PARTICIPATORY EPIDEMIOLOGY AND SEROPREVALANCE OF BOVINE BRUCELLOSIS IN NGURU LOCAL GOVERNMENT AREA, YOBE STATE, NIGERIA.

BY

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MARCH, 2016

DECLARATION

I declare that, the work in this Dissertation entitled **" Participatory Epidemiology and Seroprevalence of Bovine Brucellosis in Nguru Local Government Area of Yobe State, Nigeria''** has been carried out by me in the Department of Veterinary Public Health and Preventive Medicine, Faculty of Veterinary Medicine, Ahmadu Bello University Zaria Nigeria. The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this dissertation was previously presented for another degree or diploma at this or any other Institution.

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Name of Student Signature Date

CERTIFICATION

This Dissertation entitled **'PARTICIPATORY EPIDEMIOLOGY AND SEROPREVALENCE OF BOVINE BRUCELLOSIS IN NGURU LOCAL GOVERNMENT AREA OF YOBE STATE, NIGERIA"** by Salamatu Habu DISA meets the regulations governing the award of the degree of Master of Veterinary Public Health and Preventive Medicine of the Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This research work is dedicated to my lovely parents, Alhaji Habule Disa, Hajiya Maryam Habule Disa and to my compassionate husband Muhammad Dauda and my two little angels Aisha (Eesha), Khalil Muhammad Dauda for their support and love throughout my study period.

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TABLE OF CONTENTS

0

LIST OF TABLES

Table	Title	Page
4.1	Livestock species population in relation to cattle population as Determined through ranking in selected villages of Nguru Local Government Area of Yobe State, Nigeria.....	42
4.2	Important cattle diseases as determined through pairwise Comparative ranking in selected of Nguru Local Government Area of Yobe State, Nigeria…….	44
4.3	Mean proportion of cattle disease morbidity and mortality during The preceding 12 months period in selected villages of Nguru local Government areas of Yobe State, Nigeria…….	47

4.4	Disease matrix impact scoring of clinical signs and cattle diseases As indicated by rural farmers in Nguru Local Government Area of Yobe State, Nigeria…….	49
4.5	Summarized season scoring of cattle diseases as indicated by farmers In Nguru Local Government, Yobe state, Nigeria……	51
4.6	Prevalence and Sex specific rate based on cELISA……	55
4.7	Prevalence and Sex Specific rate using RBPT……	56
4.8	Prevalence and Age specific rate using cELISA……	57
4.9	Prevalence and Age Specific rate using RBPT… ……..	58
4.10	Prevalence of Brucellosis by RBPT and CELISA Test from selected Villages of Nguru local Government Yobe State, Nigeria……..	60
4.11	Demographic information of respondents in the study area……	63
4.12	Herd profile of cattle in the study areas…….	64
4.13	Percentage of other species of animals reared by cattle farmers as Indicated by respondents in four village of Nguru local Government Area Yobe State, Nigeria……..	65
4.14	Major clinical signs of Brucellosis as indicated by respondents In four Nguru local government areas Yobe State Nigeria……	66
4.15	Method of treatment employed by respondents…… ……	67

LIST OF FIGURES

Figure	Title	Page
3.1	Map of Nguru Local Government Area showing the study Area for Participatory Epidemiology and Serology……	26

LIST OF PLATES

Plate	Title	Page
I	Semi-structured interview at Kogga village, Nguru Local Government Area of Yobe State, Nigeria……	29
II	Proportional piling of livestock species population in Dumsai Village of Nguru Local Government of Yobe State…	41

III	Pairwise comparison ranking of common cattle disease in Hadari village of Nguru Local Government of Yobe State……	43
IV	Proportional piling exercise of major cattle disease in Dumsai Village of Nguru local Government of Yobe State, Nigeria…	45
V	Proportional piling exercise to show relative morbidity And Mortality of Brucellosis and other cattle diseases in Hadari village Of Nguru Local Government of Yobe State, Nigeria……	46
VI	Disease matrix impact scoring of cattle diseases and their Cinical signs in Kogga village of Nguru Local Government of Yobe State, Nigeria……..	48
VII	Seasonal scoring of cattle diseases in Dumsai village of Nguru Local Government of Yobe State…….	50
VIII	Elisa plate showing positive samples……	54

LIST OF APPENDICES

Appendix	Title	Page
I	Checklist for Participatory disease surveillance of Brucellosis….	87
II	Clinical case definition of Brucellosis for this study……..	89
III	Questionnaire on awareness of Brucellosis among Fulani Herdsmen in the study area…….	90

LIST OF ABBREVIATION AND SYMBOLS

PE: Participatory Epidemiology

PDS: Participatory Disease Surveillance

PDR: Participatory Disease Response

PRA: Participatory Rural Appraisal

EVK: Existing Veterinary Knowledge

PAVE: Participatory Approaches to Veterinary Epidemiology

PARC: Pan African Rinderpest Compaign

FMD:	Foot and Mouth Disease
CBPP:	Contagious Bovine Pleuropneumonia
FAO:	Food and Agricultural Organisation
AU-IBAR:	African Union/ Interafrican Bureau for Animal
OIE:	Office Internationales des Epizooties (World Organisation for Animal Health)
PA:	Participatory Appraisal
ILRI;	International Livastock Research Institute
HPAI:	Highly Pathogenic Avian Influenza
ERIC:	Enterobacterial Repititive Intergenic Consensus
RBPT:	Rose Bengal Plate Test
ELISA:	Enzyme Linked Immunosorbent Assay
SAT:	Serum Agglutinatination Test
MRT:	Milk Ring Test
SSI:	Semi-Structured Interview
CAHW:	Community-based animal health worker
SPSS:	Statistical Package for Social Science
OPD:	Optimal Density

ABSTRACT

Formal system of enquiries is of limited value when working with rural communities in developing countries. This research used alternative system of inquiry and learning that involved the application of participatory epidemiology (PE) techniques to collect existing veterinary information about brucellosis in rural areas. Participatory epidemiology methods which include semi-structured interview, proportional piling, ranking and scoring method, seasonal calendar were used on 12 informant groups in 12 selected villages of Nguru Local Government Area of Yobe State, Nigeria to understand the local perception of cattle disease signs, disease causes, prevalence, seasonal patterns of disease and indigenous control and treatment methods. Participatory epidemiology data were subjected to descriptive statistics, Friedman's test and Kendall's coefficient of concordance to determine the level of agreement between informant groups, while chi-square, Fishers exact test were used to measure associations between sex, age and seroprevalence. Results indicated that cattle constituted the largest proportion of livestock kept and the local characterization of cattle disease called *Bakali* (Brucellosis), *Baur*u (FMD), *Samore* (Trypanasomiasis), and *Ottu* (CBPP) by local farmers are consistent with modern veterinary knowledge on Brucelosis, FMD, Trypanasomiasis and CBPP respectively. Brucellosis is the second most important, a stripe by knife on the skin using fire is the traditional remedy used in the prevention of brucellosis. In addition, 365 serum samples were collected from unvaccinated cattle raised under extensive system of management. The sera were tested by Rose Bengal Plate test as a screening test and competitive Enzyme linked immunosorbent assay c-ELISA as confirmatory test. Information on management practices was obtained from cattle owners using a structured questionnaire. An overall prevalence of 9.6 % (35/365) by cELISA and 10.7% by RBPT was obtained in this study. The specific seroprevalence of

9.5% was obtained in females and 10.8% in the male cattle tested with cELISA while 10.4% was obtained in females and 18.9% in the male cattle tested with RBPT. The age band greater than 10years recorded the highest (25.0%) specific seroprevalence and the least 6.9% in age band 1-5years. There was no statistical significant difference ($p < 0.05$) between the sexes while there is a statistically significant association between age ($p < 0.05$) and occurrence of brucellosis in the study. There were differences in infection rates in the study areas, with highest prevalence rate obtained in Nguru cattle market (17.4%), followed by Kogga and Dabule (16.0%). There was low level of education, low patronage of veterinary services and lack of vaccination against brucellosis were observed among the Fulani herdsmen.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Participatory epidemiology (PE) is an emerging branch of veterinary epidemiology which is based on the use of participatory rural appraisal (PRA) techniques for the harvesting of qualitative epidemiological intelligence contained within communities based on observations and existing veterinary knowledge and methods of Participatory Rural Appraisal (PRA) (Catley and Mariner 2002). In some contexts, PE is used in a very similar way to Participatory rural appraisal but focuses on animal health issues rather than taking a broad view of problems in a given community (as is the case with PRA). At other times, PE is used to work with communities to study specific disease problems and identify best-bet solutions (Catley 2005). The emergence of rapid rural appraisal (RRA), PRA and the wider group of participatory learning approaches was intended to improve the relevance and impact of development on poor people.

A wide range of PE methods are available and these methods can be categorized into three main groups that include informal interviews, visualization methods, ranking and scoring methods. Information derived from different methods is cross-checked or 'triangulated' in a similar way that a clinician combines information from different sources to make a diagnosis (Catley 2005).

Brucellosis is one of the most important and highly contagious zoonoses caused by the bacterium *Brucella*, which can affect a wide variety of animals including cattle, pigs, sheep, goats, horses, and dogs. *Brucella* organisms can be present in aborted feotuses, foetal fluids, placentas, vaginal discharges and also in milk, meat, urine, blood, and

semen (Fensterbank 1987, Junaidu *et al.,* 2006, Kevin and Nancy, 2009, Salihu *et al*., 2011).

Brucellosis is caused by fastidious, intracellular, non-spore forming, non-motile, non-capsulated, gram negative coccobacillus (or short rod) bacterium of genus *Brucella* which contain nine well defined species. (Sammartino *et a*l., 2005; Zygmunt *et al*., 2009).

Transmission of the *Brucella* organisms among cattle is through ingestion of foetal fluids and milk and *in utero* (Junaidu *et al.,* 2006) The most common clinical sign in cattle is late-term abortion, but many infected cattle do not show any clinical sign. Most infections in humans are associated with consumption of unpasteurized milk products (Wilkinson. 1993; Acha. 2003; Cutler and Commander, 2005; Beheshti *et al.*, 2010). Nine species of *Brucella* are currently recognised, seven of them affecting animal (*B. melitensis*, *B. abortus*, *B. suis*, *B. ovis*, *B. canis*, *B. neotome* and *B. microti*) and two affect marine animals (*B. ceti; B. pinipedialis*) (Scholz *et al.,* 2008; Verger *et a.l*, 1987).

The principal *Brucella* species that infects cattle is *B. abortus*; though cattle can also become infected by *B. suis* and more commonly *B. melitensis* when they share pasture or facilities with infected pigs, goats and sheep (Acha and Sygres, 2003).

Brucellosis has been reported in 44 of the 49 African countries (Seimenis *et al*., 2006) including Nigeria (Ogundipe *et al*., 1994; Brisbe *et al*., 1996; Ajogi *et al*., 1998; Cadmus *et al*., 2006: Bertu *et al*., 2012: Mai *et al*., 2012). Recently, herd prevalence of 32.2% on a Prison cattle farm (Junaidu *et al*., 2008) and 19.5% seropositive and 25.3% positive milk samples (Junaidu *et al*., 2010) were reported in North Western State of Nigeria.

In most developing African countries like Nigeria, livestock production represents a major asset among resource-poor smallholder farmers by providing milk, meat, skin, manure and traction (Mai *et al*., 2012) However, the economic benefits of livestock populations remain marginal due to prevailing livestock diseases which are among the principal bottle necks of livestock performance and cause of high economic losses of the resource poor farmers. Some plants utilized in ruminant feeding in the country are also used to treat various illnesses of animals (for example, *Aspilia africana* among others) have been positively identified to have prophylactic properties (Chah *et al*., 2009). Some of the traditional remedies are used to treat symptoms rather than offering complete cure, particularly for chronic diseases such as tuberculosis, brucellosis, and others (Salihu *et al.,* 2011: Mai *et al.,* 2012).

Ethno Veterinary Medicine (EVM), which is also known as traditional animal health care practices, is defined as local or indigenous knowledge and methods for caring, healing, and managing livestock (Guéye, 1999). The EVM practices are used in the management of bacterial, viral, protozoan, fungal, parasitic and non-infectious causes of diseases. According to Balaji *et al*., (2010), ethnoveterinary practices approaches to animal health care is as old as the domestication of various livestock species.

