer and Taylor-Powell, 1986b). There are however, frequent clashes between these groups arising from damage to crops by animals. Arable crop farmers could be encouraged to keep their own animals, including the Muturu to supply meat and traction while ensuring better animal control in cropped areas.

It is very difficult to reduce the importance attached to crop farming in the zone. The approach by ILCA in the humid zone with West African Dwarf Sheep and goats has been to link crop and livestock production through the introduction of alley and ley farming (Sumberg, 1984). Browse species such as Gliricidia sepium and Leucaena leucocephala are intercropped with maize and tuber crops. Leys could be established using forage legumes such as Stylosanthes guianensis, S. hamata and Centrosema. With shortening fallow periods, the introduction of leys and alleys into the farming system could help to improve soil fertility rapidly and provide forage to animals. The Muturu should be incorporated into these improved systems.

A few grazing reserves exist within the Muturu's ecological zone (Federal Livestock Department, 1980). The grazing reserves were initially designed for nomadic pastoralists (Famoriyo and Awogbade, 1982). These could be turned over to

the cattle-keeping arable crop farmers as nomads become less acceptable in the tsetse-infested zone due to frequent clashes with crop farmers.

The overall essence of the changes taking place in the farming systems of the humid and subhumid zone are that better attention should be paid to livestock rearing and more and better feeds could be available to it. Except these are realized, the changes will not be worthwhile.

THE FUTURE OF THE MUTURU

There are indications that the Muturu will not become extinct, in spite of fears expressed in this connection (Ademosun, 1973; Osinowo, 1977; Orji et al., 1984). Apart from the possibilities of improving its productivity, it appears that it compares favourably with other breeds under similar environments. Favourable changes in the environment, cheaper costs of production and advances in research techniques also point to the continued existence and growing importance of the breed.

Comparison with Other Breeds

The fact that the West African Shorthorns put up performance that is identical to that of the trypanosusceptible zebu in tsetse-free environments (ILCA/FAO, 1980, Murray et al., 1990) has been mentioned. It has also been observed that the indigenous African cattle and wild Bovidae are more resistant to environmental constraints because of superior

physiological adaptation in terms of water utilization, heat tolerance and water conservation (Murray et al., 1982; Murray, 1987; Ferguson, 1987). The Muturu live under the environmental constraints of feed shortage (Waters-Bayer and Taylor-Powell, 1986b; Ferguson, 1987), and adverse climatic conditions and disease (Stewart, 1951; Murray et al., 1990; Payne, 1991).

The greater ability of the Muturu and N'dama to sweat (Amakiri, 1974; Amakiri and Onwuka, 1980) confers on them greater adaptation to the hot humid forest and derived savanna than either the exotic Bos taurus or indigenous zebu. The Muturu possesses a higher capacity to sweat than the N'dama (Amakiri, 1974). Its compact little body also demands less feed for maintenance (Vercoe, 1974; Firsch and Vercoe, 1978) in an environment where feed supply may be marginal. The trypanotolerant breeds, it has been affirmed are better adapted to remain productive under conditions of infection and marginal feed supply.

Stewart (1951) opined that it would be unwise to keep trypanosusceptible animals in tsetse-infested areas in a doped state when alternative animals exist. Both the Muturu and N'dama are known to possess superior and apparently, highly heritable resistance to trypanosomiasis (Mulligan, 1951; Roberts and Gray 1973b; Murray and Trail, 1984; Murray et al., 1990).

The low reproductive performance of the Muturu has been echoed (Nwakalor et al.,1979; Orji et al., 1985; Ezekwe and

Orji, 1986). These reports speak of the low libido; low ejaculate volume and sperm motility; low sperm count; high proportion of deformed spermatozoa of bulls, and great tendency to exhibit silent heat by the cows. These are inimical to the development of effective AI programmes. The contribution of adverse environment has not been assessed but cannot be ignored. The adverse effects of environmental stress on sexual performance are well known (Payne, 1991). Under trypanosome infection, the N'dama was shown to remain in cycle and was successfully superovulated whereas infected Boran became anoestrous (Murray et al., 1990). The same may be expected of the Muturu.

The Muturu and other West African Shorthorns are recognized as the smallest cattle breeds in the world (Montsma, 1959). In series of trials reported by Montsma (1959), the forest cattle had lower values for most body measurements at similar ages compare to zebu cattle. The trials were however, conducted under dissimilar environments, with the Muturu rated under poor conditions.

The Muturu has been ruled out as a dairy animal (Stewart, 1951; Payne, 1991). Low milk yields are common with almost all tropical breeds which are not selected for the purpose (Payne, 1991). The performance of improved exotic dairy breeds in the tropics is lower than observed in the temperate environment, even when feed supply is greatly improved. In the dual-purpose Brown Swiss, Adeneye and Adebanjo (1977) recorded a milk yield of only 1714kg over 305 days in western

Nigeria. The Brown Swiss heifers first calved at 31.4 months and had calving intervals of 582 days.

Studies by Roberts and Gray (1973a) and others have shown clearly that the productivity of the Muturu is comparable to other, larger tropical breeds such as the Zebu or the N'dama (Table 3). The Muturu is superior in age at first calving, calving interval, calving percentage and dressing percentage. On improved pastures in Nigeria, the daily live-weight gain of 18-month-old calves was 340g for zebus, 270g for N'dama, and 210g for the Muturu. These figures when converted to rate per 100kg of body weight maintained were: 135g for zebu, 140g for the N'dama, and 143g for the Muturu. When overall productivity (including calving rates, calf viability, calf weight and cow survival) were considered, the productivity index for the Muturu were not different from those of the larger breeds (Roberts and Gray, 1973a; Starkey, 1984).

Table 3 Comparative performance of Muturu and other cattle breeds in the tropics.

	Muturu	Nigerian zebu[1]	N'dama	Friesian[2]
Age at first calving (mth)	21 - 26	36 - 48	47.6	23 - 31
Calving interval (days)	330 - 630	360 - 450	472 - 570	335 - 368
Calving percentage	57 - 96	-	54 - 78	-
Birth weight (kg)	13 - 15	20 - 25	14	29 - 40
Dressing percent	50 - 53	45 - 53	42 - 51	-
Mature liveweight (kg)	120 - 450	250 - 544	222 - 419	118 - 170*
Milk yield (kg)	120 - 421	454 - 1361	150 - 270	1880 - 5041

1. Averages for Bunaji and Gudali
2. Friesian cattle kept at Vom, a high altitude, tsetse-free zone.

* The 40 - week weight.

Source: Roberts and Gray 1973a, b; ILCA/FAO, 1980; Udedibie et al, 1983 and Payne 1991.

Decline in Tsetse Population

Some positive effects of changing farming systems were discussed above. Jordan (1979) described the rapidly accelerating disappearance of Glossina morsitans from vast areas of West Africa and attributed this mainly to expanding cultivation and tree removal. In Nigeria, Putt et al., (1980) concluded that the population of G. morsitans was in general decline. Bourn et al., (1986) predicted a local extinction of this species due to contraction. They had the same view on the possible extinction of other riverine species as the forests are encroached for cultivation, logging, palmwine tapping and fuel wood. Murray and Gray (1984) cited MacLenmnan (1980) to have indicated significant tsetse control successes in Nigeria, Cameroun, Botswana, Zimbabwe, Tanzania, Sudan, Ethiopia, and eastern Senegal/ western Mali. However, the net effect at the continental level of agricultural expansion in the face of tsetse control is poor, prompting Murray and Gray (1984) to conclude that the problem of trypanosomiasis may escalate over the next decades unless more active steps were taken to control the disease.

The fact still remains that the development of mixed farming in the tsetse-infested zone would be impossible without the West African Shorthorns (Stewart, 1951; Ferguson, 1966). The other factors that limit livestock rearing in the zone have been indicated and they favour the local cattle.

Economics of Production

There are differences in costs of production between breeds of cattle and these become more pronounced where environmental modifications are needed, as in the case of trypanosomiasis. Oluokun (1980) estimated that attempts at eradicating Contagious Bovine Pleuropneumonia from Nigeria cost N16.68m (about US $40m) between 1971 and 1981 whereas between 1980 and 1984, losses of about N1.5b (over US $2b) due to the reoccurence of rinderpest in Nigeria were also estimated. Poor vaccination programmes can lead to greater losses as was experienced in Nigeria in the mid - 1980s when a virulent strain of rinderpest decimated cattle and wildlife stocks. The importance of the rinderpest vaccine to the Muturu has been stressed.

The control of trypanosomiasis by vaccination still remains elusive since no vaccine has been developed (Stewart, 1951; Murray et al., 1990). Murray et al., (1990) have speculated that when a vaccine eventually becomes available, it may be more effective on animals which also possess an innate resistance to the disease.

The control of tsetse flies is one of the attempts at ensuring successful animal rearing in the infested zone. The measures include ground spraying with chemicals, although these pose a problem of environmental contamination. It has been estimated that the development of livestock and overall agricultural growth in tsetse-infested areas could generate a further US $50b annually were trypanosomiasis completely controlled (McDowell, 1977). The costs are enormous,

however, and beyond the reach of many African countries. In Zimbabwe, costs incurred in the process of tsetse control with insecticides were in the range of US $325 - 525 per km^2 (Vale, 1987).

The alternative to vaccination within the sphere of health management is the use of trypanocidal drugs. The continued use of the same drugs over several decades without adequate attention being paid to the development of new drugs has led to the development of resistance (Murray et al., 1990; Neate, 1992). The viable option still remains the exploitation of trypanotolerant animals.

Areas of Africa which lack indigenous trypanotolerant breeds of cattle could import from other regions rather than keep trypanosusceptible breeds under drugs. The Muturu and N'dama have been shown to tolerate strains of Trypanosoma enzootic in Tanzania (Stewart, 1951) and Kenya (Murray et al., 1990). There is therefore, scope for the geographical distribution of Muturu to be expanded.

Advances in Research Techniques

Modern research techniques will change the pace of research on the Muturu and hasten its development. Stewart (1951) reported on the trekking of mature trypanotolerant cattle over hundreds of kilometres from Ghana to Nigeria in the 1930s. In the 1980s, embryo transfer techniques enabled the development of Gambian N'dama embryos in surrogate Boran dams in Kenya for use in testing the genetic basis of trypanotolerance (Murray, et al., 1990).

The development of the enzyme-linked immuno-sorbent assay (ELISA) will greatly aid in the confirmation of cases of trypanosomiasis (Nantulya, 1990). The efficiency of the ELISA technique rests on three facts - it identifies accurately the trypanosomes in mixed species infections, detects animals that are antigenaemic without patent parasitaemia, and provides more accurate measurement of the proportion of time an animal is infected (Trail and d'Ieteren 1991). ELISA was found to provide positive results in 96% of animals with parasitologically confirmed diagnosis (Nantulya and Lindqvist, 1989). The technique compensates for its marginal failure by being able to detect cases that would be missed by parasitological diagnosis (Barnett, 1947). The ELISA is regarded as the answer to some of the important questions regarding diagnosis of animal trypanosomiasis (Nantulya, 1990). The antigen - ELISA is believed to be more efficient than the antibody - ELISA. Trail and d'Ieteren (1991) also opined that antigen - ELISA would enhance the efficiency of selection of trypanotolerant cattle under tsetse challenge in the field.

Correlations have been established between PCV and parasitaemia on the one hand and trypanosome infection and productivity on the other (Stewart, 1951; Murray et al., 1990). This enables the assessment of trypanotolerance in young animals before they attain maturity. Selection on the basis of individual performance can therefore, be effected rapidly.

CONCLUSION

The Muturu occupies an insignificant numeric position among African cattle breeds. However, its importance is buoyed by the fact that it is one of the few breeds that hold the key to the development of mixed farming in tsetse-infested areas of Africa and perhaps, other parts of the world.

The dearth of reports on the Muturu prevents its development and full exploitation. Efforts at improving the breed must start with the aggregation of reports on the breed. From available reports collected into this review, the low productivity of the Muturu appears to be due to many factors extraneous to genetic inferiority.

The Muturu has a bright future and all efforts should be geared towards ensuring that it does not become extinct but survives, to play a stronger role in the development of Africa's livestock sector.

EXPERIMENT 1: PERFORMANCE OF MUTURU CATTLE UNDER TRADITIONAL VILLAGE MANAGEMENT SYSTEM AND ON INSTITUTIONAL FARM IN SOUTHERN GUINEA SAVANNA ZONE OF BENUE STATE, NIGERIA.

INTRODUCTION

Recent livestock census puts Nigeria's cattle population at 13.9 million (RIM, 1992) made up of Bos indicus (zebu) and Bos taurus breeds. The Bos indicus breeds represent over 90% of the cattle population and most of them are kept in the northern states within the Guinea Sudan and Sahel savanna zones (ILCA/FAO, 1980). The Bos taurus specie i.e Muturu, N'dama and the hybrid Keteku are few but are important because they survive in the Forest, Derived and Guinea savanna zones on account of their tolerance to trypanosomiasis which the zebu breeds have no tolerance for.

No suitable vaccine has been developed against trypanosomiasis (Stewart, 1951; Murray et al., 1990). Several strains of trypanosomes have been observed to resist many of the available trypanocidal drugs (Murray et al., 1990; Neate, 1992) while little effort has been directed towards the development of new drugs. This has made trypanosomiasis the greatest limitation to the development of Nigeria's livestock industry, and the rest of Africa. The most effective way around the threat is found in the exploitation of livestock breeds that are tolerant to trypanosomiasis especially the Muturu which is the only indigenous "purebred" trypanotolerant cattle.

In 1974/75, it was estimated that Benue State with a population of 25,000 Muturu cattle had the highest number of these animals in Nigeria (ILCA/FAO, 1980). Recent livestock census figures indicate that Benue has a total of 10,000 out of the estimated 177,000 Muturu cattle in the country (RIM, 1992). Thus, the number of Muturu in Benue State is on the decline; the reasons for which are not clear. Among guesses are that the breed is a slow grower, that its production is being hampered by poor traditional management practices and/or disease problems. There is little knowledge of the performance and actual contribution of Muturu cattle to Nigeria's beef industry because research reports on it are very scanty (Roberts and Gray, 1973a; Orji et al., 1984). Little is known about their productivity and there are yet unknown factors that limit the productivity. Because the Muturu had been little studied, the constraints to its production and improvement are also poorly understood. It is felt that more could be done towards improvement of Muturu than is currently being done. However, before any meaningful intervention can be recommended towards improving the productivity of the existing herd, a knowledge of the basic data under the present traditional management systems is considered an essential step. Such data would act as pedestal on which further research could rest.

OBJECTIVE:

The objective of this study was to obtain baseline data in Benue State on the performance of Muturu Cattle under the traditional village management system as well as on the

institutional farms rearing Muturu cattle. In the study, major issues such as reasons for keeping Muturu cattle, management systems, housing, feeding, reproductive performance, disease, marketing and constraints affecting productivity were addressed.

MATERIALS AND METHODS

A survey was designed to cover the whole of the former Benue State (Fig. 3) made up of 19 Local Government Areas (L.G.As.) namely, Ankpa, Ado, Bassa, Dekina, Gboko, Guma, Gwer, Idah, Katsina-Ala, Konshisha, Kwande, Makurdi, Ofu, Okpokwu, Olamaboro, Otukpo, Oju, Ushongo and Vandeikya (Fig. 4). It was divided into two parts, namely farm level (traditional management) and institutional farm.

It was discovered during a preliminary survey that in Benue State, Muturu cattle were found only in the 9 Tiv speaking L.G.As. namely, Gboko, Guma, Gwer, Katsina-Ala, Konshisha, Kwande, Makurdi, Ushongo and Vandeikya (Fig. 4 shaded area) hence the animals are popularly referred to as the "Tiv Cow" by all tribes of the State. For the farm level survey therefore, every farmer in the Tiv speaking L.G.A. who owned even one animal was expected to be interviewed by trained enumerators during the rainy season months of May - July, 1990. Only one institutional farm in Benue State namely, Raav Livestock Investigation and Breeding Centre (LIBC) keeps Muturu cattle. Questionnaire was administered on this farm. Specimen copies of the questionnaires are shown in appendices 1 and 2.

Fig 3 MAP OF NIGERIA SHOWING THE LOCATION OF BENUE STATE

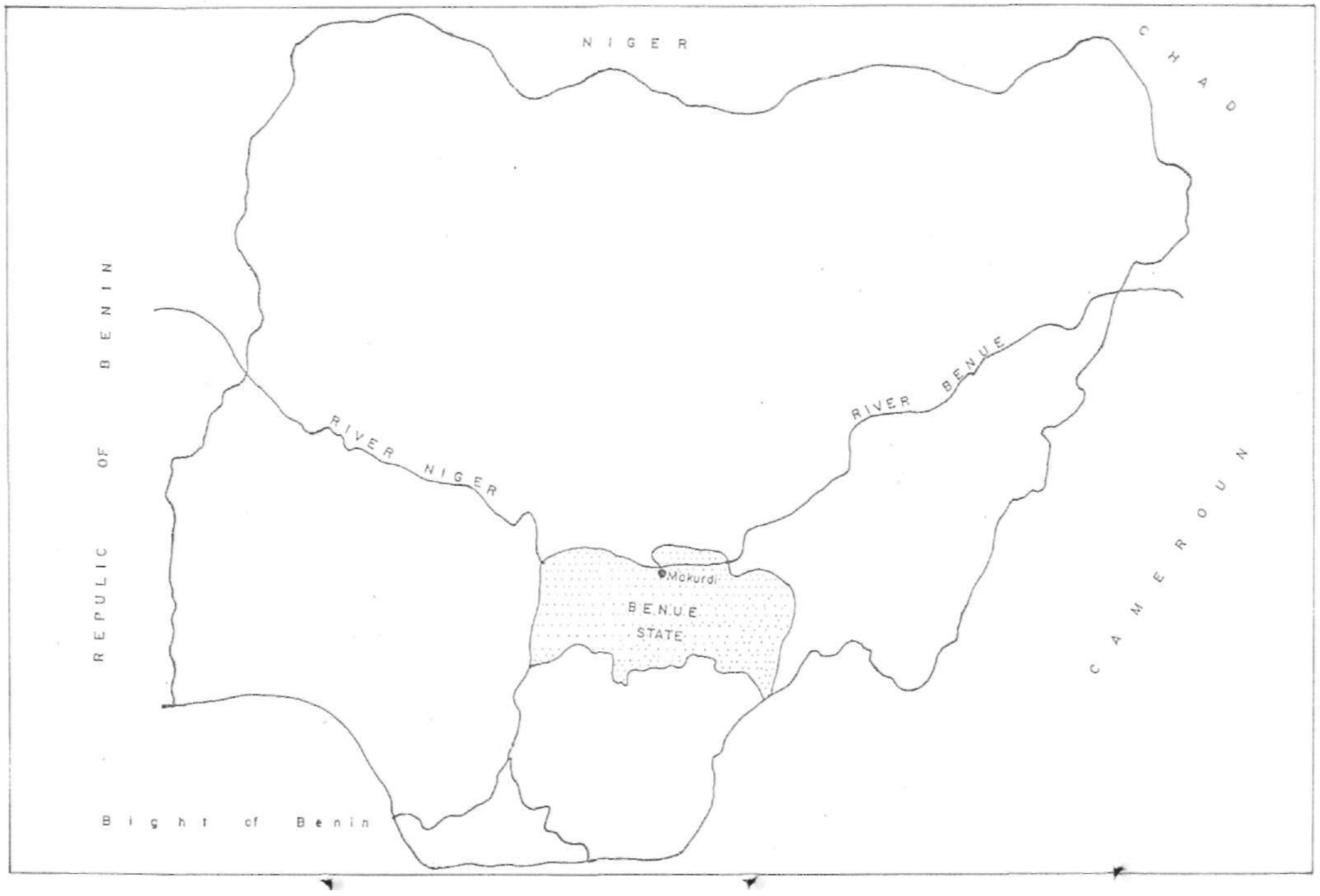
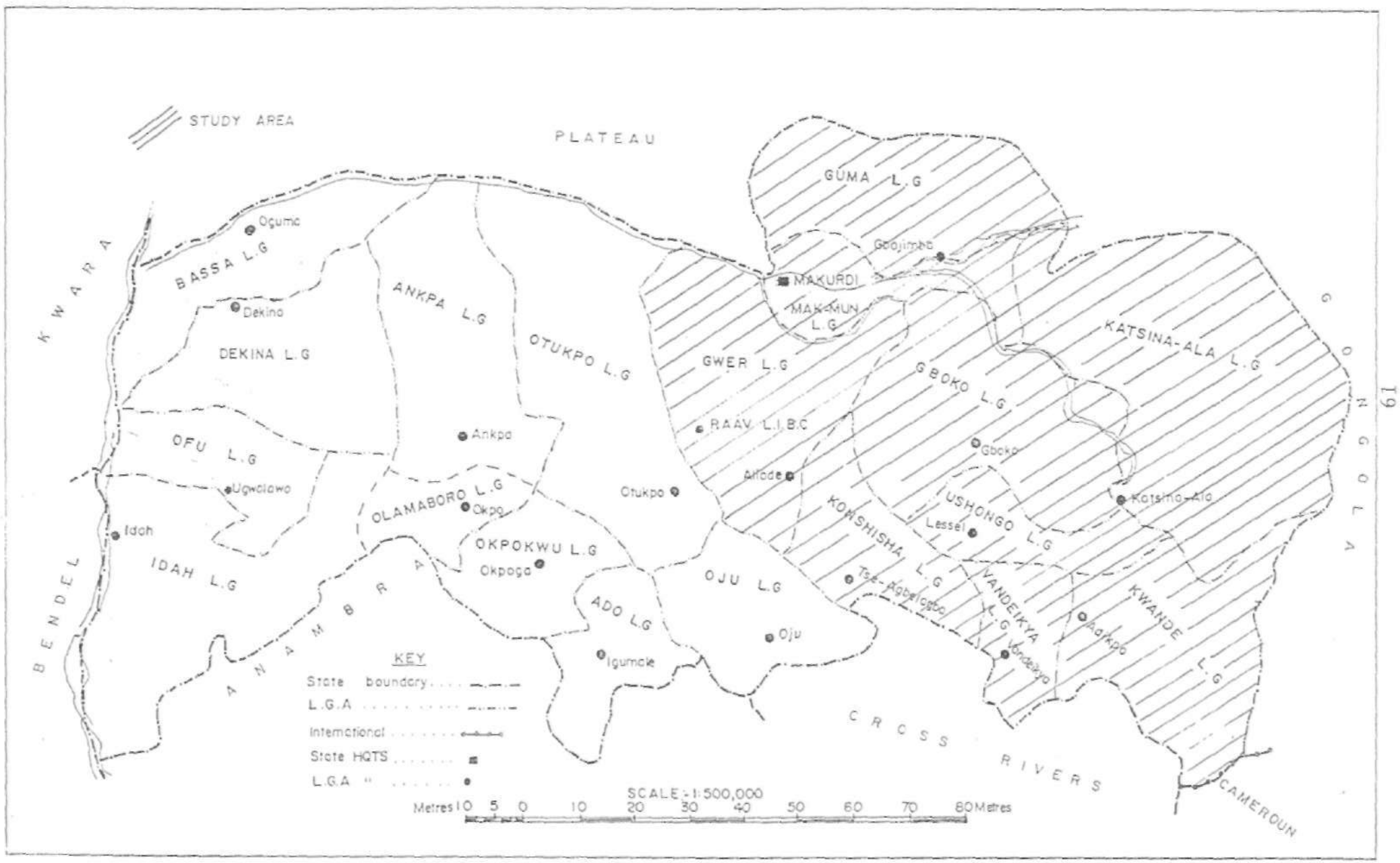


Fig. 4 MAP OF BENUE STATE SHOWING STUDY AREA



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For purposes of comparison some of the results on the household level were analysed on Local Government basis. After data clearing, only 362 and 1 completed questionnaires from household and institutional farm respectively, were used for the analysis. Results are presented as percentages of respondents.

Some problems were encountered in the administration of the questionnaires; but these are a universal phenomena with surveys in all third world countries. These problems included a general lack of personal commitment by a few of the enumerators. Some respondents were over suspicious and hence did not trust what the information would be used for. Generally, the level of literacy of the respondents were low. With all these, respondents in some cases refused to respond.

Some of these problems were however minimised during the study through:

(a) careful selection of senior Local Government Veterinary staff of the rank of Livestock Superintendents and above as enumerators ensured identification with the project as these officers considered it a good opportunity to advance their professional knowledge. Local Government staff were used because they were the closest staff to farmers who had already established familiarity with them during extension services.

(b) An awareness campaign was undertaken before commencement of enumeration. The farmers were made aware of the survey exercise through:

(i) Myself, who thoroughly briefed members of the Tiv Traditional Council (TTC) about the research. The TTC is constituted and chaired by His Highness, the Tor Tiv, and all the 57 district heads and 9 chairmen of the Tiv speaking L.G.As.

(ii) I also briefed individual Local Government Councils and Heads of Agriculture Department.

As these various groups in turn briefed the farmers, thus confidence in the exercise was assured and farmers were more willing to respond when the enumerators further briefed them and administered the questionnaires on them.

Thus within the limitations highlighted, the survey results are reliable.

RESULTS.

TRADITIONAL VILLAGE MANAGEMENT SYSTEM

After data clearing, 362 questionnaires were used for analysis. As can be seen from appendix 1, each administered questionnaire contained forty three (43) main questions and several subsidiary questions which farmers were expected to answer. However, in some cases, not all the 362 respondents answered a particular question or its subsidiary. Furthermore in few cases, some questions or their subsidiary may have even escaped being administered. These are universal problems with surveys. It is therefore not surprising that the tables presented below may sometimes show 362 respondents as answering some questions and less respondents as answering other questions.

Population and distribution of Muturu cattle.

A total of 362 farmers owning 2,490 head of Muturu cattle were involved in the survey and of these 1,225 or 49.2% were cows, 529 or 21.2% bulls, 647 or 26% calves while 89 or 3.6% were castrates (Table 4).

Table 5 shows that most farmers (57%) kept between 1 - 5 animals and those with a herd size exceeding 10 animals were very few. Most respondents came from Gboko and Katsina-Ala L.G.As..

Table 4. Population of Muturu Cattle Surveyed

Variable	No. of Observations	Sum	Percent Total
Cows	362	1225	49.2
Bulls	362	529	21.2
Calves	362	647	26.0
Castrate	362	89	3.6
Total	362	2490	100.0

Table 5. Distribution of Muturu herd by Local Government Area.

