OBSERVATIONS ON HEALTH AND STRESS IN WORKBULLS UNDER INDIGENOUS MANAGEMENT SYSTEM IN KADUNA AND KATSINA STATES OF NIGERIA

BY

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DECLARATION

I hereby declare that this thesis was written by me and that it is a record of my own research work carried out in the Department of Veterinary Surgery and Medicine, Ahmadu Bello University, Zaria under the supervision of Prof. O.O. Akerejola and Dr. G. Mohammed. It has not been presented in any previous application for a higher degree. All quotations are indicated and the sources of information are specifically acknowledged by means of references.

21/9/98

ABDULLAHI KOLO MOHAMMED

DEDICATION

This work is dedicated to the memory of my late aunt, Hajiya Fatima Kolo: May her soul rest in perfect peace, Ameen.

CERTIFICATION

This thesis titled **"Observations on Health and Stress in Workbulls Under Indigenous Management System in Kaduna and Katsina States of Nigeria"** by A.K. Mohammed meets the regulations governing the award of the degree of Master of Science of Ahmadu Bello University, Zaria, and is approved for its contribution to scientific knowledge and literary presentation.

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ABSTRACT

A total of 2,887 workbulls comprising Bunaji, Bokoloji and Rahaji breeds, aged 2.5-9 years, belonging to 240 farmers in Soba and (iivva Local Government Areas of Kadnna State and Malumfashi and Dutsin-Ma LGAs of Katsina State, were investigated for the prevalence of traumatic and non-traumatic disease conditions.

Bunaji breed constituted 91% (2627), while Bokoloji and Rahaji breeds represented 8.7% (251) and 0.3% (9)of the cases investigated, respectively. Important health problems observed were traumatic conditions (45.0%), helminthiases (24.4%), ecto-parasitism (22.2%), dermatophilosis (kirchi) (10.4%), anaplasmosis (4.2%) and babesiosis (4.0%). Other conditions included foot-and-mouth disease (1.8%), abscesses (1.1 %), foot-rot and orchitis (0.2% each). Workbulls were 13.6 times more likely to have traumatic conditions than non-workbulls in the areas studied. Significantly high relative risks ($P<0.05$) were obtained for the months of March through July. In another study, 36 of the Bunaji breed belonging to 18 tanners, derived from the same population were used to investigate the hematological and scrum biochemical changes before and immediately after ridging activity.

Significant ($P<0.01$) elevations in hematological parameters (RBC, PCV, Hb, WBC and neutrophils) were observed immediately alter strenuous ridging activity. Neutrophilia with marked lymphocytopenia and eosinopenia were demonstrated, indicating stress. While decrease in erythrocyte indices MCV, MCH and MCHC were insignificant ($P>0.05$). There were also significant ($P<0.0l$) elevations in chloride, BUN, creatinine and total protein. However, the

increase in sodium and albumin were insignificant while bicarbonate and potassium levels decreased immediately after work.

Most farmers were observed to use each workbull for about four planting seasons before replacement. Commonly used ridgers in the area were Emcort(R) (45%), loeally fabricated ones (45%), and Kasco(R) (10%). The ridgers' mean weight was 35.40 + 4.50 kg while the bulls ridging speed on a plain rain-fed soil was 0.90 ± 0.1 1 m/s. The area ridged was 0.23 ha/hour (1 ha/4.35 hours) and the bulls worked an average of 6.16 ± 1.67 hours/day during the period of active land preparation for planting (May-July). The mean live-weight of the bulls at the start of the study was 381.80 ± 60.01 kg and 372.39 ± 38.72 kg at the end of the study.

During the rainy season, workbulls maintained their weights by grazing 5-6 hours/day on natural grassland. While those weighing over 250 kg were supplemented with 3.5 - 6.5 kg agro-industrial by-products 3 times daily in the late dry season, prior to maintaining and preparing them for farm work during the early rains period.

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1.0 INTRODUCTION

Draught animal usage is widespread throughout Africa and is increasing slowly (Mathewman, 1987). In Nigeria, farming with oxen, known as 'mixed farming', was first introduced into tsetse- free regions of north-eastern Nigeria in 1922, and was slowly integrated into other farming systems. By 1931 it was considered that cultivation using oxen was both economically and technically successful and special loans were made available to farmers to purchase them (Schneider and Darling, 1967).

Draught animal power (DAP), however, suffered serious decline in the seventies due to the oil boom which encouraged large-scale tractorization even in areas where it was not suitable (Badawi, 1990). In addition to the difficult terrains and poor maintenance culture, most of the farm equipments including tractors and other implements, had short life span and were not supported with adequate spare parts. The broken down and unreplaced parts of these farm equipments were commonly seen in different parts of the country. The incredibly high cost of these farm machines and equipments made it impossible for peasant farmers to own them. Moreover, where tractors and farm machinery hiring services were available, they were often not handy. This resulted to late preparation of the fields and subsequently led to poor crop yield (Nuru, 1990). However, this widespread tractorization programme, seemed to fizzle out with the end of the oil boom, thus opening the way to the most practical alternative source of power for cultivation (Pearson *et al.*, 1996). DAP utilization is very viable and compatible with the agronomic culture of most producing households. It is readily available and affordable with low operational costs (Gefu *et*

al.,1990). Furthermore, it is an additional source of family income as work animals can be hired out to other farmers who do not own any (Katsina, 1990). At the end of their work life, the animals would have been fattened, thereby providing the much needed animal protein source to the populace (Blench, 1989).

Maintenance of health in working animals however, differs from that of other animals used for other purposes because they are subjected to heavy physical stress and occupational injuries (Wells, 1986). In Nigeria, where farmers utilize locally available cattle breeds for traction, their most important task amongst others is ploughing at the beginning of the rainy season which coincides with the time of greatest nutritional stress (Macfarlane and Bunn, 1988). This combination of stressors lead to a depressed immune response in working animals due to the effects of an increased secretion of corticosteroid hormones (Tizard, 1977; Stephens, 1980) resulting in an increased susceptibility of the animals to many disease conditions.

Although, DAP was first introduced into Nigeria's farming systems in 1922 (Sulemman, 1990), little information relating to health problems, hematological changes, and ridging capacity of workbulls is currently available. This study was therefore, designed through the use of regular farm visits to identify and document some of the animal health problems, hematological changes, ridging capacity, and feeding regimens of workbulls .

1.1 Statement of Objectives

a) To identify major health problems of workbulls

b) To access the hematological and serum biochemical changes occurring in workbulls before and after strenuous farm work

c) To ascertain (if any) the use of blood values in predicting work stress in the bulls.

d) To determine the ridging capacity of some Nigerian breeds of workbulls.

e) To document feed supplements and feeding regimens of workbulls.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Health Management

Diseases can reduce the draught capacity or result in the death of such animals. This is particularly true of chronic diseases that result in weakness, emaciation and death (Pearson *et al.*, 1996). Any disease which limits the productivity of ruminants will affect draught cattle (Kenyon *et al.*, 1985), although the relative importance of some diseases is much higher in draught animals because of the special demands made on them (Hoffmann and Dalgliesh, 1985).

2.1.1 Infectious and Parasitic Diseases

Major epizootic and enzootic infectious diseases caused by microorganisms need to be controlled if the full potential of a draught animal is to be realized (Reh, 1982). Also of importance are parasitic diseases caused by helminths and ectoparasites. These diseases are often subclinical, resulting in production losses and reduced work output (Pearson *et al.*, 1996; Kenyon *et al.*, 1985).

2.1.2 General Stress in Workbulls

Stress caused by poor husbandry or overwork, can predispose to other health problems (Munzinger, 1982). In untrained animals, stress is characterized by increased body temperature, increased respiration rate, fatigue and energy expenditure to maintain homeostasis. Overwork or underfeeding can also predispose to parasitic infection (Starkey, 1981).

Wells (1986) described the stages of a stress syndrome in draught animals as (a) alarm,(b)

resistance, and (c) exhaustion which can result in depressed immune response. Stress apparently gives rise to increased susceptibility to normally avirulent bacteria, the activation of latent viruses, and a poor response to vaccines. If protein nutrition is deficient, this suppresses immunoglobulin production. Wells (1986) considered stress to have been the cause of increased incidence of hemorrhagic septicaemia in Asian cattle and buffaloes at the beginning of the rainy season. The same stressors are thought to predispose to trypanosomiasis due to *T. evansi* in working buffalo in north Vietnam (Wells, 1986). In West Africa where zebu draught cattle are often used at the fringes of tsetse belts, similar problems may occur. Starkey (1982) discussed the health problems of trypano-tolerant N'Dama draught cattle in Sierra Leone, which also could reduce or lose their tolerance under stress.

2.1.3 Fatigue

Frandson (1976) described fatigue as a state of decreased work capacity caused by work itself. Prolonged and strong contraction of a muscle leads to a state of muscle fatigue which results from the inability of contractile and metabolic processes of muscle fibres to continue supplying the same work output (Guyton, 1981). Fatigue of striated muscles results from depletion of available energy in the form of ATP, lack of oxygen, accumulation of metabolic end products(lactic acid and carbon dioxide) and other chemical changes like reduction of Ca++ or chlorides (Frandson, 1976). Messages of fatigue are then transmitted to the brain, and the animal becomes 'tired'(Miller and West, 1970). However, as soon as more ATP is formed after a rest the muscle relaxes and the state of contracture becomes over (Guyton, 1981). Gupta (1991) has described the different grades of fatigue in bullocks (Table 1).