In Nigeria, Fulani herdsmen and others who keep animals as a means of livelihood have been involved in the treatment of animal diseases prior to the among modern medicine (Nwude, 1986), of which remedies against parasitism account for the highest means of intervention (Ibrahim *et al*., 1984).

1.2 Statement of Research Problem

The relationship between researchers and livestock keepers is a key factor affecting the reliability and validity of data. Researchers in the rural areas have usually tried to apply

conventional epidemiological methods. Typically quantitative and data driven approaches are attempted but proved to be untenable in rural areas with relatively small and mobile human population (Catley and Mariner, 2002).

The purpose of this work was to use participatory epidemiological methods to see the impacts made on brucellosis, although vaccination against brucellosis is still not carried out. Brucellosis is still present in Yobe because of migratory animals that are coming into Yobe State. Yobe State is still a developing area in the far North Eastern part of Nigeria and the level of education especially as it pertains the use of vaccination is still 'rudimentary' in Nguru, Yobe State and hence the need for the work in the area.

Brucellosis is one of the most important and highly contagious zoonoses in the world (Ryan and Ray, 2004). *Brucella abortus* infection in cattle is endemic in Nigeria resulting in huge economic losses due to problems with fetus development and vitality, and this pathogen can be passed to humans (McDermott and *A*rimi, 2002), Serological investigations and reports have shown that brucellosis is endemic in Nigeria and evidence of infection has been demonstrated in cattle, dogs, sheep, pigs, goats, camels, wild rats and humans (Esuruoso, 1974a and Esuruoso, 1974b; Alausa and Osoba; 1975; Okoh, 1979; Okoh, 1980; Nuru, 1982; Bale and Nuru, 1985; Bale, 1991; Ajogi, 1997; Falade, 2002; Ocholi *et al.,* 2005; Avong, 2006; Cadmus *et al.,* 2006; Junaidu *et al.,* 2006; Ofukwu *et al*., 2007; Bakari, 2010; Mai *et al*., 2012). Studies in Nigeria have indicated that *Brucella* has been isolated from cattle (Bale and Kumi-Diaka 1981; Ocholi *et al.,* 2005; Bertu, 2014), goats (Falade, 1981) and horses (Bale and Kwanashie, 1985 and Ocholi *et al.,* 2004). From the studies, *B. abortus* biovars 1 and 3 were identified as the predominant strains (Ocholi *et al.,* 2004 and Bertu, 2014). So far, of the different biotypes of *B. abortus* recognized, biotypes 1, 2, 3 and 4 have been isolated in

Nigeria (Eze, 1977; Bale and Kumi-Diaka, 1981; Ocholi *et al.,* 2004; 2005: Bertu, 2014).

Another large sero-prevalence survey (Mai *et al*., 2012) in three Northern States of Nigeria (Adamawa, Kaduna and Kano) showed that the disease is on the increase with prevalence of up to 26.3%.

1.3 Justification

Participatory epidemiology recognizes that local people have very rich and detailed knowledge about the animal they keep and the infectious and zoonotic diseases that can gravely affect their livelihoods and endanger human health (Catley, 2005). It is a proven technique which overcomes many of the limitations of conventional epidemiological methods, and has been used to solve a number of animal health surveillance and research problems. It is imperative to make the best use of this knowledge and develop appropriate disease surveillance system in rural areas (Catley, 2005); such system should be action-oriented and results in disease control activities that are designed in partnership with livestock keepers.

Conventional epidemiology can be expensive and logistically complex, producing large quantities of information from rural surveys that are often biased, spatially, behaviorally and logistically (Chambers, 1983).

Pastoralists do not have close contact with communities and such they do not receive regular amenities in the areas of human and animal health care. Poor educational standard by pastoralists and rural dwellers and also diseases as stumbling blocks towards efficient health care practices. The use of Ethno- Veterinary Practices is a big gap between their understanding of disease, animal health care and true situations of

livestock development. There is need to know the proper solutions for better livestock production and to use Participatory Epidemiology to determine the status Brucellosis in Nguru Local Government Area in Yobe State.

This study will contribute in providing additional epidemiological information on bovine brucellosis and its zoonotic importance.

1.4 Aim and Objectives

1.4.1 Aim

To determine the status of bovine brucellosis in Nguru Local Government Area, Yobe State using participatory epidemiology tools and seroprevalence studies.

1.4.2 Objectives

1. To generate qualitative epidemiological information on bovine brucellosis from Nguru Local Government Area of Yobe State using participatory epidemiology tools.
2. To determine the seroprevalence of bovine brucellosis in Nguru Local Government Area.
3. To determine the traditional knowledge, attitude and practice among Fulani herdsmen with certain diseases.

1.5 Research Questions

1. Is brucellosis a common disease affecting cattle in Nguru L.G.A.?
2. Are there detectable antibodies reactive to *Brucella abortus* in the sera of cattle in Nguru L.G.A.?
3. What is the knowledge, attitude and the practices among Fulani herdsmen as regards brucellosis?

CHAPTER TWO

LITERATURE REVIEW

2.1 Definition and History of Participatory Epidemiology

Participation is the voluntary process by which people influence and control the decisions that affects themselves by contributing their knowledge, resources and skills. It is both an attitude and a philosophy that encourages learning, discovery and flexibility (ILRI, 2009).

Participatory epidemiology is an emerging field that is based on the use of participatory techniques for the harvesting of qualitative epidemiological intelligence contained within community observations, existing veterinary knowledge and traditional oral history. It relies on the widely accepted techniques of participatory rural appraisal, ethno-veterinary surveys and qualitative epidemiology (Schwabe, 1984).

In the early 1970s, it became evident that formal data collection methods were not well-suited for the design of rural development programmes in less developed countries (Chambers, 1983). As a result, alternative systems of inquiry and learning began to evolve, leading to the development of participatory rural appraisal (PRA) as a multi-disciplinary approach, with the emphasis on local analysis and action with communities (Chambers, 1994).

2.1.1 Historical development of PRA

The development of PRA was influenced by two main bodies of experiences which can be summarized as negative and positive experiences (Chambers, 1983). Negative experiences included decades of poor success in the rural development in non-industrialized countries and the widespread failure of aid programmes to improve the life of poor people (Chambers, 1983). The positive experiences which contributed

towards participatory appraisal development included lessons from a diverse group of disciplines and professional experiences. But the main influences were drawn from social sciences and novel systems approaches in agricultural and ecological researches such as Freirean-style adult education in Latin America; the method of agro-ecosystem analysis developed at the University of Chiang Mai in Thailand; the value of indigenous knowledge from applied social anthropology (Catley, 1999).

2.2 Principles of PE

Participatory epidemiology is a branch of epidemiology that uses principles and methods of participatory rural appraisal and was developed to gain information directly from rural communities (Catley, 2005). This is to enable communities to do the analysis and planning using information obtained according to Schwabe, 1984. It relies on the widely accepted techniques of PRA, ethno-veterinary survey and qualitative epidemiology procedures like history taking, clinical examination and post-mortem examination are common examination tactics performed by the veterinarians and are largely subjective and qualitative in nature (Catley and Mariner, 2002).

Practitioners are required to assess their own professional and cultural biases. Essentially, they need to be genuinely willing to learn from local people, not lecture them but actively listen. Listening to, learning and understanding traditional knowledge is the key to good research and assessments at the community level (Jost *et al*., 2007). This requires respect for local knowledge and culture (Catley and Mariner, 2002). Participatory epidemiology is action- oriented and aimed at generating qualitative information that will be verified by rural communities. It is also methodologically flexible. The PE uses a wide range of interviewing and scoring, ranking and visualization methods. Interview is the most important group of methods, because they

can be used alone and also complement and form the basis for other methods (Catley and Mariner, 2002).

2.3 Participatory Epidemiology Methods

Participatory epidemiology methods evolved mainly from social sciences, especially social and medical anthropology and agro ecosystem analysis. From social anthropology came various informal interviewing methods, such as group interviews and semi-structured interviews. Visualization methods derived from approaches such as agro ecosystem analysis are a second important group of participatory methods (Conway, 1985). Ranking and scoring methods are the third main group of participatory methods and usually required informant to compare different variables using either ranks or scores (Admassu *et al*., 2005).

2.3.1 Semi structured interview (SSI)

SSI is the main core method in the toolkit for Participatory Epidemiology. This is when interviewers use check list subject to be covered is used as a point of reference rather than a structured questionnaire (Catley, 2006). SSI is like a guided conversation (Slim and Thomson, 1994; Pretty, 1995). The interview team make use of open-ended questions to allow participants the opportunity to introduce topics and issues rather than using structured, pre-set questions as in a questionnaire with a mental note of the key research theme. The interviewer could phrase and rephrase questions and follow-up interesting and unexpected responses. Closed questions are central to the methods (Catley *et al*, 2011), used in most PE studies.

2.3.2 Ranking and scoring method

Ranking and scoring methods refer to a group of techniques used to prioritize information or provide semi-quantitative estimates of the relative sizes of impacts of

categories as perceived by the participants (Catley, 2006). A number of ranking and scoring techniques exist. These include simple ranking, pair-wise ranking and proportional piling techniques (Jost *et al*., 2007). The numerical nature of ranking and scoring methods made these methods easy to standardize and repeat, with the data being analyzed using conventional statistical test (Catley *et al*, 2011). Scoring methods are more sensitive than ranking, allowing the weighing of responses. Simple ranking allows for arrangement of items in order, based on defined criteria, while pair-wise ranking is used where each item is compared individually with all the other items one-by-one. Pair wise ranking can be used to understand the relative importance of different species or diseases and through probing to understand the benefits of different species or the impacts of different diseases.

2.3.2.1 Proportional piling

Proportional piling is a very flexible technique in which respondents are asked to divide 100 objects such as seeds or stones into piles of sizes representing the relative size or importance of different categories. The number of objects in each pile is then counted to give a score. When standardized and repeated with individual informants, data can be summarized and analyzed using conventional statistical tests (Catley *et al*, 2002; Barasa *et al*, 2008; Jost *et al*, 2010; Anzaku, 2013).

2.3.2.2 Matrix scoring

Matrix scoring is more sensitive and can be used to better understand the local characterization of livestock disease and the meanings of local names for disease. It is essentially a series of proportional piling exercises where a list of items, such as disease, is scored against a number of indicators, such as clinical signs, sources of infection, etc. to create a matrix. Catley *et al*. (2001), described some examples of this tool. The

researcher can use the complete matrix in short, semi-structured interviews to follow up interesting results and cross-check information (Jost *et al*., 2007).

2.4 Visualization Tools

Visualization methods, derived from approaches such as agro-ecosystem analysis recognize that certain types of information could not easily be expressed verbally or in writing (Conway, 1987). In addition, the construction of diagrams did not necessarily require informant to be literate because objects and signs could be used to depict important features on the diagram. The visualization techniques include approaches such as participatory mapping, Venn diagram, timelines and seasonal calendar construction. Mapping usually involves clearing an area of sand and sketching with sticks or using cardboard papers and indicating the relative location of key resources and strategies used by the community. This include things such as grazing areas, cultivation areas, water sources (rivers, streams, boreholes), livestock markets, trade routes seasonal movement and emergency movement.

2.4.1 Seasonal calendar

Many animal health problems and issues are seasonal and can be analyzed through the use of calendars. A seasonal calendar can be used to visualize and analyze local perceptions of the seasonality of key farming practices, diseases, risk factors among others. This method has been used to study seasonal variation in disease incidence (Catley *et al*., 2002), seasonal variation in human livelihoods like consumption of livestock products and livestock trade (Bagnol, 2007; Ahlers *et al.*, 2009; Barasa *et al.*, 2008); seasonal variation in contact with disease vectors, neighbouring livestock and wildlife (Catley *et al.*, 2002) as well as seasonal variation in vector populations (Catley and Aden, 1996). The seasonal occurrence of disease is interesting to understand in

relation to the seasonality of factors that affect the occurrence of different diseases such as climate, management practices, and vectors among others.

2.4.2 Participatory mapping

Participatory mapping is one of the most useful tools in the PE and is often a good technique to start with, as it involves several people and can stimulate much discussion and enthusiasm. Mapping is a useful method where both literate and non-literate people can contribute to the construction of a map and can represent complex information that would be difficult to describe using text alone. It can be used in gain overview of the spatial distribution of community resources, herding patterns, livestock population contact structure, the spatial distribution of risk factors. This can highlight the risk factors and important epidemiological information, as well as contributing data to aid in estimating transmission parameters for disease models, investigate livestock movement with respect to the location of grazing areas and water points (Hadrill and Yusuf, 1994); spatial exposure to disease vectors (Catley, 2004).