Herd Size	- Number of herds by Local Government Area -									
	Gboko	Guma	Gwer	Katsina Ala	Kon-shisha	Kwande	Makurdi	Ushongo	Vande-ikya	Total
1 - 5	57 (15.83)	17 (4.72)	26 (7.22)	44 (12.22)	16 (4.44)	25 (6.94)	2 (0.56)	13 (3.61)	5 (1.39)	205 (56.94)
6 - 10	33 (9.17)	5 (1.39)	10 (2.78)	18 (5.00)	5 (1.39)	25 (6.94)	2 (0.56)	2 (0.56)	1 (0.28)	101 (28.06)
11 - 15	4 (1.11)	2 (0.56)	3 (0.83)	10 (2.78)	1 (0.28)	5 (1.39)	1 (0.28)	0 (0.00)	0 (0.00)	26 (7.22)
16 - 20	1 (0.28)	0 (0.00)	4 (1.11)	5 (1.39)	0 (0.00)	1 (0.28)	0 (0.00)	1 (0.28)	0 (0.00)	12 (3.33)
21 - 25	0 (0.00)	0 (0.00)	1 (0.28)	4 (1.11)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	5 (1.39)
26 - 30	1 (0.28)	0 (0.00)	1 (0.28)	2 (0,56)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	4 (1.11)
31 - 35	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.28)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.28)
36 - 40	0 (0.00)	0 (0.00)	2 (0.56)	1 (0.28)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	3 (0.83)
> 40	0 (0.00)	0 (0.00)	1 (0.28)	2 (0.56)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	3 (0.83)
Total	96 (26.67)	24 (6.67)	48 (13.33)	87 (24.17)	22 (6.11)	56 (15.56)	5 (1.39)	16 (4.44)	6 (1.67)	360 (100.00)

* Figures in parenthesis are percentages.

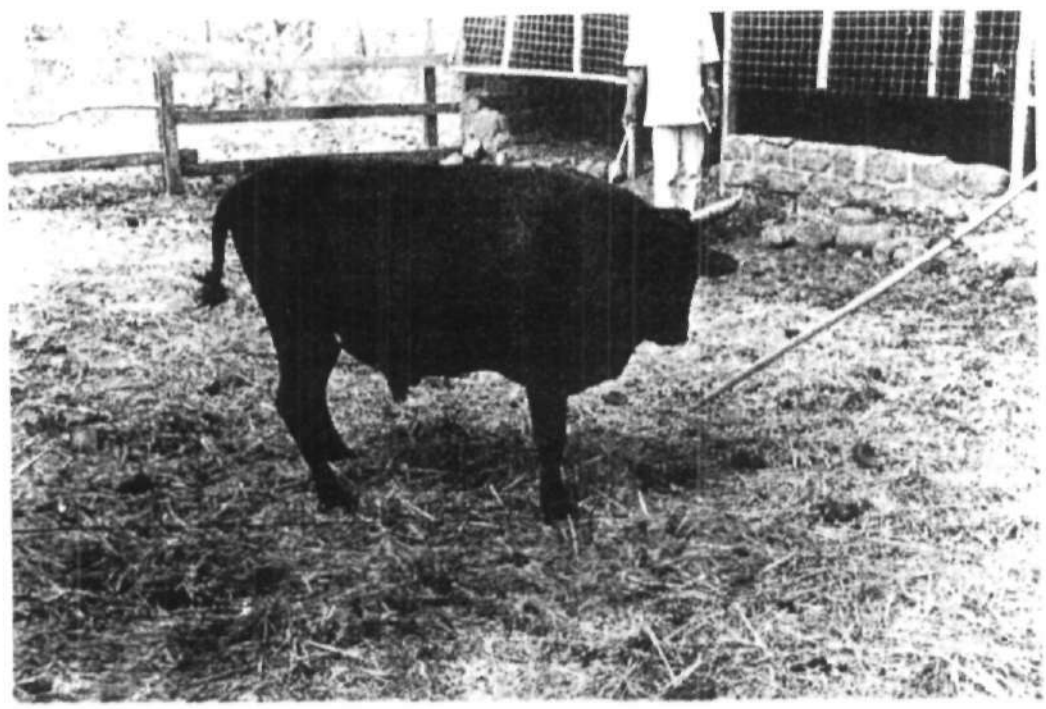


PLATE 1: A TYPICAL MUTURU BULL UNDER CONFINEMENT.



PLATE 2: A TYPICAL MUTURU COW.

Origin and source

95% of Muturu cattle came from within Benue State (Table 6) and most farmers owned their stock through purchase (42%) and inheritance (36%) (Table 7).

Reasons for keeping Muturu cattle.

Table 8 shows the breakdown of reasons for keeping Muturu cattle. 69% of respondents kept Muturu cattle for commercial purpose, that is, to generate income.

Management System.

The management systems identified were extensive/free range, semi-intensive and intensive. These are defined as follows:

Intensive system is where the animals are housed or confined and fed all the time i.e. the animals depend entirely on man for shelter and food.

Semi-intensive system is where animals are housed and fed partially and in addition, are allowed to forage to make up for their feeding requirement. The common practice where Muturu cattle are housed or tethered in compounds and taken out to the range where they are again tethered and allowed to forage, is also regarded as semi-intensive management in this study.

Table 6. Origin and Source

Origin	Herd	%
Within Benue State	342	94.5
Outside Benue State	8	2.2
No Response	12	3.3
Total	362	100.00

Table 7. Nature of Ownership

Nature of Ownership	- Number of respondents by Local Government Area -									
	Gboko	Guma	Gwer	Katsina Ala	Kon-shisha	Kwande	Makurdi	Ushongo	Vande-ikya	Total
Inheritance	27 (7.50)	9 (2.50)	17 (4.72)	30 (8.33)	10 (2.78)	32 (8.89)	1 (0.28)	3 (0.83)	1 (0.28)	130 (36.11)
Gift	29 (8.06)	1 (0.28)	19 (5.28)	15 (4.17)	4 (1.11)	4 (1.11)	0 (0.00)	1 (0.28)	0 (0.00)	73 (20.28)
Purchase	39 (10.83)	14 (3.89)	12 (3.33)	42 (11.67)	8 (2.22)	16 (4.44)	3 (0.83)	12 (3.33)	5 (1.39)	151 (41.94)
No response	1 (0.28)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	4 (0.28)	1 (0.00)	0 (0.00)	0 (0.00)	6 (3.33)
Total	96 (26.67)	24 (6.67)	48 (13.33)	87 (24.17)	22 (6.11)	56 (15.56)	5 (1.39)	16 (4.44)	6 (1.67)	360 (100.00)

* Figures in parenthesis are percentages

Table 8. Reasons for keeping Muturu Cattle

Reason	Number of respondents by Local Government Area - Gboko	Guma	Gwer	Katsina Ala	Kon-shisha	Kwande	Makurdi	Ushongo	Vande-ikya	Total
Commercial	91 (25.28)	9 (2.50)	16 (4.44)	63 (17.50)	18 (5.00)	31 (8.61)	5 (1.39)	15 (4.17)	1 (0.28)	249 (69.17)
Ceremony	4 (1.11)	10 (2.78)	26 (7.22)	11 (3.06)	4 (1.11)	21 (5.83)	0 (0.00)	1 (0.28)	2 (0.56)	79 (21.94)
Food	1 (0.28)	5 (1.39)	4 (1.11)	5 (1.39)	0 (0.00)	1 (0.28)	0 (0.00)	0 (0.00)	0 (0.00)	16 (4.44)
Pet	0 (0.00)	0 (0.00)	1 (0.28)	3 (0.83)	0 (0.00)	1 (0.28)	0 (0.00)	0 (0.00)	0 (0.00)	5 (1.39)
No response	0 (0.28)	0 (0.00)	1 (0.00)	5 (0.00)	0 (0.00)	2 (0.28)	0 (0.00)	0 (0.28)	3 (0.00)	11 (3.33)
Total	96 (26.67)	24 (6.67)	48 (13.33)	87 (24.17)	22 (6.11)	56 (15.56)	5 (1.39)	16 (4.44)	6 (1.67)	360 (100.00)

* Figures in parenthesis are percentages.

Extensive system is where animals are not housed and are not consciously fed. Animals under this system meet their feeding requirement by free ranging or foraging.

The results as shown in Table 9 reveal that semi-intensive system was the most popular system of management in Benue State. Fifty-five percent kept animals semi-intensively while only 14% kept animals intensively. The semi-intensive management system was more popular in Gboko L.G.A. than other L.G.As.

Housing

Table 10a and 10b show the results on housing and the reason for housing. Most farmers (71%) provided houses for their animals and 53% of the houses were provided during the rainy season. Mud-wall was the most common construction material used for the houses (Table 10c).

Table 9. Management Systems practiced.

Management System	- Number of respondents by Local Government Area - Gboko	Guma	Gwer	Katsina Ala	Kon-shisha	Kwande	Makurdi	Ushongo	Vande-ikya	Total
Intensive	8 (2.22)	8 (2.22)	0 (0.00)	14 (3.89)	13 (3.61)	5 (1.39)	1 (0.28)	3 (0.83)	0 (0.00)	52 (14.44)
Semi-intensive	73 (20.28)	14 (3.89)	14 (3.89)	34 (9.44)	5 (1.39)	37 (10.28)	4 (1.11)	12 (3.33)	6 (1.67)	199 (55.28)
Extensive	15 (4.17)	2 (0.56)	33 (9.17)	22 (6.11)	4 (1.11)	14 (3.89)	0 (0.00)	1 (0.28)	0 (0.00)	91 (25.28)
No response	0 (0.00)	0 (0.00)	1 (0.28)	17 (4.72)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	18 (5.00)
Total	96 (26.67)	24 (6.67)	48 (13.33)	87 (24.17)	22 (6.11)	56 (15.56)	5 (1.39)	16 (4.44)	6 (1.67)	360 (100.00)

* Figures in parenthesis are percentages.

Table 10a. *Provision of Housing/Shelter*

Response	No. of respondents	Percent
Yes	257	71.0
No	99	27.3
No response	6	1.7
Total	362	100.0

Table 10b. Season of the year when housing is provided.

Season	No. of respondents	Percent
Rainy Season	192	53.0
Dry season	33	9.1
No response	137	37.9
Total	362	100.0

Table 10c. Types of Construction material used for housing/ shelter

Type	No. of respondents	Percent
Mud-wall	194	53.6
Corrugated iron- sheet	35	9.7
Brick or cement block	14	3.9
No response	119	32.9
Total	362	100.0

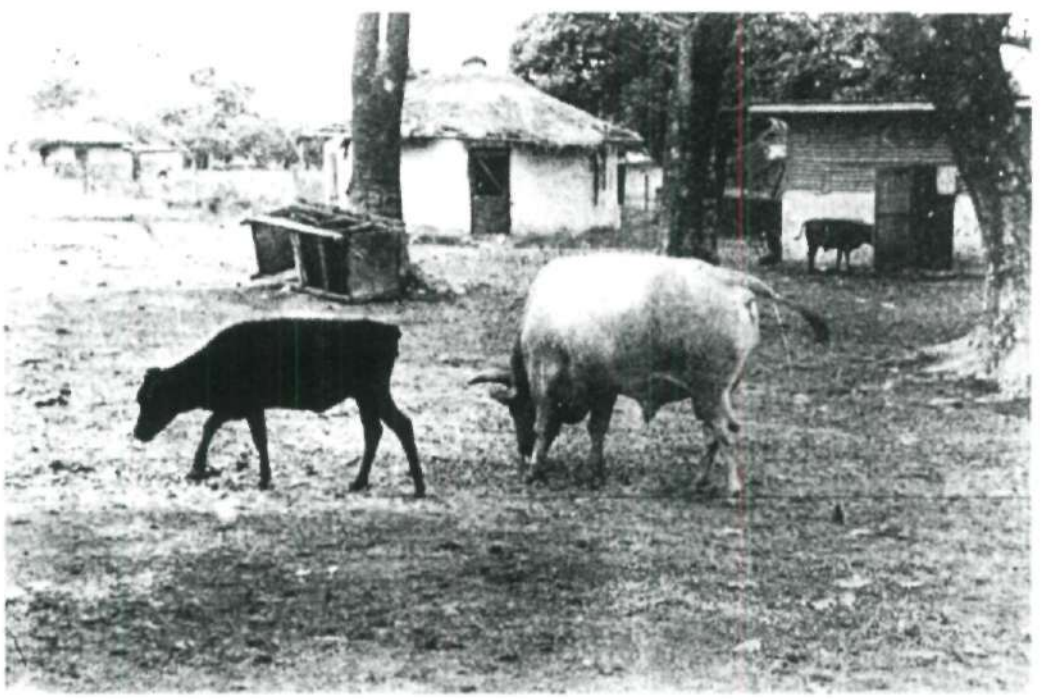


PLATE 3: SEMI-INTENSIVELY MANAGED MUTURU AND N'DAMA CONFINED IN A COMPOUND WITH MUD-WALL BUILDING AND THATCHED ROOF.

Feeding and watering.

Tables 11a and 11b show how Muturu cattle were fed during the different seasons (wet and dry) of the year. In both seasons, an overwhelming majority of the cattle (71.4 - 85.3% respondents) obtained their feed from grazing. Only about 3.6 and 8% of respondents did provide supplementary feed in the rainy season and dry season respectively. Since supplementation was hardly practiced, most farmers (60.2%) did not specify the types of animals that received supplementary feed (Table 11c).

Various reasons were given by the farmers for not giving supplementary feeds (Table 11d). The major reason was that farmers never heard(i.e did not know) of supplementary feeding.

In general there was no fixed time for giving water to the animals (Table 12).

Reproductive performance

A. Age at first service and age at first calving.

Table 13 shows that 46.4% of respondents said that they bred their heifers for the first time when the animals were less than 2 years while about 33% bred at between 2 - 3 years. 49% of respondents said that their animals had their first calf at between the ages of 2 - 3 years. Approximately 14% of respondents did not know age at first service and age

Table 11a. Feeding of animals during the rainy season.

Method of Feeding	- Number of respondents by Local Government Area - Gboko	Guma	Gwer	Katsina Ala	Kon-shisha	Kwande	Makurdi	Ushongo	Vande-ikya	Total
Grazing	91 (25.28)	14 (3.89)	44 (12.22)	70 (19.44)	15 (4.17)	49 (13.61)	4 (1.11)	15 (4.17)	5 (1.39)	307 (85.28)
Supplementary Food	3 (0.83)	3 (0.83)	3 (0.83)	2 (9.56)	1 (0.28)	0 (0.00)	0 (0.00)	1 (0.28)	0 (0.00)	13 (3.61)
Both	2 (0.56)	6 (1.67)	0 (0.00)	6 (1.67)	5 (1.39)	3 (0.28)	1 (0.28)	0 (0.00)	1 (0.28)	24 (6.67)
No response	0 (0.00)	1 (0.28)	1 (0.28)	9 (2.50)	1 (0.28)	4 (1.11)	0 (0.00)	0 (0.00)	0 (0.00)	16 (4.44)
Total	96 (26.67)	24 (6.67)	48 (13.33)	87 (24.17)	22 (6.11)	56 (15.56)	5 (1.39)	16 (4.44)	6 (1.67)	360 (100.0)

* Figures in parenthesis are percentages.

Table 11b. Feeding of animals during the dry season

Method of Feeding	Number of respondents by Local Government Area - Gboko	Guma	Gwer	Katsina Ala	Kon-shisha	Kwande	Makurdi	Ushongo	Vande-ikya	Total
Grazing	85 (23.61)	14 (3.89)	41 (11.39)	58 (11.16)	9 (2.50)	32 (8.89)	0 (0.00)	12 (3.33)	6 (1.67)	257 (71.39)
Supplementary food	6 (1.67)	4 (1.11)	4 (1.11)	1 (0.28)	9 (2.50)	0 (0.00)	4 (1.11)	1 (0.28)	0 (0.00)	29 (8.06)
Both	2 (0.56)	4 (1.11)	0 (0.00)	16 (2.78)	0 (0.00)	6 (1.67)	1 (0.28)	0 (0.00)	0 (0.00)	23 (6.39)
No response	3 (0.83)	2 (0.56)	3 (0.83)	18 (5.00)	4 (1.00)	18 (5.00)	0 (0.00)	3 (0.83)	0 (0.00)	51 (14.17)
Total	96 (26.67)	24 (6.67)	48 (13.33)	87 (24.17)	22 (6.11)	56 (15.56)	5 (1.39)	16 (4.44)	6 (1.67)	360 (100.0)

* Figures in parenthesis are percentages.

Table 11c. Types of animals that receive supplementary feed.

Types of animals	No. of respondents	Percent
Cows only	49	13.5
Bulls only	7	1.9
Calves only	13	3.6
All	75	20.7
No Response	218	60.2
Total	362	100.0

Table 11d. Reasons for not feeding supplementary feed.

Reasons	No. of Respondents	Percent
Never heard of it	159	43.9
Heard of it	31	8.6
Can't afford to buy	55	15.2
No benefit	14	3.9
Not available	26	7.2
No response	77	21.3
Total	362	100.0

Table 12. How often animals are given water.

Time	Number of respondents by Local Government Area - Gboko	Guma	Gwer	Katsina Ala	Kon-shisha	Kwande	Makurdi	Ushongo	Vande-ikya	Total
Once daily	37 (10.28)	1 (0.28)	1 (0.28)	3 (0.83)	4 (1.11)	7 (1.94)	0 (0.00)	4 (1.11)	1 (0.28)	58 (16.11)
No fixed time	24 (6.67)	5 (1.39)	37 (10.28)	6 (1.67)	17 (4.72)	33 (9.17)	1 (0.28)	3 (0.83)	0 (0.00)	126 (35.00)
Twice daily	22 (6.11)	6 (1.11)	7 (1.94)	38 (10.56)	1 (0.28)	6 (1.67)	1 (0.28)	4 (1.11)	1 (0.28)	84 (23.33)
Don't know	2 (0.56)	6 (1.67)	0 (0.83)	11 (3.06)	0 (0.00)	2 (0.56)	2 (0.56)	0 (0.00)	2 (0.56)	25 (6.94)
Thrice daily	2 (0.56)	5 (1.39)	3 (0.83)	25 (6.94)	0 (0.00)	4 (1.11)	1 (0.28)	5 (1.39)	2 (0.56)	47 (13.06)
No response	9 (2.50)	3 (0.83)	0 (0.00)	4 (1.11)	0 (0.00)	4 (1.11)	0 (0.00)	0 (0.00)	0 (0.00)	20 (5.56)
Total	96 (26.67)	24 (6.67)	48 (13.33)	87 (24.17)	22 (6.11)	56 (15.56)	5 (1.39)	16 (4.44)	6 (1.67)	360 (100.0)

* Figures in parenthesis are percentages.

Table 13. Age of heifers at first service and age at first calving.

Age of Heifers	< --- Age at first service --- > No. of respondents	Percent	<--- Age at first calving ---> No. of respondents	Percent
Less than 2 years	168	46.4	64	17.7
2 - 3 years	119	32.9	178	49.2
3 - 4 years	6	1.7	49	13.5
4 - 5 years	1	0.3	2	0.6
Over 5 years	1	0.3	3	0.8
Don't know	50	13.8	46	12.7
No response	17	4.7	20	5.5
Total	362	100.0	362	100.0

at first calving of their heifers.

B. Mating Practice.

(i) Are mature males and females kept together?

In an overwhelming majority of herds (81%), mature males were kept and run throughout the year with mature females (Table 14a and 14b).

(ii) Method of mating

While 49% of respondents did not determine when the bull should mate the cow, about 45% said they determined when the bull should mate the cow (Table 14c).

(iii) Mating season.

While 42% of respondents said that dry season was the mating season, rainy season mating had only 20% respondents. As many as 38% did not respond to this question (Table 14d).

Table 14a. Whether mature male and female animals are kept together.

Response	No. of respondents	Percent
Yes	294	81.2
No	44	12.2
No response	24	6.6
Total	362	100.0

Table 14b. When mature male and female animals are kept together.

When	No. of respondents	Percent
Throughout the year	250	69.1
Only when I want them to mate	62	17.1
Others	50	13.8
Total	362	100.0

Table 14c. Do you determine when the bull should mate the cow?

Response	No. of respondents	Percent
Yes	164	45.3
No	177	48.9
No response	21	5.8
Total	362	100.0

C. Pattern of calving.

About 61% of respondents said that their cows calved regularly (Table 15a) and the calving occurred every year (40%) or every 2 years (36%) (Table 15b).

D. Abortions.

Table 16a shows that abortion was not common in Muturu cattle. About 62% of respondents said their cows did not abort. Because abortions seldom occurred, 50% of respondents did not respond when asked to state the time abortions occurred in their herds (Table 16b).

E. Do you have cases of difficult birth in your herd?

About 74.3% of respondents did not observe cases of difficult birth in their herd (Table 17a) consequently a large number of no response (42 and 66%) was the outcome when the farmers were asked whether they knew those cows that aborted and those that had difficult birth and what they intended to do with them (Table 17b and 17c).

Table 14d. Mating Season

Response	No. of Respondents	Percent
Rainy season	72	19.9
Dry season	152	42.0
No response	183	38.1
Total	362	100.0

Table 15a. Do your cows calve regularly.

Response	No. of respondents	Percent
Yes	222	61.3
No	81	22.4
No response	59	16.3
Total	362	100.0

Table 15b. How often cows calve.

Time	No. of respondents	Percent
Every year	146	40.3
Every 2 years	130	35.9
Every 3 years	6	1.7
Every 4 years	3	0.8
Every 5 years	7	1.9
Don't know	70	19.3
Total	362	100.0

Table 16a. Do your cows abort?

Response	No. of respondents	Percent
Yes	53	14.6
No	225	62.2
No response	84	23.2
Total	362	100.0

Table 16b. When abortions occur.

Occurance	No. of respondents	Percent
All the times	23	6.4
Within last 6 months	125	34.5
6 months to 1 year ago	8	2.2
2 years agao	9	2.5
Over 2 years ago	16	4.4
No response	181	50.0
Total	362	100.0

Table 17a. Do you have cases of difficult birth?

Response	No. of respondents	Percent
Yes	48	13.3
No	269	74.3
No response	45	12.4
Total	362	100.0

Table 17b. Do you know those cows that abort and those that have difficult birth?

Response	No. of respondents	Percent
Yes	81	22.4
No	128	35.4
No response	153	42.3
Total	362	100.0

Table 17c. If yes, what do you intend to do with them?

What to do	No. of respondents	Percent
Sell them	28	7.7
Keep them	85	23.5
Slaughter them	12	3.3
No response	237	65.5
Total	362	100.0

F. Calf Mortality

Table 18a and 18b present the picture of calf mortality among Muturu cattle. 70% of respondents did not experience regular death of calves in their herds while only 10.8% said their calves died regularly with most of these few deaths (5.6%) coming from Katsina-Ala L.G.A. (Table 18a).

The few deaths among calves occurred at all seasons as indicated by 23.6% respondents and this was followed by 11.7% respondents who said that their calves died during the rainy season (Table 18b). Death during dry season was extremely low.

In general, since calf mortality did not pose a serious constraint, 63.6% did not respondent to this question (Table 18b).

G. Effect of season on the performance of Muturu cattle.

Tables 19 and 20 show the effect of season on the performance of Muturu cattle. 57.8% of respondents observed their animals grew bigger (better) during the rainy season as against 30.8% who said their animals grew smaller during the same season (Table 19).

Table 18a. Do your calves die regulary?

Response	- Number of respondents by Local Government Area -									
	Gboko	Guma	Gwer	Katsina Ala	Kon-shisha	Kwande	Makurdi	Ushongo	Vande-ikya	Total
Yes	6 (1.67	0 (0.00)	0 (0.00)	20 (5.56)	4 (1.11)	7 (1.94)	0 (0.00)	1 (0.28)	1 (0.28)	39 (10.83)
No	74 (20.56)	17 (4.72)	42 (11.67)	45 (12.50)	18 (5.00)	39 (10.83)	2 (0.56)	12 (3.33)	3 (0.83)	252 (70.00)
No response	16 (4.44)	7 (1.94)	6 (1.67)	22 (6.11)	0 (0.00)	10 (2.78)	3 (0.83)	3 (0.83)	2 (0.56)	69 (19.17
Total	96 (26.67)	24 (6.67)	48 (13.33)	87 (24.17)	22 (6.11)	56 (15.56)	5 (1.39)	16 (4.44)	6 (1.67)	360 (100.0)

* Figures in parenthesis are percentages.

Table 18b. If yes, when calves die.

Response	- Number of respondents by Local Government Area - Gboko	Guma	Gwer	Katsina Ala	Kon-shisha	Kwande	Makurdi	Ushongo	Vande-ikya	Total
All the times	14 (3.89)	1 (0.28)	0 (0.83	21 (5.83)	14 (3.89)	24 (6.67)	2 (0.56)	4 (1.11)	2 (0.56)	85 (23.61)
During Rainy season only	17 (4.72)	4 (1.11)	0 (0.00)	4 (1.11)	5 (1.39)	10 (2.78)	0 (0.00)	1 (0.28)	1 (0.28)	42 (11.67)
During dry season only	0 (0.00)	0 (0.00)	1 (0.28)	3 (0.83)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	4 (1.11)
No response	65 (18.06)	19 (5.28)	44 (12.22)	59 (16.39)	3 (0.83)	22 (6.11)	3 (0.83)	11 (3.06)	3 (0.83)	229 (63.61)
Total	96 (26.67)	24 (6.67)	48 (13.33)	87 (24.17)	22 (6.11)	56 (15.56)	5 (1.39)	16 (4.44)	6 (1.67)	360 (100.00)

* Figures in parenthesis are percentages.

Table 19. Performance of Muturu Cattle during rainy season.

Response	No. of respondents	Percent
Grow		
Bigger	208	57.78
Smaller	111	30.83
No response	41	11.39
Total	360	100.0

Table 20. Performance of Muturu Cattle during the dry season

Response	- Number of respondents by Local Government Area - Gboko	Guma	Gwer	Katsina Ala	Kon-shisha	Kwande	Makurdi	Ushongo	Vande-ikya	Total
Grow										
Bigger	22 (6.1)	13 (3.6)	10 (2.78)	34 (1.11)	4 (1.11)	17 (4.72)	2 (0.56)	13 (3.61)	3 (0.83)	118 (32.78)
Smaller	35 (9.72)	5 (1.39)	31 (8.61)	27 (7.50)	13 (3.61)	16 (4.44)	1 (0.28)	2 (0.56)	3 (0.83)	113 (36.94
No response	39 (10.83)	6 (1.67)	7 (1.95)	26 (7.22)	5 (1.39)	23 (6.39)	2 (0.56)	1 (0.28)	0 (0.00)	109 (30.28)
Reproduce										
More	30 (8.33)	11 (3.06)	6 (1.67)	22 (6.11)	1 (0.28)	9 (2.50)	0 (0.00)	9 (2.50)	1 (0.28)	89 (24.72)
Fewer	6 (1.67)	4 (1.11)	5 (1.39)	12 (3.33)	12 (3.33)	4 (1.11)	0 (0.00)	3 (0.83)	2 (0.56)	48 (13.33)
No response	60 (16.67)	9 (2.50)	37 (10.28)	53 (14.72)	9 (2.50)	43 (11.94)	5 (1.39)	4 (1.11)	3 (0.83)	223 (61.94)
Death (adults)										
More	11 (3.6)	3 (0.83)	1 (0.28)	4 (1.11)	0 (0.00)	1 (0.28)	0 (0.00)	3 (0.83)	0 (0.00)	23 (6.4)
Fewer	6 (1.67)	1 (0.28)	0 (0.00)	17 (4.72)	0 (0.00)	1 (0.28)	0 (0.00)	1 (0.28)	0 (0.00)	26 (7.2)
No response	79 (21.94)	20 (5.56)	47 (13.06)	66 (18.33)	22 (6.11)	54 (15.00)	5 (1.39)	11 (3.06)	6 (1.67)	310 (86.1)

Table 20. Contd.