2.1.4 Physical Agents

Tethering, attachment to an implement, working long hours on rough ground, pulling extremely heavy load, and competing with motor vehicles for road space predispose draught animals to physical trauma. Munzinger (1982) and Reh (1982) distinguished two types of ailments. Those resulting directly from work such as wounds, sprains, tendinitis, and inflamed hooves. The second type are those resulting from increased susceptibility induced by work and for which natural premunity or tolerance can quickly disappear under stress, e.g. trypanosomiasis and tick-borne diseases. Minor abrasions may provide suitable site for infection with the larvae of *Chryssoma bezzaina* (the screw-worm fly) which can cause extensive wounds if allowed entry through skin.

In addition, trauma caused by ropes can increase susceptibility to dermatophilosis (Bida and Dennis, 1976; Saidu, 1986) and is considered instrumental in the formation of horn cancer in Indian draught cattle (Anon, 1976). Some draught animals work hard until they are very old predisposing them to age-related diseases including arthritis and chronic tendinitis (Williamson and Payne, 1978).

2.1.5 Agro-chemicals

More use is being made of manufactured chemicals to control crop pests. This practice and the proximity of draught animals to areas of application, lead to a greater exposure to such potentially harmful agents. Many of these chemicals accumulate in animal tissues, creating a potential human health problem where old draught animals are slaughtered for human consumption (WHO, 1984).

Table 1: **Criteria Used in Quantifying Fatigue in Bullocks**

	NUMERICAL ASSESSMENT OF FATIGUE:				
PARAMETERS:	**GRADE 1**	**GRADE 2**	**GRADE 3**	**GRADE 4**	**GRADE 5**
Respiratory Rate (Breath/Min)	R + 15	R + 30	R + 45	R + 45	R + 60
Heart Rate (Beats/Min)	H + 10	H + 20	H + 30	H + 40	H + 50
Rectal Temperature (°C)	T + 0.5	T + 1.0	T + 1.5	T + 2.0	T + 2.5
Frothing	First Appearance	Dribbling saliva starts	Continuous saliva dribbling	Froth appear on upper lip	Full mouth frothing
Leg incoordination	Strides uneven	Occasional drag of feet	Incoordinated leg movement. Frequent feet dragging	Incoordinated fore/hind legs	Inability to move due to incoordination
Excitement	Composed	Disturbed	Nostrils dilated and bad temperament	Prominent eye ball movement on excitement	Furious and attempt to stop work
Inhibition of progressive movement	Brisk movement	Free walking	Slow	Very slow	Stop walking
Tongue protrusion	Mouth closed	Occasional mouth opening	Frequent tongue appearance	Continuous tongue protrusion	Tongue fully out

Note: (1) R,H and T represent resting respiration rate, heart rate and rectal temperature, respectively.

(2) These criteria have been developed at NDRI, Karnal, India (Gupta, 1991).

An Animal is said to be fatigued if the fatigue scored is more than 20.

2.1.6 Zoonosis

Interaction between draught animals and man is very high and facilitates transmission of disease, thereby contributing to zoonosis (Kakoma and Ristic, 1981). Zoonotic diseases transmitted by direct contact, such as brucellosis, staphylococcosis, tuberculosis, leptospirosis, and anthrax are important in human / draught animal interaction (Robinson, 1977).

2.2.0 Work Stress as Determined by Hematology

2.2.1 Stress and Physiological Reactions

Any systemic stress experienced by an animal provokes many defense reactions in the body (Selye, 1973). The inherent capacity of the animal to withstand stress is reflected in its blood picture and physiological reactions (Garg *et al.*, 1980). For appraising the adaptive changes brought about by the specific work load stress, studies on several parameters associated with exercise tolerance capacity e.g. physiological reactions, biochemical constituents of blood, hematology, and body water distribution have been reported (Garg *et al.*, 1980).

In a series of studies in calves subjected to different types of stress (transport, noise, cold or ACTH injections) responses showed a rise in blood 11-hydroxycorticosteroids and blood glucose (Broucek *et al.*, 1988). Herding and running increase blood catecholamines, cortisol, hematocrit, total lipid, glucose, and lactose levels (Hattingh *et al.*, 1989). Immune response and resistance to infection were observed to be affected by stress and increased colonization of the intestinal tract by *E. coli* (Hartmann, 1988).

However, post-exercise recovery indicated that most physiological processes (hematological,

biochemical, and hormone levels) returned to normal within 0.5-1.0 hour with the exception of blood lactic acid concentrations which returned to pre-exercise levels in 2-3 hours (Bhatnagar and Upadhyay, 1991).

2.2.2 Hemogram

Hematological and serum biochemical parameters of many breeds of cattle in Nigeria have been determined (Rose, 1960; Oduye and Fasanmi, 1971; Oduye and Okunaiye, 1971; Saror and Coles 1973a;1973b; 1975; Akerejola *et al.*, 1980; Gbodi and Chechet, 1981; Oyedipe *et al.*, 1984). Many of these parameters are known to be influenced by such factors as age, breed, sex, seasonal variations, lactation and pregnancy. However, no such work has been documented for workbulls in this part of the country.

Blood parameters are important in order to determine normal values and thus detect any deviations suggestive of disease or abnormal conditions. Saror and Coles (1975) examined the influence of age, season, and management practices on the hematological parameters of native Zebu cattle and found it to differ significantly from those of Zebu under modern husbandry practices.

2.2.3 Leukocytes

Muscular exercise and apprehension influence total and differential leukocyte counts. A blood sample from an animal that has been subjected to excessive exercise or one that has become emotionally disturbed by restraint is not representative of the true state of the leukocytes in that individual. If in the process of blood sample collection the animal is mishandled or caused to

exercise violently, as often occurs when restraint of an animal is attempted, the total leukocyte count may be increased, and the number of neutrophils will be greater than normal as cells move from the marginal granulocytic pool (MGP) into the circulating granulocytic pool (CGP) (Coles 1980).

Alteration in the leukocyte picture could be the consequence of a normal physiological response (Table 2) or due to a disease condition. Pathological leukocytosis could show an increase in segmented neutrophilic granulocytes. Demonstration of an increase in the number of leukocytes *on its own is of little value as an aid to diagnosis unless it is correlated with the clinical condition* observed in the patient (Kaneko,1989; Lording and Friend, 1991). Only when the two are considered together that a useful interpretation may become possible. The general causes of leukocytosis, other than physiological include (a) generalized infections, (b) localized infections, (c) intoxications,(d) rapidly growing neoplasms, (e) acute hemorrhage, particularly into one of the body cavities (thoracic, peritoneal, joint),(f) sudden hemolysis of erythrocytes, and (g) trauma.

The usual bovine response to infection and stress is an initial fall in lymphocytes that in some instances may exceed the increase in neutrophils. It is possible for a cow to have fewer total leukocytes than normal but still have evidence of an infection or stress as manifested by the increased number of neutrophils (Coles, 1980).

Table 2: Physiological Leukocytosis

Cause	*Cell type*	*Mechanism*
Increased adrenalin with fear and excitement	Neutrophils. If marked (leukocytosis) also lymphocytosis	Removal of cells from MGP to CGP
Exercise	Neutrophils. If prolonged also lymphocytosis	Accelerated blood flow. Also increased adrenalin
Anaemia	Neutrophils cells from MGP to CGP	Increased blood flow
Estrus (Cow)	Neutrophils and lymphocytes	-
Digestion (Dog/Pig)	Neutrophils	About one hour after eating
Stage of pregnancy (Dog/Cow)	Neutrophils	Occurs near term in dogs. High in cow at

* Adapted from Coles 1980.

2.2.4. Erythrocytes

In most species, excitation, apprehension and exercise dramatically increase values for total red cell count, packed cell volume, and hemoglobin levels. These alterations are probably consequences of increased adrenaline output causing splenic contraction with consequent release of erythrocytes into the peripheral circulation (Bush, 1994). This is particularly true of the horse, which has a large splenic reservoir of erythrocytes that are released into the circulation within a few minutes following excitement or strenuous exercise (Schalm *et al.*, 1975; Coles,1980).

Schalm *et al.* (1975) reported an increase in PCV ranging from 14 to 64% as a consequence of excitement in the horse. Gartner *et al.* (1969) however, reported that the increase in PCV that occurred with handling was reduced when animals became conditioned to the environment and handling procedure.

In cattle, erythrocyte counts are usually highest in calves, however, this decreases gradually until adulthood especially in animals that are aged between 1½ and 3 years (Schalm *et al.*, 1975), while PCV and MCHC remain fairly stable throughout this period. As with leukocyte determination, physiological alterations in erythrocytes must also be considered in interpretation of laboratory results. Other factors of importance include age, breed, environment, and the method used in handling an animal (Lording and Friend, 1991).

2.2.5 Serum Biochemistry

Measurements of biochemical parameters in cattle in Nigeria have been carried out (Rose 1960; Oduye and Fasami, 1971; Saror and Coles 1973c;; Gbodi *et al.*, 1989). Prior to this, conclusions

were extrapolated on data obtained from *Bos taurus* breeds under temperate conditions (Akerejola *et al.*, 1980). The knowledge of the biochemical constituents of blood of animals of different breeds and its use is essential not only in clinical and experimental investigation but also helps in the diagnosis of various diseases especially those of metabolic disorders.

2.2.6 Effect of Hyperthermia

Changes caused by acute hyperthermia in some blood constituents of cattle have been reported by Singh and Bhattacharyya (1986). Hyperthermia results in decreased hemoglobin, PCV, and serum calcium and increased erythrocyte sedimentation rate, glucose and serum inorganic phosphorus levels. Hypothermia on the other hand caused an increase of 2 - 5% in PCV (Olsen, 1973). Bhatnagar and Upadhyay (1991) observed 1.0°C and 4.0°C rise in rectal and skin temperature over 0.5 hours of work in Buffaloes.