2.5 Application of Participatory Epidemiology

Early applications of PE focused on pastoral communities whose livelihoods were heavily dependent on livestock and who had limited exposure to western veterinary medicine. Notably, over 15 years, the use of PE-type approaches expanded from East-Africa (Thompson, 1995) to Pakistan, then South-East Asia and Eastern Turkey. In part, the popularity of PE was made possible through support from international organizations such as the Food and Agriculture Organization of the United Nations (FAO/UN) and the African Union Inter-African Bureau for Animal Resources (AU/IBAR), both of which published PE training materials and supported Government Veterinary Services (Mariner and Paskin, 2000; Catley, 2005). Applications of PE

focused on needs assessment when establishing community-based animal health programmes (Jost *et al.*, 2007). The value of PE has also been shown by its use beyond Africa and its promotion by international actors such as the Food and Agriculture Organization and the International Livestock Research Institute (Grace 2003a, 2003b). The approach has been used in the rinderpest eradication programme in Pakistan, for avian influenza surveillance in South-East Asia, and for Foot-and-Mouth Disease surveillance in Eastern Turkey.

2.5.1 Animal health Survey, need assessment and action plan

The use of participatory research methods was central to the community based programmes established by the operation lifeline Sudan Livestock Programme and the Pan African Rinderpest campaign (PARC), (Leyland, 1996; Mariner, 1996). The survey included the use of methods such as wealth ranking progeny histories, over the years, methods like transect walks, mapping and ranking were also used to gain an appreciation of local knowledge, attitudes and practices in order to design community animal health worker training programmes that built on EVK. These assessments were also used to understand the way in which communities approached decision-making, so that animal health programmes would reinforce local institutions and have greater local acceptance.

2.5.2 Ethno-veterinary knowledge

Ethno-veterinary studies have tended to use a narrow range of interviewing methods (Catley and Mariner, 2004). Often these methods have been more formal than informal, with questionnaires and structured owner interviews forming the basis for data collection. The PE was also used to gain ethno-veterinary knowledge, attitudes and practices in order to design community animal-health worker training programmes.

2.5.3 Monitoring, impacts assessment and evaluation.

Participatory methods are widely used during the initial stages of veterinary epidemiological projects implementation, their use in project monitoring and evaluation has been less extensive (Catley and Mariner, 2002). In Ethiopia, the assessment of community based animal health workers (Admassu *et al.*, 2004) was one piece of evidence which led to their legal recognition. Also, in Ethiopia, retrospective cohort studies using PE methods shower the limited impact of vaccination on livestock mortality during drought (Catley *et al.*, 2008) and prompted various international actors to revise vaccination strategies and best practices. In East Africa, modelling studies on rinderpest (Mariner *et al*., 2005) helped to raise awareness of issues such as the role of low vaccination coverage in maintaining the disease in pastoralist areas. The PE was being used in impacts assessment of veterinary intervention disease investigation and epidemiological and economic studies.

2.5.4 Participatory research

Participatory research is a source of considerable contention and evolved as an alternative system of knowledge production by challenging the premise of conventional social sciences research methodology. Participatory Approach to Veterinary Epidemiology (PAVE) project of the International Institute of Environment and Development (IIED), involves participatory research methods (Catley and Mariner, 2002). In each research location, livestock keepers identified the diseases under investigation as priorities. The PE has been used in several African countries to investigate tick infestation and tick-borne diseases in Somalia, CBPP in Ethiopia, bovine trypanosomosis in Sudan, Rift valley fever in Kenya and Tanzania (Catley and Adden, 1996; Gizaw, 2004; Elnasri, 2005; Jost *et al*, 2010).

In Pakistan PE has been used to investigate FMD and Peste des Petits Ruminants (Anjum *et al.*, 2006; Hussain *et al.*, 2008; Zahur *et al.*, 2008.

2.5.5 Participatory disease searching (PDS)

This is one branch of PE that requires interpretation of information provided by livestock keepers. PDS is a specific adaptation of PE for epizootic disease control that evolved in the Pan African Rinderpest Campaign and used pastoralists' knowledge of rinderpest to local disease outbreaks in remote areas. The approach was based on participatory method such as semi structured interviews and in particular, the use of probing questions to delve deeply into local knowledge about rinderpest (Catley, 2004).The PDS was becoming increasingly important within the Pan African Programme for the Control of Epizootics (PACE). Programmes were established in Afghanistan, Tajikistan and Uzbekistan, and regional training workshops were used to introduce PDS to these countries. Participatory disease searching was used to strengthen disease surveillance in Central Asian countries in an FAO regional project to enhance epizootic disease control including OIE notifiable diseases such as PPR and FMD (Jost *et al.*, 2007).

2.5.6 Participatory disease response

This method was initiated in Indonesia to aid in responding to and controlling outbreaks of highly pathogenic avian influenza (HPAI). In Indonesia, PE can also be used as a sensitive tool to confirm the absence clinical disease. The concept of PDS has been extended to include participatory disease response (PDR) teams, trained in social mobilization techniques (Normile, 2007). The main objective of the programme is to implement rapid response tied to early detection through active surveillance (Capua and Alexander, 2006).

2.5.7 Disease modelling

Disease modelling generates computer stimulations of disease which can assist epidemiologists to develop or improve disease control strategies. By understanding the way disease moves between animals in a population, appropriate methods to interrupt disease transmission can be identified. Participatory epidemiological approaches and methods has also been employed, in combination with disease models, quantitative techniques (Mariner *et al.*, 2005; Mariner *et al*., 2006).

Disease modelling often makes use of expert opinion provided by technicians to estimate parameter values where hard data is limited or too expensive to collect (Catley and Mariner, 2002).

2.6 Data Collection and Analysis in Participatory Epidemiology

Sampling methodologies used in PE include the selection of key informants and a risk-based approach to identifying sampling sites. Random sampling is sometimes employed when participatory approaches are used to make quantitative estimate. Key informants are individuals or groups who are likely to have well-developed knowledge or an especially relevant perspective of the problem under investigation. In risk-based sampling, the information on the target disease available from key informants and secondary sources are used to create a qualitative risk map. Initial sampling sites are selected from the risk map, and subsequent sampling sites are based on the trail of information revealed by the study. As information is collected, the risk map and overall study hypothesis are refined in a process of iterative analysis (Jost *et al*., 2007).

2.7 Participatory Epidemiology and the Future

The network for PE and public health has been established to advance the science of PE through targeted research, capacity building, policy enhancement and practitioner education.

Coordinated by the International Livestock Research Institute (ILRI), the networks include the FAO, OIE, AU-IBAR, and non-governmental organizations experienced in PE methods. Regional PDS programmes, such as those in East-Africa and Asia, were the first to bring countries together to develop a harmonized PDS approach to active surveillance. The network will build on this approach by strengthening existing programmes and establishing new regional programmes to increase regional cooperation in participatory value chain approaches.

Incorporating participatory approach to epidemiology into University curricula will have a long-term impact on the veterinary profession. Debate discussion and consultation continue to further the process of integrating participatory methods with conventional epidemiological approaches and the international guidelines, such as the OIE Terrestrial Animal Health Code (45) and WHO international health regulations (43).

2.8 BRUCELLOSIS

2.8.1 History and definition of brucellosis

Brucellosis was named after Sir David Bruce, who in 1886 isolated the causative agent from a soldier in Malta where the disease caused considerable morbidity and mortality among British military personnel. During the 19th Century, Brucellosis was thus not known as Malta or Mediterranean fever (Charters, 1980). Brucellosis is caused by

species of the bacterial genus – *Brucella* (Morgan and Mackinnon, 1979; Helling and Tourg, 1994).

Ten species of Brucella are currently recognized, seven of them affect terrestrial animals (*B. melitensis, B. abortus, B. suis, B. ovis, B. canis, B.neotome* and *B. microti*) and two affect Marine animals (*B. cetii* and *B. penipedialis*) (Scholz *et al.,* 2008 Verger *et al*., 1987) and *B. inopinata* (unknown) (O'Callaghan and Whatmore, 2011). Four out of the ten known *Brucella* species can infect humans. The most pathogenic and invasive for human is *B. melitensis* followed in descending order by *B. suis, B. abortus* and *B. canis* (Acha *et al.,* 2003). *B. abortus, B. melitensis,* and *B. suis* have also been identified as agents amenable for use in bioterrorism and are listed as category B priority pathogens by the United States Center for Disease Control (CDC), (Younggun, 2012).

Brucellosis is one of the most important worldwide zoonoses that is recognized as a major cause of significant economic losses in livestock due to its primary effects on the reproductive system in affected animals with concomitant reduction in production and also a serious threat to human health (Young, 1991; Adams, 2002; Santellano-Estrada *et al*., 2011). Brucellosis is caused by fastidious, intracellular, non-spore forming non-motile, gram-negative coccobacillus and capsulated bacteria of the genus *Brucella*. (Sammartino *et al.,* 2005, Zygmun *et al.,* 2009). Seven biovars have been identified for *B. abortus*, three for *B. melitensis* and five for *B. suis*.

Brucella species and their biotypes are distinguished by differential tests based on serotyping, phage typing, dye sensitivity, CO_2 requirements, H_2S production and metabolic propers (Alton *et al.,* 1988, Alton and Forsth, 1996).

2.8.2 Aetiology

Nine different biotypes of *B. aborius* have so far been recognized to cause brucellosis in cattle (Nielsen and Duncan, 1990). In countries where *B. melitensis* occurs in sheep and goat, cattle may contact *B. melitensis* from them (Nielson *et al.*, 1990). Experimentally, cattle can also be infected with *B. suis* (Stableforth, 1959). So for the *B. abortus* biotypes, only biotypes 1, 2, 3 and 4 have been isolated in Nigeria (Eze, 1978; Bale and Kumi Diaka, 1981; Ocholi, *et al*., 2004, 2005). Bovine brucellosis was first reported in Nigeria in 1922, Since then several studies have been carried out to determine its prevalence in different parts of the country. *Brucella abortus* is the species that affects mainly cattle but it has been reported in other livestock species such as sheep and goat in Nigeria (Ocholi *et al*., 2005; Bertu, 2014).

Bovine brucellosis is distributed throughout the world, but has been eradicated from the livestock population of most European countries, Japan, Canada and the United States of America (Nicolette, 1980), however it has remained widely distributed in Africa and Asia. Its occurrence and prevalence has been studied in Africa, Asia and Latin America. A high prevalence has been reported in Uganda (Faye *et al*., 2005) Egypt, Sudan and Senegal (Chukwu, 1985). Moderate prevalence rates were reported in Nigeria, Tanzania, Ghana and Botswana (Chukwu, 1987), while a low prevalence was seen in Kenya (Kagumba and Nandokha, 1978), Djibouti (Chantal *et al*., 1994) and Eritrea (Omer *et al.*, 2000).

2.8.3 Epidemiology of brucellosis

Epidemiological studies on brucellosis revealed some important factors which contribute to the prevalence and spread of the disease in livestock this include farming system and practices, such as farm sanitation, livestock movement, mixing animals and

sharing of grazing sites (Kadohiri *et al.*, 1997; Kabagambe *et al.*, 2001; Omer *et al*., 2007). McDermott and Arimi (2002) in their epidemiological review of brucellosis in Sub-Sahara Africa reported that the disease is very common in cattle, but less well studied in small ruminants. Since pastoralists use an estimated 23% of land in the Middle East and North Africa, the persistence of brucellosis is important in these areas of the world, especially due to the presence of *B. melitensis* (in particular, biovar 3) in sheep and its transmission to humans (FAO, 2010). Bovine brucellosis is confined mostly to parts of the world where an intensive cattle herding is practiced (Carpenter and Hubert, 1963). The incidence and prevalence of brucellosis in man and animal is difficult to determine in any particular locality, and therefore not known accurately in many parts of the world (Alausa, 1983; Alausa and Osoba, 1975). According to the Office of International Epizootics (OIE), 1987; 2000), Burkina Faso, Cameroun, Mali and Ivory Coast were the only African Countries cited as either reporting or suspecting the presence of bovine brucella. In Jordan, the highest prevalence of brucellosis is found in cattle and sheep, whereas camels are the most important source of the disease in Iran, Egypt and Saudi Arabia, and goats are the primary contributor to human brucellosis in Iraq (Hotez *et al.,* 2012). These regions maintain national disease surveillance and Health Service programmes, as well as large-scale therapeutic drug and vaccine campaigns.