Response	Number of respondents by Local Government Area - Gboko	Guma	Gwer	Katsina Ala	Kon-shisha	Kwande	Makurdi	Ushongo	Vande-ikya	Total
Death (calves)										
More	2 (0.56)	2 (0.56)	1 (0.83	3 (0.00)	0 (0.00)	1 (0.28)	0 (0.00)	3 (0.83)	0 (0.00)	12 (3.33)
Fewer	30 (8.33)	1 (0.28)	0 (0.00)	17 (4.72)	0 (0.00)	2 (0.56)	0 (0.00)	2 (0.56)	1 (0.28)	53 (14.72)
No response	64 (17.78)	21 (5.83)	47 (13.06)	67 (18.61)	22 (6.11)	53 (14.72)	5 (1.39)	11 (3.06)	5 (1.39)	293 (81.39)
Abortions										
More	19 (5.28)	1 (0.28)	3 (0.83)	10 (2.78)	1 (0.28)	7 (1.94)	0 (0.00)	0 (0.00)	1 (0.28)	42 (11.67)
Fewer	13 (3.61)	2 (0.56)	1 (0.28)	18 (5.00)	0 (0.00)	3 (0.83)	0 (0.00)	2 (0.56)	0 (0.00)	39 (10.83)
No response	64 (17.78)	21 (5.83)	44 (12.22)	59 (16.39)	21 (5.83)	46 (12.78)	5 (1.39)	14 (3.89)	5 (1.39)	296 (76.67)
Total	96 (26.67)	24 (6.67)	48 (13.33)	87 (24.17)	22 (6.11)	56 (15.56)	5 (1.39)	16 (4.44)	6 (1.67)	360 (100.00)

* Figures in parenthesis are percentages.

Because of the critical nature of dry season feeding, the performance of Muturu cattle during this season was studied in greater detail (Table 20). More animals grew smaller (36.9%) compared to 32.8% who said their animals grew bigger during this season.

A much higher number of respondents (24.7%) observed their animals reproduce more during the dry season than 13.3% who said fewer animals reproduced during the dry season. However, most respondents (61.9%) did not observe any difference in reproduction during this season.

Few adult and calf mortalities occurred during the dry season and abortions were also generally low. An overwhelming majority of respondents (86.1%, 81.4% and 76.7%) did not observe deaths in adults, deaths in calves and cases of abortion respectively during the dry season.

Diseases.

A. Time of the year animals fell sick most and age group usually more affected.

About 48.1% of respondents did not encounter sickness in their animals while 32.5% of respondents said their animals fell sick most during the rainy season and that sickness during the dry season was low (Table 21a).

Table 21a. Time of the year animals fall sick most

Season	- Number of respondents by Local Government Area - Gboko	Guma	Gwer	Katsina Ala	Kon-shisha	Kwande	Makurdi	Ushongo	Vande-ikya	Total
Rainy season only	46 (12.78)	6 (1.67)	11 (3.06)	28 (7.78)	0 (0.00)	15 (4.17)	0 (0.00)	10 (2.78)	1 (0.28)	117 (32.50)
Dry season only	9 (2.50)	2 (0.56)	2 (0.56)	14 (3.89)	1 (0.28)	6 (1.67)	0 (0.00)	1 (0.28)	0 (0.00)	35 (9.72)
Both	11 (3.06)	4 (1.11)	0 (0.00)	6 (1.67)	1 (0.28)	12 (3.33)	0 (0.00)	1 (0.28)	0 (0.00)	35 (9.72)
No response	30 (8.33)	12 (3.33)	35 (9.72)	39 (10.83)	20 (5.56)	23 (6.39)	5 (1.39)	4 (1.11)	5 (1.39)	173 (48.06)
Total	96 (26.67)	24 (6.67)	48 (13.33)	87 (24.17)	22 (6.11)	56 (15.56)	5 (1.39)	16 (4.44)	6 (1.67)	360 (100.00)

* Figures in parenthesis are percentages.

The majority of respondents, 55.8%, were unable to associate sickness with age (Table 21b).

B. Incidence of diseases in Muturu cattle and season of occurrence.

Table 22 shows signs of disease in Muturu cattle and season of occurrence. In general, the common signs of disease were not observed in Muturu cattle in Benue State and as such an overwhelming majority of respondents observed no diarrhoea (72.9%), no signs of inappetence and drinking (87.8%), no skin problem (85.9%), no foot-rot (95.8%), no persistent coughing (90.5%), no circling and twisting of neck (97.5%), no blood in urine (94.2%), no worms in faeces (91.1%), no swollen joints (97.0%) and no sudden death (97.2%).

The highest sign of disease was diarrhoea (27.1%) and this occurred mainly during the rainy season.

C. When animals are sick, do you report to Veterinary or Agricultural Extension Workers?

43.6% of respondents did not report to extension workers when their animals were sick and those who reported were only very few (25.4%) (Table 23).

Table 21b. Age group usually more affected.

Age	No. of respondents	Percent
Adult	100	27.6
Calves	51	14.1
Weaners	9	2.5
No response	202	55.8
Total	362	100.0

Table 22. Signs of disease in Muturu Cattle.

Disease Sign	Yes	No	Total response	<--- Season of Occurence ---> Rainy	Dry	None
Diarrhoea	98(27.1)	264(72.9)	362(100.0)	34(9.4)	18(5.0)	310(85.6)
Not eating and drinking	44(12.2)	317(87.8)	361(100.0)	12(3.3)	10(2.8)	339(93.9)
Skin problem	51(4.1)	310(85.9)	361(100.0)	21(3.3)	17(4.7)	324(89.5
Foot problem (foot-rot)	15(4.2)	346(95.8)	361(100.0)	5(1.4)	5(1.4)	352(97.2)
Abortion	15(4.2)	346(95.8)	361(100.0)	7(2.0)	4(1.1)	351(97.0)
Persistent coughing	35(9.7)	326(90.3)	361(100.0)	6(1.7)	25(6.9)	331(91.4)
Circling and twisting of neck	9(2.5)	352(97.5)	361(100.0)	2(0.6)	3(0.8)	357(98.6)
Blood in urine	21(5.8)	340(94.2)	361(100.0)	19(5.2)	0(0.0)	343(94.8)
Worm in faces	32(8.9)	329(91.1)	361(100.0)	4(1.1)	17(4.7)	341(94.2)
Swollen joints	11(3.0)	350(97.0)	361(100.0)	2(0.6)	3(0.9)	357(98.6)
Sudden death	10(2.8)	351(97.2)	361(100.0)	5(1.4)	4(1.1)	353(97.5)

* Figures in parenthesis are percentages.

Table 23. When animals are sick, do you report to Veterinary or Agricultural extension workers?

Response	No. of respondents	Percent
Yes	92	25.4
No	158	43.6
No response	112	30.9
Total	362	100.0

Table 24. Deaths recorded in the last one year.

Class of Cattle	No. of respondents	Percent
Cows	67	18.5
Bulls	22	6.1
Calves	21	5.8
No response	252	69.6
Total	362	100.0

D. Deaths recorded in the last one year.

An overwhelming majority (69.6%) did not record deaths in their herd in the last one year (Table 24).

E. Vaccination

Tables 25a and 25b show whether animals were vaccinated and when such vaccinations were carried out. Most farmers (76.4% of respondents) did not vaccinate their animals but the few (20%) who vaccinated, did so every year.

F. Treatment

Tables 26a, 26b and 26c show the result. The number of farmers treating their animals (44.2% of respondents) was about the same as those who did not treat their animals (45.0% of respondents) (Table 26a).

Treatment was carried out mainly by the owners (68.8% of respondents) as against only 31.2% of respondents who said that treatment was carried out through veterinary services (Table 26b). Notice that only 112 out of 360 farmers responded to this question, an indication that treatment was not seriously carried out since animals were rarely sick.

Table 25a. Vaccination of animals

Response	- Number of respondents by Local Government Area -									
	Gboko	Guma	Gwer	Katsina Ala	Kon-shisha	Kwande	Makurdi	Ushongo	Vande-ikya	Total
Yes	27 (7.50)	0 (0.00)	4 (1.11)	20 (5.56)	12 (3.33)	1 (0.28)	0 (0.00)	5 (1.39)	3 (0.83)	72 (20.00)
No	69 (19.17)	22 (6.11)	39 (10.83)	62 (17.22)	10 (2.78)	54 (15.00)	5 (1.39)	11 (3.83)	3 (0.83)	275 (76.39)
No response	0 (0.00)	2 (0.56)	5 (1.39)	5 (1.39)	0 (0.00)	1 (0.28)	0 (0.00)	0 (0.00)	0 (0.00)	13 (3.61)
Total	96 (26.67)	24 (6.67)	48 (13.33)	87 (24.17)	22 (6.11)	56 (15.56)	5 (1.39)	16 (4.44)	6 (1.67)	360 (100.00)

* FIgures in parenthesis are percentages.

Table 25b. When animals vaccinated.

Time	- Number of respondents by Local Government Area -									
	Gboko	Guma	Gwer	Katsina Ala	Kon-shisha	Kwande	Makurdi	Ushongo	Vande-ikya	Total
Every year	27 (7.50)	0 (0.00)	0 (0.00)	17 (4.72)	1 (0.28)	2 (0.56)	0 (0.00)	3 (0.83)	3 (0.83)	53 (14.72)
Only when outbreak	6 (1.67)	0 (0.00)	2 (0.56)	5 (1.39)	12 (3.33)	2 (0.56)	0 (0.00)	2 (0.56)	0 (0.00)	29 (8.06)
No response	63 (17.50)	24 (6.67)	46 (12.78)	65 (18.06)	9 (2.50)	52 (14.44)	5 (1.39)	11 (3.06)	3 (0.83)	278 (77.22)
Total	96 (26.67)	24 (6.67)	48 (13.33)	87 (24.17)	22 (6.11)	56 (15.56)	5 (1.39)	16 (4.44)	6 (1.67)	360 (100.00)

* Figures in parenthesis are percentages.

Table 26a. Treatment of animals.

Response	- Number of respondents by Local Government Area - Gboko	Guma	Gwer	Katsina Ala	Kon-shisha	Kwande	Makurdi	Ushongo	Vande-ikya	Total
Yes	45 (12.50)	10 (2.78)	16 (4.44)	47 (13.06)	16 (4.44)	18 (5.00)	0 (0.00)	5 (1.39)	2 (0.56)	159 (44.17)
No	38 (10.56)	12 (3.33)	27 (7.50)	25 (6.94)	6 (1.67)	37 (10.28)	3 (0.83)	11 (3.06)	3 (0.83)	162 (45.0)
No response	13 (3.61)	2 (0.56)	5 (1.39)	15 (4.16)	0 (0.00)	1 (0.28)	2 (0.56)	0 (0.00)	1 (0.28)	39 (10.83)
Total	96 (26.67)	24 (6.67)	48 (13.33)	87 (24.17)	22 (6.11)	56 (15.56)	5 (1.39)	16 (4.44)	6 (1.67)	360 (100.00)

* Figures in parenthesis are percentages.

An overwhelming majority of the owners (81.8% of respondents) effected treatment through traditional methods i.e. the use of herbs and "western method" of treatment was very low (Table 26c). Here again only 99 out of 360 farmers responded.

G. Do you cull your animals?

44.2% of respondents culled their animals while 35.4% did not (Table 27).

Marketing of Muturu cattle.

Majority of farmers (73.5% of respondents) sold their stock life (Table 28a) for reasons of income generation for family support (Table 28b).

Majority of farmers (59.9% of respondents) sold their animals on the farm and sales in the market were very low (Table 28c).

About 47.5% of respondents said they realized N1,000 in a year from sale of Muturu cattle while 36.7% realized between N1,000 - N5,000 in a year (Table 28d). Those realizing above N5,000 from sales of their Muturu cattle were few.

Table 26b. Treatment done by

Response	No. of respondents	Percent
Self/Owner	77	68.8
Veterinary Services	35	31.2
Total	112	100.00

Table 26c. If treatment done by you, how do you effect it?

Response	No. of respondents	Percent
Traditional method (Herbs)	81	81.82
Western method	17	17.17
Both	1	1.1
Total	99	100.00

Table 27. Do you cull your animals?

Response	No. of respondents	Percent
Yes	160	44.2
No	128	35.4
No response	74	20.4
Total	362	100.0

Table 28a. How do you sell your stock?

Response	No. of respondents	Percent
Life	266	73.5
Slaughter	20	5.5
Both	25	6.9
No response	51	14.1
Total	362	100.0

Table 28b. Reasons for selling stock

Reason	No. of respondents	Percent
Reaching market weight	84	23.2
Diseased	14	3.9
Lack of feed and water	21	5.8
Culled	70	19.3
Support	123	34.0
Others	54	14.9
Total	362	100.0

Table 28c. Where do you sell your animals?

Place	No. of respondents	Percent
On the farm	217	59.9
In the market	29	8.0
Both	62	17.1
Others	54	14.9
Total	362	100.0

Table 28d. Revenue realized in a year from sale of Muturu Cattle.

Amount (₦)	No. of respondents	Percent
1000	172	47.5
1000 - 5000	133	36.7
5000 - 10,000	28	7.7
10,000 - 15,000	13	3.6
15,000 - 20,000	7	1.9
> 20,000	9	2.5
Total	362	100.0

Constraints to production.

Table 29 shows the numerous problems facing Muturu cattle farmers.

Lack of feed and water were identified as the biggest problems facing most farmers (40.8% of respondents) and this problem was more severe in Gboko Local Government than the other Local Government Areas (Table 29).

Lack of adequate Veterinary extension services, lack of capital and lack of grazing land were the other problems faced by Muturu cattle farmers. Lack of market was not a problem since majority of the animals were sold on the farm (Table 29).

Suggestions for improving Muturu herd.

The suggestions for improving Muturu herd are presented in Table 30. These suggestions are classified into first and second priorities.

In the first priority, 301 out of 360 farmers responded and of these 56.8% suggested that provision of loans would improve their Muturu herd management and productivity while 12.3 and 9.3% respectively thought that veterinary services and availability of water would improve their management and productivity.

Table 29. Problems facing Muturu Cattle farmers.

Problem	- Number of respondents by Local Government Area - Gboko	Guma	Gwer	Katsina Ala	Kon-shisha	Kwande	Makurdi	Ushongo	Vande-ikya	Total
Lack of feed and water	66 (18.33)	0 (0.00)	17 (4.72)	32 (8.89)	22 (6.11)	2 (0.56)	0 (0.00)	6 (1.67)	2 (0.56)	147 (40.83)
Lack of Vet. Ext. Services	14 (3.89)	0 (0.00)	13 (3.61)	7 (1.94)	0 (0.00)	20 (5.56)	0 (0.00)	10 (2.78)	0 (0.00)	64 (17.78)
Lack of Capital	7 (1.94)	14 (3.89)	4 (1.11)	18 (5.00)	0 (0.00)	11 (3.06)	0 (0.00)	0 (0.00)	0 (0.00)	54 (15.78)
Lack of grazing land	3 (0.83)	9 (2.59)	1 (0.28)	12 (3.33)	0 (0.00)	14 (3.89)	5 (1.39)	0 (0.00)	2 (0.56)	46 (12.78)
Lack of Market	1 (0.28)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	3 (0.83)	0 (0.00)	0 (0.00)	0 (0.00)	4 (1.11)
No response	5 (1.39)	1 (0.28)	13 (3.61)	18 (5.00)	0 (0.00)	6 (1.67)	0 (0.00)	0 (0..0)	2 (0.56)	45 (12.50)
Total	96 (26.67)	24 (6.67)	48 (13.33)	87 (24.17)	22 (6.11)	56 (15.56)	5 (1.39)	16 (4.44)	6 (1.67)	360 (100.00)

* Figures in parenthesis are percentages.

Table 30. Things to improve Muturu herd.

Response	No. of respondents	Percent
1st Priority		
Loans	171	56.8
Vet services	37	12.3
Water	28	9.3
Feed	24	8.0
Land	19	6.3
Others	22	7.3
Total	301	100.0
2nd Priority		
Vet/Extension services	101	34.6
Feed	45	15.4
Land	43	14.7
Loan	34	11.6
Water	27	9.2
Others	42	14.4
Total	292	100.0

In the second priority ranking, only 292 out of 360 farmers responded that provision of veterinary extension services, feed and grazing land would improve their Muturu herd.

INSTITUTIONAL FARM SYSTEM.

Only one institutional farm exists in Benue State for raising Muturu cattle and this is a Benue State Government farm known as Raav LIBC (Fig. 4).

Population

Table 31 shows the population of Muturu cattle kept at Raav LIBC. Out of a total number of 28 animals more than half were calves (53.6%) while 35.7% were cows, bulls constituted 7.1% and weaners 3.6%.

Source of stock.

While some animals on the farm originated from Katsina-Ala Local Government Area of Benue State, some others were purchased from Shendam and Pankshin Local Government Areas of Plateau State.

Objectives.

The objective of the farm is to multiply and distribute trypanotolerant cattle to farmers. Apart from Muturu cattle, the trypanotolerant N'dama cattle are also raised at Raav LIBC and these number five times more than the Muturu cattle at the time of the study.

Table 31: Population of Muturu Cattle at Raav LIBC

Variable	Sum	Percent Total
Cows	10	35.7
Bulls	2	7.1
Calves	15	53.6
Weaners	1	3.6
Castrate	-	0.0
Total	28	100.00

Reproductive performance.

(a) Age at first service was 18 - 30 months.

(b) Age at first calving was 27 - 39 months

(c) Calving rate was 57%

(d) Calf mortality was 5%

(e) Weaning rate was 80 - 90%

(f) Culling rate was 1%

(g) Pasture mating was the method of mating practised i.e. breeding males and females were kept together throughout the year.

(h) Cows conceived once every two years.

(i) No abortions occurred.

(j) No dystocia (difficult birth) was encountered on the farm.

(k) The apparent poor performance during the dry season was attributed to insufficient funds which militated against procurement and provision of supplementary feedstuffs.

Diseases.

(a) The animals on the farm were rarely ill and when they fell sick, calves were usually more affected.

(b) Common diseases in order of importance were Heartwater (Cowdria ruminantum) and Helminthiasis.

(c) Animals were vaccinated annually against Rinderpest, Contagious Bovine Pleuropneumonia (CBPP), Anthrax, Haemorrhagic septicaemia and Blackquarter (BQ).

(d) Animals were sprayed twice a month against ectoparasites and dewormed once in three months during the dry season and twice every three months during the rainy season.

(e) Animals were rarely culled except when bulls with cryptorchidism were culled and sold.

Marketing.

(a) Animals were normally sold on the farm and not in the market.

(b) Animals were sold on liveweight basis at N10 per kg in 1991 and the usual customers were elites, not farmers.

(c) About N6,000 was realized annually from sale of these animals.

Weight of animals.

(a) Birth weight of calves was about 14kg.

(b) Weaning weight at 6 - 8 months was about 48kg.

(c) Mean weight of cows at mating was 143kg.

General.

(a) Management problems on the farm were listed as lack of fenced land and paddocks, lack of improved pastures, transportation difficulties and insufficient funds.

(b) The following suggestions were offered for improvement of the herd on the farm:

(i) increased stock numbers
(ii) provision of more funds.

(c) The following livestock were kept apart from Muturu cattle: N'dama cattle, Bunaji cattle, Sheep, Goats and Rabbits. Poultry was previously raised but had since been abandoned.

(d) Crops were cultivated in the past but these have also been abandoned.

(e) The following categories of enterprise (in order of importance) were carried out at Raav LIBC:

(i) raising Muturu cattle
(ii) raising other livestock

(iii) growing of crops.

The reason for this was that of achieving the objectives for which the farm was established namely, to multiply and distribute trypanotolerant cattle to farmers; and more importantly that Muturu are an indigenous breed of cattle to Benue State.

DISCUSSION

About 2 to 3 decades ago, it was generally believed that Muturu cattle in Benue State originated from the neighbouring Cross Rivers State. This is contrary to the findings in this study in which 95% of the animals came from within Benue State particularly from Gboko and Katsina-Ala L.G.As. Contrary to the usual belief that Muturu cattle were kept for ceremonial purposes particularly funerals, and were never kept as a regular source of income (ILCA/FAO, 1980), the findings in this study revealed that an overwhelming majority of farmers kept Muturu cattle for commercial reasons i.e. to generate income. Consequently most farmers owned their stock through purchase.

The semi-intensive system was the most popular system of management of Muturu cattle but the reason for this system being most popular in Gboko Local Government than other L.G.As. is not known. Transhumance is the most popular system of traditional management of Zebu cattle in Nigeria during which pastoralists move from place to place in search of water and pasture. Under this system, cattle experience considerable loss of weight and the movement aids in spread of disease and conflict between cattle rearers and crop farmers. Since Muturu cattle were managed semi-intensively, the adverse effects of transhumance namely considerable loss of weight, and spread of disease were minimal in the study area. Ferguson (1988) pointed out that under village management conditions, Muturu cattle were for the most part

free-roaming or confined overnight and herded in daytime and that confinement and herding reduced the social conflicts resulting from crop damage by free-roaming livestock. He further contended that management involved confinement or tethering on bare ground from dusk until around 9.00 a.m. thus providing only about 9 hours of grazing time for animals that would spend several of these hours resting and ruminating in the shade under free-choice condition. The restriction according to Ferguson (1988), constituted more of a problem when herdsmen were employed having only limited proprietary interest in performance other than milk yield. He concluded that this was a major factor responsible for poor condition and low performance of village herds.

The provision of houses for the animals during the rainy season was to ensure that animals especially calves were protected from rains which were often long and heavy.

Inspite of the numerous benefits derived from supplementary feeding, Muturu cattle under the traditional village management condition in Benue State were hardly supplemented even during the dry season when the nutritive value of the natural pasture were severely depleted. Pullan (1980) identified malnutrition in the dry season as being the major constraint to cattle productivity in Plateau State. His investigation pointed to the effect of poor nutrition obtained from natural fodder during the dry season as well as gross overgrazing as causes of low growth rate of calves and mature cattle as well as high calf mortality in Bunaji

cattle. Similarly, Otchere (1986b) found that supplementary feeding of Bunaji cows significantly improved the weight of their calves at birth and at 1 year of age compared to the unsupplemented controls. Furthermore, at 365 days of age, viability of calves from supplemented dams was enhanced. Supplementation however, did not improve calving interval. It is likely therefore that lack of supplementary feeding to Muturu cattle in Benue State is seriously affecting the productivity of these animals.

The major reason for not providing supplementary feed was that of ignorance. Okoh et al. (1988) found that supplementary feed was not given in most nomadic Fulani herds investigated for reasons of unavailability of supplementary feed. It would appear therefore that the nomadic Fulani are much better informed of the need to supplement their animals than the Tiv people of Benue State who raise Muturu cattle. The ignorance surrounding the use of supplementary feed poses a great challenge and established a serious indictment on the Livestock extension services in Benue State.

The majority of Muturu cattle owners had no fixed time for giving water to their animals. This can be attributed to the fact that crop farming is the major pre-occupation of these farmers; the tendency is for them to take care of their animals only after their cropping activities. In view of the importance of water in the metabolism of animals and its subsequent productivity, it is likely that the productivity of these animals is being hampered by the haphazard manner

that these animals were given water and probably insufficient water.

The age at first calving of 2 - 3 years recorded in this study is much lower than the 4 - 5 years reported in village herds (ILCA/FAO, 1980). The reasons for this difference is not known but may be related to the differences in village management conditions. The practice of running males and females together throughout the year ensures that cows in heat were settled by bulls. The report by ILCA/FAO (1980) showed that under the traditional village conditions, Muturu bulls used to service cows usually came from the same village. It is likely therefore that there may be serious cases of inbreeding in these animals which also could account for their low productivity. The reason for the high incidence of mating during the dry season observed in this study is not apparent but could be related to improved nutrition and greater exposure of cows to bulls, since this period coincided with the period when cattle were not confined. At this period these animals roamed freely thus increasing their chances of mating.

Furthermore, the animals are in better body condition during the early dry season as a result of good feeding during the previous rains. Adequate nutrition is known to affect body condition and ovulation both of which would enhance breeding during this period (Mani, 1992). The calves would then arrive during the next rains when the dams would have enough milk from the luscious pasture.

The low incidence of mating in the rainy season is not surprising because this is a period of cattle confinement (tethering) when all surroundings are heavily cropped and as a result the chances of mating is largely reduced. The regular calving of every one to two years by Muturu cattle reported in this study appears too impressive under the traditional village management condition.

Low abortions, calf mortality and low signs of disease and the fact that the Muturu cattle in Benue State, were seldom vaccinated and majority remained untreated yet hardly fell sick, confirms that Muturu cattle are very hardy animals. ILCA/FAO (1980) had earlier reported that Muturu cattle generally did not receive any veterinary treatment, as diseases and premature mortality were uncommon. According to Ferguson (1966), the most important cause of deaths among young stock was helminthiasis with a few sporadic cases of anthrax.

The hardy nature of trypanotolerant cattle has been reported in the literature. Trypanotolerant cattle are resistant not only to trypanosomiasis but also to several other important infectious diseases such as streptothricosis (Stewart, 1937; Coleman, 1967; Oduye and Okunaiya, 1971), tick-borne diseases including heartwater (Cowdria ruminantum), anaplasmosis, endemic piroplasmosis and babesiosis (Epstein, 1971; Ilemobade, 1984). However, a few cases of heartwater, foot-and-mouth disease have been reported among N'dama herds kept on ranches (ILCA/FAO 1980). Esuruoso (1973) reported a

brucellosis infection rate of up to 60% in N'dama settled herds in the Western State of Nigeria during a five year study and concluded that brucellosis was likely to be carried to other herds through the sale of N'dama bulls to farmers. In this study, 97.0% of respondents said they noticed no swollen joints (an indication of brucellosis) in their Muturu herds. The highest disease incidence in this study was diarrhoea (27.1% respondents) and this occurred mainly during the rainy season.

N'dama and Muturu are reported to be much more susceptible to rinderpest than Zebu (Stewart, 1937, 1951; Cornell and Evans, 1937; Ferguson, 1967), while Van Hoeve (1972) noted that Muturu, but not N'dama, were highly susceptible to foot-rot. In this study 95.8% respondents did not observe foot-rot in their Muturu herds.

The findings in this study that more animals grew at a slower rate during the dry season may be related to the general scarcity of pasture and lower nutritive value during this season. A much higher number of farmers observed their animals reproduced more during the dry season because, as earlier observed, the majority of the cows conceived during the dry season when the cattle were not confined but roamed freely.

The findings that most Muturu cattle were sold on the farm rather than in the market appears realistic in that in the whole of the 9 Tiv speaking L.G.As. of Benue State where

these animals are found, only two Muturu cattle markets exist, one in Gboko and another in Katsina-Ala L.G.A. In view of the fact that Muturu cattle are generally very expensive (each animal on the average costs between N2,000 - N3,000), the reported revenue of N1000 realized in a year by majority of farmers is a misnomer. It is probable that these farmers did not disclose their actual earnings for fear of taxation.

The reason for the findings that lack of feed and water were the biggest management problems facing most Muturu cattle farmers in Benue State especially in Gboko Local Government, was not apparent but may not be unconnected with the fact that since most of the people are crop farmers and as more and more land is being put to cropping, grazing land continues to diminish thus creating scarcity of forage which is the main source of feed for these animals. Furthermore, because of the high urbanisation of Gboko L.G.A. and the rapid industrialization in this Local Government more than the other L.G.As., the available land is further depleted thus making the availability of grazing land and feed a serious limitation. The more severe lack of water in Gboko L.G.A. may also be due to the fact that this Local Government generally has much fewer sources of water such as streams than any of the other L.G.As.