2.2.7 Blood Glucose

Exercise causes a relatively faster decrease in blood glucose concentration and an increase in lactic acid concentration (Bhatnagar and Upadhyay, 1991). The turnover of glucose increased after exercise due to stimulated glycolysis. These biochemical changes are in tune with a hypothesis that the oxygen-carrying system participates in the response to physical exercise (Matthewmann *et al.*, 1990).

2.3 Management of Workbulls in Northern Nigeria

2.3.1 Climate, Vegetation and Topography Affecting the usage of Animal Traction

The combined factors of climate, vegetation, and topography should not be overlooked because

they are highly associated with animal power utilisation. Animals work well in flat areas with sandy soils and open savanna. The rainfall must be light and should not be the type that will cause flooding and gully erosion. Pulling a plough or cart over a hilly terrain or rocky rooted soil has been reported to tire animals very quickly (Bolaji, 1990; Kaufmann and Blench, 1990).

2.3.2 Sex, Type and Size of Animal

Sex has a bearing on the power and temperament of draught animals. Male animals seem to be bigger, more powerful and more difficult to train than the females. Females endure less and cannot be optimally used during pregnancy or lactation. Studies have shown that bulls are 50-100 kg heavier than cows of the same breed and age (Smith,1981). Hence, bulls can work for more hours than cows and thus the advantage to make use of male animals. The conformation of an animal is a reflection of its health and hence its draught capacity (Inns, 1980). A haggard animal will exert less force than a well conformed one. A draught animal should therefore have well built shape, powerful shoulders and legs, and should also be low to the ground. It should have a broad frontal dimension that will conveniently accommodate a harness (FAO, 1972).

2.3.3 The Management of Draught Animals

Draught animal husbandry and management is very much the same as in other farm animals, but there are special management features which require attention and include (a) their ability to work when they might be least able to do so (i.e. at the end of dry season), (b) the need to harmonize husbandry practices (e.g. vaccinations, mating of draught cows) in conjunction with work requirements, (c) work can cause stress and predispose draught animals to further health problems, (d) due to these stressing factors draught animals are therefore more vulnerable to illnesses, the need for veterinary care required at specific times, (e) draught animals are

predisposed to some specific health hazards of work (f) good foot care is required at all times, (g) because draught animals are useful to man, they need to be handled with care. (h) the need for a high labor input especially in the area of feeding, (i) a draught cow's nutrition is more complex than that of an oxen, (j) care must also be taken because draught animals may suffer heat stress (Matthewmann *et al.*, 1990).

2.3.4 Housing

Because of their value, draught animals offer one of the best ways of introducing improved animal husbandry methods to local farmers. A simple shelter would provide the necessary protection from rain. Shelters should have a sloping floor to allow run-off to keep them dry and clean, and dung should be removed daily to reduce the problem of flies. Good hygiene is essential and more harm than good can be caused by allowing houses or shelters to become dirty. Houses should be periodically disinfected and clean bedding provided. Troughs for food and water should be provided (Pearson, 1986).

2.3.5 Duration of Work

The amount of work expected from an animal should be determined by the food input, the condition of the animal, and stage of lactation and pregnancy in females. If necessary, animals should not be worked every day, but the more work that an animal performs, the more efficient it is in doing that work. Starkey (1981) found that well-fed oxen could work 4-5 hours per day for 5 days a week. Little is known about whether heat affects work output, but the preferred time to work is in the cooler parts of the day (6.00-11.00 hrs; 16.00-19.00 hrs. (Goe and McDowell, 1980). If body condition is being lost, the work load must be reduced or significant

supplementary feeds must be given. In temperate regions animals can work for 6-8 hours per day, presumably as a result of cooler conditions and better food inputs. It might be possible to extend the working period in the tropics if animals are fed higher quality diets and when greater advantage is taken of the cooler parts of the day, thereby reducing the problems encountered as a result of heat stress (Matthewman *et al.*, 1990).

2.3.6 Working Capacity of Workbulls

The power generation ability of an animal is influenced by the breed, both nutritional and health status. It can also be influenced by the terrain of the work field (Agarwal, 1995). Increase in power demand will necessitate a reduction in work speed and/or reduction in work hours or both. It is estimated that a 10% increase in tractive power, and a 15% rise in speed would necessitate a 25% decrease in daily working time (Kaul, 1990).

2.3.7 Average Tractive Years of Bulls

The age of an animal is a factor associated with animal power utilisation. Oxen, for example are best trained at the age of 3 or 4 years and become difficult thereafter. They perform best at age of 7 or 8 years and can work until they are 12 or more (Kemp, 1987; Mathews, 1987).

2.3.8 Preparation of Workbulls

Once the bulls have been brought home, routine treatments for worms, wounds, and external parasites are carried out. Also, trimming of sharp pointed horns are done to prevent deep piercing wounds resulting from fights. During this period the animals also get used to frequent handling by workbull trainers. Nose punching then follows after which a nose rope is fixed in

the nasal septum. The hole should be made as far from the front of the nose as possible to reduce the danger of the nose tearing, and the nose punch should be done at least a week before training begins (Kanu and Sanko, 1990).

2.3.9 Animal Selection

Intact bulls are mainly used for draught purposes in Nigeria. Castrated animals tend to become fattened and sluggish in carrying out work (Goe,1983; Badawi 1990). Animals selected for draught should be (a) stocky, (b) strong muscled (particularly thigh, hind quarters, and loins), (c) short legs that must be straight for smooth movement, (d) powerful and strong jointed, (e) have large feet with solid soled hooves, (f) broad and deep -cheated, and (g) the pair of animals be of approximately equal size, weight and height for balancing (FAO, 1972).

2.3.10 Age at Training

In Hausa society of northern Nigeria where draught is combined with fattening, young bulls of about two years are preferred than older ones. The disadvantage of this method lies in the fact that bulls take 1 to 2 years before they become strong to do effective work. Ideally, the age at training should be 3 to 4 years. The advantage of this method is that bulls are well developed at this age and the training duration can be shortened to one week (Badawi, 1990).

Table 3: Normal Optimum Tractive Power and Speeds for Various Work Animals

Animal	Weight range (kg)	Approximate Draught (kg)	Average speed (m/s)
Bullock	500-900	60-80	0.6 - 0.8
Cow	400-600	50-60	0.6 - 0.7
Buffalo	400-900	50-80	0.8 - 0.9
Donkey	200-300	30-40	0.5 - 0.7
Horse	700-900	60-90	0.8 - 1.0

Adapted from Kaul, 1990
m/s = metre per second

2.3.11 Materials Needed for Training

These can be categorized into two, namely harness and implement. The harness is made up of a wooden neck-yoke (2.5 metres long and 15cm thick), 2 control nylon ropes (4.5 m each),2 nose-ropes (1.5 m), and 1 in-between rope (1.5 m). The implements include ridger, cart, cultivator, plough, harrow, a log of wood, 4 short woods or rods of about 30 cm long, and a nose puncher (a rod of about 30 cm long with pointed end "Basilla" or "Buda" (Badawi, 1990).

2.3.12 Duration of Training

Bulls can be trained for between 1 and 3 weeks during the dry season. Training may be delayed up to one month before the onset of the wet season. It is recommended that training be done in the early hours of morning (6.00 hrs - 11.00 hrs) or late afternoon (16.00 hrs - 19.00 hrs). Four hours of training per day is considered adequate so that animals are not stressed (Goe and McDowell, 1980).

2.3.13 Training Techniques

It is important to ensure that the pair of bulls match in size, height, and weight. This is to ensure evenness of work efficiency. The bulls are first harnessed and trained to walk with harness. The yoke is placed on their neck and tied. The two nylon ropes are attached to the nose-rope and used to control the speed and direction of movement as well as to keep the bulls in a straight line. The other short ropes (1.5 m) are used to hold the bulls at a distance of 1.5 m away from each other. A variety of commands are used by animal handlers which are better given in the local language to avoid unnecessary confusion (Badawi, 1990).

The animals are then yoked, trained to walk together at the same pace and to pull a log attached to the yoke with chain for one week. They are trained to cultivate in the second week and in the third week they should be trained to ridge in a straight line as well as to pull a cart. However, highly temperamental animals should be carefully watched because they can kick from behind (Goe and McDowell, 1980).

2.3.15 Operator Training

The operator has a significant role in the animal power usage. He has to have adequate training on animal handling and the various methods of hitching the implements being used. The training activities ranged from familiarizing the animals to handling of work such as cultivation, ridging and carting. It is also preferable to start the training with trained animals and after acquiring the skill for one or two weeks, the operator could then be allowed to handle an untrained pair (Badawi, 1990).

2.4.0 Implements

Animals provide only the power or the drive, but the actual work is done by the machine which it pulls. The design and selection of the equipment to be used will naturally depend on the magnitude of the power expected from a particular class of animal. Animal power basically is a biological system which can be influenced by many thermal factors e.g. temperature and non-thermal factors e.g. time, duration of work, age, health status, operator control, and vegetation. One should therefore be conscious of the biological nature of the source which implies variations due to several factors as stated above (Kaul, 1990).

Animal power can be used both for driving stationary machines like threshers, water lifting devices, and mobile operations e.g. ploughing, harrowing, and transportation. The power availability varies between the different class and breed of animal (Iversen, 1987).

2.5 Feeding of Workbulls

Draught animals, like other farm animals, have a requirement for water, energy, proteins, minerals, and vitamins. The level of these requirements depends on the age, size, amount of work load, and productive stage of the animal (Hrabovsky, 1983).

One of the problems facing many farmers at the beginning of the cropping season is that animals are often undernourished. This is especially true of animals that are not fed some form of supplement (Macfarlane and Bunn, 1988). Utilizing these animals for work is not only inefficient, owing to their lack of strength and poor physical condition, but also due to risks of injury and impairment of future performance (Goe, 1983).