In Nigeria, the distribution of brucellosis among humans is not well known. The first documented evidence of human brucellosis in Nigeria was by Collard (1962), where *Brucella* antibodies were detected in sera of healthy persons in various parts of the country. The present status of bovine brucellosis in Nigeria including its prevalence and isolation have been reviewed and brought into proper perspective (Nuru and Schnurrenberger, 1975; Eze 1977; Halle and Ajogi, 1997; Falade, 2002; Ocholi *et al*.,

2004; Cadmus *et al*., 2006; Junaidu et *al*., 2006, Mai *et al*., 2012; Farouk *et al*., 2013, Bertu, 2014).

2.8.4 Susceptibility

Susceptibility of cattle to *B. abortus* infection is influenced by the age, sex and reproductive status of the individual animal; sexually matured pregnant cattle are more susceptible to infection with the organism than sexually immature cattle of either sex (Crawford *et al*., 1990). The disease is obviously a disease of adult, pregnant female, which in the absence of previous exposure or immunization are highly susceptible to infection, though, non-pregnant animals are also susceptible (Morgan, 1970).

Natural exposure to field strains occur primarily at the time of parturition of infected cows. The greater the number of infected cows that abort or calved, the greater the exposure risk to the other cattle in the herd (Crawford *et al*., 1990). Calves are relatively resistant but when fed with infected milk can excrete the organism in faeces and are therefore a source of infection for susceptible cattle (Lambert *et al.*, 1964). Man is also infected by brucellosis through drinking of unpasteurized or un-boiled milk or by exposure to infected discharge or by accidental injection of *B. aborius* strain 19 vaccine (Crawford *et al*., 1990).

2.8.5 Clinical findings

Clinical findings are dependent upon the immune status of the herd. In highly susceptible non-vaccinated pregnant cattle abortion after the 5^{th} month of pregnancy is the cardinal feature of the disease in cows (Rodostits and blood 1997). Abortion generally occurs during the late trimester of pregnancy and is followed by retention of foetal membranes (Anon, 2001). If an infection appears in a herd which has never been exposed to the disease, all pregnant animals will abort in what is known as “abortion

storm" (Seifert, 1996). In the male, orchitis, epididymitis, seminal vesiculities and later infertility are the major signs. Additionally, in both sexes, hygroma in patella on the carpal joint and catarrhal or endometritis are characteristic features of chronic infections (Fensterbank, 1987).

In some African countries in certain herds, abortion is uncommon but retained placenta constitute the only evidence of brucellosis. The cardinal clinical feature of brucellosis in cows are retained placenta, abortion during the last trimester of pregnancy, birth of weak or dead full-term calves, mucopurulent vaginal discharge and temporary or permanent infertility (Blood and Henderson, 1968).

2.8.6 Diagnosis of bovine brucellosis

The existence of the disease may be suspected from herd history indicating occurrence of one or several abortions at about seventh month of pregnancy. Differential diagnosis of abortions may be difficult clinically and requires laboratory assistance for confirmation (Morgan, 1970). These methods includes direct smear, isolation, animal inoculation, serological diagnosis which includes Rose Bengal Plate Test (RBPT), serum agglutination test (SAT), milk ring test (MRT). Other conventional methods include immunoassay, radio immunoassay techniques, fluoro immunoassay and ELISA.

2.8.7 Molecular detection and typing

Several molecular techniques have been employed to find DNA polymorphisms which would enable the molecular typing of *Brucella* species and their different biovars. These include enterobacterial repetitive intergenic consensus (ERIC) sequence-PCR, NAD repetitive intergenic palindromic (REP) [Mercier *et al*, 1996; Tcherneva *et al.*, 2000). Randomly amplified polymorphic DNA – PCR or arbitrary primed-PCR (Fekete *et al.*, 1992; Tcherneva *et al.*, 2000). Several investigators reported a good sensitivity of PCR

for detecting Brucella DNA on pure culture (Barly *et al.*, 1992; Romero *et al*., 1995; Da Coasta *et al*., 1996).

While culturing is a specific method, the time required for culturing field specimens can be long and tissues or fluids that are only contaminated with non-viable or a low number of *Brucella* may not be detected (Anon, 2001). Therefore, the identification of a stable DNA-specific marker is considered a high priority for diagnostic, epidemiological and economic purposes. Among these, detection of restriction fragment length polymorphism is considered a reproducible and easily performed method within a laboratory. Alternatively, pulse-filled gel electrophoresis (PFGE) of total genomic DNA digested with restriction enzymes (RE) that cut frequently has been a useful technique for discriminating among the species and among several isolates in the same species of *Brucella* (Jensen *et al.*, 1995; 1990). But a common problem is incomplete protease digestion by RE of the DNA caused by incomplete cell lyst or incomplete protease digestion (Farber, 1996).

2.8.8 Control

A successful campaign would require the designing of control measure compatible with the socio-cultural, economic and political factors of the cattle owners. In addition to the biological characteristics of the disease agent, the transmission and the host responses (Rikin, 1988a). The fact that brucellosis is a disease of major economic and zoonotic importance, a strategy for its control in animals, especially livestock, is vital especially in endemic areas. The primary focus of the control strategy should be the reduction of the infection in animal population to such a level that the impact of the disease on human health and animal production is minimized. The *B. abortus* S19 and *B. melitensis* Rev. 1 vaccines are the cornerstones of control programme in cattle and small ruminants, respectively (Smith., 2013). Prevention and control of brucellosis in animals

essentially include test and culling of positive reactors, quarantine, zoning and tracing. The general principles for control of brucellosis varry from one country or region to another and depends on the prevailing conditions in such country or region. Based on this understanding, Anon (1971), recommended guidelines for a systematic approach to the control programme which include surveillance, testing and vaccination procedure. Serological testing of livestock should be routinely carried out using approved serological tests. All animals reacting positively to the tests should be destroyed or consigned for immediate slaughter in an approved abattoir following strict hygienic procedures. The supra mammary, medial, internal iliac, retropharyngeal, parotid and prescapular lymph nodes and spleen from such animals should be submitted for Brucella culture (Animal Health Australia., 2005). However, there is a limitation to eradication by test and slaughter as some cases of latently-infected young animals remain serologically negative to standard tests until late into their first pregnancy. Time of quarantine should be long enough to ensure that all pregnant animals complete their gestation without any evidence of infection

The elimination of the disease from the population is not the objective of a control, and it is implicit that some "acceptable level" of infection will remain in the population (WHO; FAO; OIE, 2006). Control programs have an indefinite duration and will need to be maintained even after the "acceptable level" of infection has been reached, so that the disease does not re-emerge (WHO; FAO; OIE, 2006). In many countries, methods for the control of brucellosis are backed by governmental regulation. Certain principles can be used:

1. The reduction of exposure to *Brucella* species.
2. Improving management practices in herds

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study Area

Nguru is a Local Government Area in Yobe state, Nigeria. Its headquarters is in the town of Nguru near the River Hadejia at $12^{o}52^{'}45^{''}$N $10^{o}27^{'}09^{''}$E/12.87917^{o}N 10.45250^{o}E (Fig 3.1). It has an area of 916 km^{2} and a population of 150,632 as at the 2006 census. It has the following villages Yakubari, Kachallari, Kogga, Mirwa kabir, Maidashi, Balanguwa, Dumsai, Yamdigo, Hadari, Maja Kura, Dabule, and Saleri. The major occupation of the people of Nguru L.G.A is farming and the livestock found in the area include cattle, sheep, goat, camel, poultry among others and their livestock market is called “kasuwan dabobi”. Nguru has a state and L.G.A veterinary clinic.

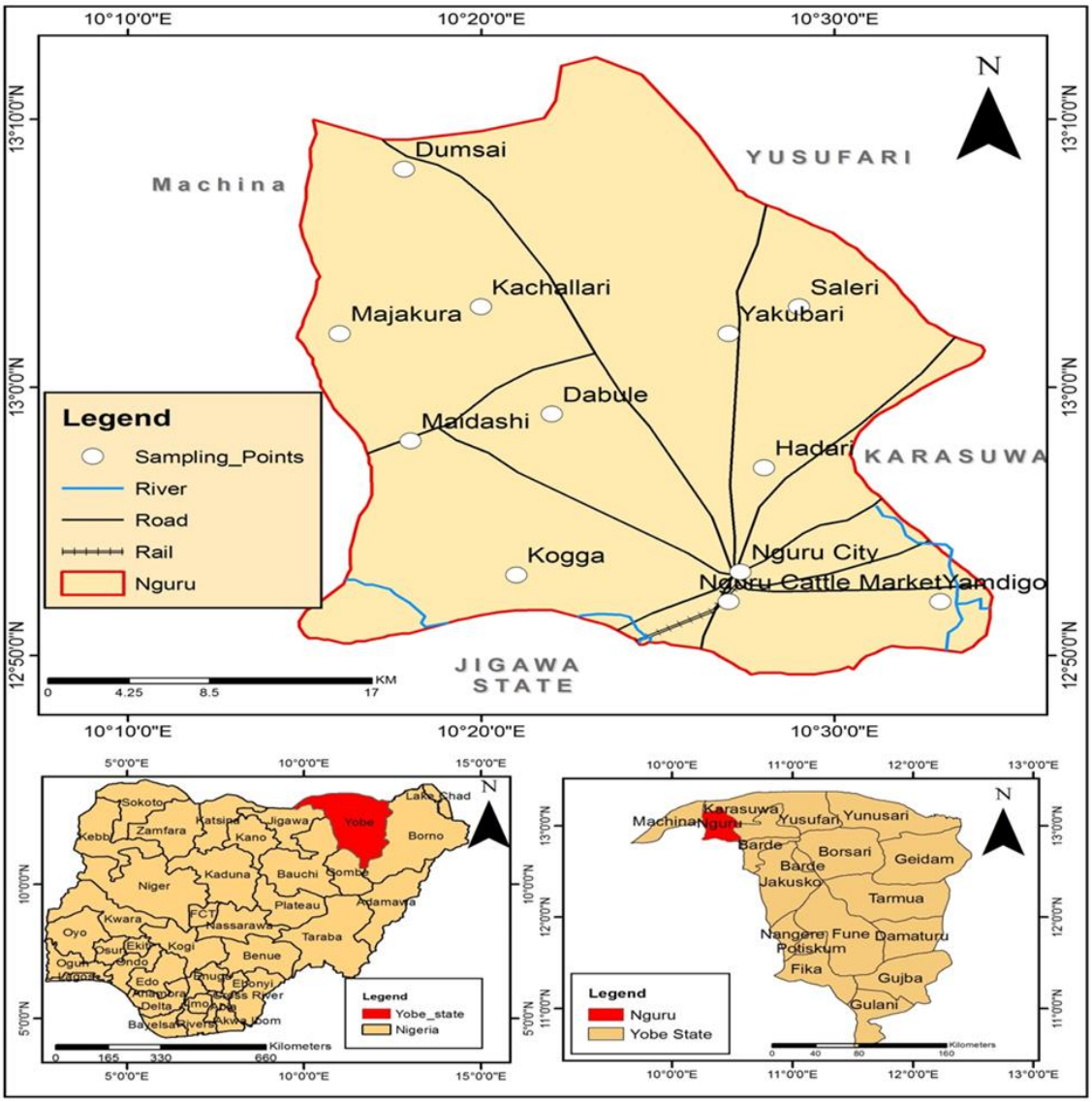


Figure 3.1: Map of Nguru Local Government Area showing study area for Participatory Epidemiology and Serology.

Source: Adapted from the Administrative map of Yobe State, 2011

3.2 Study Population

For participatory epidemiology, the study population comprised mainly of Hausa and Fulani rural farmers that are settled. Information about selected villages were derived from Zonal Veterinary and Zonal Livestock Officers of Ministry of Animal and Fisheries Development, Yobe State. All villages have a well organised traditional system headed by Village head 'Maigari or Lamido.' Each village was considered as one Epidemiological Unit. For serology, the study population consisted of cattle in randomly selected houses and chosen villages. Houses with one to five cattle were excluded from participating and houses with more than five cattle were included.

3.3 Study Design

The study utilized two related cross sectional studies. The first study was carried out using PE approaches for data collection. The second study involved serological survey for antibodies to *Brucella abortus* in cattle herds in Nguru LGA, Yobe State.