It is not surprising that an overwhelming majority of farmers indicated the provision of loans as a means of improving their herds because loan facilities from various government

organizations and banks are now available to farmers in Benue State for cropping and other livestock enterprises such as pig and poultry production. It is therefore natural that the Muturu cattle farmers would also wish to benefit from these loan facilities. The findings from this research therefore clearly indicates the desire for this assistance to be extended to cover improvement of Muturu cattle.

Commercial farms and government breeding or multiplication ranches keeping Keteku and N'dama cattle in Nigeria are listed (ILCA/FAO, 1980). However, similar institutional farms keeping Muturu cattle are extremely few.

At Raav LIBC, the age at first service of 18 - 30 months for Muturu heifers is higher than that reported by Roberts and Gray (1973a) who found at the Nigerian Institute for Trypanosomiasis Research (NITR) farm Vom, Plateau State known to be tsetse-free that Muturu heifers were sexually mature at 12 months, N'damas at $13^{1}/_{2}$ (thirteen and half) months and the Zebu at 16 months. Similarly, age at first calving of 27 - 39 months in Muturu heifers at Raav LIBC is higher than that reported by Roberts and Gray (1973a) at Vom of 635 days (21 months) for Muturu cattle, and 684 days (23 months) for Zebu animals but similar to that of Ferguson (1967) who recorded an average age at first calving of 26 months at Ado Ekiti Livestock Investigation Centre (LIC) in Ondo State under unrestricted mating conditions.

The reasons for the better performance of the Muturu cattle from Vom than Raav LIBC in terms of age at first service and age at first calving is not apparent but may have been influenced by the absence of tsetse in Vom and presence of the fly in Raav. It has been established that trypanosome infection affects the productive performance of infected cattle (ILCA/ILRAD, 1986a, b; ILRAD 1986). Secondly while animals at Vom were supplemented during the dry season, the supplementation of the animals at Raav was very erratic and according to the Farm Manager, most times, the animals were not supplemented because of lack of funds to procure supplementary feeds. In Ethiopia, Azage Tegegne and his co-workers (ILCA, unpublished data) found that supplemented Boran heifers reached puberty earlier, were heavier at puberty and had larger ovaries than unsupplemented heifers.

Roberts and Gray (1973a) also found that Muturu heifers had shorter mean calving intervals (350 days) compared to 363 days in N'dama and 403 in Zebu cattle in Vom. The lower age at first service, lower age at first calving and shorter calving interval of Muturu cattle than the N'dama and Zebu demonstrates the superiority of Muturu over N'dama and Zebu in these reproductive traits and underlines the importance of exploring the Muturu for enhanced productivity. Similarly, the calving rate of 57%, low calf mortality (5%), high weaning rate (80 - 90%) and low culling rate (1%) of the Muturu cattle at Raav LIBC could easily be improved further under better management and feeding conditions.

The birth weight of Muturu calves at Raav LIBC of 14kg was similar to that recorded at Vom of 13.7 - 13.9kg (Roberts and Gray 1973a). The weaning weight of 48kg obtained at Raav LIBC, however, was much lower than the 82.5 - 98.1kg for the same breed at Vom (Roberts and Gray 1973a). The reason for the lower growth rate of Muturu cattle at Raav LIBC than those at Vom is most likely related to the high incidence of tsetse in Raav but not at Vom, and the poor feeding practices on the Raav LIBC.

It appears from these results that Muturu cattle at Raav LIBC did not perform better than those under traditional village management condition. This may have been due to lack of adequate supplementary feeding as funds for procuring them were always insufficient.

CONCLUSIONS

The benefits of supplementary feeding has eluded the Muturu cattle farmers of Benue State as this vital feeding technique is not practised by them mainly because they are ignorant of this feeding strategy. This posses a great challenge and clearly points to the defect in the livestock extension services in Benue State. It is suggested that intervention through adoption of supplementary feeding practices may enhance the productivity of Muturu cattle under the traditional village management system in Benue State.

The hardy nature of Muturu cattle under the traditional village system is clearly demonstrated by the fact that disease was not a constraint militating against production. All that needs to be done now is to explore and take advantage of these unique characteristics and effect increased productivity of Muturu cattle through improved management.

The desire by an overwhelming majority of Muturu cattle farmers for loans to improve their herd is genuine. It is desirable that lending agencies extend their credit loan package on livestock to include farmers raising Muturu cattle.

The reproductive performance indices of Muturu cattle on Raav LIBC and those under village management system indicate that the breed has credible beef potentials which should be further explored to enhance the contribution of Muturu cattle to Nigeria's beef industry.

EXPERIMENT 2: ASSESSING THE ROLE AND CONSTRAINTS TO MUTURU CATTLE PRODUCTION IN THE FARMING SYSTEMS OF SOUTHERN GUINEA SAVANNA OF BENUE STATE, NIGERIA.

INTRODUCTION

In the previous study, baseline data were obtained on the performance of Muturu cattle under traditional village management conditions and on one LIBC in Benue State. However, the findings from that study did not clearly delineate the role and constraints to Muturu cattle production in the farming system.

Muturu cattle farmers in Benue State may be classified according to Waters - Bayer and Taylor - Powell (1986a) as cattle-keeping farmers i.e crop farmers who keep some cattle; as such cattle husbandry is subsidiary to crop husbandry. However, the question remains, how are these farmers able to integrate raising of Muturu cattle alongside their major cropping activities? In other words, is there any mutual benefit in this form of integration? Furthermore, what feeding strategies if any, have the farmers adopted in feeding their cattle during the dry season in the face of feed scarcity during this period?

This study addressed the issues raised above through focusing on the integration of Muturu cattle into mixed farming system, land use, utilization of crop residues by Muturu cattle, use of manure from cattle to improve crop

productivity, grazing practice, and the use or otherwise of Muturu cattle for traction.

MATERIALS AND METHODS.

This was the same as described in the previous study except that the institutional farm aspect was eliminated. Secondly, this study was conducted during the dry season months of November - February instead of the rainy season as was done in the previous study.

Specimen copy of the questionnaire is shown in appendix 3.

For purposes of comparison, some of the results were analysed on Local Government basis.

After data clearing, 394 questionnaires were used for analysis. Results are presented as percentages of respondents.

RESULTS.

After data clearing, 394 questionnaires were used for analysis. As can be seen from appendix 3, the questionnaire contained thirty three (33) main questions and several subsidiary questions which farmers were expected to answer. However, in some cases, not all the 394 respondents answered a particular question or its subsidiary. Furthermore, in very few cases, some questions or their subsidiary may not even be administered. These are universal problems with surveys. It is therefore not surprising that the tables presented below may sometimes show 394 respondents in

addressing some issues and show 392 or less respondents in addressing other issues.

Population and distribution of Muturu cattle.

A total of 394 farmers owning 2,336 head of Muturu cattle were interviewed and of these animals 1,144 or 49.0% were cows, 552 or 23.6% were bulls, 609 or 26.1% were calves while 31 or 1.3% were castrate (Table 32).

Table 33 shows that most farmers (60.7%) kept between 1 - 5 animals and those with a herd size exceeding 10 animals were very few. Most respondents came from Katsina-Ala and Gboko L.G.As.

Mixed Farming System.

Other Livestock kept apart from Muturu.

An overwhelming majority of farmers (90.9%) kept other livestock apart from Muturu cattle while those who kept Muturu cattle alone (8.6% respondents) were few (Table 34a). A combination of goats, pigs and sheep were kept by 26.5% of the farmers while 15.1% and 12.5% kept a combination of pigs and goats, pigs and poultry respectively (Table 34b).

Table 35a shows that 86.0% of respondents considered raising of Muturu cattle a more important livestock enterprise than keeping other livestock. Several reasons were responsible for this but profitability (79.3% respondents) and prestige (17.2% of respondents) were the main reasons why Muturu cattle were more important than other livestock (Table 35b).

Table 32. Population of Muturu Cattle Surveyed

Variable	No. of Observations	Sum	Percent Total
Cows	394	1144	49.0
Bulls	394	552	23.6
Calves	394	609	26.1
Castrate	394	31	1.3
Total	394	2336	100.0

Table 33. Distribution of Muturu herd by Local Government Area.

Herd Size	- Distribution of herds by Local Government Area -									
	Gboko	Guma	Gwer	Katsina Ala	Kon-shisha	Kwande	Makurdi	Ushongo	Vande-ikya	Total
1 - 5	66 (16.84)	33 (8.42)	15 (3.83)	68 (17.35)	16 (4.08)	22 (5.61)	2 (0.51)	11 (2.81)	5 (1.28)	238 (60.71)
6 - 10	32 (8.16)	19 (4.85)	8 (6.90)	28 (7.14)	6 (1.53)	18 (4.59)	2 (0.51)	2 (0.51)	1 (0.26)	116 (29.59)
11 - 15	4 (1.02)	3 (0.77)	3 (0.77)	7 (1.79)	1 (0.26)	3 (0.77)	1 (0.26)	0 (0.00)	0 (0.00)	22 (7.61)
16 - 20	2 (0.51)	0 (0.00)	2 (0.51)	0 (0.00)	0 (0.00)	1 (0.26)	0 (0.00)	1 (0.26)	0 (0.00)	6 (1.53)
21 - 25	0 (0.00)	0 (o.00)	2 (0.51)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	2 (1.51)
26 - 30	0 (0.00)	1 (0.26)	0 (0.28)	0 (0.56)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.26)
31 - 35	0 (0.00)	1 (0.26)	0 (0.00)	1 (0.26)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	2 (0.51)
36 - 40	0 (0.00)	0 (0.00)	1 (0.26)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.26)
> 40	0 (0.00)	0 (0.00)	3 (0.77)	1 (0.26)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	4 (1.02)
TOtal	104 (26.53)	57 (14.54)	34 (8.67)	105 (26.79)	23 (5.87)	44 (11.22)	5 (1.28)	14 (3.57)	6 (1.53)	392 (100.00)

* Figures in parenthesis are percentages.

Table 34a. Other livestock kept apart from Muturu cattle.

Response	No. of respondents	Percent
Yes	358	90.9
No	34	8.6
No response	2	0.5

Table 34b. List of other livestock kept.

Type	No. of respondents	Percent
Goats, Pigs, Sheep	91	26.5
Pigs, goats	52	15.1
Goats, Pigs, Poultry	43	12.5
Goats alone	43	12.5
Goats, Sheep, Poultry	36	11.3
Goats, Sheep	31	10.5
Pigs alone	14	4.1
Other combinations	38	11.0
Total	344	100.0

Table 35a. Categories of livestock enterprise more important.

Response	No. of respondents	Percent
Muturu cattle	339	86.0
Other livestock	54	13.7
No response	1	0.3
Total	394	100.0

Cropping.

Table 36a shows that all Muturu cattle farmers (100%) cultivated crops and that yams (84.6% respondents) was by far the most important crop cultivated (Table 36b).

Feeding of crop residues

Table 37a shows that the majority of Muturu farmers (66.1%) fed crop residues to Muturu cattle while 33.9% did not. Yam and cassava peels (38.5 and 19.8% respondents respectively) were the commonest crop residues fed. Feeding of cereal crop residues such as maize and rice straw on individual basis was low (Table 37b). However, when all the cereal crop residues are considered together as a feed resource, their contribution of 39.5% becomes important.

Categories of enterprise in order of importance.

The first priority of Muturu cattle farmers was crop farming, while their second and third priorities were raising cattle and other livestock respectively (Table 38).

Land use system

Land ownership

Table 39a shows that nearly all Muturu cattle farmers (97.7%) owned land and the nature of ownership was mainly through inheritance (95.4%) while those who owned land through purchase or lease were very few (Table 39b).

Table 35b. Reasons why Muturu Cattle are more important than other livestock.

Response	No. of respondents	Percent
Profitable	203	79.3
Prestige	44	17.2
Easy to control	4	1.6
Pleasure	3	1.2
Inheritance	1	0.4
Commonly used	1	0.4
Total	256	100.0

Table 36a. Do you cultivate crops?

Response	No. of respondents	Percent
Yes	394	100.0
No.	0	0

Table 36b. Crops Cultivated.

Response	No. of respondents	Percent
Yam	328	84.6
Ground nut	32	8.3
Rice	13	3.4
Citrus	3	0.8
Cassava	1	0.3
Maize	1	0.3
Total	388	100.0

Table 37a. Feeding of crop residues to Muturu Cattle

Response	- Number of respondents by Local Government Area -									
	Gboko	Guma	Gwer	Katsina Ala	Kon-shisha	Kwande	Makurdi	Ushongo	Vande-ikya	Total
Yes	71 (18.11)	50 (12.76)	28 (7.14)	47 (5.36)	21 (5.36)	17 (4.34)	5 (1.28)	14 (3.57)	6 (1.53)	259 (66.07)
No	33 (8.42)	7 (1.79)	6 (1.53)	58 (14.80)	2 (0.51)	27 (6.89)	0 (0.00)	0 (0.00)	0 (0.00)	133 (33.93)
Total	104 (26.53)	57 (14.54)	34 (8.67)	105 (26.79)	23 (5.87)	44 (11.22)	5 (1.28)	14 (3.57)	6 (1.53)	392 (100.00)

* Figures in parenthesis are percentages.

Table 37b. Crop residues fed to Muturu Cattle.

Crop Residue	Percent respondents
Yam peels	38.5
Cassava peels	19.8
Guinea corn stover	13.2
Maize stover	10.0
Rice straw	8.8
Soyabeans straw	6.1
Ground nut haulms	1.4
Others	2.2

Table 38. Categories of enterprise in order of importance.

Enterprise	No. of respondents	Percent
1st Priority		
Crop farming	308	82.1
Raising Muturu Cattle	67	17.9
Total	375	100.0
2nd Priority		
Raising Muturu Cattle	269	77.5
Other livestock	53	15.3
Crop farming	25	7.2
Total	347	100.0
3rd Priority		
Other livestock	259	92.1
Raising Muturu Cattle	19	6.8
Crop farming	3	1.1
Total	281	100.0

Table 39a. Do you own your own land?

Response	No. of respondents	Percent
Yes	385	97.7
No	6	1.5
No response	3	0.8
Total	394	100.0

Table 39b. Nature of land ownership.

Nature of ownership	No. of respondents	Percent
Inheritance	376	95.4
Purchased	9	2.3
Lease	4	1.0
Gift	1	0.3
Others	4	102
Total	394	100.0

How much land owned.

More than half of the farmers (52.5%) did not know the amount of land they owned. For those who knew, 18.5% stated they owned between 1 - 20 hectares followed by 9.9% respondents who said they owned over 100 hectares (Table 40).

Land set aside for cropping and raising Muturu cattle.

More land was set aside for cropping than raising Muturu cattle. Table 41 shows that while 40.1% of respondents set aside more than half their land for cropping only 16.5% respondents said they set aside more than half the land for raising Muturu cattle. Similarly, while only 19.3% respondents set aside less than half their land for cropping, 38.6% said they set aside less than half of their land for raising Muturu cattle.

Utilization of most fertile portion of farm land.

Table 42 shows that an overwhelming majority of Muturu cattle farmers (81.2%) utilized the most fertile portion of their farm land for cropping while those who raised Muturu cattle on the most fertile portion of their farm land were few (16.0%).

Table 40. How much land do you own?

Hectares	No. of respondents	Percent
1 - 20	73	18.5
20 - 40	13	3.3
40 - 60	40	5.1
60 - 80	14	3.6
80 - 100	28	7.1
> 100	39	9.9
Don't know	207	52.5
Total	394	100.0

Table 41. Land set aside for cropping and raising Muturu Cattle.

Amount of land	Cropping		Raising Muturu	
	Number of respondents	Percent	Number of respondents	Percent
None	106	26.9	136	34.5
Less than half	76	19.3	152	38.6
Half	32	8.1	9	2.3
More than half	158	40.1	65	16.5
No response	22	5.6	32	8.1
Total	394	100.0	394	100.0

Table 42. Utilization of the most fertile portion of farm land.

Enterprise	No of respondents	Percent
For Cropping	320	81.2
For Raising Muturu Cattle	63	16.0
For Other Livestock	11	2.8
Total	394	100.0

Table 43. What Muturu Cattle Graze on.

	No of respondents	Percent
Natural grass	366	92.9
Improved pasture	27	6.9
No response	1	0.3
Total	394	100.0

Table 44. Are your Cattle allowed to:

	No of respondents	Percent
Roam freely	325	82.6
Confined	53	13.5
No response	16	3.9
Total	394	100.0

Grazing Practice.

General

An overwhelming majority of farmers (92.9%) said their cattle grazed natural pasture while only 6.9% said their Muturu grazed improved pasture (Table 43).

Table 44 shows that while an overwhelming 82.6% respondents allowed their cattle to roam freely only 13.5% confined their cattle. Most farmers confined their cattle through tethering (79.4%) while only 15.0% confined by fencing (Table 45). About half of the farmers (49.5%) confined the cattle during rainy season, while 31.2% confined during both rainy and dry season while confinement during the dry season was low (Table 45).

Majority of farmers (67.5%) confined their cattle both in the daytime and overnight, while 19.5% confined these animals in the daytime only and those confining the animals only overnight were very few (8.9%) (Table 46).

Problems resulting from crop damage by free roaming Muturu cattle.

Majority of farmers (80.2%) reported problems of crop damage by free roaming cattle and only 5.1% respondents did not experience this problem (Table 47).

Table 45. Method and season of confinement.

Method/Season	No of respondents	Percent
Tethering	319	79.4
Fencing	59	15.0
Rainy Season	195	49.5
Dry Season	64	16.2
Both	123	31.2

Table 46. Time of the day cattle are confined.

Time	No of respondents	Percent
Day time	77	19.5
Overnight	35	8.9
Both	266	67.5
No response	16	4.1
Total	394	100.0

Table 47. Problems resulting from crop damage by free roaming Muturu CAttle.

Response	No of respondents	Percent
Yes	316	80.2
No	20	5.1
No response	58	14.7
Total	394	100.0

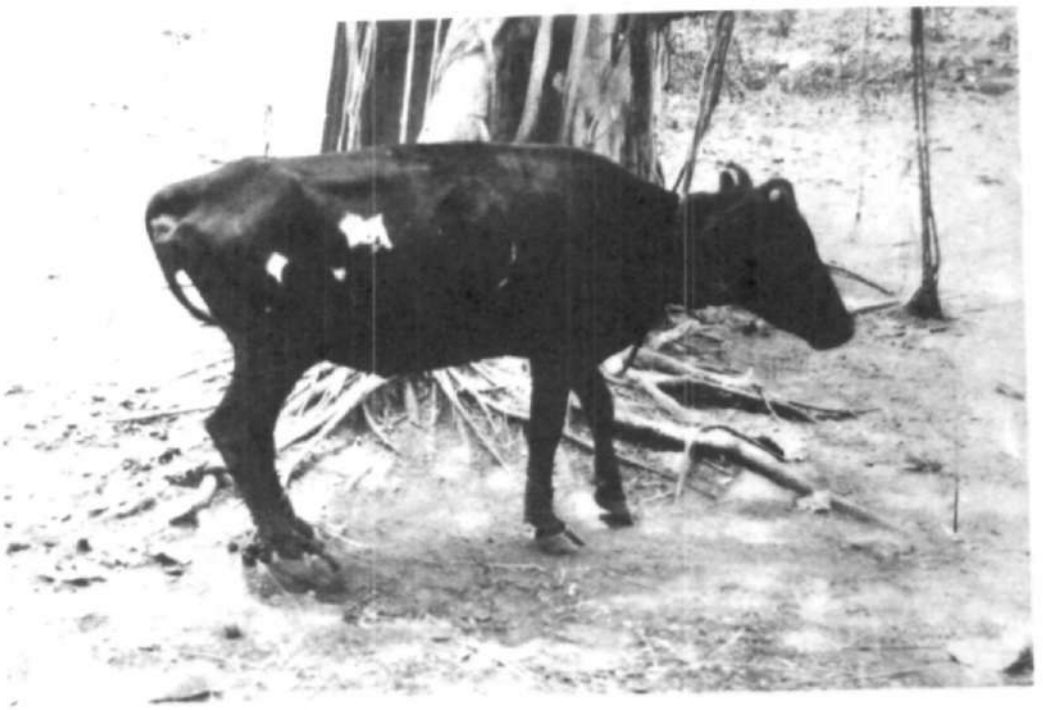


PLATE 4 : MUTURU COW TETHERED DURING CROPPING/ RAINY SEASON.

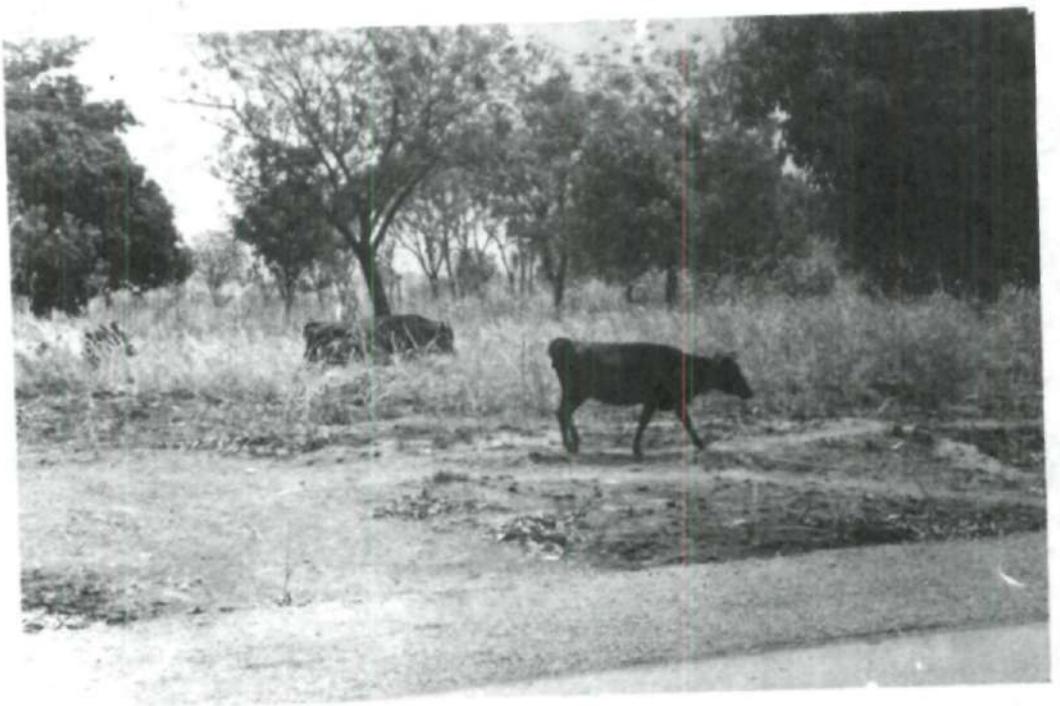


PLATE 5: FREE - ROAMING MUTURU DURING DRY SEASON.



PLATE 6: UNCONFINED MUTURU HERD

Herding of cattle

Table 48 shows that more than half of the farmers (55.9%) had their cattle herded while 33.9% did not. Most of the herding activity took place in Katsina-Ala and Gboko L.G.As.

Grazing on fallow land.

More than half of the Muturu cattle farmers (55.9%) grazed their cattle on fallow land especially in Gboko and Guma LGAs. Those who did not practice grazing on fallow land were only 37.8% (Table 49).

Communal grazing.

Table 50 shows that more than half of the farmers (57.7%) did not practice communal grazing and those who practiced communal grazing were 40.1% with Guma L.G.A. having the highest number of respondents (11.2%) practising communal grazing.

As many as 64.0% of respondents would like provision of communal grazing, and of these 24% came from Katsina-Ala L.G.A. alone. However, 30.1% did not like provision of communal grazing or were not bothered by the lack of it (Table 51).

Table 48. Are your cattle herded?

Response	- Number of respondents by Local Government Area - Gboko	Guma	Gwer	Katsina Ala	Kon-shisha	Kwande	Makurdi	Ushongo	Vande-ikya	Total
Yes	63 (16.07)	3 (0.77)	6 (1.53)	80 (20.41)	29 (5.87)	29 (7.40)	3 (0.77)	7 (1.79)	5 (1.28)	219 (55.87)
No	18 (4.59)	42 (11.70)	28 (7.14)	24 (6.12)	0 (0.00)	15 (3.83)	1 (0.26)	4 (1.02)	1 (0.26)	133 (33.93)
No response	23 (5.87)	12 (3.06)	0 (0.00)	1 (0.26)	0 (0.00)	0 (0.00)	1 (0.26)	3 (0.77)	0 (0.00)	40 (10.20)
Total	104 (26.53)	57 (14.54)	34 (8.67)	105 (26.79)	23 (5.87)	44 (11.22)	5 (1.28)	14 (3.57)	6 (1.53)	392 (100.00)

* **Figures in parenthesis are percentages.**

Table 49. Do your cattle graze on land left fallow?

Response	- Number of respondents by Local Government Area -									
	Gboko	Guma	Gwer	Katsina Ala	Kon-shisha	Kwande	Makurdi	Ushongo	Vande-ikya	Total
Yes	58 (14.80)	49 (12.40)	13 (3.32)	30 (6.65)	22 (7.40)	29 (0.26)	1 (2.81)	11 (1.53)	6 (0.56)	219 (55.89)
No	35 (8.93)	8 (2.04)	21 (5.36)	66 (16.84)	0 (0.00)	12 (3.06)	3 (0.77)	3 (0.77)	0 (0.00)	148 (37.76)
No response	11 (2.81)	0 (0.00)	0 (0.00)	9 (2.30)	1 (0.26)	3 (0.77)	1 (0.26)	0 (0.00)	0 (0.00)	25 (6.38)
Total	104 (26.53)	57 (14.54)	34 (8.67)	105 (26.79)	23 (5.87)	44 (11.22)	5 (1.28)	14 (3.57)	6 (1.53)	392 (100.00)

* Figures in parenthesis are percentages.

Table 50. Whether communal grazing is practiced

Response	- Number of respondents by Local Government Area -									
	Gboko	Guma	Gwer	Katsina Ala	Kon-shisha	Kwande	Makurdi	Ushongo	Vande-ikya	Total
Yes	25 (6.38)	44 (11.22)	27 (6.89)	17 (4.34)	9 (2.30)	28 (7.14)	0 (0.00)	6 (1.53)	1 (0.56)	157 (40.05)
No	71 (18.11)	13 (3.32)	7 (1.79)	87 (22.19)	14 (3.57)	16 (4.08)	5 (1.28)	8 (2.04)	5 (1.28)	226 (57.65)
No response	8 (2.04)	0 (0.00)	0 (0.00)	1 (0.26)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	9 (2.30)
Total	104 (26.53)	57 (14.54)	34 (8.67)	105 (26.79)	23 (5.87)	44 (11.22)	5 (1.28)	14 (3.57)	6 (1.53)	392 (100.00)

* **Figures in parenthesis are percentages.**

Table 51. Would you like provision of communal grazing in your area?