According to Pearson *et al.* (1988), regularly worked bulls had total estimated energy expenditures of 1.3 to 1.8 times that of maintenance. For working bulls therefore, the primary need is to raise food intake to achieve metabolizable energy (ME) intakes of 1.3 to 1.8 times maintenance. This is necessary if energy intake is to match expenditure and also avoid body weight losses (Bathalomew *et al.*, 1994). It is generally estimated that draught animals require about 30% more feed than a bull that is not used for traction (Hrabovsky, 1983). The exact nutrient needs for traction animals are based on the type and duration of work assigned to each animal as well as their speed (Ibrahim, 1985). If maintenance levels could be sustained during

the dry season and increased feeding commenced one month prior to the time of land preparation, animals could perform very efficiently (Pearson, 1986).

Yahaya and Abubakar (1993) studied the effect of feeding wheat straw ad-libitum to workbulls in the sub-Sahel region of Borno State. Their results showed that to prevent the animals from losing body condition and weight there was the need to improve the quality of straw if the animals were expected to work for 4 to 6 hours a day. Generally, many unsupplemented and or unmodified tropical forages are incapable of supporting intakes that would prevent workbulls from losing body condition during the cropping season (Mohammed-Saleem and Kaufmann, 1989).

2.5.1 Water Requirements

During the rainy season, grazing animals have access to considerable amounts of water from the grasses and other succulent forages they consume. Under these circumstances, measuring water consumption is not an accurate indication of water requirements (Table 4). Actual water needs are determined by size, species, breed, environment and intensity of work. Muscular activity (work) generates additional heat. Working animals lose water from sweating and therefore need to increase their water intake (Anon, 1994). Working animals should have access to water at least 3 times per day, morning, noon and night. Horses and some cattle engaged in heavy work may need a short drink every two or three hours. Zebu cattle, donkeys and mules can work for longer periods without a drink, but still should be offered water during the mid-day resting/grazing period.

Table 4: **Water Requirements of Draught Animals**

Animal:	Litres per day:
Oxen	10-30
Horse	15-40 (rainy season)
Horse	30-50 (dry season)
Donkey	10-20
Mule	15-30

Adapted from Anon, 1994.

A heated animal should never be allowed free access to water as this could predispose to founder (Bakrie *et al.*, 1988). Some animals tend to drink too much water in the evening. This may prevent them from eating their concentrate feeds. They should not be allowed to drink freely until after feeding. A small drink may be given before food is offered (Anon, 1994).

CHAPTER THREE

3.0 AN EPIDEMIOLOGICAL OBSERVATION ON HEALTH PROBLEMS OF WORKBULLS IN KADUNA AND KATSINA STATES

3.1 ABSTRACT

A total of 2,887 cases of health problems of workbulls aged between 2.5 and 9 years were attended to in parts of Kaduna and Katsina States over a 3-year period (1994-1996). Bunaji breed constituted 91% of the cases, while Bokoloji and Rahaji breeds represented 8.7% and 0.3% of the cases, respectively. Important health problems observed were traumatic conditions (45.0%), helminthiasis (24.4%), ecto-parasitism (22.2%), dermatophilosis (kirchi) (10.4%), anaplasmosis (4.2%) and babesiosis (4.0%). Others included foot-and-mouth disease (1.8%), abscesses (1.1%), foot-rot and orchitis (0.2%) each. Workbulls were 13.6 times more likely to have traumatic conditions than non-traction bulls in the areas. Significantly high relative risk ($P<0.05$) were obtained for the months of March through July.

3.2 INTRODUCTION

Draught animals provide a major source of power in agricultural and transport sectors of African countries where tractors are largely unavailable or beyond the reach of most rural based peasant farmers. Animal traction is predominantly used in agropastoral areas where draught animals are readily available (Gefu *et al.*, 1990) though most of the farmers that use the animals for traction are not traditional livestock husbandry men, (Adewuyi, 1990).

Maintenance of health in working animals however, differs from that of other animals used for

other purposes because they are subjected to heavy physical stress and occupational injuries (Wells, 1986). In Nigeria, where farmers utilize locally available cattle breeds for traction, their most important task amongst others is ploughing at the beginning of the rainy season which coincides with the time of greatest nutritional stress (Macfarlane and Bunn, 1988). This combination of stressors lead to a depressed immune response in working animals due to the effects of an increased secretion of corticosteroid hormones (Tizard, 1977; Stephens, 1980) resulting in an increased susceptibility of the animals to many disease conditions.

Although, draught animal power was first introduced into Nigeria's farming systems in 1922 (Suleiman, 1990), there is still little information relating to the health problems of workbulls. This study was therefore, designed through the use of regular farm visits to identify and document some of the health constraints of workbulls in the locality.

3.3 MATERIALS AND METHODS

3.3.1 Sampled Population

A total of 240 farmers using workbulls were selected from Giwa and Soba LGAs in Kaduna State and Dutsin-ma and Malumfashi LGAs in Katsina State during the study. The selected areas were within the agropastoral systems of northern guinea savanna.

The variables investigated included (a) seasonal effect, (b) breeds of cattle used, (c) age when first used, and (d) major health problems.

3.3.2 Clinical Examination of Workbulls/Laboratory Analysis

The study consisted of planned periodic visits to workbull owners or on the request of the farmers. Visits were made to the farms between January 1994 and December 1996 during which individual examination of all bulls reported sick or injured were made. A total of 2,887 cases of workbulls with health problems were examined. Diagnosis of the conditions were based on detailed history, clinical signs, and laboratory analysis of the samples taken.

3.3.3 Statistical Analysis

The relative risks (RR) were calculated and 95% confidence intervals (CI) were set up for each factor. A value of RR greater than 1 indicates that statistical association exists between the factor (traction) and the disease. A 95% CI which does not include 1 was taken as statistically significant. The specific or proportional morbidity rates for workbulls and the months were calculated as described by Harnett and Murphy (1974), and Schwabe *et al.* (1977).

3.4 RESULTS

Majority of the ill-health conditions attended to occurred between March and October (Table 5) which corresponded with the beginning of rains when land clearing and cultivation start, to the end of rains when most farming activities come to an end. Bunaji breed constituted 91.0% of the cases, while Bokoloji and Rahaji breeds represented 8.7% and 0.3% respectively. The bulls which had an average tractive years of seven were aged between 2.5 and 9 years.

Of the 2,887 cases examined, 1,299 (45.0%) were traumatic conditions (whip wounds 12.9%, traumatic injuries caused by implements 9.3%, swollen necks 6.4%, nasal injuries 14.9%, and

tail fractures (1.5%; Table 6). Table 5 presents the month specific proportional morbidity rates of traumatic conditions and month specific RRs. Relative risks above 1 were obtained for the months of March through July. The month specific rates were also high for months of March (41.5%) through August (30.1%). This shows remarkable seasonality with a higher prevalence occurring during the (rainy) period of active farm work (Figs. 3,4 & 5).

The distribution of cases by breed is presented in Table 7. Significantly ($P<0.01$) high RR was obtained in the Bunaji breed when compared to the other breeds combined. Breed specific rates for traumatic conditions were highest in the Bunaji (33.4%), followed by Bokoloji (19.4%), and Rahaji (11.1%; Table 7). Workbulls were found to be 13.6 times more likely to have traumatic conditions (Table 6) than non-workbulls (Table 8) in the area. Prominent among disease conditions encountered in the workbulls were helminthiasis 24.4%; ecto-parasitism 22.2%, dermatophilosis (kirchi) 10.4%, anaplasmosis 4.2% and babesiosis 4.0%. Others include foot and mouth disease 1.8%, abscesses 1.1%, foot-rot 0.6%, and orchitis 0.2% (Table 6).

Table 5: **Monthly Prevalence of Traumatic and Non-Traumatic Disease Conditions of Workbulls (1994-1996)**

Month:	*Traumatic Disease Cases:*	*Non-Traumatic Diseases Cases:*	*Month Specific Rates:*	*RR:*	*95%*	*CI*
January	15	100	13.0	0.3	0.19	0.48
February	0	49	0	0	0	0
March	54	76	41.5	1.6	1.3	1.98
April	98	126	43.8	1.7	1.45	1.99
May	141	167	45.8	1.9	1.66	2.17
June	208	333	38.5	1.4	1.24	1.58
July	192	326	37.1	1.3	1.15	1.47
August	165	384	30.1	1.0	0.87	1.15
September	20	186	9.7	0.2	0.13	0.30
October	6	101	5.6	0.1	0.05	0.22
November	0	63	0	0	0	0
December	0	77	0	0	0	0

* TC = Traumatic conditions

Table 6: **The Prevalence of Traumatic Conditions and Other Diseases of Workbulls Between 1994 and *1996***

Disease:	1994:	1995:	1996:	Total:	%
Traumatic Conditions:					
Whip wounds	121	144	108	3730	12.91
Traumatic Injuries	82	119	68	269	9.3
Swollen Necks	42	79	64	185	6.4
Nasal Injuries	7	18	5	30	1.1
Tail Fractures	20	16	5	42	1.5
Non-Traumatic Conditions:					
Helminthiases	179	245	280	704	24.4
Ectoparasites	112	140	370	642	22.2
Dermatophilosis	61	137	103	301	10.4
Foot-and-Mouth Disease	10	41	0	51	1.8
Abscess	5	19	7	31	1.1
Foot Rot	3	13	0	16	0.6
Orchitis	5	2	0	7	0.2
Babesiosis	40	48	28	116	4.0
Anaplasmosis	57	30	33	120	4.2
Total	**744**	**1051**	**1072**	**2887**	

Table 7: The Prevalence of Traumatic and Other Disease Conditions in Three Breeds of Workbulls