3.4 Data Collection

3.4.1 Participatory epidemiology

Selection of PE site was guided with a sampling frame that contain the list of villages within the study area. A total of twelve villages were considered which included: Yakubari, Kachallari, Kogga, Mirwa Kabir, Maidashi, Balanguwa, Dumsai, Yamdigo, Hadari, Maja Kura, Dabule, and Saleri.

3.4.1.1 Selection of participatory epidemiology participant

Interview with participants comprised the main background information for this research. Secondary data included published and unpublished literature on bovine brucellosis and the traditional ways of treating other cattle diseases. Focused group discussion took place in twelve villages .Hakimi or Maigari pre-informed and selected

some members of the community that were known to involve in cattle rearing participant consisted of old and youths that were engaged in cattle rearing .Participants relied on practical experiences, information from extension workers and indigenous believes. .

3.4.1.2 Semi-structured interview

Semi-structured interview (SSI), ranking, scoring, proportional piling, seasonal calendars, participatory mapping and transect walking were employed. Existing Veterinary knowledge (EVK) about bovine brucellosis and the traditional way of treatment were accessed using guided checklist with probing question to ascertain consistency.

The most important tool with guided conversation used at every stage and all villages in combination with other tools. The interviews were informal. The participants were asked to list different diseases affecting their livestock, the different types of livestock kept and the clinical case definition with pictorial representation of major clinical signs of the disease to have a clear understanding of the disease. These interviews were held in all the villages. Before each interview, the interviewers asked their informants for permission to record the conversations and to take photographs. The interview was conducted using a check list of open ended questions in accordance with the method by Mariner and Roeder (20034a).

They were asked to describe local treatment methods and preventive measures against brucellosis .Twelve group of informants consisted of 10-12 persons participated in the interview (Plate I).



Plate I: Semi-structured interview at Kogga village of Nguru Local Government of Yobe State, Nigeria.

3.4.1.3 *Ranking*

Simple ranking:

The participantS were asked to rank livestock species kept based on population contribution to family income and immediate family needs .This tool was used in three villages based on convenience.

Pairwise ranking:

This method was used to compare individual diseases of cattle obtained from SSI with other diseases one-by-one (Catley *et al*., 2002b). Diseases of cattle were written on a paper vertically (y-axis) and horizontally (x-axis). Participants were asked which disease is more important between pairs. A probing question like why is a chosen disease more important than the other was asked. This method was used in three villages.

3.4.1.4 Proportional piling

This tool was used to estimate the relative population of livestock species kept, relative occurrence of diseases of cattle, morbidity, mortality and case fatality of diseases of cattle during the preceding 12-months period.

Proportion of livestock species by population:

Participants were asked to list major livestock species kept in the village. Circles were drawn on cardboard corresponding to each animal species kept (Catley *et al*., 2009). Participants' allocated 100 counters (beans) to each circle according to estimated relative population of each species .Agreement between participants was reached on the distribution of counters before recording result.

Relative occurrence of diseases of cattle:

The method adapted by ILRI (2009) was used to estimate the relative occurrence of diseases of cattle. Participant listed all major diseases of cattle drawn from SSI. Using a pile of 100 beans to depict diseases of cattle, the beans were divided by informants into different circles representing each disease of cattle. This method was conducted in three villages consisting of 10-15 informants. .Mean prevalence and 95% confidence limits were calculated for each disease. The level of agreement between informants was assessed using Kendall's coefficient of concordance.

Relative morbidity, mortality and case fatality of diseases of cattle:

Method described by Catley, (2002a) was employed to estimate morbidity, mortality and case fatality of major diseases of cattle during the preceding 12-month period. Participants were asked to list major diseases of cattle. Using a pile of 100 bean seed to represent cattle diseases. The beans were divided by participants into sick and healthy cattle during the last year. The pile of beans representing sick cattle was subdivided by informants to show the relative number of cattle that had suffered from *Bakali* (Brucellosis), *Ottu or Rangaza* (CBPP), *Samore* (Trypanosomosis) and *Boru* (FMD). The participants were further asked to sub-divide the relative number of cattle that had died from each of the diseases. This method was conducted in three villages. Mean morbidity, mortality, and case fatality were calculated using descriptive statistics.

3.4.1.5 Matrix scoring

This method was used to understand the local perception of main clinical signs diseases of cattle. This tool was adapted by method described by Catley *et al*., (2001). Diseases of cattle were drawn from SSI. A matrix was drawn on a cardboard paper with diseases written on the top axis (x-axis) with major clinical signs (indicators) itemized vertically

(y-axis). Using a total of 30 bean seed informants were asked to score the signs, on how common a particular sign is attributable to a disease. This exercise was conducted in six groups.

3.4.1.6 Seasonal calendars

Seasonal calendar was used to describe the seasonal incidence of diseases of cattle drawn from SSI, seasonal scoring of diseases of cattle and local names of season were written along the line corresponding to the months. Participants were asked to list 12 months that make a year. A line was drawn on cardboard paper to represent a year. Local names of seasons were written along the line corresponding to the month. Participants were asked to indicate the period of rainfall relative to other seasons and to indicate season that record more outbreaks of a particular disease.

Seasonal scoring:

The method describe by ILRI, (2009) was adapted to score the major diseases of cattle based on seasonal occurrences. A matrix was drawn on a cardboard with seasons at the top (x-axis) and major diseases of cattle on a vertical column (y-axis). Using 30 bean seed participants were asked to divide the bean seed according to the season they witness more outbreaks of brucellosis. This method was conducted in three groups.

3.4.1.7 Participatory mapping

Participatory mapping was used to provide spatial information on livestock distribution and outbreaks of brucellosis, to identify natural resources and infrastructure as described by Catley (2009). Participants were asked to indicate location of key features in the villages: e.g main roads, public places, disposal sites, cattle market etc. The map was drawn on a cardboard paper and this was conducted on 3 groups.

3.4.1.8 Transect walking

Transect walking was used to make direct observation and to make informal interviews with rural dwellers. Accompanied by nominated rural livestock keeper, information about community life, production systems and farming activities were observed and noted during a straight work across the community.

3.5 Sero Prevalence Studies

Sample size determination

Sample size will be calculated at a confidence level of 95%.

$N = \frac{Z^2pq}{d^2}$ (Thrusfield, 1997).

Where

N=Sample size,

q=1-p,

P=Prevalence (5.7%) = 0.057 (Tijjani *et al*., 2009).

D= allowable error = 3% = (0.03)

Therefore, $N = \frac{1.96^2 \times (0.057 \times 0.943)}{(0.03)^2} = 229$ samples

However for this work, a total of 365 samples were taken.

3.6. Sampling Procedure

A cross sectional study design was employed.

The sampling frame consisted of a list of all villages obtained from Nguru Zonal Veterinary Clinic, Yobe State. The villages were selected based on the presence of cattle that have had previous outbreak of brucellosis. Samples were taken from all the twelve villages that were selected.

3.7. Sample Collection and Transportation

3.7.1. Collection of blood for serum

Five millilitre of blood was collected via jugular venipuncture using an 18 gauge sterile hypodermic needle and 10ml syringe. The syringes were labelled and kept in a slanting position in Nguru Zonal Veterinary Clinic and transferred into a plain clean and properly labelled 5 ml sample bottle and transported to Federal Medical Centre Nguru, Yobe State on ice. The sera were harvested; transferred into sterile serum bottles and stored at -20℃. All the sera at the end of the sampling were taken to Bacterial Zoonoses Laboratory Department of Veterinary Public Health and Preventive Medicine, Ahmadu Bello University, Zaria for analyses.

3.8 Laboratory Analyses

3.8.1 Detection of *Brucella* antibodies in cattle using Rose Bengal Plate test

The sera were screened by RBPT for antibodies to *Brucella abortus* using the method of Alton, (1988) as follows

One drop of the serum was placed on a test area of clean improvised glass plate and also one drop of the Rose Bengal *Brucella abortus* stained antigen was placed adjacent to the test serum.

Using steralized tooth pick, the serum and the antigen were mixed gently.

The glass plate was rocked slowly for 4 minutes (rotation period) with hand.

The result in the wet state after 4 minutes rotation period was interpreted as follows.

Positive (+) = Any degree of agglutination.

Negative (-) = No agglutination.

Doubtful (+_) = Doubtful to be repeated.

All RBPT Positive samples were confirmed by cELISA.

3.8.2 Competitive-ELISA (cELISA)

The ELISA kits were obtained from Animal Health and Veterinary Laboratories Agency, Surrey, Weybridge, United Kingdom

Preparation of reagents:

The cELISA procedure was done in accordance with the manual included in the kit.

Diluting Buffer: The diluting buffer was prepared by adding 5 tablets of PBS, 500ul phenol red indicator and 250ul of Tween 20 to 500ml distilled water. The pH must be between 7.2 and 7.6, phenol red will turn yellow below pH 7.2 and violet above pH 7.6. If the pH of the diluting buffer is not within target range it should be discarded. The preparation was stored at 4^0C.

Washing Solution: The washing solution was prepared by adding Na_2HPO_4 and 1ml of Tween 20 distilled water and stored at room temperature.

Conjugate: The conjugate was reconstituted and 100ul of the conjugate using multi-channel pipette was added to each well.

Stopping Solution: The stopping solution was prepared by diluting the contents of citric acid with 38ml of distilled water and stored at room temperature.

Controls: The positive and negative control sera in the kit were reconstituted with 1ml sterile distilled water. They were allowed to stand until an even suspension was obtained and then stored at 4^0C.

OPD: This was prepared by adding hydrogen peroxide tablets in distilled water.

ELISA Procedure

The microtitre plate has 96 wells coated with *B .abortus* antigen; twelve wells arranged horizontally (1-12 wells) while vertically, eight wells are arranged (A-H).

The plate was prepared by adding 100ul of the diluting buffer to each well, then followed by 20ul of the test sera leaving columns 11 and 12 for controls, 20ul of the positive control sera was added into wells F11, F12, G11, G12, H11, and H12 while 20ul of the negative control was added into wells A11, A12, B11, B12, C11, and C12, wells D11, D12, E11, E12, served as conjugate controls. The remaining wells giving a serum dilution of 1/6.The plate was then vigorously shaken (on the microtitre plate shaker) for 2 minutes in order to mix the serum and conjugate solution. The plate was then covered with lid and incubated at room temperature for 30 minutes. The plate was then shaken with hand for 30 seconds, followed by 10 seconds hand-shaking at 10 minutes interval for an hour. This was done carefully to keep the liquid within their respective wells. The content of the plate was then discarded and rinsed 5 times with washing solution and then dried by tapping on an absorbent tissue paper. The substrate chromogen was then immediately prepared and mixed thoroughly; 100ul of the solution was then added to each wells. The plate was left at room temperature for 10 minutes; the reaction was lowered by adding 100ul of the stopping solution to each wells.

The plate were read at 450nm with machine. The result was interpreted as follows; lack of colour development indicates that the sample tested was positive..

Validation of the test

The test was considered valid when:

Mean value of optical density of 6 positive control wells is less than 0.100.

Mean value of optical density of the 6 negative control wells is greater than 0.700. (The optical mean negative OD is 1.000).

Mean value of optical density of the 4 conjugate control well is greater than 0.700 (The optical mean conjugate control OD is 1)

3.8.3. Questionnaire design and administration

Structured questionnaire were pretested and administered to respondents from four selected villages of Nguru town of Yobe State to get information about husbandry practices, biosecurity measures and major constraints against rural production system based on convenience.

3.9 Statistical Analyses

The data obtained from participatory methods were entered and stored in Microsoft Excel 2010 where descriptive statistics were used and later exported to SPSS version 16.0 2007,for analysis using non parametric statistical test. Information between the informant groups on the data obtained from proportional piling disease matrix impacts scoring and seasonal scoring were assessed using Kendall's coefficient of concordance (W) (SPSS version 16.0, 2002.A non-parametric test, Friedman test, was also used to measureassociation between sets of ranks assigned to objects by judges (or groups of

judges) and to compute a W value between 0 and 1. A high or significant W value (nearer to 1) means that the judges are ranking the objects using similar standard. The test is particularly useful for determining inter-judge reliability (Seigel and Castellan, 1994; Mochabo *et al*., 2005). Agreement was termed weak, moderate and good if W-values were/less than 0.26, between o.26 and 0.38 ($p<0.05$) and greater than 0.38 ($p<0.01$ to 0.001) respectively (Seigal and Castellan, 1994). Information between informant groups on the data obtained from simple and pair-wise ranking was assessed using Friedman rank test, Friedman statistic is a non-parametric test that is used to compare several populations when all treatments are applied (in random order) to each subject in the sample (Conover, 1999; Catley *et al*., 2002a).