	- Number of respondents by Local Government Area -									
	Gboko	Guma	Gwer	Katsina Ala	Kon-shisha	Kwande	Makurdi	Ushongo	Vande-ikya	Total
Yes	29 (7.40)	53 (13.52)	23 (5.87)	94 (23.98)	8 (2.04)	28 (7.14)	4 (1.02)	8 (2.04)	4 (1.02)	251 (64.03)
No	65 (16.58)	3 (0.77)	0 (0.00)	10 (2.55)	15 (3.83)	16 (4.08)	1 (0.26)	6 (1.53)	2 (1.51)	118 (30.10)
No response	10 (2.55)	1 (0.26)	11 (2.81)	1 (0.26)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	23 (5.87)
Total	104 (26.53)	57 (14.54)	34 (8.67)	105 (26.79)	23 (5.87)	44 (11.22)	5 (1.28)	14 (3.57)	6 (1.53)	392 (100.00)

* Figures in parenthesis are percentages.

Use of Manure.

Table 52 shows that an overwhelming majority of farmers (74.5% respondents) did not apply Muturu cattle manure on crop farms while those who used manure from the cattle droppings on their crop farms were only 25.3%.

Traction.

An overwhelming majority of Muturu farmers (87.6%) did not use Muturu cattle for traction while as few as 3.0% respondents said they used Muturu for traction (Table 53).

Investment of income.

Table 54 shows that more than half of the Muturu farmers (58.9%) invested income from cropping into raising Muturu cattle while an overwhelming majority of the Muturu farmers (80.1%) invested income from Muturu cattle into cropping (Table 55).

Table 52. Use of manure from droppings on crop farms.

Response	- Number of respondents by Local Government Area -									
	Gboko	Guma	Gwer	Katsina Ala	Kon-shisha	Kwande	Makurdi	Ushongo	Vande-ikya	Total
Yes	26 (6.63)	10 (2.55)	9 (2.30)	20 (5.10)	11 (2.81)	10 (2.55)	0 (0.00)	7 (1.53)	6 (1.53)	99 (25.26)
No	77 (19.64)	47 (11.99)	25 (6.38)	85 (21.68)	12 (3.06)	34 (8.67)	5 (1.28)	7 (1.79)	0 (0.00)	292 (74.49)
No response	1 (0.26)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.26)
Total	104 (26.53)	57 (14.54)	34 (8.67)	105 (26.79)	23 (5.87)	44 (11.22)	5 (1.28)	14 (3.57)	6 (1.53)	392 (100.00)

* Figures is parenthesis are percentages.

Table 53. Use of Muturu cattle for traction.

Response	No. of respondents	Percent
Yes	12	3.0
No	345	87.6
No response	37	9.4
Total	394	100.0

Table 54. Investment of income from cropping into raising Muturu cattle.

Response	- Number of respondents by Local Government Area - Gboko	Guma	Gwer	Katsina Ala	Kon-shisha	Kwande	Makurdi	Ushongo	Vande ikya	Total
Yes	44 (11.22)	52 (13.27)	0 (0.00)	87 (22.19)	20 (5.10)	18 (4.59)	0 (0.00)	6 (1.53)	4 (1.02)	231 (58.93)
No	55 (14.03)	5 (1.28)	34 (8.67)	17 (4.34)	3 (0.77)	24 (6.12)	5 (1.28)	8 (2.04)	2 (0.51)	153 (39.03)
No response	5 (1.28)	0 (0.00)	0 (0.00)	1 (0.26)	0 (0.00)	2 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	8 (2.04)
Total	104 (26.53)	57 (14.54)	34 (8.67)	105 (26.79)	23 (5.87)	44 (11.22)	5 (1.28)	14 (3.57)	6 (1.53)	392 (100.00)
Total	104 (26.53)	57 (14.54)	34 (8.67)	105 (26.79)	23 (5.87)	44 (11.22)	5 (1.28)	14 (3.57)	6 (1.53)	392 (100.00)

* Figures in parenthesis are percentages.

Table 55. Investment of income from raising Muturu Cattle into cropping.

	Number of respondents by Local Government Area									
	Gboko	Guma	Gwer	Katsina Ala	Kon-shisha	Kwande	Makurdi	Ushongo	Vande-ikya	Total
Yes	76 (19.39)	51 (13.01)	24 (6.12)	86 (21.94)	19 (4.85)	37 (9.44)	5 (1.28)	12 (3.06)	4 (1.02)	314 (80.10)
No	24 (6.12)	5 (1.28)	10 (2.55)	18 (4.59)	3 (0.77)	7 (1.79)	0 (0.00)	2 (0.51)	2 (0.51)	71 (18.11)
No response	4 (1.02)	1 (0.26)	0 (0.00)	1 (0.26)	1 (0.26)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	7 (1.79)
Total	104 (26.53)	57 (14.54)	34 (8.67)	105 (26.79)	23 (5.87)	44 (11.22)	5 (1.28)	14 (3.57)	6 (153)	392 (100.00)

* Figures in parenthesis are percentages.

DISCUSSION

The previous study involving 362 respondents and a total of 2,490 head of Muturu cattle in the rainy season (Table 4) and the present study involving 394 respondents and a total of 2,336 head of Muturu cattle during the dry season (Table 32) were not a census exercise. However, since every farmer who owned even one animal was expected to have been interviewed, the 4,826 head of cattle covered during the two studies could be said to represent a large if not the entire population of Muturu cattle in the study area. This figure cannot be said to be accurate since due to the difficult terrain, some farmers could not be reached. Even among those who were reached, some refused to be interviewed because of the superstitious belief among Tiv people that every Muturu cattle owner was a wizard and therefore, is potentially dangerous in the community; consequently, these farmers hesitated to reveal their identity which they feared would be made public through this sort of interview. However, with the advent of christianity, these superstitious beliefs are fast dying and people who refused to be interviewed on this count were probably not too many. Also, some respondents were suspicious and did not trust what the information was needed for.

The population of Muturu cattle in Benue State was estimated in 1974/75 to be 25,000 (ILCA/FAO, 1980). Recent figures indicate that Benue State had a total of 10,000 head of Muturu cattle (RIM 1992). The 4,826 head of Muturu cattle obtained in this survey, which probably represents a large

population of the breed in Benue State, may indicate that the breed could be growing to extinction.

It is therefore not surprising that most farmers owned small herd size of 1 - 5 animals.

Muturu cattle are a very important breed because they survive in the tsetse infested zones on account of their tolerance to trypanosomiasis. There is therefore an urgent need to conserve this breed by the establishsment of Multiplication and Breeding Centres in the study area (and perhaps other areas).

Most Muturu cattle farmers in Benue State kept other livestock but considered raising of Muturu cattle a more important livestock enterprise mainly because of reasons of profitability and to a lesser extent for prestige. This finding is similar to that reported in the previous study where an overwhelming majority of farmers kept Muturu cattle for commercial reasons i.e. to generate income which is contrary to the usual belief that Muturu cattle were kept for ceremonial purposes particularly funerals, and were never kept as a regular source of income (ILCA/FAO, 1980).

All the Muturu cattle farmers cultivated crops and the most important enterprise of these farmers was crop farming rather than raising Muturu cattle or other livestock. They can thus be classified according to Waters - Bayer and Taylor - Powell (1986a) as cattle - keeping farmers i.e. crop farmers who keep some cattle, but such that cattle keeping is subsidiary

to cropping. This classification is further confirmed from this study in view of the fact that majority of Muturu cattle farmers set aside more land for cropping than raising Muturu cattle and utilized most fertile portion of their farm land for cropping rather than raising Muturu cattle.

Nearly all Muturu cattle farmers in Benue State owned the land on which the animals are raised but unfortunately more than half of these farmers did not know the size of land they owned. The inability of some farmers to know the size of land they owned may have been responsible for the incessant land dispute in the study area. Since these farmers raise the animals on land owned by them, nomadic and transhumant husbandry practiced by the Fulani and its attendant disadvantages such as loss of weight through great treks by animals, could be avoided in Muturu cattle.

The Fulani who are the major owners of Nigeria's cattle population estimated at 13.9 million (RIM, 1992) do not own land but rely on grazing their livestock as they move from one place to another. Even under settled/sedentary conditions, the Fulani do not own grazing land and therefore have no title to land the animals graze on. In some instances however, the Fulani has gained land right through purchase or after lengthy occupation of unclaimed land. In most cases, the Fulani are generally regarded as only temporary occupants of any piece of land they occupy. Each time the Fulani shifts their homesteads, they make new arrangements with farmers or village leaders for rights to

use specific areas for dwelling and cropping. In most cases, no time limit is set, but rights to crop fields not contiguous with the homestead site must be renewed regularly. The farmers do not demand payment, but a Fulani wishing to retain permission for land use customarily provides cattle manure free of charge for the farmer's fields and makes an occasional gift of meat or even a calf to the farm family (Waters - Bayer and Taylor - Powell, 1986b). Land can also be loaned to the Fulani by the farming community in exchange for manure for the farmers' fields. Under these circumstances therefore, cattle raising by the Fulani can be regarded as an unstable enterprise seriously affected by lack of land ownership. However, as far as land is concerned, the hardship experienced by the Fulani through landlessness is not the case with Muturu cattle farmers of Benue State who own their own land and thus guarantee the raising of Muturu cattle as a more stable enterprise. This stable system will make it easier for developing strategies of improving the productivity of the cattle under traditional village management systems in Benue State.

Majority of livestock farmers in Benue State fed crop residues to their Muturu cattle. The finding in this study that tuber residues (yam and cassava peels) are most often fed than the commonly used cereal crop residues (guinea corn, maize and rice straw) is an indication that the animals are usually raised in very close proximity to homes and thus can be easily fed kitchen waste. Cereal crops, however, are usually grown far away from homes and access to them may

therefore be limited if the animals were raised in close proximity to homes. In the crop - livestock system widely practised in the subhumid zone of Nigeria, Waters-Bayer and Taylor-Powell (1986b) stated that the successive use of land for grazing and cultivation could increase the production potential of both livestock and crop enterprises. In this system, sorghum, millet, rice and soyabean residues were grazed during the dry season, accounting for 50% of the dry season feed and 20% of the total annual grazing time of cattle. Waters-Bayer and Taylor-Powell (1986b) attributed animal production gains such as increase in fertility that coincides with early crop residue grazing to the crude protein and phosphorus contents of the crop residue diet, which were two to three times higher than those found in the natural range during the same period of the year.

Since feeding of crop residues to Muturu cattle in Benue State is popular among majority of the farmers, it may be desirable to assess the nutritional value of the crop residues and the production gains of the animals on this diet.

In Benue State, the production of Muturu cattle is based almost entirely on natural pasture while grazing of improved pasture is extremely low if not non-existent. These natural forages vary in quantity and quality with seasonal climatic changes, consequently affecting the supply of nutrients to the grazing animal. Kapu (1975) reported that during the early wet season, the new regrowth of the perennial grasses

had a CP content of 8 - 9% in the DM but the amount of herbage on the ground was small. Two months later, the biomass increased but the level of crude protein decreased to less than 5% and at the beginning of the dry season, the tall straw - like material contained 1 - 2.5% CP in DM. Kapu (1975) further observed that apart from the low digestibility of the forages for much of the year, deficiencies of minerals and protein occurred. It may well be that the productivity of Muturu cattle in Benue State is being hampered because of their dependence on natural pasture, hence the need to supplement.

Half the Muturu herds were confined (tethered) during the rainy season because during this period, all surroundings were heavily cropped. In the previous study, the low incidence of mating by Muturu cattle in the rainy season was attributed to cattle confinement during which the chances of bulls meeting the cows for mating were low.

The low level of confinement of Muturu cattle during the dry season as reported in this study may be due to the general scarcity of forage during this time and also due to the fact that some crops are harvested during this period. In the previous study the high incidence of mating by Muturu cattle in Benue State during the dry season was attributed to non-confinement at this time.

More than half of the farmers herded their Muturu cattle. This is contrary to the report by ILCA/FAO (1980) that village cattle were rarely herded, except sometimes in the

savanna areas by hired Fulani herdsmen during the cropping season. Moreover, the finding in this study that an overwhelming majority of cattle were allowed to roam freely resulting in numerous problems of crop damage do not support the result that herding of Muturu cattle was a common feature. Perhaps the type of herding understood by these farmers in this study is the practice of taking the animals to the bush for tethering during the cropping season; which is not strictly speaking, herding.

An overwhelming majority of cattle were allowed to roam freely resulting in numerous problems of crop damage as reported by most farmers. This may have contributed to the dwindling population of Muturu cattle in Benue State because Muturu farmers were compelled to sell their animals in order to reduce the population of their stock and lessen problems of crop damage and conflict. In most cases, these animals irrespective of sex, were sold to butchers such as members of wealthy corporate bodies called "bam" who slaughtered the animals and shared the meat among themselves. In this way, the process of further breeding and multiplication of Muturu is negated thereby perpetuating the decrease in numbers of the breed. The high sales of Muturu cattle in Benue State to generate income as earlier reported may have been due to compelling reasons of reducing stock population in order to lessen problems of crop damage and conflict.

Even though communal grazing is little practiced probably because of lack of grazing land, most farmers would like

provision of communal grazing land because according to them, this was the best way to minimize land waste, reduce problems of crop damage by free roaming cattle and also check the rampant cases of conflict arising from crop damage by cattle. Among the 9 Tiv speaking L.G.As. of Benue State, by far the highest cropping activities take place in Katsina-Ala L.G.A. If provision of communal grazing would minimize land waste, reduce problem of crop damage and conflict, the farmers from Katsina-Ala L.G.A. stand to benefit most. It is therefore not surprising that out of the 64% respondents who would like provision of communal grazing in their area, 24% came from Katsina-Ala L.G.A. alone (Table 51). Since nearly all Muturu cattle farmers kept other livestock such as goats, sheep and pigs problems of crop damage and conflict may also arise from the destruction caused by these animals as well.

Apart from the provision of communal grazing land as a means of checking the problem of crop damage and conflict caused by Muturu cattle, fencing of small portions of land by individual farmers to confine these animals may assist in alleviating the problem and consequently minimize indiscriminate sale of Muturu cattle to butchers for slaughter and thus assist in conserving the breed. This proposition is practicable and achievable because majority of Muturu cattle farmers own only a small herd size of 1 - 5 animals. The provision of loans to these farmers as earlier advocated will assist in construction of these fences, provision of improved pasture and enhance the productivity of the Muturu cattle.

The low use of cattle manure on crop fields by Muturu cattle farmers in Benue State is an indication that these farmers rely on the use of inorganic fertilizer for their crops even though these are often not available. Due to the scarcity and high cost of chemical fertilizer, these farmers could be advised by extension workers to adopt the use of cattle manure on their crop farms. ILCA/FAO (1980) reported that under village husbandry, manure was collected only occasionally from Muturu cattle herds in the western and south eastern Nigeria. However, Ruthernberg (1980) reported that in the subhumid region of Nigeria, the Fulani rely almost exclusively on cattle manure to fertilize their crop fields. In mixed farming systems, Waters-Bayer and Taylor-Powell (1986b) reported that in the Abet farming community in Kaduna State, Bunaji cattle were used for draught and provision of manure to cropland and meat and milk for the household. According to Toulmin (1983), such an integration occurred in situations where household labour supply was adequate to cope with the management of both crops and livestock particularly during periods in the wet season when labour demands for cropping were high such as weeding and harvesting. Where labour was in short supply, some farmers hired Fulani to herd and manage their cattle.

The finding in this study that Muturu cattle were hardly used for traction is similar to the earlier report by ILCA/FAO (1980). In Benue State, the use of draught animals is unpopular because as Powell (1986a) observed, four systems of labour are used in cropping in the subhumid zone and a farmer

can employ any or a combination of (a) self: all work is done by the individual farmer, with help from children and or wife (wives); (b) "Adashe": an arrangement among a group of relatives or friends who co-operate in cultivating each individual's farm in turn; such arrangements usually covered only the strenuous cultivation tasks such as ridging, making yam mounds and weeding; (c) "Gaya": group work for a specific task with food and drink given in return and (d) Contract: labour is hired and this may include tractor hire. The use of tractor hire is very popular among the farmers in Benue State even though these tractors are expensive and their supply often erratic and unreliable due to small numbers. In view of these shortcomings, it is advocated that Muturu cattle could be explored for use as a draught animal.

In recognizing the value of the West African Shorothorn cattle to Africa, Stewart (1951) stated that the development of mixed farming would be impossible without them as the cattle provide the peasant farmer with his draught oxen, his manure and little milk. Starkey (1984) reported that the N'dama cattle were often used for traction within their natural area of distribution and even the females of the breed were used successfully. Tourie (1976) on the other hand dismissed trypanotolerant cattle as being of limited usefulness for traction because of their small size. It is probable that crossbred Zebu x trypanotolerant cattle could provide a better option for draught purposes wherever the tsetse challenge was light enough to permit this.

There is little doubt that the larger breeds will usually provide more draught power per animal unit than the small breeds. Lawrence (1987) compared the draught qualities of American Brahman and two Criollo breeds in Costa Rica and found that the distance travelled, work done, speed and power, all followed predictable trends where the value were greatest for the heavier Brahmans and least for the lighter Criollo breeds. However, this does not imply that small animals cannot be successfully used for draught. Ferguson (1988) opined that farmers who wished to employ animal traction would make use of whichever competent animals that were available locally and that efficiency of operation would probably be determined at least as much by the design and quality of harness and equipment as by the breed of cattle used.

The use of Bunaji cattle for draught is generally popular in the subhumid zone of Nigeria (Waters-Bayer and Taylor-Powell, 1986b). However, these authors further observed that in the Abet farming community of the subhumid zone in Kaduna State, Fulani resented the use of cattle for farming because according to them soils were heavy and studded with bush, equipment was expensive and cattle would suffer.

The fact that an overwhelming majority of Muturu cattle farmers invest income from Muturu cattle into cropping confirms earlier findings in this study that crop farming was a more important enterprise than raising Muturu. Furthermore, the fact that more than half of the Muturu

farmers in this study invested income from cropping into raising Muturu cattle indicates that raising of cattle is becoming an integral part of the farmers' production systems.

It appears from these findings that the rearing of Muturu cattle is not properly integrated into the mixed farming system of the mainly crop farmers in Benue State. However, the popular practice of grazing natural pasture and feeding crop residues during the dry season calls for an urgent need to determine and assess the nutritional value of these feed resources in meeting the demands for improved productivity of Muturu cattle under the traditional village management system.

CONCLUSIONS

The population of Muturu cattle in Benue State is dwindling. This is partly due to the fact that farmers are forced to reduce the population of their stock through sales for slaughter in order to lessen problems of crop damage from the free-roaming herds. In order to improve its productivity it is suggested that communal grazing areas be established to minimize land waste, reduce problems of crop damage and check rampant cases of conflict arising from crop damage by these free-roaming animals. Furthermore, since most Muturu cattle farmers own only a small herd size of 1 - 5 animals, fencing of small portions of land by individual farmers to confine these animals will lessen problem of crop damge, and thus eliminate or minimize the need for indiscriminate sale of cattle to butchers and thus assist in conserving the breed. Similarly, the breed could be revived through the establishment of breeding and multiplication centres in the study area and in other areas where the animals are considered native.

Crop farming is the most important farming activity of Muturu cattle farmers in Benue State who practice mixed farming. Consequently, large quantities of crop residues are produced and fed to Muturu cattle but the quantities of these crop residues are unknown. It is suggested that the quantity of crop residues produced in Benue State be determined in order to ascertain their sufficiency or otherwise in supporting the population of Muturu cattle and other livestock that utilize them. It is further suggested that since Muturu cattle in

Benue State depend mostly on grazing natural pasture and crop residues, it is desirable to assess the nutritional value of these feedstuffs in meeting the demands for improved productivity of Muturu cattle under village management systems.

In Benue State, Muturu cattle are hardly used for traction. However, due to general labour shortage, expensive, erratic supply and often unavailability of tractors, it is suggested that Muturu cattle be explored for use as a draught animal. Its small size not withstanding, the efficiency of the animal could be improved through the modification of the design and quality of harness and equipment.

EXPERIMENT 3: THE PREVALENCE OF TRYPANOSOME ORGANISM IN MUTURU CATTLE RAISED UNDER TRADITIONAL VILLAGE MANAGEMENT CONDITION AND ITS EFFECT ON SOME BLOOD METABOLITES.

INTRODUCTION

There is a dearth of information on the effects of trypanosomiasis on the productivity of trypanotolerant cattle especially the Muturu. In trypanotolerant breeds, Djabakou et al. (1985) reported abortions, premature births and still births. Maehl et al. (1988) and Trail and d'Ieteren (1991) found that parasitaemia due to trypanosome infection affected calving intervals and overall productivity of N'dama cattle. Animals that maintained a high PCV had 11% shorter calving interval, 9% heavier calf weaning weight and 24% superior cow productivity than those whose PCV were lowered by the disease.

In general, knowledge about the influence of trypanosomiasis on the productivity of trypanotolerant breeds is scanty and needs further investigation. There are indications that trypanotolerant breeds of animals with trypanosomiasis have less reproductive problems than trypanosusceptible animals (Murray et. al. 1981). However, all animals including game animals which are usually the symptomless carriers (Murray et al. 1981) and trypanotolerant breeds do come down with trypanosomiasis when subjected to extreme stress. There are also indications that malnourished animals with

trypanosomiasis have more reproductive problems than well nourished animals (Reynolds and Ekwuruke, 1988).

Determination of the prevalence of trypansomiasis infection is important as it aids in the decision to institute treatment and effect control measures. The problems associated with diagnosis of trypanosomiasis in domestic animals have been reviewed (Nantulya, 1990). The parasitologic technique of stained thick and thin smears are suitable for field condition. Examination of wet blood films is quick and the method is suitable for screening large numbers of animals. This method, however, is insensitive as half of the infected animals may be missed (Barnett, 1947). The microhaematocrit centrifuge technique (MHCT) and the buffy coat method require electricity therefore limit their application in the field. Similarly, animal innoculation technique and complement fixation test are unsuitable for application in the field.

An alternative approach to laboratory diagnosis is the development of the enzyme - linked immunosorbent assay (ELISA) which greatly aid in the confirmation of cases of trypanosomiasis (Nantulya, 1990). The efficiency of the ELISA technique rests on three facts - it identifies accurately the trypanosomes in mixed species infections, detects animals that are antigenaemic without patent parasitaemia, and provides more accurate measurement of the proportion of time an animal is infected (Trail and d'Ieteren, 1991). The technique compensates for its marginal

failure by being able to detect cases that would be missed by parasitological diagnosis (Nantulya and Lindqvist, 1989). The ELISA is regarded as the answer to some of the important questions regarding diagnosis of animal trypanosomiasis (Nantulya, 1990). The antigen - ELISA is believed to be more efficient than the antibody - ELISA. Trail and d'Ieteren (1991) also opined that antigen - ELISA would enhance the efficiency of selection of trypanotolerant cattle under tsetse challenge in the field.

Since the Muturu is a trypanotolerant breed and the area under study is endemic for trypanosomiasis, it was hoped that information on the prevalence of the trypanosome organism and its effect on the animal would make the study more complete by providing a reliable indication of the disease status (Murray, 1979) and productive performance (ILCA/ILRAD, 1986 a, b) of trypanosome - infected Muturu cattle.

The objectives of this study therefore were to:

(a) Determine the prevalence/incidence of trypanosomiasis in Muturu cattle;

(b) Ascertain the effects, if any, of the presence of trypanosome organism on Hb, PCV, protein and some minerals in the blood of Muturu cattle;

(c) Appraise the intake of protein and minerals and ascertain their sufficiency or insufficiency in Muturu cattle raised under traditional village management system.

MATERIALS AND METHODS

Location

The experiment was conducted in five of the 9 Tiv speaking LGAs namely, Gboko, Gwer, Katsina-Ala, Kwande and Ushongo (Fig. 4).

Experimental Design

The experiment covered the period of one year during which Muturu cattle under traditional village management system in each of the five selected LGAs were randomly selected and bled. Bleeding was done during the rainy season months of September 1991, May and July 1992 and dry season months of Novemeber 1991, January and March 1992. About fifty animals were expected to be bled every month with 10 from each L.G.A. but this was not always possible as some farmers refused access to their animals. Also, since the herd size is usually small (1 - 5 animals/herd) and to ensure a wider coverage, more than one herd was bled from each L.G.A. during each blood sampling exercise. After animals from a herd were bled, mineral salt lick, cotton seed cake and spent sorghum were given to farmers as incentive. Once an animal was bled, it was never bled again during the subsequent blood sampling. This was to avoid confounding the effects of these supplemets on blood levels of magnesium, calcium, phosphorus and protein which were being determined in this study.

Before blood samples were collected, the sex of each animal was recorded and its age determined through dentition.

Rectal temperatures were also taken during the rainy season months of May, July and September when tsetse flies were expected to be more abundant (Onyiah, 1993).

Blood Sampling

Blood samples were collected from the jugular vein of each animal with a 14 G. needle. 10ml were collected into heparinized vacutainer tubes for plasma processing, and a further 10ml without anti-coagulant for serum processing. The heparinized samples were placed into an ice bath while blood samples for serum were allowed to clot in the field. Because of the difficult terrain, poor road network and long distances from the villages where these animals were bled to Gboko town where the samples were processed, it was not always possible to process these samples the same day they were collected but in most cases the samples were stored in a refridgerator for processing the following day. Due to logistic problems including the refusal of some farmers for their animals to be bled, it usually took a whole day to sample animals from one L.G.A. and the following day to process the sample. The heparinized samples were used for preparation of thick and thin smears as well as determination of Hb concentration and PCV at the Nigerian Institute for Trypanosomiasis Research (NITR) laboratory in Gboko town. Blood samples for serum were centrifuged and serum removed and stored in plain plastic tubes at - 15^{o}C until transported to Kaduna in an ice bath where they were again stored at - 15^{o}C until analysed.

During each month's sampling exercise, it took 10 - 13 days to bleed and process blood samples from the five L.G.As.

Analytical Methods

Thin and thick blood smears were made from heparinized blood samples and stained with Giemsa. Stained films were examined under x 10 power microscope for trypanosome organism and other blood parasites.

Antibody-detection ELISA technique as described by Luckins (1977) was further used to detect trypanosome antibody in the sera of each animal. The technique involved:

(a) preparation of antigen through separation of trypanosome species from infected blood,

(b) preparation of antigen coated plates for assays,

(c) reaction of test sera with antigen coated plates,

(d) application of enzyme conjugated anti-specific globulin and substrate to assay plates.

The method of Lanham and Godfrey (1970) for separating Trypanosoma Sp (T. vivax, T. congolense and T. brucei) in experimentally infected mammalian blood was used.

Trypanosoma Species stabilates for the preparation of antigens for the ELISA were obtained from the Department of Veterinary Parasitology and Entomology, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria.

T. congolense and T. brucei stabilates were used to infect two groups of 20 mice each, and the T. vivax stabilate was used to infect a goat, for antigens preparation. After a fulminating parasitaemia had developed in the animals, blood was collected from them and passed through columns of diethyl amino ethy cellulose (DE52) PH 8.0 in order to separate the trypanosomes from the blood elements.

The separated trypanosomes in suspension were centrifuged at 17,000rpm at 3°C for 20 minutes on a Beckman centrifuge Model J21B, the supernatant was discarded and the resulting trypanosomes pellet were pooled together and washed three times in phosphate buffered saline (PBS) PH 7.4 by centrifugation at 17,000rpm for 20 minutes at 3°C.

To prepare the antigen, the pelleted trypanosomes (deep frozen stock) were diluted 1:4 with PBS, and sonicated using an ultrasonic Sonicator at maximum amplitude for 20 seconds, then centrifuged at 10,000g for 20 minutes to concentrate the antigen. The supernatant was retained and stored in 0.1ml aliquots at -20°C as stock antigen for use in the assays.