Breed:	Traumatic Cases:	Non-Traumatic Cases:	Type Specific Rates:	RR:	95%	CI:
Bunaji	**876**	1750	33.4	1.06	0.98	1.14
Bokoloji	**49**	203	19.4	0.51	0.39	0.66
Rahaji	1	**8**	11.1	0.26	0.08	1.65
Total	**926**	1961				

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Table 8: Prevalence of Disease Conditions in Non-Workbulls (1994-1996)

Disease:	1994:	1995:	1996:	Total:	%
Helminthiases	109	173	115	397	33.6
Ectoparasites	105	149	98	352	29.8
Kirchi	55	87	79	221	18.7
Trauma	3	9	15	27	2.3
Foot-and-Mouth Disease	22	44	0	66	5.6
Abscess	1	2	0	3	0.3
Anaplasmosis	8	18	20	46	3.9
Babesiosis	10	16	43	69	5.8
Total	313	497	371	1181	

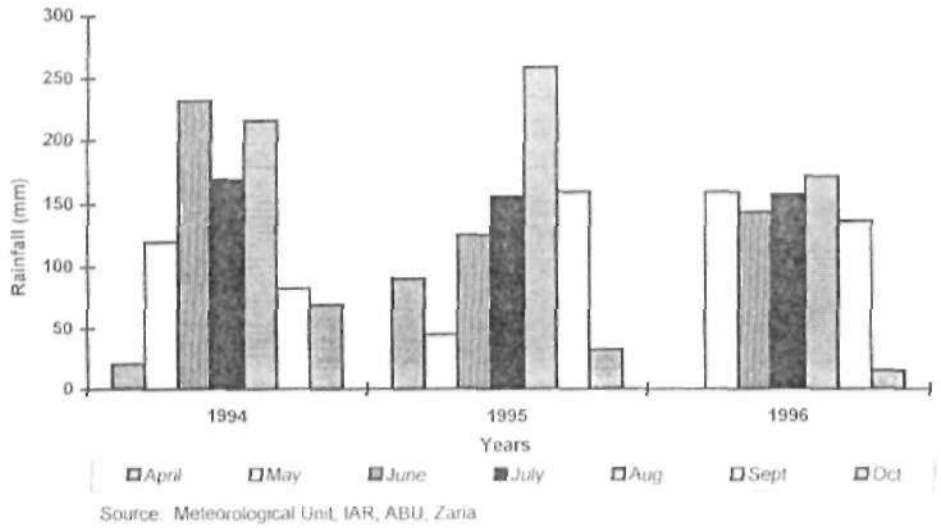
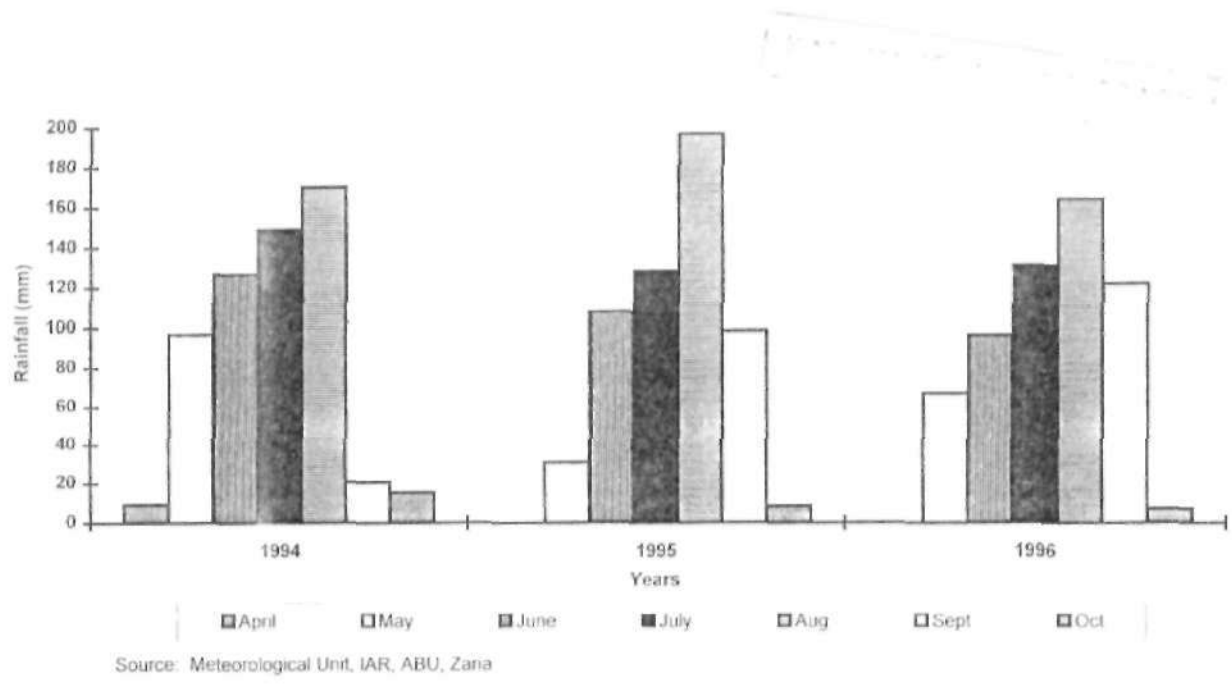


Fig. 1: Seasonal Rainfall Pattern, Soba, Kaduna State (1994-1996)



Source: Meteorological Unit, IAR, ABU, Zaria

Fig. 2: Seasonal Rainfall Pattern, Malumfashi, Katsina State (1994-1996)

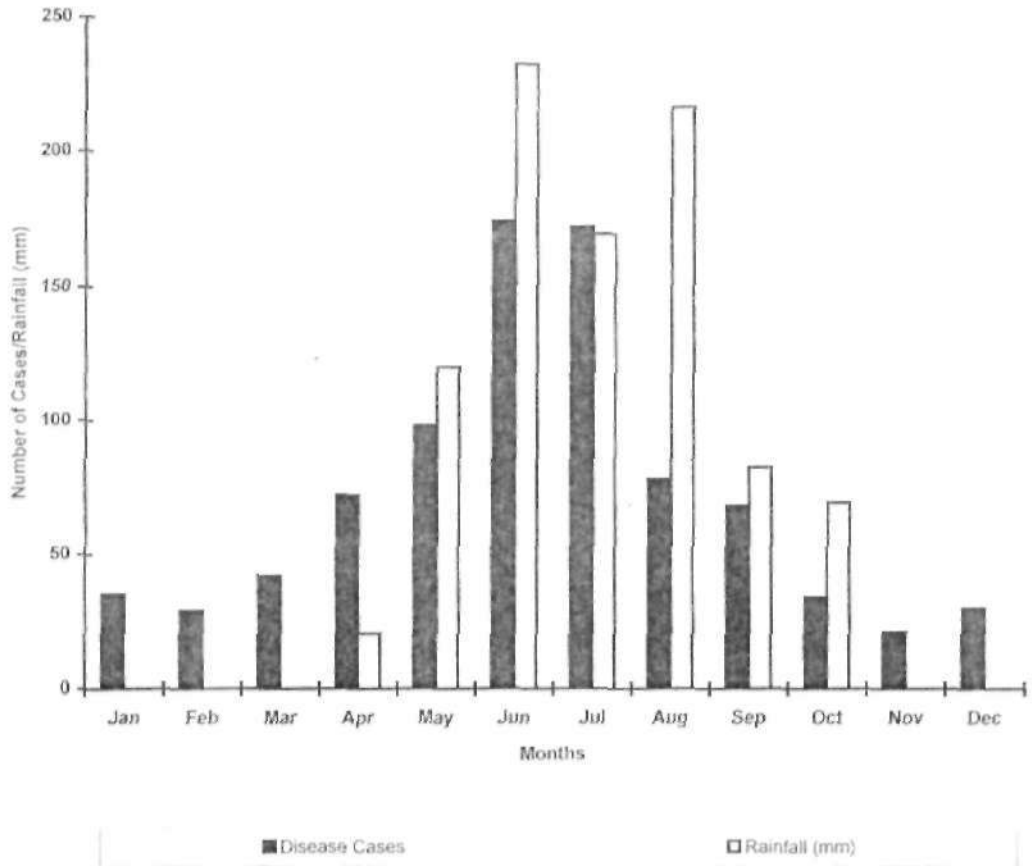


Fig. 3: Monthly Disease Prevalence in Workbulls and Rainfall Pattern for the Selected Areas in Kaduna and Katsina States (1994)