Data obtained from serology were also analysed using SPSS package version 16 ,categorical variables were evaluated using chi square to check for associations, odds ratio at 95% confidence interval was used to measure strength of association between variables and seroprevalence of Brucellosis. Values of $p<0.05$ were considered significant.

Seroprevalence was estimated using the formula:

$$\text{Seroprevalence} = \frac{\text{No of positive samples}}{\text{Total no of sample analyzed}} \times 100$$

CHAPTER FOUR

RESULT

4.1 Participatory Epidemiology of Brucellosis

4.1.1 Characteristics of study population and existing veterinary knowledge

From this study, majority of the inhabitants of the selected villages were Hausa and Fulani natives. There is no variation in livestock production and socioeconomic system between these two natives. The Hausa dominated Nguru city engaged in crop farming while the Fulani populated villages: Kogga, Hadari, Dumsai, Yamdigo, Maidashi, Mirwa sagir, Mirwa kabir, Dabule and were predominantly engaged in crop farming and livestock (cattle, sheep, and goat) production which serves as their livestock production system. Most of the participant gave reasons as to why they preferred cattle production because the cattle easily provide immediate family needs, and the management and housing system were not demanding.

This study revealed that Fulani herdsmen could easily differentiate among different types of diseases and signs in their livestock production system (Table 4.2). They used preventive measures to achieve this by a stripe of knife on the skin using fire. They believed that brucellosis could be transmitted to other cattle but humans could not be infected. There were other preventive measures used by the farmers that included pouring of water that was used for washing millet on the leg of an animal for the prevention of Foot and Mouth disease and also by using honey. The Fulani were unaware that brucellosis was zoonotic.

4.1.2 Livestock species kept and population

As determined through simple ranking and proportional piling cattle constituted the largest proportion (ranked 1st) of livestock specie kept in the study area as shown in Table 4.1. This is followed by sheep (ranked 2nd), goat (ranked 3rd) and poultry (ranked

4th). Kendall's coefficient of concordance (w) among the group was 0.901 this shows a good agreement amongst the groups. (Table 4.1).

4.1.3 Cattle diseases

From SSI there are four main cattle diseases affecting cattle in the selected villages. These included *Bakali* (Brucellosis), *Bauru* (FMD), *Samore* (Trypanasomoses) and *Ottu* (CBPP) as determined through pair wise ranking. Trypanasomoses is the most important and *Bakali* (Brucellosis) is the second most important while *Ottu (CBPP)* is the least important as shown in Table 4.2.

4.1.3.1 Relative morbidity and mortality of cattle diseases

Table 4.3 presents the estimated relative annual morbidity of 4.67%, mortality of 5.67% for *Bakali* and other cattle diseases as determined through proportional piling exercise in Kogga, Dumsai, and Yamdigo village of Nguru Local Government Area of Yobe State. There is a good agreement between the three informant groups (Kendall's coefficient W=0.782).There is also a good agreement between the informant groups (Kendall's coefficient W=1.000) as shown in Table 4.4 in disease matrix scoring of clinical signs. There was low agreement in seasonal scoring of cattle diseases between the informant groups except for *ottu* (CBPP) which shows a good agreement (Kendall's coefficient W=0.818) as shown in Table 4.5.



Plate II: Proportional pilling of livestock species population in Hadari village of Nguru LGA, Yobe State, Nigeria.

Table 4.1: Relative livestock species ranking in selected villages of Nguru local Government Area of Yobe State.

Livestock species	Yamdigo (n=3)	Kogga (n=3)	Dumsai (n = 3)	Ranks
Cattle	4	4	4	4
Sheep	3	3	3	3
Goat	2	2	2	2
Chicken	1	1	1	1

Interpretation of ranks, 4= most populated,1= Least populated. n= number of groups (villages) where ranking was conducted. There is a statistically significant difference between ranks of the groups (Friedman test, $P < 0.05$)



Plate III: Pairwise comparison ranking of common cattle diseases in Kogga village of Nguru Local Government of Yobe State, Nigeria.

Table 4.2: Important cattle diseases as determined through pairwise comparative ranking in selected Villages of Nguru Local Government Area of Yobe State, Nigeria

Disease	Yamdigo (n=3)	Kogga (n=3)	Dumsai (n=3)	Ranks
Bakali	2.0	2.0	2.0	2.0
Bauru	3.0	3.0	3.0	3.0
Samore	4.0	4.0	4.0	4.0
Ottu	1.0	1.0	1.0	1.0

Interpretation of rank, I= least important, 4= most important. n= number of group (villages) where pairwise ranking was conducted. There are a statistical by significant differences between rank of the groups (Friedman test,-*$P < 0.05$)

Bakali=Brucellosis

Bauru=FMD

Samore=Trypanosomosis

Otto=CBPP

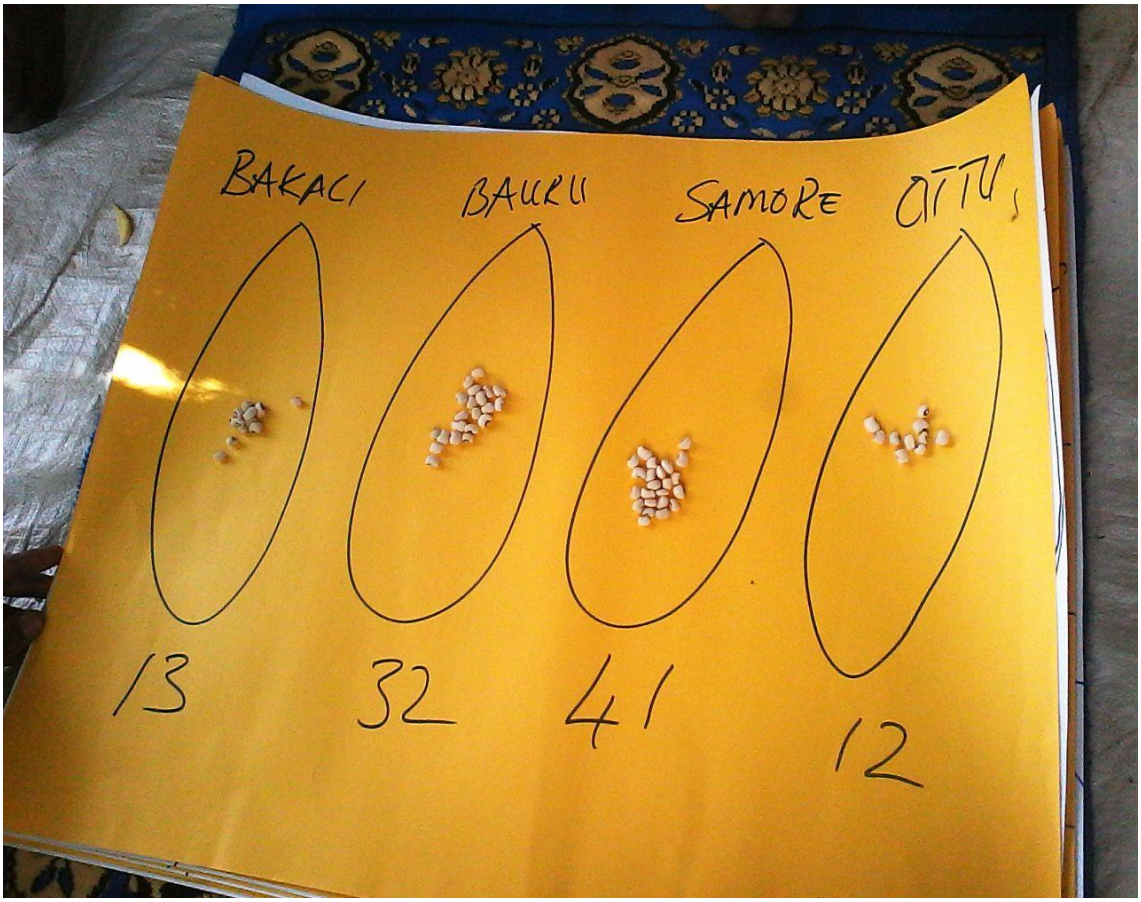


Plate IV: Proportional pilling exercise of major cattle disease in Dumsai village of Nguru LGA, Yobe State, Nigeria.



Plate V: Proportional piling exercise to show relative morbidity and mortality of brucellosis and other cattle diseases in Hadari village of Nguru Local Government of Yobe State, Nigeria.

Table 4.3: Mean proportion of cattle disease morbidity and mortality during the preceding 12 months period in selected villages of Nguru Local Government Areas of Yobe State, Nigeria.

Disease	Mortality (%)	Morbidity (%)
Bakali	5.67 ± 2.08	4.67 ± 3.21
Bauru	19.00 ± 6.56	3.00 ± 1.73
Samore	22.33 ± 4.93	3.00 ± 1.00
Ottu	11.33 ± 13.58	0.33 ± 0.58

n= Number of villages where proportional pilling exercise was conducted

There is a good agreement between groups (Kendall's coefficient, W= 0.782) $p < 0.05$



	BAKALI	BAURU	SAMORE	OTTU
KUMBURIN KAFA	10	20	0	0
KURAJE	0	25	5	0
MAJINA	0	5	5	20
GASHI YANA ZUBA	0	5	25	0
MIKA WUYA	0	0	2	28

Plate VI: Disease matrix impact scoring of cattle diseases and their clinical signs at Kogga village of Nguru Local Government of Yobe State, Nigeria.

Table 4.4: Disease matrix impact scoring of clinical signs and cattle diseases as indicated by rural farmers in Nguru local government area of Yobe State, Nigeria

	Bakali	***Bauru***	***Samore***	***Otto***
Kunburin				
kafa	19	10	**0**	**0**
W=0.901*	**(10-20)**	**(9-20)**	**(0-1)**	**(0-1)**
Kuraje	0	18	8	0
W=0.976*	**(0-0)**	**(16-25)**	**(5-12)**	**(0-6)**
Majina	0	5	6	20
W=0.655	**(0-0)**	**(4-20)**	**(5-8)**	**(2-20)**
P>0.05				
Zuban gashi	0	7	23	0
W=1.000*	**(0-0)**	**(5-8)**	**(22-25)**	**(0-0)**
Mika wuya	0	0	**7**	**23**
W=1.000*	**(0-0)**	**(0-0)**	**(2-8)**	**(22-28)**

Number of informant groups=3; W= Kendall concordance coefficient (*P<0.05, **P<0.001, *** P<0.0001).

Note: Kumburin Kafa- Hygroma, Kuraje- Lesions, Majina- Nasal discharge, Zuban Gashi- Alopecia, Mikawuya- Distension of Neck.