For preparation of antigen coated plates for assay, the stock antigen was diluted in carbonate-bicarbonate buffer pH 9.6 (Appendix 4) at approximately 1.0ug/ml (1/1000 dilution) protein. The dilution of the antigen for use in the assay was obtained using a checker board ELISA (Empirical test titration).

Each well of a polystyrene micro ELISA plate (NUNCLON^{R}) was filled with 100ug (100ul) of the antigen solution containing 1.0ug/ml protein. The coated plates with antigen were incubated overnight at 4^{o}C.

For the reaction of test sera with antigen coated plates, the antigen plates were washed three times for three minutes each with PBS containing 0.05% Tween 20 (Appendix 5) and dried by shaking onto an absorbent paper towel.

Each well of the antigen coated plate was then coated with 100ul of the serum samples to be tested. The optimum dilution of the test serum samples for use in the assay were obtained by checker board ELISA. The test serum samples were each diluted 1/1000 with PBS/Tween 20 and each sample was added to the plates in duplicate wells, with each well containing 100ul of the diluted serum sample. Positive and negative control sera were each diluted 1/1000 and included in duplicate wells in the assay. The plates were then incubated at 37^{o}C for 60 minutes.

For the application of enzyme conjugated anti-specie globulin and substrate to assay plates, the incubated plates with the serum samples were removed and washed with PBS/Tween 20 as above, dried before adding 100ul of the enzyme-conjugated anti-specie globulin (rabbit anti-bovine IgG horse raddish peroxidase (Nordic Immunologicals). The enzyme conjugate was diluted 1/1000 with PBS/Tween 20/0.1% BSA (Appendix 6). The dilution had earlier been obtained by checker board ELISA.

The plates were incubated at 37^{o}C for 60 minutes, then washed with PBS/Tween 20 as above, dried and the substrate chromagen 3, 3', 5, 5', Tetramethyl benzidine in citrate buffer pH 6.0 (Appendix 7) was added to each well in 100ul volumes, and incubated at 37^{o}C for 15 minutes.

The reaction mixture turned blue after incubation (Plate 7). The reaction was stopped by the addition of 50ul of 2M sulphuric acid to each well. Completed reaction showed a yellow coloration on addition of the acid solution (Plate 8). The more intense the colour the higher the antibody level. Wells with no colour change had no antibodies, indicating negative sera samples.

The degree of coloration was assessed by using a Uniskan II Micro ELISA plate reader (Dynatech) at a wave length of 450 nm.

Interpretation of Antibody ELISA Results

The antibody status of each serum sample was assessed on the basis of the optical density (OD) values of the negative control, positive control and test serum samples.

The assay parameters were optimized such that the negative control sera did not produce any colour change in the assays. All colour changes observed were therefore due to trypanosomal antibodies in the serum samples.

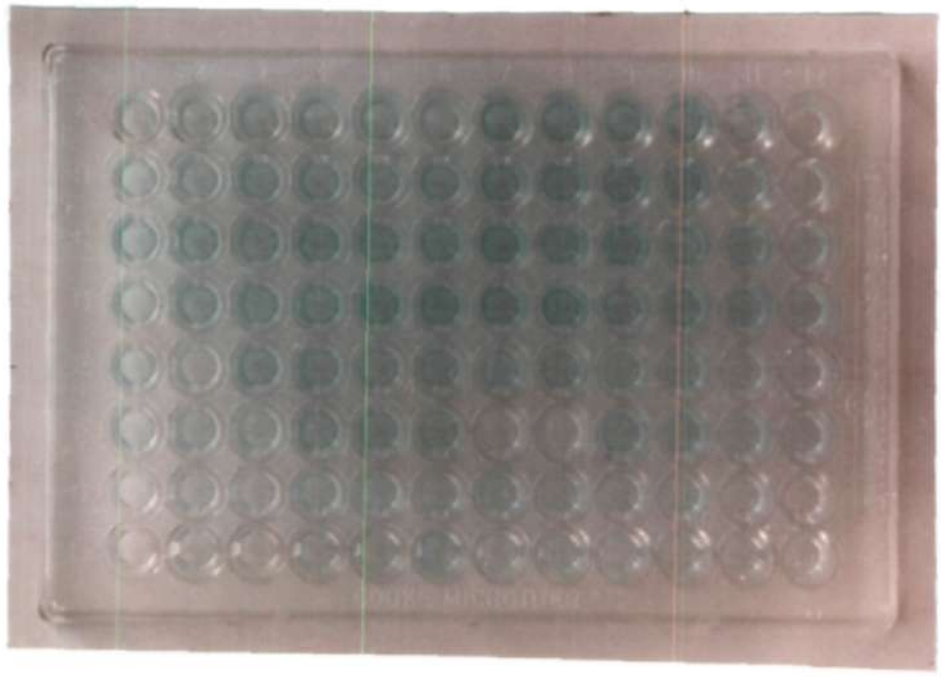


PLATE 7: ANTIBODY DETECTION ELISA FOLLOWING SUBSTRATE CHROMAGEN REACTION.

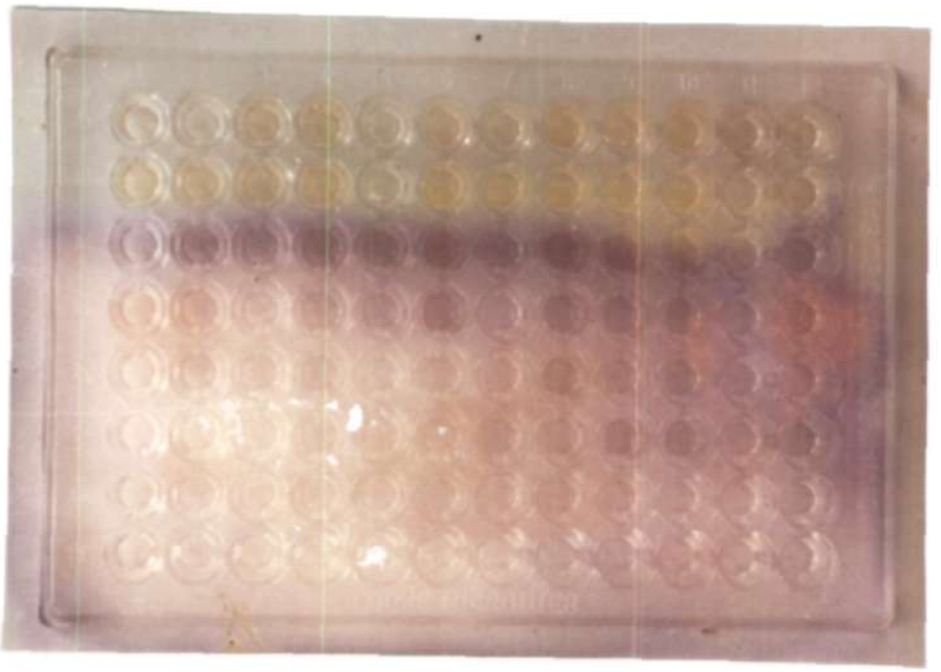


PLATE 8: ANTIBODY DETECTION ELISA AFTER STOPPING SUBSTRATE CHROMAGEN REACTION WITH 2M SULPHURIC ACID.

Day 0 and 42 pre- and post- infection sera were used in the assays as negative and positive control serum samples respectively.

Before the result of the assay was accepted, the binding ratio for the plate was calculated, which was the mean of the OD of the positive control serum over that of the negative control serum. The ratio must be greater than 6 before the result of the assay plate was accepted.

The negative and positive cut-off point for each assay plate was calculated based on the OD values of the negative (-ve) and positive (+ve) control serum samples.

Readings greater than the OD value of the positive control serum were taken as positive for the infection of the Trypanosoma sp under investigation. All wells showing no colour change were regarded as negative, while wells with slight colour change were also taken as negative.

The serum samples were each tested for antibodies against T. vivax, T. congolense and T. brucei using their respective antigens.

Hb concentrations were determined by the visual colour comparison method as described by Cheesbrough and M^{C} Arthur (1980). The test involved mixing of N/10 hydrochloric acid (HCL) with heparinized plasma which converted the Hb to a dark brown acid haematin solution which was then matched

against a coloured glass standard. From the standard, 100% was equivalent to 14.6gm/100ml of blood.

PCV was determined by the Microhaematocrit method as described by Cheesbrough and M^{C} Arthur (1980) during which the capillary tubes containing heparinized blood were centrifuged at 10,000 r.p.m. for five minutes using Hanskey$^{(R)}$ Microhaematocrit centrifuge and read on Hanskey$^{(R)}$ Microhaematocrit reader.

Total protein content of the serum was determined as described by King (1951). The test involved digestion of 0.2ml of serum with $^{N}/_{10}$ sulphuric acid (H_2 SO4) and addition of Nessler's reagent to develop a colour which was read on Spectronic 20.

Calcium and magnesium content of the serum were determined by subjecting 0.2ml of serum in duplicate to wet oxidation using strontium chloride solution (1: 50 dilution). The mineral content of the serum samples were read using Atomic absorption spectrophotometer model AA - 650, Schimadzu Corporation, Kyoto, Japan.

Phosphorus content of serum was determined in duplicate by subjecting 1ml of serum to wet oxidation using Trichloroacetic acid (TCA) at 1:5 dilution; and by addition of molybdovanadate solution to develop a yellow colour whose absorbance was measured at 430nm using Spectronic 20.

Statistical Analysis

The data obtained were subjected to a series of statistical procedures from simple frequency contigency table analysis to descriptive statistics computing means, standard errors and coefficient of variability.

The final part used generalised least square procedures which examined the various factors affecting some of the parameters measured. The factors included effects of L.G.A. where samples were collected, sex of animals, age of animals, season of the year when samples were collected, the prevalence of trypanosome organism in the animal as determined through parasitologic method and ELISA technique on the variables namely, rectal temperature of the animals, haemoglobin, packed cell volume, total protein, magnesium, calcium and phosphorus from serum of the animal.

The analysis were undertaken at the National Animal Production Research Institute (NAPRI), Zaria. The package used for the procedure was SAS (1988).

RESULTS

Prevalence of Trypanosomiasis

Out of a total of 247 Muturu cattle that were examined during the one year period, 22 of these representing 8.9% were positive for trypanosomiasis as detected by the parasitologic method of thick smears (Table 56). Prevalence was higher in the rainy season (14 positive or 5.7%) than in the dry season (8 positive or 3.2%). Gwer L.G.A. had the highest prevalence rate (19.6%) among the L.G.As. (Table 56).

Of the 8.9% positive cases detected by parasitologic technique, T. vivax accounted for 6.1% while T. brucei accounted for 2.8% whereas T. congolense was not detected by this method (Table 57). The parasitologic method of thin smears could not detect any positive case of trypanosomiasis.

The ELISA technique detected antibody in 165 or 66.8% of the Muturu cattle (Table 57). The assay was also specific in that it was capable of differentiating between the different Trypanosoma Species in cases of mixed infections. Also, all cases that were positive by parasitological examination were also positive by Antibody ELISA technique. Of the 66.8% positive cases, mixed infection of T. vivax and T. brucei and that of T. vivax, T. brucei and T. congolense each accounted for 19.0%. T. vivax and T. congolense mixed infection accounted for 15.8% while T. brucei and T. congolense mixed infection accounted for only 0.8%; and the balance were due to single infections of T. brucei (5.7%), T. vivax 5.3% and T. congolense (1.2%) (Table 57).

Tāble 56: Prevalence of Trypanosomiasis in Muturu Cattle in Benue State during the rainy season and dry season as detected by Parasitologic Technique.

S/No.	L.G.A.	No. of Animals Examined	No. of animals positive			No. not examined
			Rainy Season	Dry Season	Total	
1.	Gboko	67 (27.1)	0 (0)	2 (3.0)	2 (3.0)	
2.	Gwer	46 (18.6)	9 (19.6)	0 (0)	9 (19.6)	
3.	K/Ala	69 (27.9)	1 (1.4)	4 (5.8)	5 (7.2)	
4.	Kwande	33 (13.4)	2 (6.1)	2 (6.1)	2 (12.2)	
5.	Ushongo	32 (13.0)	2 (6.3)	0 (0)	2 (6.3)	
6.	All LGAs (1 to 5)	247 (100)	14 (5.7)	8 (3.2)	22 (8.9)	6 (2.4)

* Figures in parenthesis are percentages

Table 57: Prevalence of Trypansomes in 247 Muturu Cattle in Benue State as detected by Parasitologic and Antibody ELISA Techniques.

Species of Trypansome	PARASITOLOGY		ANTIBODY ELISA	
	No. Positive	% Positive	No. Positive	% Positive
T. vivax (T.v.)	15	6.1	13	5.3
T. brucei (T.b.)	7	2.8	14	5.7
T. Congolense (T.c.)	0	0	3	1.2
T.v + T.b	0	0	47	19.0
T.b + T.c	0	0	2	0.8
T.v + T.c	0	0	39	15.8
T.v + T.b + T.c	0	0	47	19.0
TOTAL	22	8.9	165	66.8

A comparison between the parasitologic and Antibody ELISA techniques for detection of trypanosomes therefore revealed that the Antibody ELISA technique was a more sensitive screening test than the parasitologic technique (Table 57).

The prevalence of other blood parasites in the cattle revealed that only 3 or 1.2% were positive for babesiosis; all from Gboko L.G.A. and during the rainy season (Table 58).

Effect of trypanosomiasis on rectal temperature and some blood variables

The results of the effect of trypanosomiasis on rectal temperature, serum Hb, PCV, total protein, Mg, Ca and P are presented in Table 59. The presence of trypanosome organism (as detected both by the parasitologic and ELISA techniques) revealed that with the exception of total protein, the rest of the variables appeared normal. Serum total protein, however, tended to be very low. Statistical analysis revealed that the organism had no significant effect ($P>0.05$) on rectal temperature, Hb, PCV, total protein, Mg, Ca and P levels in the blood (Table 62).

Table 58: Prevalence of Babesiosis in Muturu Cattle in Benue State during the Rainy Season and Dry Season as detected by Parasitologic Technique.

S/No.	L.G.A.	No. of Animals Examined	No. of animals positive			No. not examined
			Rainy Season	Dry Season	Total	
1.	Gboko	67 (27.1)	3 (4.5)	0	3 (4.5)	
2.	Gwer	46 (18.6)	0	0	0	
3.	K/Ala	69 (27.9)	0	0	0	
4.	Kwande	33 (13.4)	0	0	0	
5.	Ushongo	32 (13.0)	0	0	0	
6.	All LGAs (1 to 5)	247 (100)	3 (1.2)	0 (0)	3 (1.2)	6 (2.4)

* Figures in parenthesis are percentages

Table 59: Rectal temperature and some blood parameters in the serum of Muturu Cattle affected by Trypanosome organism in Benue State.

Factor	n	Rectal Temp. °c	Hb gm/100ml	PCV ml %	Total protein gm/100ml	Mg mg/100ml	Ca mg/100ml	P mg/100ml
Parasitology								
T. brucei (T.b.)	7	39.3±0.2	10.4±0.8	32.7±2.4	4.1±0.3	2.1±0.3	14.1±2.5	6.6±1.4
T. congolense(T.c.)	0	0	0	0	0	0	0	0
T. vivax (T.v.)	15	39.3±0.2	10.6±0.6	36.9±2.0	4.0±0.2	2.3±0.2	16.2±1.8	8.9±1.0
Nil (-ve)	225	39.2±0.1	11.0±0.3	35.6±1.0	3.9±0.1	2.7±0.1	15.1±0.8	9.4±0.4
ELISA								
T.b	14	39.3±0.2	11.2±0.6	34.5±1.8	3.7±0.2	2.4±0.3	14.6±1.9	9.6±1.3
T.c.	3	39.3±0.5	11.6±1.2	37.1±3.5	4.6±0.3	2.1±0.5	11.6±3.3	9.2±1.9
T.v.	13	39.1±0.2	10.2±0.6	33.7±1.9	4.0±0.2	2.2±0.3	15.0±2.0	10.0±1.2
T.b. + T.c.	2	39.3±0.4	10.1±1.5	39.3±4.2	4.2±0.4	2.4±0.6	17.8±4.1	13.5±2.3
T.b. + T.v.	47	39.2±0.1	10.9±0.4	34.5±1.3	3.9±0.1	2.2±0.2	13.6±1.4	9.2±1.0
T.c. + T.v.	39	39.3±0.1	11.7±0.5	36.6±1.4	4.0±0.1	2.2±0.2	11.9±1.5	8.7±1.1
T.b. + T.c. + T.v	47	39.3±0.1	10.9±0.4	35.3±1.2	4.0±0.1	2.3±0.2	14.0±1.4	10.2±1.0
Nil (-ve)	82	39.3±0.1	10.8±0.4	35.0±1.3	4.1±0.1	2.3±0.2	14.6±1.3	10.0±1.0

Means within a column without superscripts are not significantly different (P>.05).

Table 60: Rectal temperature and some blood parameters in the serum of Muturu Cattle affected by factors of L.G.A. and season in Benue State.

Factor	n	Rectal Temp. °c	Hb gm/100ml	PCV ml%	Total protein gm/100ml	Mg mg/100ml	Ca mg/100ml	P mg/100ml
L.G.A.								
Gboko	68	39.2±0.2	10.8±0.5	34.6±1.5	4.1±0.1	2.0±0.2[a]	15.0±1.5	9.5±1.1
Gwer	48	39.3±0.1	10.4±0.4	35.2±1.4	4.0±0.1	2.5±0.2[b]	12.8±1.3	9.8±1.(
Katsina-Ala	72	39.4±0.2	10.8±0.5	35.2±1.4	4.0±0.1	2.0±0.2[a]	14.6±1.4	10.6±1.(
Kwande	33	39.4±0.2	10.5±0.5	34.7±1.6	4.1±0.2	2.3±0.2[b]	13.8±1.6	11.2±1.
Ushongo	32	39.1±0.2	10.9±0.5	35.7±1.7	4.0±0.2	2.4±0.2[b]	14.5±1.6	9.2±1.
Season								
Rain	138	39.3±0.2	11.2±0.4[d]	36.7±1.3[d]	4.7±0.1[d]	2.3±0.2	15.8±1.3[d]	10.5±1.(
Dry	115	-	10.2±0.4[c]	33.5±1.4[c]	3.4±0.1[c]	2.2±0.2	12.5±1.3[c]	9.6±1.(

Means within a column with different letter superscripts are significantly different (P<.01, P<.001).

Table 61: Rectal temperatures and some blood parameters in the serum of Muturu Cattle affected by factors of sex and age of the Muturu in Benue State.

Factor	n	Rectal Temp °c	Hb gm/100ml	P C V ml %	Total Protein gm/100ml	Mg mg/100ml	Ca mg/100ml	P mg/100ml
Sex								
Male	68	39.3±0.1	10.8±0.4	35.3±1.4	3.7±0.1[a]	2.2±0.2	14.2±1.4	10.1±1.0
Female	185	39.2±0.1	10.5±0.4	34.9±1.3	4.4±0.1[b]	2.3±0.2	14.1±1.3	10.0±0.9
Age								
< 2yrs	70	39.2±0.1	10.6±0.5	35.1±1.4	4.1±0.1	2.1±0.2	13.3±1.4	10.6±1.0
2 - 4yrs	99	39.2±0.1	10.6±0.4	35.5±1.3	4.2±0.1	2.2±0.2	13.8±1.3	10.0±1.0
4 - 6yrs	58	39.4+0.1	10.5±0.5	36.4±1.4	4.0±0.1	2.1±0.2	14.4±1.4	9.7±1.0
> 6yrs	26	39.2±0.2	11.0±0.6	33.4±1.8	4.0±0.2	2.6±0.2	15.1±1.8	9.9±1.2

Means within a column with different letter superscripts are significantly different ($P < .001$)

Table 62: Summary of statistical analysis of the effects of LGA, sex, age, season, parasitological method and ELISA on rectal temperature and some blood parameters in the serum of Muturu Cattle in Benue State.

		Rectal Temp.		Hb		P C V		Total Protein		Mg		Ca		P	
Factor	d.f.	MS	F value	MS	F value	MS	F value	MS	F value	MS	F value	MS	F value	MS	F value
L G A	4	0.28	1.20	2.16	0.56	7.68	0.24	0.17	0.60	2.07	3.71^{xx}	39.44	1.42	16.62	1.88
Sex	1	0.32	1.39	3.87	1.00	7.93	0.25	18.99	66.84^{xxx}	0.43	0.73	0.32	0.01	0.61	0.07
Age	3	0.38	1.66	1.58	0.41	47.17	1.48	0.41	1.48	1.31	2.35	19.91	0.71	5.66	0.66
Season	1	–	–	60.20	15.61^{xxx}	474.42	14.913^{xxx}	80.11	282.02^{xxx}	1.05	1.80	528.44	19.09^{xxx}	20.57	2.33
Parasitol method	2	0.02	0.09	1.83	0.47	33.14	1.04	0.10	0.34	1.30	2.33	18.70	0.67	21.23	2.46
ELISA	7	0.06	0.24	5.70	1.48	24.10	0.76	0.41	1.44	0.16	0.28	29.23	1.06	7.41	0.84

xx Highly significant ($P<0.01$)

xxx Very highly significant ($P<0.001$)

Effect of L.G.A. and season on the rectal temperature and some blood variables.

Serum Mg levels in Muturu cattle from Gwer, Kwande and Ushongo L.G.As. were significantly ($P<0.01$) higher than those from Gboko and Katsina-Ala LGAs (Tables 60 and 62). There was however no significant ($P>0.05$) effect of L.G.A. on rectal temperature, Hb, PCV, total protein, Mg, Ca and P. Serum Hb, PCV, total protein and Ca were significantly ($P<.001$) higher in the rainy season than in the dry season (Tables 60 and 62). There was however, no significant ($P>.05$) effect of season on serum Mg and P in these animals.

Serum total protein levels were low while the rest of the variables appeared normal (Table 60).

Effect of sex and age on rectal temperature and some blood variables.

Serum total protein in female animals were significatnly ($P<.001$) higher than in male animals. There was no significant ($P>.05$) age effect on rectal temperature, Hb, PCV, total protein, Mg, Ca and P (Tables 61 and 62). All these variables appeared normal except serum total protein which was low.

Correlation.

The correlation between the variables for male and female animals is presented in Table 63.

Table 63: Table of correlation between parameters (upper diagonal for females, lower for males)

MALES \ FEMALES	TP	Mg	Ca	P	RT	Hb	PCV
TP	1·00 n=63 n=152	0·011 n=113	0·127 n=129	0·084 n=109	0·098 n=81	0·244 ** n=149	0·413 *** n=143
Mg	0·153 n=60	1·00 n=65 n=165	0·295 *** n=140	0·315 ** n=120	0·158 n=96	0·118 n=162	-0·153 n=153
Ca	0·392 n=49	0·065 n=52	1·00 n=53 n=152	0·210 * n=109	0·243 * n=87	0·131 n=153	-0·135 n=144
P	0·162 n=46	0·205 n=50	0·225 n=41	1·00 n=51 n=127	-0·031 n=70	-0·059 n=125	0·056 n=118
RT	-0·226 n=32	0·009 n=35	0·080 n=25	0·092 n=29	1·00 n=35 n=103	0·175 n=103	-0·402 *** n=94
Hb	0·295 * n=60	0·095 n=64	0·198 n=52	-0·102 n=51	0·012 n=35	1·00 n=65 n=180	-0·018 n=168
PCV	0·232 n=58	-0·020 n=62	-0·143 n=51	-0·241 n=49	-0·322 n=34	0·021 n=63	1·00 n=63 n=170

* = P < ·05 *** = P < ·001

** = P < ·01 n = No. of Observations.

In the male animals, only Hb and total protein were correlated (r = . 295) and this was significant (P<.05). In the female animals, Hb was also positively correlated with total protein (r = .244) and this was significant (P<.01). Similarly, PCV was positively correlated with total protein (r=.413) and this was highly significant (P<.001). PCV was however negatively correlated with rectal temperature (r= -.402) and this was highly significant (P<.001).

Other positive correlations in the females included serum P and Mg (r=.315, P<0.01), Ca and Mg (r=.295, P< 0.001), P and Ca (r=.210, P< 0.05) and rectal temperature and Ca (r=.243, P< 0.05).

DISCUSSION

The prevalence of trypanosomiasis in Muturu cattle in Benue State as determined by parasitological method was generally low (8.9%) especially for an area that the disease is considered endemic and more so when compared to the much higher rates reported in the first half of the century (Onyiah, 1993). The fairly high prevalence rate (19.6%) in Gwer L.G.A. as determined by parasitological method is probably due to the fact that there is in this L.G.A. a very large wildlife park called "Ikwe Wildlife Park" with several wild animals which could serve as reservoir for the trypanosome organism.

The methods presently employed for field diagnosis of bovine trypanosomiasis which includes clinical signs and parasitological techniques are inadequate. Serological techniques are therefore the best alternatives. Luckins (1977); Luckins and Mehlitz (1978) and Luckins et al (1979) have used Antibody ELISA for serodiagnosis of bovine and camel trypanosomiasis.

The Antibody ELISA as used in this study detected 66.8% cattle to be positive for trypanosome antibodies. Luckins et al, 1978; 1979 and Nantulya et al, 1984; 1986 all reported that antibody levels do not decline to basal levels but may persist for several months after treatment or self cure. Therefore the mere detection of antibodies in an animal may not indicate a current infection. However in this study,

positive control sera were included in all the assay. These sera were from animals known to be carrying current infection. All animals with antibody levels higher than the positive control sera samples were therefore regarded as positive and considered to be carrying current infections. Consequently, 66.8% Muturu cattle were considered currently infected with trypanosomiasis.

The present study confirms the Antibody ELISA to be highly sensitive (66.8%) than conventional parasitological techniques (8.9%) and can be used for field diagnosis of bovine trypanosomiasis.

The Antibody ELISA is therefore viewed as a suitable technique for epidemiological survey of trypanosomiasis in developing countries like Nigeria, because it is cheaper and easy to develop than the Antigen ELISA. It is also very sensitive and significantly specific. The reagents for the Antibody ELISA are also easily acquired than the Antigen ELISA. However, for planned control measures against bovine trypanosomiasis, the use of Antibody ELISA for preliminary assessment of the extent of the problem is recommended while the Antigen ELISA which directly picks up current infection be used for confirmation of cases and evaluation of the success of control/eradication programmes that may be employed. It is to be noted however that Antigen ELISA technique was not available to me.

The extremely low level of other blood parasites (1.2% babesiosis) confirms earlier findings that the breed is resistant to tickborne diseases (Epstein, 1971; Ilemobade, 1984).

The presence of trypanosome organism did not have any significant effect on rectal temperature, Hb, PCV, total protein, Mg, Ca and P. These variables (except total protein) were within the normal limit for other tropical breeds of cattle (Oduye and Okunaiya, 1971; Saror and Coles, 1973; Mitruka and Rawnsley, 1977 and Oyedipe et al., 1984).