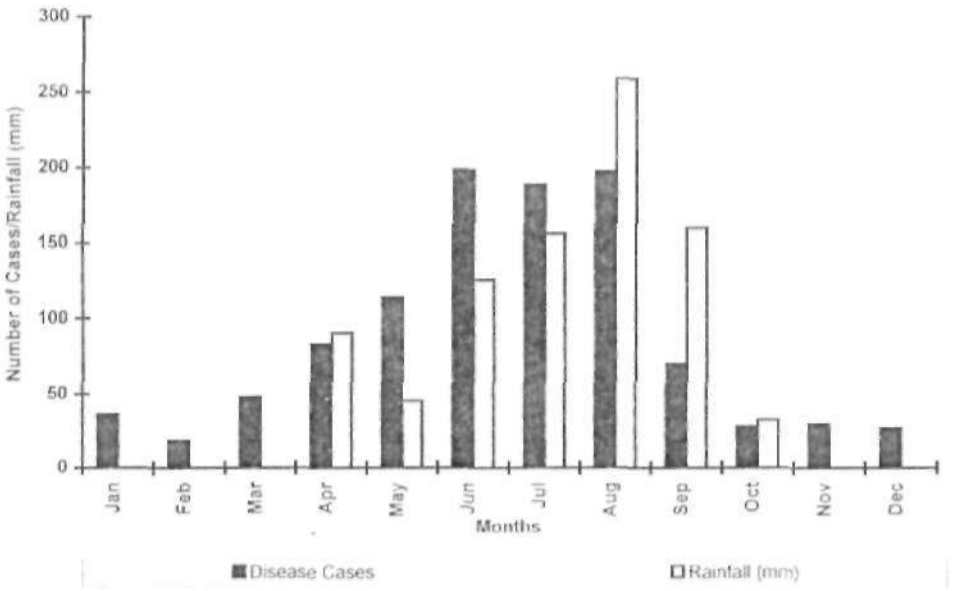
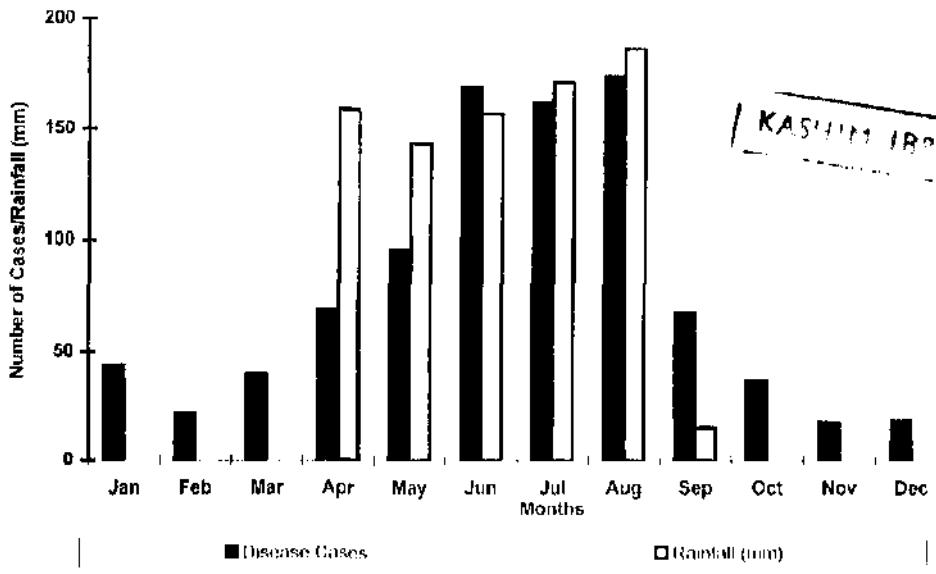


Fig. 4: Monthly Disease Prevalence in Workbulls and Rainfall Pattern for the Selected Areas in Kaduna and Katsina States (1995)



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Fig. 5: Monthly Disease Prevalence in Workbulls and Rainfall Pattern for the Selected Areas in Kaduna and Katsina States (1996)

3.5 DISCUSSION

Traumatic conditions accounted for 45% of the workbull disease cases (Table 6), and these were seen mainly around the humps and legs. The injuries were caused by the sharp cutting edges of the ridger when wrongly attached or detached from un-cooperating bulls. Fighting among the bulls also resulted in leg injuries and deep piercing wounds on the body. Whip wounds were caused by excessive and merciless whipping of the bulls by handlers especially on newly trained, sluggish, and un-cooperating bulls.

Tail fractures were observed mainly on highly temperamental bulls undergoing training. Some handlers sometimes resort to biting or manually squeezing the tail to force the unwilling bulls to work. This sometimes result in fractures. Nasal septum injuries on the other hand, were seen mostly on newly acquired bulls undergoing training. Bleeding does not result if the punching is outside the highly vascularized portion of the septum. Swollen necks (6.4%) were caused by friction between yoke and the neck as a result of working long hours on rough, rocky ground or when pulling extremely heavy load. The use of better yoke design and careful handling of bulls and their implements will help alleviate some of these traumatic conditions. Helminthiasis and ecto-parasitism accounted for 24.4% and 22.2%, respectively. These problems are insidious and occur seasonally affecting livestock mainly during the rainy season. They cause considerable losses due to weight loss, damage to hides, poor production, and sometimes death (Maina, 1986; Voh (Jr) *et al.*, 1993).

Dermatophilosis, a debilitating skin disease (Macadam, 1970; Oduye, 1975; Bida and Dennis, 1976) accounted for 10% of the cases. Although no previous reports looked at composite diseases

of work bulls in northern Nigeria, several reports on cattle diseases abound. Bida and Dennis (1976) on dermatophilosis, Maina (1986) and Voh (Jr) *et al.* (1993) on prevalence and seasonality of diseases of cattle kept under traditional agropastoral system are all in close agreement with the findings of the current study.

Majority of the farmers in the study area used only the Bunaji breed (91%) for traction because of their availability, large size and docility (Otchere *et al.*, 1986).

3.6 CONCLUSION

It is concluded from the study that traumatic conditions and other debilitating diseases of workbulls in the area showed remarkable seasonality in pattern with higher prevalence occurring during the period of active farm work i.e. rainy season. While Bunaji, the most dominant breed in the area was observed to be the most commonly used by farmers for traction.

CHAPTER FOUR

4.0 HEMATOLOGICAL AND SERUM BIOCHEMICAL CHANGES IN WORKBULLS

4.1 ABSTRACT

Thirty six Bunaji workbulls derived from 18 agropastoral farmers were used to investigate hematological and serum biochemical parameters before and immediately after strenuous ridging activity.

Significant ($P<0.01$) elevations in hematological parameters (RBC, PCV, Hb, WBC and neutrophils) were observed. Decrease in erythrocyte indices; MCV, MCH and MCHC were insignificant ($P>0.05$), while neutrophilia with lymphocytopenia and eosinopenia were observed, indicating stress. There were also significant ($P<0.01$) elevations in chloride, BUN, creatinine and total protein. However, the increase in sodium and albumin were insignificant while bicarbonate and potassium levels decreased immediately after work.

4.2 INTRODUCTION

The blood picture of workbulls under traditional mixed farming systems is of interest in view of their seasonal use to provide mobile work energy for cultivation and transportation (Thomas *et al.* 1990). Hematological parameters of many breeds of cattle in Nigeria have been determined (Rose, 1960; Oduye and Fasanmi, 1971; Oduye and Okunaiye, 1971; Saror and Coles 1973a; 1973b; 1975; Akerejola *et al.*, 1980; Gbodi and Chechet, 1981; Oyedipe *et al.*, 1984 Gbodi *et al.*,1989). Many of these parameters are known to be influenced by such factors as age, breed,

sex, seasonal variations, lactation and pregnancy (Schalm *et al.*, 1975). Few studies however, have been carried out on the hemogram and serum biochemical levels of working bulls to establish effect of exercise and work. These parameters are important in order to determine normal values and thus detect any deviations suggestive of disease or abnormal conditions.

The purpose of this work was to document baseline values for hematological changes occurring in Bunaji workbulls before and immediately after strenuous ridging farm work.

4.3 MATERIALS AND METHODS

4.3.1 Workbulls Used

Thirty six Bunaji workbulls aged 3-7 years belonging to 18 cooperating agropastoral farmers were used for this study. They were distributed within Giwa LGA (Shika, Mahuta, Unguwar Galadima villages) and Soba LGA (Yazzara village) of Kaduna State. Each bull was dewormed with Nilzan(R) bolus (*2g d, 1-tetramisole and 1.4 oxyclozanide*), vaccinated against Contagious bovine pleuro-pneumonia, Rinderpest and Blackquarter. They were also given routine acaricide bath.

4.3.2 Blood and Fecal Sampling

Blood and fecal samples were examined for parasites. Two blood samples were collected from each animal before ridging commenced to determine resting values, and another 5-10 minutes post-ridging. A total of 36 samplings were done. In each case, 20ml of blood was collected through jugular by venipuncture. Three millilitres were put in Bijou bottles containing disodium salt of ethylene diamine tetraacetic acid (EDTA) for haematological analysis. Three millilitres were put in fluoride oxalate tubes for blood glucose estimation and the remainder in plain sterile

universal tubes (without anticoagulant) for serum extraction. Samples for haematology and glucose determination were transported to the laboratory on ice packs. The serum was harvested soon after clot formation to minimise the movement of potassium and inorganic phosphate ions across the cell membrane. The serum was frozen until used for biochemical determinations.

4.3.3 Analyses

The packed cell volume (PCV) was determined using hawksley micro-haematocrit centrifuge. Total erythrocytes and leucocytes (WBC) were determined using coulter counter. Haemoglobin concentration (Hb) was estimated using coulter haemoglobinometer. Differential counts were carried out on Giemsa-stained thin smears by direct microscopic counting of 100 leukocytes. The erythrocyte indices, i.e. mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), and mean corpuscular volume (MCV) were calculated from the PCV, Hb, and RBC values.

The serum was analysed for sodium, potassium, chloride, inorganic phosphate, bicarbonate, urea, creatinine, total protein, and albumin contents using the SMA 12/60 Auto analyser *(Technicon, Ireland Ltd, Dublin,)*. Rectal temperatures (°C) of the workbulls were taken at rest and 5-10 minutes after work. The results obtained were subjected to statistical analysis using the paired t-test method.

4.4 RESULTS

The thirty six Bunaji workbulls sampled were apparently clinically normal and fit. Their rectal temperature, pulse, heart, and respiratory rates were within the normal range for clinically normal

cattle. The results of haematological and serum biochemical changes are presented in Tables 9 and 10, respectively.