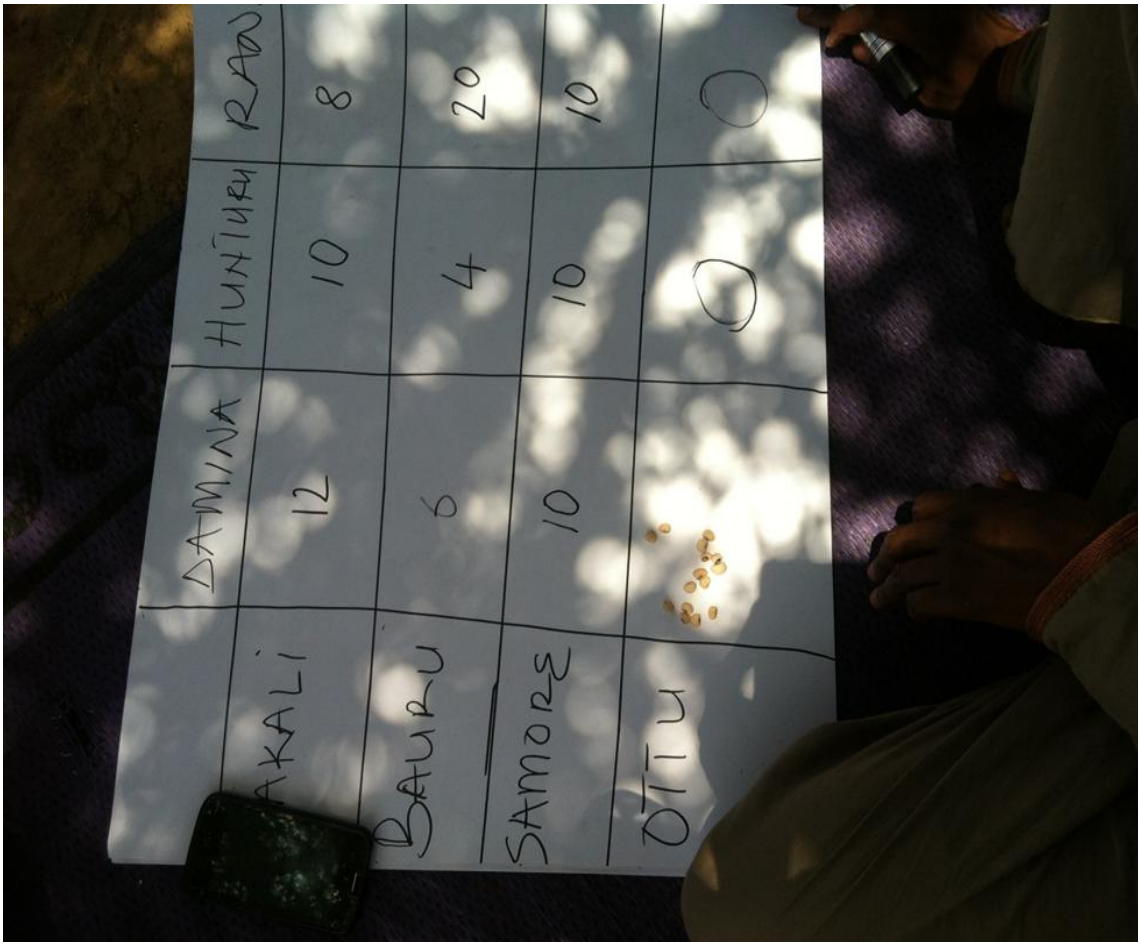


Plate VII: Seasonal scoring of cattle diseases in Dumsai village of Nguru Local Government of Yobe State, Nigeria.

Table 4.5: Summarized Season Scoring of Cattle Diseases as indicated by Farmers in Nguru Local Government Yobe State, Nigeria

Season in Hausa												
	***Damina*(Rainy Season)**					***Hunturu*(Harmattan)**			***Rani*(Dry Season)**			
	Months in Gregorian Calendar											
	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR
Brucello												
Bakali	**12**					**10**			**8**			
W=0.333	**(8-14)**					**(7-12)**			**(4-15)**			
P>0.05												
Bauru	**6**					**10**			**14**			
W=0.500	**(8-12)**					**(4-10)**			**(10-20)**			
P>0.05												
Samore	**10**					**10**			**10**			
W=0.000	**(8-12)**					**(9-11)**			**(7-11)**			
P>0.05												
Otto	**28**					**2**			**0**			
W=0.818	**(14-30)**					**(0-6)**			**(0-10)**			
P>0.05												

Number of villages involved in the exercise=3; W= Kendall concordance coefficient

(*P<0.05, **P<0.001, *** P<0.0001).

4.1.4 Local perceptions of cattle disease signs.

The result of the matrix scoring indicates that, there was a good agreement (w=0.90 – 0.97) between informant groups (Table 4.4). The scores allocated to the diseases showed that the informant understood the scoring method. *Bakali* (brucellosis) received the highest score for hygroma (*Kunburin kafa*.) Other signs enumerated by the informants included abortion, repeat breeders and orchihs.

4.1.5 Seasonal distribution of cattle diseases.

Summarized seasonal calendar for cattle diseases is shown figure 4.5. There was a good agreement (w=0.03 – 0.818) between three informant groups where this tools was performed. *Bakali* (brucellosis) has a higher relative prevalence during raining season (*Damina)* that is between july and September followed by *Ottu* (CBPP), *Bauru* (FMD), and *Sammore* (Trypanosomiasis) had a higher prevalence during the raining season. However, all the diseases occured throughout the year..

4.1.6 Direct community observation.

There is no any variation in cattle distribution patterns among various communities. Outbreaks of brucellosis is closely related to the fact that the Fulani practice extensive system of production and reared small ruminants especially sheep alongside cattle. Communities have organised historical traditional ruling system. There is no variation in settlement pattern among communities. Most communities are organised into linear settlement along major roads with some farming cluster settlement while others form relatively mobile population pattern.

4.2 Serology

The overall sero-prevalence in the study area of *Brucella* antibodies using cELISA was 9.6% and 10.7% using RBPT. (Table 4.6 and 4.7). The seroprevalence of *Brucella* antibodies in male cattle were 10.8% and 16.2% using C-ELISA and RBPT respectively while the corresponding figures for female cattle were 9.5% and 10.1% respectively (Table 4.6 and 4.7). There was no statistical difference (P> 0.05) between male and female cattle.

As presented in Table 4.8 there were differences in prevalence among the different age groups of cattle screened based on C-ELISA. Cattle older than 10 years old recorded 25.0% (1/4) while a prevalence of 14.9% (17/114) was obtained among cattle between 6-10 years. Cattle between the ages of 1-5 years had a prevalence of 6.9% (17/247). From the age related differences in prevalence, comparing age group older than 10 years with age group 6-10 years, an odds ratio of 0.22 and 0.422 and 95% confidence interval of odds ratio (CI:0.22:0.207 (P< 0.05) was obtained. There was significant statistical difference (P>0.05) between the different age groupS of the cattle screened. The seroprevalence was higher among cattle older than 10 years than those between 1-5 years.

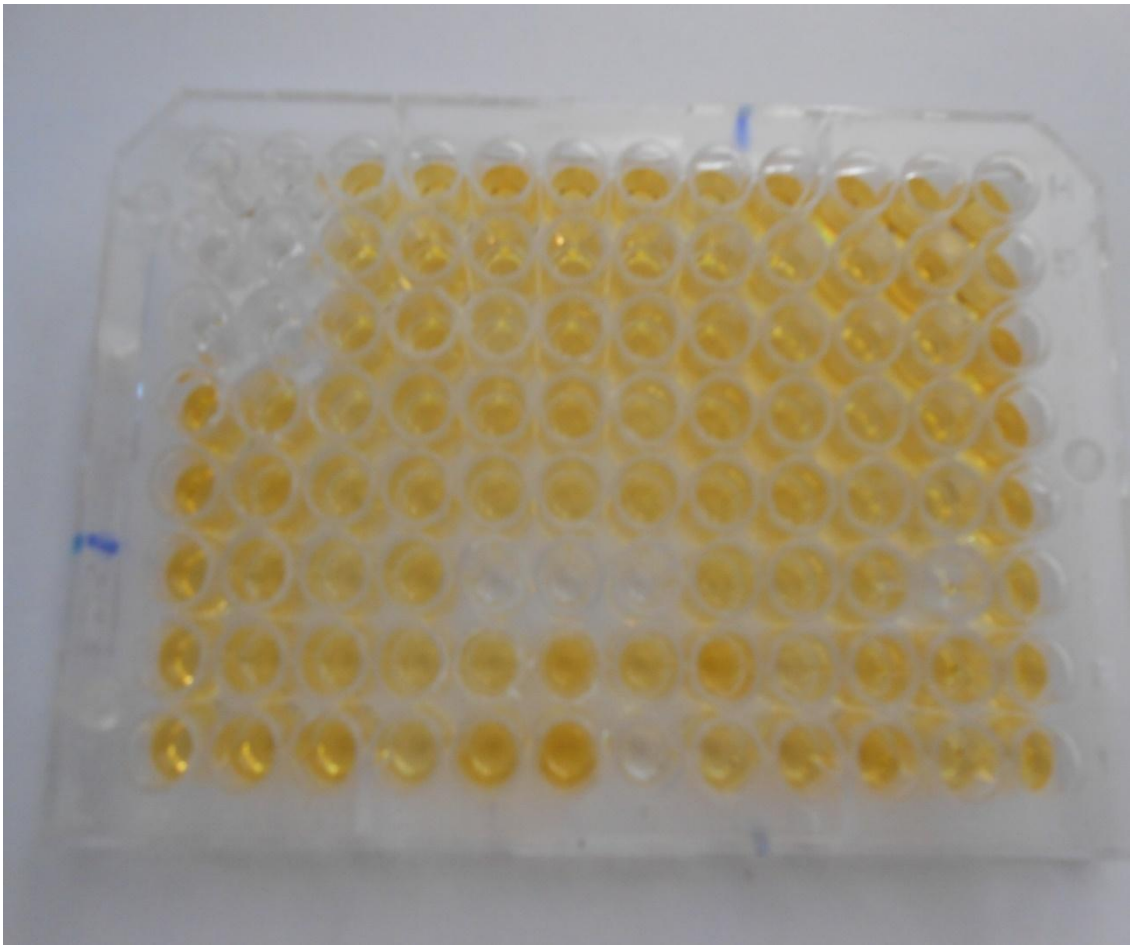


Plate VIII: ELISA plate showing positive samples.

Table 4.6: Prevalence and Sex Specific rate using cElisa.

Sex	**Total No. Sampled**	**cELISA positive (%)**	**Odds Ratio**	**95 % C.I.**
Male	37	4 (10.8)*	1 (Ref)	
Female	328	31 (9.5)	1.161	0.386 – 3.494
Total	**365**	**35 (9.6)**		

Fisher's Exact test p = 0.485

Table 4.7: Prevalence and Sex Specific rate using RBPT

Sex	**Total No. Sampled**	**RBPT positive (%)**	**Odds Ratio**	**95 % C.I.**
Male	37	6 (16.2)	1 (Ref)	
Female	328	33 (10.1)	1.497	0.544 – 4.120
Total	**365**	**39 (10.7)**		

$\chi^2 = 0.617$, df = 1; p = 0.432

Table 4.8: Prevalence and Age specific rate using cELISA

Age (Years)	Total No. Sampled	cELISA	P –value*	OR	95 % C.I.
1 - 5	247	17 (6.9)	0.039	1 (Ref)	
6 -10	114	17 (14.9)	0.018	0.422	0.207 – 0.860
> 10	4	1 (25.0)	0.202	0.222	0.022 – 2.248
Total	**365**	**35 (9.9)**			

*Fisher's exact test

Table 4.9: Prevalence and Age Specific rate using RBPT

Age (Years)	Total No. Sampled	RBPT	P- value*	OR	95 % C.I.
1 - 5	247	18 (7.3)	0.023	1 (Ref)	
6 -10	114	20 (17.5)	0.01	0.394	0.195 – 0.797
> 10	4	1 (25.0)	0.202	0.222	0.022 – 2.248
Total	**365**	**39 (10.7)**			

*Fisher's exact test

4.3 Prevalence Based On Location Using C-ELISA AND RBPT

Individual herd prevalence varied among villages within the Local Government. The highest prevalence was obtained in Nguru cattle market (17.4%) followed by Balanguwa and Dabule (16.0%), Nguru city and Dumsai (12.0%), Yakubari and Mirwa Kabir (8.0%), Maidashi (7.9%), Kachallari (3.4%) and Mirwa Sagir (0.0%) using C-ELISA and the highest prevalence was obtained in Dabule (28.0%) followed by Nguru cattle Market (21.7%), Kogga and Balanguwa (16.0%), Dumsai and Nguru city (12.0%), Yakubari and Mirwa kabir (8.0%), Maidashi (7.9%),Hadari (4.0%), Kachallari (3.4%), Mirwa Sagir (0%) using RBPT.

Table 4.10: Prevalence of Brucellosis by RBPT and cELISA Test from selected villages of Nguru local Government Yobe State, Nigeria.

Village	Total no. sampled	cELISA Positive (%)	RBPT Positive (%)
Dabule	25	4 (16.0)	7 (28.0)
Nguru Catlle Market	23	4 (17.4)	5 (21.7)
Maidashi	38	3 (7.9)	3 (7.9)
Mirwa Sagir	25	0 (0.0)	0 (0.0)
Balanguwa	25	4 (16.0)	4 (16.0)
Dumsai	25	3 (12.0)	3 (12.0)
Kogga	25	4 (16.0)	4 (16.0)
Yamdigo	25	1 (4.0)	1 (4.0)
Mirwa Kabir	25	2 (8.0)	2 (8.0)
Nguru City	50	6 (12.0)	6 (12.0)
Yakubari	25	2 (8.0)	2 (8.0)
Hadari	25	1 (4.0)	1 (4.0)
Kachallari	29	1 (3.4)	1 (3.4)
Total	**365**	**35 (9.6)**	**39 (10.7)**

RBPT: Fisher's Exact test; p = 0.436

ELISA: Fisher's Exact test; p = 0.328

4.4 Knowledge of Herd Owners on Brucellosis

Although, the Fulani who constitute more than 85% involved in this survey know the disease as “Bakali”, differences exist in understanding the symptoms and ways of transmitting the disease. Herd owners from Nguru cattle market have the higher number of respondents 26.9% (32/119) followed by those interviewed at Hadara Dumsai 25.2% (30/119) and Kogga 22.7% (27/119).