Trypanotolerance is measured by at least three main characteristics (Murray, 1987). These are the animals' ability to control parasitaemia, its ability to develop an effective immune response, and the ability to resist anaemia. Anaemia is a well recognized and inevitable consequence of trypanosome infections in domestic animals (Stewart, 1951; Murray, 1974; Morrison et al., 1981; Murray and Dexter, 1988). Following on this knowledge, it has been established that the measurement of anaemia gives a reliable indication of the disease status (Murray, 1979; Trail et al., 1991) and productive performance (ILRAD, 1986; ILCA/ILRAD, 1986a,b) of tryponosome infected cattle. Thus the ability of these cattle to resist anaemia by maintaining normal levels of PCV coupled with the low parasitaemia confirms the trypanotolerant nature of these animals.

The critical PCV has been estimated at 15% and infected animals with values at or below this level have to be treated

with trypanocidal drugs to prevent death (Murray at al., 1990).

With regards to the regulation of parasitaemia, Murray (1987) observed different patterns with different strains of trypanosomes. Trypanosoma brucei is controlled by the animal's ability to regulate parasite growth, followed by induction of the immune response. In T. vivax infections, the ability to mount an immune response is the important path of control. In the N'dama, Paling et al, (1987) found no relationships between control of parasitaemia and anaemia although both controls were observed (Murray and Dexter, 1988) during infection. The Muturu possesses all three, mechanisms of control listed above (Stewart, 1951; Murray et al., 1990).

The serum total protein values obtained in this study (3.4±0.1 - 4.7±0.1) were lower than the normal values of (5.7±0.7 - 8.60±0.6) reported for tropical breeds of cattle (Mitriuka and Rawnsley, 1977; Oyedipe et al., 1984; Rekwot et al., 1989). This low value may be due to the low crude protein of the grasses and crop residues (Tables 64 - 67) which were the main feed resources of these animals under the traditional village management system. This finding is in agreement with that of Oyedipe et al., (1984) who showed that a reduction in the protein level of the feed resulted in reduced Hb, PCV and serum protein values of zebu heifers. In this study however, Hb, and PCV level were not reduced probably due to haemoconcentration when animals were under range condition.

Muturu cattle from Gwer, Kwande and Ushongo L.G.As. had significantly higher serum Mg level than their counterparts from Gboko and Katsina-Ala L.G.As. The resason for these differences is not clear. Although the Mg content of grasses from Gwer and Kwande LGAs appeared generally higher than those from Gboko and Katsina-Ala LGAs (Table 64), these differences were not statistically significant (Table 65).

The significantly higher serum Hb and PCV values in the rainy season than the dry season may probably be due to higher crude protein levels in the grasses consumed during the rainy season than the dry season (Table 64). This confirms earlier observations in zebu cattle that level of protein intake was closely associated with serum PCV and Hb (Oyedipe et al., 1984). In the White Fulani and its crosses with Friesians however, Saror and Coles (1973) did not find any significant differences in serum PCV and Hb between wet and dry seasons.

The significantly higher serum total protein in the rainy season than the dry season may again be due to higher crude protein in the natural grasses consumed by the cattle in the rainy season (Table 64). These increases are almost certainly due to improved protein status resulting from an increase in the availability of nutrients in the pasture for the synthesis of protein during the rainy season as earlier observed in zebu cattle in Australia by Uza and Murray (1985a).

The seasonal variations in serum Ca levels is rather surprising as Ca content in the natural grasses consumed by the Muturu cattle were consistently lower in the rainy season than the dry season (Table 64).

The significantly higher serum total protein level in the female than their male counterparts may be due to the efficient homeostatic mechanisms in the female to cope with the demands of pregnancy and lactation. It may also have been due to the much higher number of females than males used in the study (185 females and 68 males).

Age did not have any effect on the variables measured in this study. In tropical Australia however, Uza and Murray (1985b) reported highest values of blood urea -N in 4 - 7 months zebu calves on range during the pre-weaning period and considered this as an age effect as the young weaners developed to the functional ruminant state and thus more efficient in utilizing dietary nitrogen for the production of plasma protein.

Of the 247 Muturu cattle involved in the study, only very few (26) that were above 6 years of age, could be regarded as old animals (Table 61). In other words, the farmers kept mainly animals of productive age group (i.e less than 6 years). This is an indication that the farmers culled and sold old animals leaving the young and productive ones whose productivity could be more readily improved through improved management.

The table of correlations revealed that correlations between variables were much higher in the females than males. In the males, only Hb was positively correlated to total protein. The higher correlation in the female animals than their male counterpart may probably be due to the fact that many more females (185) than males (68) were used in the study. Furthermore, these differences may have been due to the complex physiological processes in the female in an attempt to meet demands arising from pregnancy, formation of skeleton of the foetus and lactation which are absent in the male animals.

The significantly ($P<.05$) positive correlation between Hb and total protein in the male and female ($P<.01$) and between PCV and total protein in the female tend to confirm that level of protein intake was closely associated with PCV and Hb (Saror, 1975; Oyedipe et al., 1984). In this study, serum total protein was low possibly reflecting the low protein intake from low crude protein contents of the grasses and crop residues (Tables 64 - 67). Even though the PCV and Hb levels in the serum in this study appeared to be within the normal limit for other tropical breeds, these (PCV of 35.5% and Hb of 10.6gm/100ml) appeared lower than mean serum PCV values of 37.9±3.6% and mean serum Hb values of 12.5±1.8 gm/100ml for trypanotolerant N'dama cattle (Oduye and Okunaiya, 1971). It is reasonable to infer that the lower PCV values in this study may have been due to the low protein intake. Oyedipe et al., (1984) had observed high correlations between average daily gain and PCV, Hb and total protein for zebu cattle under low protein intake and concluded that PCV and Hb may be

used as indirect indices of liveweight gain under conditions of prolonged low protein intake. A significant ($P<.001$) negative correlation ($r= - 0.402$) was established between PCV and rectal temperature. In trypanosusceptible animals this was expected since infection with trypanosome organism is usually manifested in increased rectal temperature and decreased PCV due to anaemia. In this study however, though the Muturu demonstrated the ability to resist anaemia, PCV values were generally lower in those animals with current infection of T. brucei as detected through parasitologic techniques than those that were negative for trypanosomiasis (Table 59). Similarly, slightly higher rectal temperatures were observed in Muturu cattle with current trypanosomiasis infection than those without.

The significantly positive correlations between Ca, P and Mg in the female cattle in this study confirms the interrelations involving these macro-minerals.

There is a long - held view that the ratio of Ca to P in the diet is of importance in the proper utilization of these two elements. While a wide Ca:P ratio is deleterious when the diet is deficient in P, "it is not possible to state the optimal ratio of Ca:P for animal performance or whether such a ratio exists" (ARC 1980).

CONCLUSION

The use of Antibody ELISA technique showed a higher prevalence rate of trypanosomiasis infection in Muturu cattle (66.8%) as against only 8.9% prevalence rate determined through parasitological method. The Antibody ELISA not only discriminated between infected and non-infected cattle but differentiated between different Trypanosoma Species in cases of mixed infections. For this reason, the Antibody ELISA was considered a suitable and more sensitive epidemiological tool for screening bovine trypanosomiasis in Nigeria than the conventional parasitological techniques.

The presence of trypanosome organism did not have any effect on the rectal temperature, Hb, PCV, total protein, Mg, Ca and P levels of the Muturu cattle. This confirmed the trypanotolerant nature of these animals.

The near absence of other blood parasites in the Muturu as reported in this study indicate that the breed is resistant to tickborne diseases. This implies that raising the Muturu could be less expensive in terms of investment in tick control measures.

The low serum total protein observed in this study was a reflection of low protein intake from the poor quality native grasses and crop residues grazed by the Muturu. One of the ways of improving the productivity of the breed under traditional village management systems therefore could be to

adopt supplementary feeding practices, a useful feeding strategy which has not been adopted by Muturu cattle rearers in Benue State.

EXPERIMENT 4: THE NUTRITIONAL VALUE OF NATURAL PASTURES GRAZED AND CROP RESIDUES FED TO MUTURU CATTLE UNDER TRADITIONAL VILLAGE MANAGEMENT SYSTEM IN THE SOUTHERN GUINEA SAVANNA OF BENUE STATE, NIGERIA.

INTRODUCTION

Results from Experiments 1 and 2 revealed that under the traditional systems of management, semi-intensive system was the most popular. The results further revealed that natural pastures and crop residues provided the principal feed resources for the cattle. Results from Experiment 3 however revealed that these feed resources supported low levels of serum total protein both during the rainy and dry seasons. It was earlier observed that supplementary feeding with concentrates was rarely practiced as the Muturu farmers were ignorant of this feeding strategy.

Since grazing of natural pastures and feeding of crop residues constituted the main feeding regimen of Muturu cattle under the traditional village management system, it was considered important to determine the nutritive value of these feedstuffs in order to assess their contribution to the general performance of Muturu cattle particularly during the nutritional stress period of the dry season.

The nutritional value of savanna grasses, browses and crop residues have been reported (Kapu, 1975; de Leeuw, 1977; Alhassan, 1985 and Umunna and Agishi 1988). However, these

works have been confined to the drier Sahel, Sudan and Northern guinea savanna where the dry season ranges from 5 - 8 months and rainfall range from 500 - 1250mm (Ray and de Leeuw, 1974). In these ecological zones, the grasses are low in crude protein, 1.5 to 2.5% and deficient in P, potassium (K), Ca, Mg and sodium (Na) (Kapu, 1975; Umunna and Agishi, 1988). Crude protein contents and the contents of P, K, Ca, Mg and Ca of browse plants were above maintenance requirements of ruminants (Umunna and Agishi, 1988). Cereal crop residues of maize, millet and sorghum constituted the major feed resource during the dry season in these ecological zones but are often low in crude protein 1.6 - 5.4% and high in ligno - cellulosic compounds (Alhassan, 1985).

Since Benue State is located in the southern guinea savanna which has heavier rainfall (above 1250mm) during 8 months of the year, it was thought necessary to determine the quality of the grasses and crop residues grazed by the Muturu cattle.

The objectives of this study therefore were to:

(a) Identify natural pasture species and crop residues commonly used by Muturu cattle as a feed resource in the study area.

(b) Assess the nutritive value of the natural pastures and crop residues by determination of their chemical composition and establishment of their sufficiency or insufficiency in protein, and minerals in meeting requirements.

MATERIALS AND METHODS.

The Environment

Forage and crop residues commonly grazed by Muturu cattle were collected from Gboko, Gwer, Katsina Ala, Kwande and Ushongo L.G.As. (Fig. 4).

The study area lies between latitude 6.8^{o} - 8.3^{o}N and longitude 8.2^{o} - 9.8^{o}E. Annual rainfall range is from 1105 - 1600mm spread over a period of 160 days (Emirate Technical Services, 1977; PME Annual Report, 1993). Its distribution is usually bimodial with an initial peak in June/July, and a slight trough in August rising again to a main peak in September. A four month dry season is usually experienced, from about mid November to mid March. Temperature and humidity vary according to the changes in the prevailing winds. Temperatures range between 21 - 32^{o}C. Relative humidity ranges from 70 - 90% during the rainy season and 30 - 40% during the dry season. Dry season temperatures are reduced by the prolonged presence of the dry dusty harmattan winds from the north east which sharply reduces relative humidity. The hot season comes mid - February and lasts until mid - April with temperatures of 32^{o}C - 38^{o}C and high humidity.

The main soil patterns are sandstones, shales, basement complex, iron pans and alluvium and are characterized by well drained deep soils to sandy soils that exhibit poor drainage and mottling (AADP, 1981). Other characteristics include very coarse, fine angular gravel, complicated iron pans and

very high fertile alluvium soils. Massive laterite and laterite gravel occurs extensively throughout the state, generally on crests and ridges, where the sweeter grasses over shale are favoured by cattle (AADP, 1981). According to AADP (1981) assessment, Benue State soils are nutritionally very poor, due to leaching and are of low classification and deficient in phosphorus. Fertility has to be built up by allowing long bush fallows and re-afforestation, which allows deep rooted plants to bring up minerals from the "weathering rock" stratum to the surface area, where burning of bush releases them. The leaf fall and roots produced add the much needed organic material to the top soil. The use of chemical fertilizers has improved soil fertility and crop yield even though their supply is very erratic. Benue State soils are also prone to erosion especially around Katsina Ala L.G.A.

The vegetation is influenced by the underlying soils of the area; there is the long established local agricultural systems of shifting cultivation with bush fallow and the seasonal pattern of rainfall. True forests only exist in the Forest Reserve, while other areas are classified as Tree Savanna, Shrub Savanna, Derived Savanna, Palm Forest and some minor components (AADP, 1981). Tree savanna and Shrub savanna are the predominant natural vegetation cover. Tree savanna dominants (which are well known economic farm trees) are:

Daniellia oliveri

Khaya senegalensis

Prosopis africana

Butyrospermum paradorum

Shrub savanna covers extensive areas in the central plains of Tiv land with fewer trees, and some shrubs and grass dominant, especially Andropogan sp, Hyparrhenia sp, Schizachyrium sanguineum, Rottboellia sp. and Beckeropsis uniseta (Emirate Technical Services, 1977; AADP, 1981). Bush burning during the dry season months of November - January is a characteristic feature of the study area.

Forage Sampling

After blood sampling of Muturu cattle as described in the previous study, herders who looked after the animals were taken out to the rangeland to identify the forages usually grazed by Muturu. The forage samples were collected during the dry season months of January and March 1992 and during the rainy season months of May and July 1992. A representative sample of each forage type was collected according to the sampling procedures described by Jones et al. (1971). All samples were washed several times with water to avoid any contamination from accumulated dust and soil particles. The forage samples which were leafy materials were air dried under the shade, packed in polythene bags and stored in the refrigerator (to prevent undue loss of moisture) until they were analysed. Also, small quantities of the forage samples were brought to the International Livestock Centre for Africa (ILCA), Kaduna for identification.

Crop residues commonly fed to Muturu cattle were randomly collected during the dry season for nutritive component

analysis. These consisted of yam peels, cassava peels, sorghum stover, maize stover and rice straw.

Analytical Methods

Forage and crop residue samples were oven dried at 100^{oC} for 24 hours and ground to pass through 2mm sieve. 0.5 - 1.0gm of samples were weighed separately for analysis. The forage samples were analysed for DM, Ash and CP using A.O.A.C. (1979) procedure while NDF and ADF analysis were by the method of Goering and Van Soest (1970).

Calcium and magnesium contents were determined by subjecting samples in duplicate to wet oxidation with a mixture of nitric, perchloric and sulphuric acid and read at wave - lengths of 4227 A^{o} and 2852 A^{o} for calcium and magnesium respectively using Atomic Absorption Spectrophotometer model AA - 650, Schimadzu Corporation, Kyoto, Japan.

Phosphorus content was determined in duplicate by wet digestion with nitric, perchloric and sulphuric acids and the acid solution was treated with molybdovanadate reagent to develop a yellow solution whose absorbance was measured at 430nm using Spectronic 20.

The nitrogen content was determined in duplicate by the Macro-Kjeldahl method.

Statistical Analysis

Chemical composition data on 7 species/varieties of grass from 5 LGAs namely; Gboko, Gwer, Katsina-Ala, Kwande and Ushongo collected over two seasons (dry: January/March and Wet: May/July 1992) were analysed by least-squares analysis of variance procedure (Harvey, 1990) which fitted LGA, season and LGA by season interaction as fixed effects.

Data on various types of crop residues (yam and cassava peels, maize and sorghum stovers and rice straw) offered during the dry season (January/March) were similarly analysed by fitting type of residue as a fixed effect.

Contrasts were made among predetermined comparison of means by the use of the "t" test.

RESULTS.

Chemical composition of grasses

Grass species grazed by Muturu cattle during the dry and wet seasons and their chemical composition are shown in Table 64. During both seasons, Andropogon spp appeared to be the most common native grass; other grasses included Imperata cylindrica, Hyparrhenia sp, Panicum sp and Pennisetum pedicellatum.

Chemical composition values did not differ among the LGAs. Only the DM, Ash and Ca were significantly influenced by season (Table 65). DM of grasses consumed during the dry season was significantly ($P< 0.001$) higher (96.3 $\pm$ 1.18%) than those consumed in the wet season (30.2 $\pm$ 1.40%) (Table 64). Ash content in the wet season (25.2 $\pm$ 2.36%) was higher ($P< 0.01$) than those in the dry season (7.9 $\pm$ 2.00%). The Ca content of grasses consumed in the dry season (0.69 $\pm$ 0.053%) was significantly ($P< 0.01$) higher than that found in the grasses consumed in the wet season (0.34 $\pm$ 0.063%).

Chemical composition of crop residues

The chemical composition of crop residues consumed by Muturu cattle during the dry season is shown in Table 66. Statistical analysis as shown in Table 67 revealed that the DM, CP and Ca contents of the residues were not statistically different ($P> 0.05$). On the other hand NDF, ADF and P differed significantly ($P< 0.01$) among the various residues.

Table 64: Chemical composition of grasses grazed by Muturu cattle during the dry and wet seasons.

LGA	Season	Specie	DM (%)	Ash (%DM)	NDF (%DM)	ADF (%DM)	CP (%DM)	Mg %	Ca %	P %
GBOKO	Dry	Andropogon gayanus Andropogon tectorum	96.5±2.65	10.5±4.47	71.3±9.39	47.3±6.72	4.1±0.96	0.1±0.07	0.7±0.11	0.03±0.011
	Wet	Andropogon ascinadis Hyparrhenia bagirmica	29.9±2.65	18.3±4.47	62,2±9.39	41.2±6.72	5.1±0.96	0.13±0.07	0.3±0.12	0.04±0.011
GWER	Dry	Pennisetum pedicellata Andropogon tectorum	96.8±2.65	5.8±4.47	75.1±9.39	48.9±6.72	3.4±0.96	0.1±0.07	0.7±0.12	0.05±0.011
	Wet	Andropogon tectorum	25.6±3.75	19.3±6.32	94.1±13.29	41.5±9.49	4.3±1.36	0.1±0.10	0.4±0.17	0.05±0.016
KATSINA-ALA	Dry	Andropogon gayanus Imperata cylindrica	96.2±2.65	6.8±4.47	72.5±9.39	42.1±6.72	3.5±0.96	0.2±0.07	0.8±0.12	0.04±0.011
	Wet	Andropogon tectorum Hyparrhenia sp.	29.6±2.65	27.9±4.47	62.6±9.39	45.5±6.72	5.9±0.96	0.1±0.07	0.2±0.12	0.06±0.011
KWANDE	Dry	Andropogon tectorum Andropogon tectorum	95.8±2.65	7.8±4.47	69.5±9.39	44.7±6.72	4.2±0.96	0.2±0.07	0.4±0.12	0.03±0.011
	Wet	Andropogon gayanus Imperata cylindrica	30.7±2.65	25.9±4.47	64.4±9.39	44.7±6.72	4.5±0.96	0.30±0.07	0.2±0.12	0.03±0.011
USHONGO	Dry	Andropogon gayanus Imperata cylindrica	96.4±2.65	8.5±4.47	70.9±9.39	47.2±6.72	3.5±0.96	0.13±0.07	0.9±0.12	0.04±0.011
	Wet	Panicum sp. Andropogon tectorum	35.7±3.74	34.4±6.32	60.8±13.29	27.3±9.49	5.2±1.35	0.05±0.10	0.6±0.17	0.03±0.016
OVERALL MEAN	Dry		96.3±1.18	7.9±2.00	71.9±9.39	46.0±6.72	3.7±0.96	0.1±0.07	0.69±0.053	0.03±0.01
	Wet		30.2±1.40	25.2±2.36	68.8±10.95	40.0±7.83	5.0±1.12	0.1±0.08	0.34±0.063	0.04±0.01

Table 65: Analysis of variance for chemical composition value of grasses grazed by Muturu cattle.

Source of Variation	df	Mean Squares DM (%)	Ash (%DM)	NDF (%DM)	ADF (%DM)	CP (%DM)	Mg %	Ca %	P %
Location	4	8.2	31.9	179.2	29.9	0.32	0.111	0.087	0.0002
Season	1	18172.0***	1248.5***	38.5	149.5	6.5	0.001	0.543**	0.0003
Location X Season	4	9.5	41.0	109.7	62.1	0.65	0.007	0.032	0.0001
Residual Error	1	14.0	39.9	176.5	90.2	1.84	0.011	0.028	0.0003

*** = $P < 0.001$

** = $P < 0.01$

Table 66: **Chemical composition of crop residue consumed by Muturu cattle during the dry season.**

Type	Chemical Composition							
	DM (%)	Ash (%DM)	NDF (%DM)	ADF (%DM)	CP (%DM)	Mg %	Ca %	P %
Yam Peels	96.5±0.71	5.4±1.46	81.6±3.98	12.2±4.74	6.3±0.8	0.10±0.016	0.6±0.151	0.03±0.024
Cassava Peels	95.7±0.71	5.3±1.46	30.0±3.98	17.2±4.74	4.8±0.8	0.08±0.016	0.7±0.151	0.40±0.024
Sorghum Stover	96.9±0.71	6.5±1.46	71.7±3.98	45.7±4.74	4.7±0.8	0.15±0.016	0.8±0.151	0.25±0.024
Maize Stover	95.9±0.71	5.7±1.46	67.6±3.98	41.8±4.74	5.3±0.8	0.13±0.016	0.60±0.151	0.05±0.024
Rice Straw	97.4±0.71	15.2±1.46	70.2±3.98	43.5±4.74	2.8±0.8	0.10±0.016	0.67±0.151	0.03±0.024
Overall Mean	96.5±0.31	7.6±0.65	64.2±1.78	32.0±2.09	4.7±0.3	0.10±0.010	0.61±0.067	0.08±0.011

Table 67: Analysis of variance for chemical composition values of crop residues consumed by Muturu cattle.

Sources of Variation	df	Mean Squares DM (%)	Ash (%DM)	NDF (%DM)	ADF (%DM)	CP (%DM)	Mg %	Ca %	P %
Crop Residue	4	1.03	36.1*	788.9**	515.4**	3.10	.0031*	0.012	0.018**
Residual Error	5	1.02	4.2	31.8	44.8	1.32	.0005	0.045	0.001

** = $P < 0.01$

* = $P < 0.05$

Similarly, Ash and Mg contents differed (P< 0.05) among the various crop residues. NDF of yam peels (81.6 ± 3.98%) (Table 66) differed signficantly (P< 0.001) from those of cassava (30.0 ± 3.98%). The P content of sorghum stover (0.25 ± 0.024%) was significantly (P< 0.05) higher than that of maize stover (0.05 ± 0.024%). Similarly, the P and Mg contents of sorghum stover was singificantly (P< 0.01) higher than that for rice straw. Ash contents of rice straw was significantly (P< 0.001) higher than that of maize stover while Mg contents of maize stover was significantly (P< 0.05) higher than the corresponding value for rice straw. When the tuber peels were compared with the cereal stovers/straw, the NDF, ADF and Ash contents were all significantly (P< 0.05) higher for the stovers than the peels.

DISCUSSION

The grass species sampled in this study were those the farmers perceived as the commonest forages grazed by the Muturu. According to these farmers, "Muturu cattle grazed only grasses while goats browsed". The native grasses were highly fibrous, low in protein and deficient in P and Mg during the wet and dry seasons (Table 64). Mean CP levels of 4.4% DM were below the recommended A.R.C. (1965) value of 8% for cattle maintenance. Similarly, mean P and Mg levels of 0.04 and 0.1% were far below the estimated maintenance needs of 0.12% and 0.20% for P and Mg respectively for tropical breeds of cattle (Boudet, 1975). These factors lend to their poor utilization (low intake and digestibility) by livestock (Adu and Adamu, 1982; Minson, 1982; Said and Wanyoike, 1987). Hakkila et al (1987) attributed reduced forage intake to high fibre content. As grasses matured, organic matter digestibility and nitrogen content reduced while neutral detergent fibre (NDF) concentration increased (Klopfenstein et al 1987). The changes have been shown (Van Soest, 1982; Umunna and Iji, 1993) to have negative effect on forage intake and productivity. The utilization of the energy components of such forages by ruminants is also dependent on the efficiency of fermentative activity of the rumen (Mehrez et al, 1977) which depends in turn on adequate supplies of nitrogen in the rumen.

There is however considerable scope for increasing animal productivity from these native pastures through management. These options include manipulation of stocking rates,

controlled burning, introduction of legumes and grasses by oversowing, pasture renovation and reseeding with grasses and legumes and establishment of fodder (protein) banks and strategic supplementation. The use of adapted legumes to improve the quality and quantity of forage from tropical pastures has been demonstrated in many environments. For example, introduction of legumes to native pasture has substantially increased animal production without any fertilizer input (Clatworthy and Holland, 1979; Shaw and Mannetze, 1970). The increase in animal production is not only due to higher body weight gain but is also due to higher carrying capacity. Beef production of between 260kg and 500kg liveweight per hectare per year has been obtained from sown tropical grass/legume pastures (Mannetze, 1984). The increase in animal production from including legumes in tropical grasses is attributed to increased dry matter and nitrogen production of associated grasses due to high soil nitrogen, increased nitrogen content of the herbage grazed by the animals as well as higher mineral content in legumes than grasses.

Results of surveys undertaken in the first experiment revealed that the biggest problem facing Muturu cattle farmers in Benue State was lack of adequate supply of feed and water (Table 29). To compound the problem, the majority of Muturu cattle farmers had no fixed time that they provided water to their animals (Table 12). In effect these farmers were pre-occupied with crop farming which is their major farming activity and tended to provide water to their animals only after their cropping activities. The water requirements

of ruminant animals are met from three sources namely, water consumed voluntarily, water contained in feed and water formed within the animal's body as a result of metabolic oxidation (metabolic water),_(Wilson, 1961). The findings in this study that the natural grasses had high water content during the rainy season (average DM content of 29.7%) means that part of the animal's water requirement may be met from these grasses. However, during the dry season, both grasses and crop residues were extremely dry (96.4 and 96.5% DM respectively); the animals would need substantial amount of water consumed voluntarily. Since these farmers have no fixed time of giving water to the animals, it would appear that the Muturu cattle were partially deprived of water and the consequences of this deprivation in the body metabolism of animals and subseqeunt productivity should be more pronounced during the dry season.

In the tropics, Wilson (1961) confirmed that when water was freely available to grazing cows, they usually drank 2 - 5 times daily and probably not more than 7 times. In Yankasa sheep, Umunna et al. (1981) observed marked decrease in liveweight gain and decline in feed efficiency as the period of water deprivation increased from once in 24 hours to once in 48, 72 and 96 hours respectively. It is therefore important that adequate water supply should be available preferably constantly each day to these animals in order to cope with the demand especially during the dry season period when natural grasses and crop residues are highly deficient in water content.

Like native grasses, the nutritive value of crop residues as livestock feed is limited by their high fibre, low nitrogen and mineral contents (Table 66) therefore low digestibilities (Said and Wanyoike, 1987). This confirms earlier findings that crop residues were low in protein and minerals and high in ligno-cellulosic compounds (Alhassan, 1985). However, their nutritive value can be improved either by treatment methods that increase the availability of nutrients by breaking down the ligno-cellulose constituents or through supplementation methods that add deficiency nutrients or correct nutrient imbalances (Klopfenstein, 1978; Sundstol et al 1978; Kategile et al 1981, Butterowrth and Mosi, 1986 and Lufadeju et al 1993). In Kaduna State, sprinkling of urea on crop residues is currently being widely practiced by dairy co-operative farmers as a means of improving the quality and nutritive value of crop residues in feeding Bunaji dairy cows. While farmers have reported improved milk production by this method, the economics of the feeding strategy has not been assessed especially in the face of the present large subsidy on fertilizer. Urea treated crop residues could improve the productivity of Muturu cattle and in view of the available large quantities of crop residues in Benue State (Appendix 8), it is recommended as an economical strategy to improve the nutritive value of residues.