There were significant increases ($P < 0.01$) in RBC, Hb, PCV, WBC and neutrophils. Decrease in MCV, MCH and MCHC were insignificant ($P > 0.05$). Lymphocytes and eosinophils were slightly reduced ($P > 0.05$) while monocytes were slightly increased ($P < 0.05$). Significant increases ($P < 0.01$) in the levels of chloride, BUN, creatinine, and total protein occurred immediately after ridging (Table 10). Whereas the bicarbonate and potassium levels were decreased insignificantly ($P > 0.05$), the levels of sodium, phosphate, and albumin were slightly increased ($P < 0.05$). Blood glucose level, however, decreased insignificantly ($P > 0.05$).

There was a significant increase ($P < 0.01$) of 0.8°C in rectal temperature (38.7 $\pm$0.4°C before to 39.5 $\pm$ 0.5°C after ridging).

4.5 DISCUSSION

The results of this study have indicated significant elevations in RBC, Hb, PCV, and WBC immediately after strenous farm work (ridging). Similar changes have been reported in draught cattle following stressful exercise (Bhatnagar and Upadhyay, 1991; Anil and Thomas, 1994).

Table 9: Mean Haematological Values of Thirty Six Workbulls Before and after Ridging Work

Parameter:	Before Ridging:	After Ridging:	Significance Level:	P Value: *
RBC x 10^{12} L^{-1}	6.71 ± 0.98	7.21 ± 0.98	15.14	P<0.01
Hb g L-1	100.69 ± 2.11	110.40 ± 1.95	7.27	P<0.01
PCV %	31.41 ± 6.45	33.22 ± 6.45	13.84	P<0.01
MCV fl	47.16 ± 6.58	46.31 ± 6.44	-3.67	P>0.05
MCH pg	16.19 ± 1.78	15.86 ± 1.67	-3.59	P>0.05
MCHC g L-1	340.66 ± 2.79	340.51 ± 2.49	-1.01	P>0.05
WBC x 10^{9} L^{-1}	10.69 ± 2.65	13.03 ± 2.65	12.50	P<0.01
Neutrophils %	20.82 ± 6.06	28.52 ± 6.87	10.31	P<0.01
Lymphocytes %	69.85 ± 5.11	54.93 ± 5.21	-23.83	P>0.05
Monocytes %	0.87 ± 2.17	0.96 ± 1.43	0.56	P>0.05
Eosinophils %	10.85 ± 2.96	7.32 ± 2.80	-12.79	P>0.05

* Significant at P<0.01

Table 10. Mean Serum Biochemical Values in Thirty Six Workbulls Before and after Ridging Work

Parameter:	Before Ridging:	After Ridging:	Significance Level:	P Value: *
Na^+ mmol L^{-1}	144.97 ± 2.42	145.67 ± 1.84	1.07	P > 0.05
K^+ mmol L^{-1}	4.91 ± 0.66	4.64 ± 0.59	90.03	P > 0.05
Cl^- mmol L^{-1}	96.59 ± 2.57	99.51 ± 1.66	7.26	P < 0.01
PO_4^- mmol L^{-1}	1.72 ± 0.26	1.79 ± 0.21	2.02	P > 0.05
HCO_3^- mmol L^{-1}	33.44 ± 5.80	31.59 ± 6.56	3.40	P > 0.01
BUN mmol L^{-1}	2.94 ± 1.16	6.30 ± 0.70	4.80	P < 0.01
Creatinine μmol L^{-1}	64.52 ± 12.32	84.39 ± 9.08	15.63	P < 0.01
Total Protein g L^{-1}	87.75 ± 6.05	91.06 ± 6.24	8.36	P < 0.01
Albumin g L^{-1}	43.22 ± 5.78	44.25 ± 4.23	2.15	P < 0.05
Glucose mmol L^{-1}	2.30 ± 3.24	2.04 ± 2.89	-15.68	P > 0.05

* Significant only at P < 0.01

There were slight decreases in MCV, MCH, and MCHC following exercise. In horses, a significant decrease in MCH and MCHC with no change in MCV following stress has been reported by Rose and Hodgson (1982). Since bovine erythrocytes mature in the bone marrow before reaching circulation, it is not likely that there would be a release of immature erythrocytes into the circulation following excitement, stress, or exercise (Pearson and Archibald, 1989). The increase in RBC, Hb, and PCV may be due to haemoconcentration caused by severe sweating following stressful ridging activity that the bulls were subjected. These alterations were probably due to increased adrenaline output causing splenic contraction and release of erythrocytes into the peripheral circulation (Coles, 1980).

Muscular exercise influences total and differential leukocytes counts (Kaneko, 1989). This also applies to cattle where leukocytosis is expected with increased severity of stressful work. In this study, a significant leukocytosis was observed immediately after work with neutrophils dominating ($P<0.01$). Vigorous exercise in working bulls is reported to provoke the release of endogenous glucocorticoids particularly cortisol and also adrenalin (Bush, 1994) which produce a response of temporary leukocytosis with neutrophilia, lymphopenia, and eosinopenia similar to what was observed in race horses (Rossdale *et al.*, 1982) indicating stressful conditions (Tietz, 1976).

The insignificant increase in sodium and chloride levels following work may suggest the release of aldosterone during exercise which causes retention of these elements (Narinder *et al* 1980) resulting in little or no marked losses in sweat. It also appears that the state of intra- and extra-cellular hydration was normal and the slight but insignificant decrease in potassium level may

imply that there was no undesirable movement of the ions across the cell membrane since there was no apparent dehydration, electrolyte losses, or muscle damage which may be indicated by significant increase in serum potassium.

The increase in the levels of blood urea nitrogen, creatinine and inorganic phosphate may be due to the breakdown of creatinine phosphate, a major source of energy to creatinine and phosphate which is consistent with changes that occur during strenous exercise in such animals (Lording and Friend, 1991). Also, under such conditions, the increased production of these serum constituents, may be attributed to reduced hepatic and renal perfusion, as a result of redistribution of blood flow to active muscles (Murphy and Henry 1979). While the changes in total protein and albumin levels may reflect high protein diet (Bush, 1994). The decrease in bicarbonate levels may be related to the buffering of the lactic acid produced during exercise and also to the sustained loss of carbon dioxide in respiration, about 95% of which is contributed by bicarbonate (Narinder, *et al* 1980). Blood glucose levels may have decreased because exercise is reported to cause a relatively fast decrease in blood glucose concentration and an increase in lactic acid concentration (Bhatnagar and Upadhyay, 1991).

The rise in mean rectal temperature following 4 hours work was 0.8°C (38.7±0.4°C to 39.5±0.5°C). This is in agreement with observations of Anil and Thomas (1994) and Cole and Steinbach (1996).

4.6 CONCLUSION

In this study physiological reactions, haematological and serum biochemical parameters did not

change beyond physiological limits indicating no physical or functional damage done to the body, which is in agreement with earlier reports of Acharya *et al.* (1979) and Upadhyay and Madan (1985).

CHAPTER FIVE

5.0 RIDGING CAPACITY OF BUNAJI WORKBULLS IN THE FARMING SYSTEMS OF NORTHERN KADUNA STATE

5.1 ABSTRACT

Thirty six Bunaji workbulls aged 3-7 years belonging to 18 agropastoral farmers within Giwa and Soba Local Government areas of Kaduna State were used for this study. The bulls mean weight at the start of the study was 381.80 ± 60.1 kg and 372.39±38.72 at the end of experiment. Their ridging speed on a plain rain fed soil was 0.90±0.11 m/s while the area ridged was 0.23 ha/hour (1 ha/4.35 hours). The bulls worked an average of 6.16 ± 1.67 hours/day during the period of active land preparations for planting (May - July). Most farmers used the bulls for about four planting seasons before they were replaced. Commonly used ridgers in the area were Emcort(R) 45%, locally fabricated 45% and Kasco(R) 10%. The ridgers mean weight was 35.4 ± 4.5 kg.

5.2 INTRODUCTION

Several types of power sources are used for both on-farm and off-farm agricultural activities during the wet and dry seasons. Animal power, unlike mechanical or electric devices, is basically a biological system which is influenced by many factors like breed, age, sex, nutrition, health status, environment, duration of work/day, and the handler (Kaul, 1990; Matthewmann *et al.*, 1990). Also, the design and selection of an appropriate animal drawn implement depends on the magnitude of the power expected from a particular class of animal (Iversen, 1987).

Animal power can be used for several purposes including mobile operations like transportation,

ploughing, harrowing, and ridging (Thomas *et al.*, 1990). Lawrence (1986) described the methodology for calculating the amount and duration of work that could be expected from a workbull on particular diets if the animal is not to lose weight. Starkey (1981) found that well fed oxen could work 4-5 hours per day for 5 days a week and that the more work an animal performs, the more efficient it is.

Very few studies have been conducted in northern Nigeria to determine the draught capabilities of workbulls (Musa, 1978; Adeoti, 1990). Therefore, this study was aimed at finding out the ridging performance of indigenous Bunaji workbulls during the planting seasons under conditions of savanna farming systems.

5.3 MATERIALS AND METHODS

5.3.1 Workbulls used

Thirty six Bunaji bulls aged 3-7 years belonging to 18 cooperating agropastoral farmers were used for this study. They were distributed within Giwa and Soba LGA of Kaduna State between June 1994 and December 1996.

5.3.2 Baseline Treatment

Each bull was dewormed, with Nilzan$^{(R)}$ bolus (2g d, l-tetramisole and 1.4 oxyclozanide) vaccinated against Contagious Bovine Pleuro-Pneumonia, Rinderpest and Blackquarter. They were also given routine acaricide bath. Blood and faecal samples were taken for parasitological analysis. Information on the type of implements, training and average working years before the bulls are sold off were obtained.

The work parameters measured were (a) distance travelled which is measured as length of furrow in (metres) x the number of field passes using a measuring tape, (b) ridging speed determined using a stop-clock, (c) and the area ridged as determined by width x length per day (Ndlovu *et al.*, 1996).

The implements were weighed using the Salter(R) hanging balance. Body weights were estimated by measurement of the chest girth. The age of the animals was based on the farmers' estimation and the dental erruption pattern was used for confirmation.

Statistical analysis was by the paired t-test method.

5.4 RESULTS

Some observations made during the study are summarised in Table 11. The bulls aged 3 - 7 years with live weights in the range of 381.80 ± 60.01 kg at the start of the study and 372.39 ± 38.72 kg at the end were not castrates and had been trained for draught work for at least 2 years prior to the start of this study. The useful ridging capacity of the bulls working 6 hours/day was 0.23 ha/hour. Free grazing, some with concentrate supplementation and watering were allowed during the non-working hours.

Table 11: Working Capacity of Workbulls

Ridging Speed: (m/s)	Ridging Capacity: (ha/hr)	Working Capacity: (hrs/day)	Tractive Period Before Disposal: (Years)
0.90 ± 0.11	0.23	6.15 ± 1.67	<7

5.5 DISCUSSION

Ridging capacity in this study, was taken as the total size of an area ridged within a specified time period (Bathaglia and Mayrose, 1981; Ndlovu *et al.*, 1996). All the bulls used in this study had been trained as draught animals for at least 2 years before the onset of the study and had worked regularly since then. They were all thoroughly familiar with the implements.

Working capacity of any working animal depends on the animal, the harness used, the type of implement used, the nature of soil, and the skill of the handler (Anon, 1994; Bathalomew *et al.*, 1994). Power produced by animals varies according to the tractive effort and speed of travel that can be sustained. The use of work units (force x distance) in some classifications, and time for others does not allow for accurate calculation of energy needs. Energy requirements of an animal for work vary directly with the amount of power produced (Goe, 1983; Agarwal, 1995). Power, though not calculated in this study, is the rate at which work is performed and calculated using two components; (a) power as "force x speed", and (b) that the faster the rate of work, the more power is needed (Mathews, 1987).

Most of the bulls worked an average of 6 hours/day, 3-4 times/week during the period of active land preparation for planting. They were allowed free grazing, watering, and rest afterwards. Intact bulls were mostly used by farmers for draught during the rains and some were returned to breeding herds after the farm work period.

Although workbulls can be easily maintained by the rural populace, most farmers used them only for a maximum of 4 or less planting seasons before replacement by younger ones because of the

fear of thieves hunting for fat bulls. Unlike highly sophisticated machines, only two types of animal drawn implements are used in the area studied. "Gimbiya" (Emcort[R]) together with the locally fabricated ridgers and the cart are very much understood and appreciated by most farmers.

The acquisition of a good set of workbulls in the area can raise farmers' social standing and economic status and has helped increase agricultural productivity, rural farm income, and boosted the locally available implement fabrication industry.

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CHAPTER SIX

6.0 SURVEY OF FEED SUPPLEMENTS AND FEEDING REGIMENS OF WORKBULLS IN PARTS OF KADUNA AND KATSINA STATES

6.1 ABSTRACT

Workbulls weighing over 250kg are supplemented with one head-panfull (3.5-6.5kg) of a combination of locally available agro-industrial by-products 3 times daily during the late dry season and early rains to prepare and maintain the animals for farm work. The agro-industrial by-products widely used in various proportions include: Sorghum threshed panicle ("kaikayi"), maize, millet and sorghum bran ("dussa"), rice offal ("bunu"), locust bean powder ("garin dorawa") and undelinted cotton seed ("gurya"). Cotton seed cake where available is however given singly for bulls engaged in long duration work. Groundnut haulms and cowpea vines, leaves and husks ("harawa") are mainly used for dry season feeding in addition to other grain crop residues.

6.2 INTRODUCTION

In northern Nigeria, most cattle enter the farming season (beginning of rains) in a poor body condition due to inadequate dry season feeding (Macfarlane and Bunn, 1988). Most draught animals are kept predominantly on crop residues in the dry season and natural grazing during the rains. The influence of improved roughage quality and graded levels of supplementation on the work output of draught animals in the area is of little relevance (Alhassan, 1990).

The inclusion of available agro-industrial by-products in workbull rations has often resulted in

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increased feed intake and faster liveweight gains (Alawa and Umunna, 1993). However, only a limited number of farmers provide supplementary feeding to ensure that bulls are in a good condition for work when rains set in (Alhassan, 1990). Reports indicate that not more than 20% of the agro-industrial by-products should be fed to avoid creating a substitution effect for the basal straw diet (Owen *et al.*, 1969; Pickard *et al.*, 1969). The abundance of crop residues and agro-industrial by-products in the area make them cheap sources of nutrients for ruminants, although they are said to be generally low in nutrients (Nicholson, 1984). It is however, important to ensure adequate feeding in order to enhance the productivity of bulls.

This survey was therefore undertaken to document the available feed supplements and feeding regimens of workbulls in the area.

6.3 MATERIALS AND METHODS

Workbull farmers in the area were interviewed for the types of feed supplements and feeding regimens used for the bulls. A Salter$^{(R)}$ measuring scale was used to measure the types and quantities of feed supplements given to the bulls. Water intake was estimated in litres.

6.4 RESULTS

Most of the farmers interviewed admitted giving feed supplements to their workbulls (Table 12). One head-panfull ("kongiri") of feed supplements weighing 3.5-6.5 kg was given 3 times daily (morning, afternoon, and evening) to the bulls weighing over 250 kg. Sorghum threshed panicle ("kaikayi") and bran ("dussa") which are usually given singly or in combination were the most widely used by the farmers. The bran ("dussa") is a by-product of hand or machine milling of the

food grains. The two products served as the basal ration for mixing with any of the locally available agro-industrial by-products. They are usually combined in various proportions depending on availability. Rice offal ("buntu") is also gaining acceptance by farmers and appears to be the cheapest of all. It is mainly given as a mixture with either "kaikayi" or "dussa", although it can be fed alone. Locust bean seed powder ("garin dorawa") is not widely used compared to the others because of problem with availability and its powdery nature. As such, it is usually given in combination with other materials and has to be sprinkled with water to avoid aspiration of particles which would lead to cough. Undelinted cotton seed ("gurya") and cotton seed cake, where available, are given alone to bulls engaged in long duration work. The average water intake per day was 56.53±6.66 litres.

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Table 12: **Types of Locally Available Agro-industrial By-products Given as Supplements to Workbulls**

Local Name:	Description:	Weight per *Tiya* *(Kg):	Quantity per *Feeding* ♪ (Kg):
Kaikayi	Sorghum threshed panicle	0.7	3.5
Buntu	Rice Offal	0.9	4.5
Dussa	Grain Bran	0.9	4.5
Gurya	Undelinted Cotton Seed	1.3	6.5
Kowan Wake	Cowpea Husks	0.6	3.0
Garin Dorowa	Locust Bean Seed Powder	0.8	4.0

* Local measure
♪ Usually fed in combination

6.5 DISCUSSION

Supplementing workbulls during late dry season and early rains is widely practiced by farmers. The abundance of crop residues and agro-industrial by-products especially during dry season make them very cheap sources of nutrients for ruminants. Farmers used locally available agro-industrial by-products for supplementing their workbulls but in different proportions. These supplements, they claimed, were meant to strengthen the knees of the bulls and at the same time boost their development. The use of bran ("dussa") and sorghum threshed panicle ("kaikayi") either in combination or singly topped the list of the agro-industrial by-products usage. "Dussa" is an all year round available grain by- product which forms bulk of the supplements. Rice offal ("buntu") though seasonal in occurrence may be used in place of bran ("dussa") because it costs less. Undelinted cotton seed ("gurya"), a high protein source, is obtained from ginneries and fed mainly to animals engaged in long duration work. It is claimed by some farmers that too much of "gurya" causes sluggishness and non-performance in bulls. In some parts of Kano state, workbull owners resist the feeding of concentrate supplements like cotton seed cake or bran because they do not want their animals to be fattened. They claimed that fattened bulls are lazy and sluggish (Badawi, 1990). Agro-industrial by-products have been used for a long time in cattle production for fattening and also to avoid the annual weight loss of cattle during the 5-6 months dry season in the northern parts of Nigeria.

CHAPTER SEVEN

7.0 CONCLUSION

It is concluded from the study that traumatic conditions and other debilitating diseases of workbulls in the area showed remarkable seasonal pattern of occurrence with higher prevalence during the period of active farm work i.e. rainy season. While Bunaji, the most predominant breed in the area, was observed to be the most widely used by farmers for traction.

Physiological reactions, haematological and serum biochemical parameters did not change beyond physiological limits indicating no physical or functional damage done to the animals' body. Also with adequate and good quality feeding, Bunaji workbulls were able to ridge 0.23 hectres of farm land per hour. This therefore indicates that acquisition of a good set of workbulls in the area can help increase agricultural productivity, raise rural farm income and boost the locally available implement fabrication industry.

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7.1 Recommendations

To obtain maximum benefits from the use of workbulls the following recommendations are made:

a) *Provision of adequate and good quality feed, water and shelter*

b) Careful handling of bulls both at work and when applying or removing the implements to prevent causing traumatic injuries

c) Routine inspection of bulls to treat any abrasions and wounds

d) Routine vaccinations against major cattle epidemic diseases such as rinderpest, contagious bovine pleuro-pneumonia and blackleg.

e) *Routine deworming and deticking*

f) Trimming of sharp pointed horns to prevent deep piercing wounds resulting from fights

g) Selection of bull pairs to match in size, height and weight for balancing

h) Adequate training of bulls for easy handling

i) Use of proven implements

j) Workbulls should not be over-worked to prevent stress/fatigue

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