It is known that concentrations of mineral elements in forages are generally dependent upon interactions of edaphic, biotic and climatic factors (McDowell, 1976). Some differences are species - specific, i.e some plants being

able to accumulate higher levels of certain mineral elements than others growing on the same soil (Beeson, 1961). Stage of maturity of forages also affects level of mineral contents with elements such as P, Mg, Zn, Cl and Na declining as the plant matures (Underwood, 1966). This may have been responsible for the significant differences between the crop residues in terms of ash, Mg and P contents (Table 67).

The deleterious effects of low nitrogen and deficient phosphorus have been reviewed (Little, 1970). These include, reduced voluntary feed intake, low growth rate, low conception rate and increased first post - partum oestrus. Because the Muturu in Benue State is subjected to low crude protein and phosphorus intake year round, it may well be that its productivity is being hampered by these deficiencies. Furthermore, this malnutrition may derail trypanotolerance as pointed out by Payne (1991).

Signs of phosphorus deficiency and low nitrogen intake were not apparent in the Muturu cattle during the period of the study as the animals appeared to be in good body condition even during the dry season. This might be due to the fact that the animals were kept free range during the dry season when they have access to some browse plants in addition to the native grasses and crop residues. Browse plants are generally higher in protein and mineral contents than native grasses and crop residues (Agishi, 1989). Therefore, animals having access to high protein and mineral browse plants could be expected to consume more and show high digestibility of

low quality forages by increasing the overall level of digestible nitrogen in the diet. The amount of browse in the diet of animals vary and tends to increase with decreasing grass: browse density (Payne and Macfarlane, 1963). These authors reported about 35% browse contribution in the diet of grazing animals during dry season in East Africa. Browse plants are usually higher in minerals than native grasses and crop residues, consquently, mineral deficiency in the low quality roughages may be offset in the animals consuming some browse plants in addition to native grasses and crop residues. Similarly, under range conditions, the animals have liberal supply of vitamin D from the sun for efficient utilization of phosphorus. Finally, it may well be that the animals are able to mobilize skeletal reserves of phosphorus, magnessium and tissue protein to prevent clinical appearance of specific deficiency from pasture and crop residues consumed.

It would appear that it is during the rainy/cropping season when Muturu cattle are tethered that the greatest nutritional stress to the animals in Benue State is posed. In the dry season, not only do the free roaming Muturu have a choice of consuming the highly nutritous browse plants, but they have sufficient quantities of crop residues and grasses to consume in the numerous fadama areas of the state.

Cattle nutrient requirements for maintenance have already been highlighted as 8% C P on DM basis, 0.12% phosphorus, 0.20% calcium and 0.20% magnesium. Apart from calcium, the

grasses and crop residues in Benue State cannot support these requirements. It is most probable that parts of these requirements are being met from leguminous and non-leguminous browse plants which provide enough of these nutrients for the free roaming Muturu during the dry season. It may well be that the nutrient requirements of the Muturu are lower than for the other tropical cattle breeds given their small size and millenia of natural selection. This is worth further investigation as Vercoe (1974) and Firsch and Vercoe (1978) pointed out that the compact little body of the West African Shorthorn cattle demanded less feeds for maintenance.

CONCLUSION.

An evaluation of the native pasture and crop residues grazed by Muturu cattle in Benue State through digestibility trials is needed in order to assess more fully the nutritional needs of these animals. For the time being, it is suggested that supplementation with protein source and phosphorus be encouraged in feeding these Muturu cattle. Since supplementation with concentrate feeds such as cotton seed cake is expensive, supplementation could be achieved at minimal cost through the introduction of alley and ley farming and careful feeding of urea.

In southern Nigeria, the adoption of alley and ley farming has been low due to two main reasons: firstly, the amount of arable land in the region is relatively small because of the high population density, consequently, most farmers are unwilling to set aside portions of land for browse and pasture establishment; secondly, the majority of the small scale farmers who are participants in this farming practice are tenant farmers (Uza, 1994). The tenancy system allows them to grow annual crops only. The two leguminous browse plants (i.e Gliricidia and leucaena spp.) recommended for alley farming or feed garden are perenial plants. In Benue State however, arable land is vast and most Muturu farmers own their land (Table 39a) and may be more willing to set aside portions of their land for browse and pasture establishment.

Browse species such as Gliricidia septium and Leucaena leucocephala could be intercropped with cereal and tuber crops. Leys could be established using forage legumes such as Stylosanthes guianensis, S. hamata and centro. With shortening fallow periods, the introduction of alleys and leys into the farming system could help not only to improve soil quality and provide forage to animals but aid in integrating the Muturu into these improved systems.

GENERAL DISCUSSION

Most parts of Nigeria are infested with tsetse fly, the vector of the disease trypanosomiasis which by far remains the greatest limitation to the development of Nigeria's livestock industry. The infested area coincides with good forage growth and availability of water. This area cannot however, be used extensively for livestock farming. No suitable vaccine has been developed against trypanosomiasis (Stewart, 1951; Murray et al., 1990). Several strains of trypanosomes are resistant to many of the available trypanocidal drugs (Murray et al., 1990; Neate, 1992). Tsetse control programmes in Nigeria over several decades have not achieved the desired results. The most effective way around the threat to trypanosomiasis is found in the exploitation of livestock breeds that are tolerant to the disease.

The Muturu which is the only indigenous trypanotolerant breed of cattle in Nigeria has been little studied. Little is known about their productivity and there are yet unknown factors that limit the productivity. The constraints to its production and improvement as well as its contribution to Nigeria's beef industry are also poorly understood because research reports on it are very scanty (Roberts and Gray, 1973a; Orji et al., 1984). This pioneer study was undertaken in Benue State among the Tiv people where the population of the Muturu is on the decline (Table 2). However, Muturu cattle are widely distributed in Nigeria (Fig. 2) and its management may be influenced by cultural differences among

tribes that raise them (RIM, 1992) as well as differences in ecology and farming systems. Consequently, the findings in this study may not be extrapolated to other parts of the country. It is suggested that similar studies be undertaken in some other parts of Nigeria where Muturu cattle are kept. The collated results from the various studies would give more complete picture of current status of Muturu cattle production in Nigeria.

In Benue State, it was discovered that Muturu cattle were found only in the Tiv speaking area (Fig. 4) hence the animals are popularly referred to as the "Tiv cow" by all tribes of the State. Under the traditional village management system, Muturu cattle keeping is secondary to cropping therefore does not receive much attention. Many farmers are forced to reduce the population of their Muturu stock through sales for slaughter in order to lessen conflict problems arising from crop damage caused by free-roaming herds. Seasonal exploitation of pastures in the subhumid and humid zones by Zebu - owning pastoral groups is a common feature. One of the effects of the rising human population has been the increased intensification of slash and burn farming, which has expanded the "derived" savanna at the expense of the rain forest enabling the trypanosusceptible zebu population to move southwards, more or less on a permanent basis. This has not only reduced the habitat of the Muturu, but it has also facilitated interbreeding between these two populations. The above reasons may have contributed to the decline in the population of the Muturu in Benue State and perhaps other parts of the country.

A national programme to develop this breed is therefore urgent. Not only would this conserve the endangered specie but that the Muturu may also provide suitable genes for traits such as those for trypanotolerance to other breeds through biotechnology in the future.

Under traditional village management system, the Muturu are hardy. Even under the ravages of tsetse infestation, trypanosomiasis did not have any effect on rectal temperature, Hb, PCV, total protein, Mg, Ca and P levels of the animals. This confirmed the trypanotolerant attribute of the Muturu. Disease was therefore not a constraint militating against production. Good production parameters were also obtained such as age at first service of less than 2 years, age at first calving, 2 - 3 years, calving interval mostly 1 year and low calf mortality. When compared with ranch managed Muturu at Raav LIBC, the ranch animals did not appear to perform better than those under the traditional village management system. All that is needed to be done was to explore and take advantage of these unique characteristics and effect increased productivity through improved management.

The major limitations under the traditional village management system of the Muturu are firstly, that, its rearing is not properly integrated in the mixed farming system in Benue State as evidenced by problems of crop damage from free-roaming animals, cattle manure being hardly used for crop growth and the cattle hardly used for traction. Secondly, even though the use of crop residues in feeding the

Muturu is widely practiced, these crop residues along with native pastures which constitute the primary feed resources for the animals, are highly fibrous, low in protein and deficient in minerals all year round. These animals are hardly ever supplemented because farmers are ignorant of this feeding strategy. This poor quality feed will no doubt lead to low intake and digestibility resulting to poor productivity of the animals (Adu and Adamu, 1982; Minson, 1982; Van Soest, 1982; Hakkila et al., 1987; Said and Wanyoike, 1987). However, during the dry season when animals are on free range, they have access to browse plants in addition to native grasses and crop residues. These browse plants are generally higher in protein (11.25 - 27% CP on DM basis) and minerals than the grasses and crop residues (Agishi, 1989). It is probably for this reason that inspite of the poor quality native pastures and crop residues, the Muturu appear to be in good body condition even during the dry season. It appears that it is during the rainy/cropping season when Muturu cattle are tethered that their greatest nutritional stress is posed.

The productivity of the Muturu on the native pastures and crop residues could be improved through management. These options include, modifications to farming systems in which browse plants such as Gliricidia septium and Leucaena leucocephala could be intercropped with cereal and tuber crops. Leys could be established using forage legumes such as stylosanthes guianensis, S. hamata and centro. This could help not only to improve soil quality and provide nutritous

forage to animals but aid in integrating the Muturu into these improved systems.

Direct supplementation with agro-industrial by-products is expensive. However, urea treated crop residues could improve the productivity of Muturu cattle, and in view of the available large quantities of crop residues in Benue State, it is recommended as an economical strategy to improve the nutritive value of residues.

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Appendix 1: Obtaining Baseline Data on the Performance of Muturu Cattle under the Traditional Village Management System and on Institutional Farm in the Southern Guinea Savanna Zone of Benue State, Nigeria.

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FORM A

Questionnaire at Farm Level

1. Name of Village/compound .....
2. District/clan .....
3. L.G.A. .....
4. Name of Respondent .....
5. Name and Rank of Interviewer .....
6. Date .....
7. Questionnaire No .....
8. Population figures:

Bulls	Bullocks (Castrate)	Cows	Calves	Total

Origin and Source

9. Where did you get your animals from?

Within Benue State ☐

Which L.G.A.? _____

Outside Benue State ☐

Specify _____

10. How did you get them

Inheritance ☐ Gift ☐ Purchased ☐

11. If Gift, was it through:

Marriage ☐

Others (specify) _____

12. If purchased, was it through:

Personal Income ☐ Payment in kind for services ☐

☐ Loan (Specify whether from Money Lender, Co-operative Union, Co-operative Bank, Agric. Bank, Commercial Bank, Others). _____

Reasons for keeping Muturu Cattle

13. Why do you keep Muturu Cattle?

Commercial ☐ Ceremony ☐ Food ☐

Pet ☐ Other (specify) _____

Management

14. How do you manage your animals?

Intensive ☐ Semi-Intensive ☐ Extensive ☐

Others (Specify) _____

15. (a) Do you provide housing/shelter for your animals?

Yes ☐ No ☐

(b) If yes, when?

Rainy season ☐ Dry season ☐

Others (Specify) _____

(c) What type of construction material do you use?

Mud-wall building with thatched roof ☐

Corrugated iron walled building ☐

Brick or block building ☐

Others (specify) _____

(d) Do you provide bedding?

Yes ☐ No ☐

(e) If yes, type of bedding

Grass straw ☐

Wood shavings ☐

Others (Specify) _____

16. How do you feed your animals during?

(a) Rainy Season: Grazing ☐ Supplementary feed ☐

Both ☐

(b) Dry Season: Grazing ☐ Supplementary feed ☐

Both ☐

17. (a) If you feed supplementary feed, state type

Cotton Seed Cake ☐

Groundnut Cake ☐

Dried Brewers Grains ☐

Molasses ☐

Mixed feed from Industry ☐

Others (Specify) _____

(b) Is the feed free or purchased?

Free ☐ Purchased ☐

(c) Who are the suppliers? _____

(d) What type of animals receive the supplementary feeds?

Cows ☐ Bulls only ☐

Calves only ☐ All of the above ☐

Other combination (Specify) _____

(e) If you don't feed supplementary feed, state reason(s):

Never heard of it ☐

Heard of it ☐

Can't afford to buy ☐

No benefit ☐

Not available ☐

Any other reason(s) (state) _____

18. (a) How often do you water your animals?

Once daily ☐ No fixed time ☐

Twice daily ☐ Don't know ☐

Thrice daily ☐

Herd Performance

19. At what age do you breed your heifers for the first time?

Less than 2 years ☐

2 - 3 years ☐

3 - 4 years ☐

4 - 5 years ☐

Over 5 years ☐

Don't know ☐

20. At what age do your animals have their first calf?

less than 2 years ☐

2 - 3 years ☐

3 - 4 years ☐

4 - 5 years ☐

Over 5 years ☐

Don't know ☐

21. (a) Do you keep male and female animals of breeding age together?

Yes ☐ No ☐

(b) If yes, is it throughout the year ☐

Only when you want them to mate ☐

Others (Specify) _____

22. (a) Do you determine when the bull should mate the cow?

Yes ☐ No ☐

(b) If yes, when?

During rainy season ☐

During dry season ☐

(c) Why? _____

23. (a) Do your cows calve regularly? Yes ☐ No ☐

(b) If yes, how often?

every year ☐

every 2 years ☐

every 3 years ☐

every 4 years ☐

every 5 years ☐

Don't know ☐

24. (a) Do your cows abort?

Yes ☐ No ☐

(b) If yes, when?

All the times ☐

Within last 6 months ☐

6 months to 1 year ago ☐

2 years ago ☐

Over 2 years ago ☐

25. Do you have cases of difficult birth?

Yes ☐ No ☐

26. (a) Do you know those cows that abort and those that have difficult birth?

Yes ☐ No ☐

(b) If yes, what do you intend to do with them?

Sell them ☐

Keep them ☐

Slaughter them ☐

Others (Specify) _____

27. (a) Do your calves die regularly?

Yes ☐ No ☐

(b) If yes, when?

All the time ☐

During rainy season only ☐

During dry season only ☐

Other combinations (Specify) _____

28. (a) How do your animals perform during the rainy season?

Grow:	Bigger	☐	Smaller	☐
Produce:	More	☐	Fewer	☐
Death (adult):	More	☐	Fewer	☐
Death (calves):	More	☐	Fewer	☐

Abortions: More ☐ Fewer ☐

Others (Specify) _____

29. (a) How do your animals perform during the dry season?

Grow: Bigger ☐ Smaller ☐

Produce: More ☐ Fewer ☐

Death (adult): More ☐ Fewer ☐

Death (calves): More ☐ Fewer ☐

Abortions: More ☐ Fewer ☐

Others (Specify) _____

30. Herd Health

What time of the year do your animals fall sick most?

Rainy season only ☐

Dry season only ☐

Both seasons ☐

Others (Specify) _____

31. Which age groups are usually more affected?

Adult ☐ Calves ☐ Weaners ☐

Others (Specify) _____

32. Have you ever had the following signs of disease in your herd?

Disease Sign	Yes/No	Season
Diarrhoea		
Not eating and drinking		
Skin problem		
Foot problem		
Abortion		
Persistent coughing		
Circling and twisting of neck		
Blood in urine		
Worm seen in faeces		
Swollen joints		
Sudden death		
Others (Specify)		

33. When your animals are sick, do you report to Veterinary or Agricultural Extension workers?

Yes ☐ No ☐

34. How many deaths have you recorded in the last one year?

Cows ☐ Bulls ☐ Calves ☐

35. (a) Do you vaccinate your animals?

Yes ☐ No ☐

(b) If yes, when

Every year ☐ Only when there is an outbreak ☐

Others (Specify) _____

36. (a) Do you treat your animals? Yes ☐ No ☐

(b) If yes, who does the treatment?

_____

(c) If treatment is done by you, how do you effect it?

Traditional method (herbs) ☐

Western Medicine ☐

Others (Specify) _____

37. (a) Do you cull your animals? Yes ☐ No ☐

38. How do you sell your stock/products?

Life ☐ Slaughter ☐ Both ☐

39. Reasons for selling your stock/product?

Reaching market weight ☐

Diseased ☐

Lack of feed and water ☐

Culled ☐

Support ☐

Others (Specify) _____

40. Where do you sell your animals?

On the Farm ☐ In the Market ☐ Both ☐

Others (Specify) _____

41. How much money do you get in a year from sale of your animals/products?

_____

Constraints

42. List problems facing Muturu cattle farmers in your area?

Lack of feed and water ☐

Lack of Veterinary extension services ☐

Lack of capital ☐

Lack of grazing land ☐

Lack of Market ☐

General

43. List five things you think should be done to improve your herd

_____

_____

_____

_____

_____

Appendix 2: Obtaining Baseline Data on the Performance of Muturu Cattle under the Traditional Village Management System and on Institutional Farm in the Southern Guinea Savanna Zone of Benue State, Nigeria.

FORM B

Questionnaire for LIBC/Institutional Farms

1. Name of LIBC/Institutional Farm _____
2. District/Clan _____
3. L.G.A. _____
4. Name of Respondent _____
5. Name and Rank of Interviewer _____
6. Date _____
7. Questionnaire No. _____
8. Population figures:

Bulls	Bullock (Castrate)	Cows	Calves	Weaners	Total

Source

9. State source of your stock?

Within Benue State ☐

L.G.A. in Benue State _____

Outside Benue State ☐

Specify _____

Objective

10. What is the objective of your farm? _____

_____

Management

11. Type of main feeds used: _____

12. Type of supplementary feeds used: _____

13. When supplementary feeds used: _____

14. Classes of animals that receive supplementary feeds:

_____

15. Grazing used:

(a) Herding using herdsmen? _____

(b) Do your animals graze:

improved pasture ☐

range land ☐

browse plants ☐

16. What is the stocking density? _____

17. (a) Do you feed crop residues to your animals? Yes ☐ No ☐

(b) If yes, list crop residues _____

18. What type of housing/shelter that is built for your animals?

_____

19. How much money do you spend on feed for your animals per year?

_____

Herd performance

20. At what age do you breed heifers for the first time? _____

21. At what age do your animals have their first calf? _____

22. Calving? _____ %

23. Calf mortality rate? _____ %

24. Weaning rate? _____ %

25. Cow culling rate? _____ %

26. What method(s) of mating do you practice on the farm?

Hand mating ☐

Pasture mating ☐

Artificial Insemination ☐

Others (Specify) _____

27. How often do your cows conceive? _____

28. (a) How many abortions do you have in a year? _____

(b) What is the cause? _____

29. (a) Do you have cases of difficult birth (dystocia)? _____

(b) How often? _____

(c) How many in a year? _____

30. (a) Assess the general performance of your animals during the rainy season and the dry season:

	Rainy Season	Dry Season
Growth	_____	_____
Reproduction	_____	_____
Calf mortality	_____	_____
Illness	_____	_____
Abortions	_____	_____

(b) What explanation can you offer?

_____

_____

_____

Herd Health

31. How often do your animals fall sick? _____

32. What age groups are more usually affected? _____

33. Name the common diseases often seen in your herd (in order of importance). _____

_____

34. (a) Do you vaccinate your animals? _____

_____

35. If yes, Name the diseases and specific vaccines used for such diseases? _____

_____

_____

36. How often do you prevent your animals against:

ectoparasites _____

endoparasites _____

37. How often do you cull your animals? _____

38. Why do you cull them? _____

39. What do you do with culled animals? _____

_____

Marketing

40. Do you normally sell your animals? _____

41. If yes, where do you sell them?

On the farm ☐

In the Market ☐

Others (Specify) _____

42. Do you sell on liveweight basis? _____

43. If yes, how much per kg. liveweight? _____

44. Who are your usual customers?

Farmers ☐

Elites ☐

45. What is your income in a year from sale of your animals?

_____

Weight Sampling

46. What is the average weight (kg):

(a) Birth weight of calves (10 No) _____kg

(b) Weaning weight at 6 - 8 months (10 No) _____kg

(c) Weight of cows at mating (10 No) _____kg

General

47. List five problems facing Muturu Cattle operation on your farm.

_____

_____

_____

_____

48. What do you think should be done to improve your herd performance?

_____

_____

_____

49. Do you keep other livestock apart from Muturu Cattle?

50. If yes, name them _____

_____

_____

51. Do you cultivate crops? _____

52. If yes, crops cultivated:

Crop Grown	Plot Size	Yield last year	Value (N)

53. (a) Which of the following categories of enterprise is more important on your farm (list in order of importance: Raising Muturu Cattle, raising other livestock and crop enterprise?

_____

_____

_____

(b) Can you offer explanation for this?

_____

_____

_____

_____

Appendix 3: Assessing the Role of Muturu Cattle in the Farming System and the Problem of Dry Season Constraint of Feed Scarcity in the Southern Guinea Savanna Zone of Benue State, Nigeria.

Questionnaire at Farm Level

1. Name of Village/Compound _____
2. District/Clan _____
3. L.G.A. _____
4. Name of Respondent _____
5. Name and Rank of Interviewer _____
6. Date _____
7. Questionnaire No _____
8. Population Figures: _____

Bulls	Bullocks (Castrate)	Cows	Calves	Total

9. Mixed Farming System

   (a) Do you keep other livestock apart from Muturu cattle?

   Yes ☐ No ☐

   (b) If yes, name them _____

10. (a) Which one of the two categories of livestock enterprise is more important to you?

   Raising Muturu cattle ☐

   Raising other livestock listed in 9 above ☐

(b) Why? _____

11. Do you cultivate crops?

Yes ☐ No ☐

12. List crops cultivated:

13. (a) After harvesting, do you feed some of your crop residue to Muturu cattle?

Yes ☐ No ☐

(b) If yes, name the crop residues that you feed to your Muturu cattle.

_____

_____

_____

14. (a) List in order of importance the categories of enterprise more important to you: Raising Muturu cattle, other livestock, crop farming:

_____

_____

_____

Land Use System

15. (a) Do you own your own farm land?

Yes ☐ No ☐

(b) If yes, state nature of ownership:

Inheritance ☐

Purchased ☐

Lease ☐

Gift ☐

Others (Specify) _____

16. How much land do you own?

1 - 20 Hectares ☐

20 - 40 " ☐

40 - 60 " ☐

60 - 80 " ☐

80 - 100 " ☐

More than 100 hectares ☐

I don't know ☐

17. How much of your farm land is set aside for cropping?

None ☐

Less than half ☐

More than half ☐

18. How much of your land is set aside for raising Muturu cattle?

None ☐

Less than half ☐

Half ☐

More than half ☐

19. Which one of the following is used on the most fertile portion of your farm land:

Cropping ☐

Raising Muturu cattle ☐

Raising other Livestock ☐

Grazing Practice

20. Do your Muturu cattle graze on:

Natural grass ☐

Improved Pasture ☐

21. (a) Are your cattle:

Allowed to roam freely ☐

Confined ☐

22. If confined, specify method of confinement:

Tethering ☐

Fencing ☐

Others (specify) _____

23. (a) State time of the year when you confine the cattle:

Rainy Season ☐

Dry Season ☐

Both ☐

(b) Why? _____

24. (a) What time of the day do you confine the cattle

Day time ☐

Overnight ☐

Both ☐

25. If allowed to roam freely, do you have problems resulting from crop damage by these animals?

Yes ☐ No ☐

26. (a) Are your cattle herded?

Yes ☐ No ☐

(b) If yes, who herds the animals?

Fulani, employed by you ☐

My Children/relations ☐

Others (specify)_____

27. Do your cattle graze on land left fallow?

Yes ☐ No ☐

28. Do your cattle and those of other people graze in one place owned by all of you (communal grazing)?

Yes ☐ No ☐

29. (a) Would you like the provision of communal grazing for your area?

Yes ☐ No ☐

(b) Why? _____

Manure

30. (a) Do you apply manure from droppings of your cattle on your crop farm?

Yes ☐ No ☐

(b) If yes, has the application of the manure increased your crop yield?

Yes ☐ No ☐

Traction

31. (a) Do you use Muturu cattle to till the soil for your crops?

(b) If yes, state sex of cattle used:

Male ☐

Female ☐

Both ☐

32. Do you invest income from cropping into raising Muturu cattle?

Yes ☐ No ☐

33. Do you invest income from raising Muturu cattle into cropping?

Yes ☐ No ☐

APPENDIX 4: CARBONATE - BICARBONATE BUFFER pH 9.6

Sodium chloride (Analar)	1.59g
Sodium bicarbonate	2.93g
Add Distilled water to 1000ml	

APPENDIX 5: PBS/TWEEN 20 pH 7.4

Sodium chloride	8.0g
Potassium dihydrogen orthophosphate	0.2g
Disodium hydrogen orthophosphate	1.15g
Potassium chloride	0.2g
Tween 20	0.5ml
Add distilled water to 1000 ml	

APPENDIX 6: PBS/Tween 20/BSA

Sodium chloride	8.0g
Potassium dihydrogen orthophosphate	0.2g
Disodium hydrogen orthophosphate	1.15g
Potassium chloride	0.2g
Tween 20	0.5ml
Bovine Serum Albumin (BSA)	10.0g
Add distilled water to 1000ml	

APPENDIX 7: SUBSTRATE BUFFER, pH 6.0

Sodium acetate	0.82g
Add Distilled water to 100ml	
Adjust p^H with 0.5M citric acid dropwise to p^H 6.0	

Substrate, pH 6.0

3, 3′ 5, 5′ tetramethyl benzidine (TMB)	10.0mg
Dimethyl sulphoxide (DMSO)	1.0ml
Substrate buffer p^{H}6.0	99.0ml
Hydrogen peroxide, 30% w/v	15.0ul

Precaution:

Dissolve TMB in DMSO before adding to the substrate buffer; add H_2O_2 just when you are ready to add the substrate buffer to the plates. DO NOT add H_2O_2 to the buffer and keep for a long period before adding to the plates, in order not to weaken the catalytic effect of the H_2O_2.

APPENDIX 8: CROP RESIDUE ESTIMATES IN BENUE STATE FOR THE PERIOD 1991 - 1993.

CROP	ANNUAL GRAIN YIELD (MT)	STOVER/STRAW YIELD[1] (MT)	LEAF YIELD[2] (MT)	LEAF AVAILABLE FOR CONSUMPTION[3] (MT)
Sorghum	119,790	239,580	52,708	26,354
Maize	160,940	213,888	80,470	40,235
Rice	617,020	888,509	222,127	111,064
Millet	39,790	79,580	17,508	8,754
Total	937,540	1,421,549	372,813	186,407

1. For sorghum, maize and millet stover yield is assumed to be twice the weight of grain and for rice, it is 1.44 times the yield of grain (Alhassan, 1985).

2. Leaf extraction rate for sorghum is 22% (Powell, 1984), for maize is 25% (Russell, 1986) and for rice and millet, it is assumed to be 25 and 22% respectively.

3. It is assumed that half of leaf yield is lost to various casuses leaving the other half for consumption (Alhassan, 1985; Males, 1987).