Herd owners involved in this study lack knowledge of the Zoonotic nature of Brucellosis or its symptoms in humans. 100% of the respondents were adult and married. 73.1% of them had informal education, 4.2% had formal education and 22.7% had none.

Most of the type of labour employed fall under Family Responsibility with 58.8%, Head of the Family was 32.8%, 5.0% was under the category of Children while Hired Labour was 3.4%.

Majority of the respondents had number of male and female animals between 21 to 50 and 71 to 90 respectively. The number of adult and young animals were also between 21 to 50 and 71 to 90 respectively. Percentage of other species of animals reared by cattle farmers as indicated by the respondents are Goats and Sheep 10 (8.4%), Chicken, Goats and Sheep 36 (30.3%), Chicken 2 (1.7%), Goats 14 (11.8%), Sheep 7 (5.9%) Horse 3 (2.5%) Dogs 5 (4.2%), Many Species 41 (34.5%), None 1 (0.8%).

Major clinical signs of Brucellosis as indicated by respondents were abortion, retained placenta, repeat breeder and presence of hygroma. History of abortion in the four selected locations were Kogga 19%, Nguru Cattle Market 18%, Hadari 17%, Dumsai 15%. Retained Placenta: Kogga 12%, Dumsai 7%. Repeat Breeder: Nguru Cattle Market 7%, Kogga 4%, Dumsai 4%, Hadari 1%. Presence of Hygroma: Dumsai 6%,

Kogga 5%, Nguru Cattle Market 4%, Hadari 3%. There was no history of vaccination against Brucellosis in the study area.

On method of treatment employed by the respondents 87(73.1%) reported patronizing the Stata Veterinary Services clinics while 15(12.6%) and 12(10.8%) reported using Local Government clinics and Private clinics (Table 4.15).The method of treatment employed by the respondents: 20% of them in Kogga patronized State Veterinary Services while only 2% patronized Local Government Veterinary Services; in Hadari, 22% employed State Veterinary Services while only 4% patronized Local Government Veterinary Services, 3% patronized Private Veterinary Services and 1% none as for Dumsai, 21% patronised State Veterinary Services, 3% patronized Local Government Veterinary Services and 5% were private services; in Nguru Cattle Market, 19% went to State Veterinary Services, 6% patronized Local Government Services, 4% patronized private services and 1% none.

Table 4.11: Demographic information of respondents in the study area

Category	Variable	No. of respondents	Per cent (%)	X^2	P-value
Village	Kogga	27	22.7	0.429	0.934
	Dumsai	30	25.2		
	Hadari	30	25.2		
	Nguru C/Market	32	26.9		
	Total	**119**	**100.0**		
Marital status	Married	119	100.0		
	Single	0	0.0		
	Total	**119**	**100.0**		
Age	Adult	119	100.0		
	Young	0	0.0		
	Total	**119**	**100.0**		
Education	Informal Education	87	73.1	90.824	0.000
	Formal Education	5	4.2		
	None	27	22.7		
	Total	**119**	**100.0**		
Type of Labour					
	FR	70	58.8	98.580	0.000
	HD	39	32.8		
	CD	6	5.0		
	HL	4	3.4		
	Total	**119**	**100.0**		

Key;

FR= Family Responsibility, HD= Head of the Family, CD= Children, HL= Hiredlabour

Table 4.12: Herd profile of cattle in the study areas

Category	Variable	No. of Responses (%)	X^2	P-value
No of male animals	< 20	103 (86.6)	153.496	0.000
	21 to 50	14 (11.8)		
	51 to 70	2 (1.7)		
	Total	**119 (100.0)**		
No. of females	< 20	21 (17.6)	83.227	0.000
	21 to 50	62 (52.1)		
	51 to 70	16 (13.4)		
	71 to 90	4 (3.4)		
	> 90	16 (13.4)		
	Total	**119 (100.0)**		
No. of Adults	< 20	44(37.0)	54.571	0.000
	21 to 50	43 (36.1)		
	51 to 70	11 (9.2)		
	71 to 90	9 (7.6)		
	> 90	12 (10.1)		
	Total	**119 (100.0)**		
No. of Young	< 20	81 (68.1)	191.882	0.000
	21 to 50	28 (23.5)		
	51 to 70	7 (5.9)		
	71 to 90	1 (0.8)		
	> 90	2 (1.7)		
	Total	**119 (100.0)**		

Table 4.13: Percentage of other species of animals reared by cattle farmers as indicated by respondents in four village of Nguru local Government areas Yobe State, Nigeria.

Presence of other species	Variables	No. responses (%)	Fisher's exact	p-value
	Goats and sheep	10 (8.4)	32.432	0.026
	Chicken, goats, sheep	36 (30.3)		
	Chickens	2 (1.7)		
	Goats	14 (11.8)		
	Sheep	7 (5.9)		
	Horse	3 (2.5)		
	Dogs	5 (4.2)		
	Many species	41 (34.5)		
	None	1 (0.8)		
	Total	**119 (100.0)**		

Table 4.14: Major clinical signs of Brucellosis as indicated by respondents in four Nguru local government areas Yobe State Nigeria.

Category	**Total number of responses**	**Variable**		**Fisher's exact**	**P-value**
1. Vaccination History		BLQV	None	7.304	0.028
Kogga	27	27	0		
Dumsai	30	30	0		
Hadari	30	28	2		
Nguru Cattle Market	32	27	5		
2. History of Abortion		Present (%)	Absent (%)	X^2	P-value
Kogga	27	19	8	2.546	0.467
Dumsai	30	15	15		
Hadari	30	17	13		
Nguru Cattle Market	32	18	14		
3. Retained placenta		Present (%)	Absent (%)	X^2	P-value
Kogga	27	12	15	5.967	0.127
Dumsai	30	7	23		
4. Repeat Breeder		**Present (%)**	**Absent (%)**	**X^2**	**P-value**
Kogga	27	4	23	4.789	0.176
Dumsai	30	4	26		
Ha**dari**	30	1	29		
Nguru Cattle Market	32	7	25		
5. Presence of Hygroma		Present (%)	Absent (%)	Fisher's exact	P-value
Kogga	27	5	22	1.625	0.690
Dumsai	30	6	24		
Hadari	30	3	27		
Nguru Cattle Market	32	4	28		

Note; BLQV= Blackquater Vaccine.

Table 4.15: Method of treatment employed by respondents

		Veterinary Services				
Location	**No. of Respondents**	**State (%) Private (%)**	**Local (%)**	**None (%)**	**Fisher's Exact**	**P-value**
Kogga	27	250	2	0	11.086	0.212
Dumsai	30	215	3	1		
Hadari	30	223	4	1		
NCM	32	194	6	3		
Total	119	87 (73.1) 12(10.8)	15(12.6)	5		

Note: NCM= Nguru Cattle Market.

CHAPTER FIVE

DISCUSSION

This study revealed that there was a considerable agreement between indigenous knowledge of brucellosis (and other cattle disease) among cattle farmers in the study area and modern veterinary knowledge. This is consistent with the report of Catley *et al.,* (2002), Catley and Mariner (2002), Anzaku (2013), Abdurrahman *et al*. (2015) that showed that farmers possessed a good knowledge of local diseases, their symptoms, period (s) of their occurrences and the relative environmental conditions. Similarly the study has demonstrated that cattle constituted the largest proportion of livestock species kept in the study area.

The study has also revealed local remedies used in preventing brucellosis by local farmers as they said a stripes by knife on the skin using fire. The four major diseases identified by participants to affect livestock were brucellosis, FMD, Trypanosomiasis and CBPP with Brucellosis as the second most important in terms of economic impact on cattle production system as determined through pairwise ranking.

The serological study revealed the presence of brucellosis among sampled cattle from selected villages of Nguru Local Government of Yobe State. An overall sero-prevelence of 9.6% from the villages of Nguru Local Government Area of Yobe State by c-ELISA and 10.7% by RBPT, There is a little increase in the prevalence rates when compared with previous report from Yobe State. Tijjani *et al.*, 2009 reported a prevalence of 5.7% and Adamu *et al.* 2014 reported a prevalence of 3.5%. The high and variable sero-prevelence of brucellosis has been associated with differences in the specificity and sensitivity of different serological tests in use, large herd size, and extensive movement of cattle and mingling with other herds at common grazing and other water point

(Kadohira *et al*., 1997). Recently, herd prevalence of 32.2% on a Prison cattle farm (Junaidu et al., 2008), 26.3% by Mai et al., 2012 in North Eastern Nigeria but within 3.3-40% reported in some African countries (Ocholi *et al*., 1996, Nakoune *et al*., 2004). The overall sero-prevelence obtained in this study may be attributed to non-vaccination against brucellosis low patronage of Veterinary Services and pastoralist low level of western education. Majority of the farmers had no formal education were majorly are full time farmers.

The overall results in this study by the two tests RBPT and c-ELISA showed that both tests are sensitive and specific but one is more specific. Highest infection rate detected by RBPT was 10.7 % while c-ELISA detected 9.6 %. This shows that the c-ELISA is a highly specific test that tends to minimize false positive results.

The overall prevalence of *Brucella* antibodies in cattle herds in Nguru local government area of Yobe State as determined by CELISA was 9.6%. The increasing rate of infection in the study area is on the increase and suggestive of reduction in infection rate within the past year. Sparse vegetation, direct sunlight and longer dry periods (Daries & Casey, 1973) don't favour survival of *Brucella abortus* in environment hence the low prevalence.

The prevalence rate of infection by age was highest among Cattle older than 10 years old recorded 25.0% (4/1) compared to those between the ages of 6-10 years14.9% (17/114) and also Cattle between the ages of 1-5 years 6.9% (17/247). An explanation to this is that, cattle older than 10 years are higher at risk to be seropositive for brucellosis than 1-5 years old (Cadmus *et al*., 2008, Mai *et al.*, 2012) because infection increases with age and most diseased animals carry the infection throughout their lives (Akakpo and Boranel, 1987: Oloffs 1996, 1998).

The prevalence and sex specific rate based on cELISA was (10.8 %) and (9.5%) male and female cattle. However, the prevalence rate by sex of the population sampled using RBPT indicated that 6 (16.2%) out of 37 male cattle were positive to brucellosis while 33 (10.1%) out of 328 were also positive. There was no significant statistical difference (P>0.05) between male and female. The increasing rate of infection is influenced by age, sex and reproduction status of individual animal as the animal advances in age observed in this report agreed with earlier reports that young animals tend to be more resistant to brucella infection and frequently eliminate the infection while sexually matured animal are more susceptible to infection with the organism than sexually mature cattle of the either sex (Chukwu, 1987, Crawford *et al.,* (1990). The higher sero-prevelence obtained in the female than male could be associated with fact that the female animals remained in the breeding herds for a longer period than the male that are from time being culled and sold to meet pastoralist economic needs. This agreed with the earlier report Adamu *et al.,* (2014). The higher sero-prevelence in the female may have also resulted from the fact that the foci of infection remain in females, which spread the infection from one animal to another as earlier observed by Ogundipe *et al.,* (1994). Brucellosis is essentially a disease of the sexually mature animals, the predilection site being the reproductive tract, especially the gravid uterus. Salihu *et al.,* (2011) also reported that there was a significant difference between animals of different age groups

In the case of the overall herd prevalence rate, Nguru Cattle market had highest 17.4%, followed by Kogga and Dabule 16.0% and the least was Kachallari, Hadari and Yamdigo 3.4%, 4.0%, 4.0%. An explanation also to this could be the nature of husbandry system, which allow different herds with different status of infection drinking water from same watering points which favours the spread of infection from

herd to herd. Secondly influx of cattle from neighbouring countries like Niger Republic to Nguru cattle market for sale can be a source of introducing animals with the infection. This high prevalence rate obtained in this study (9.6%) is alarming and requires government attention and intervention.

Herd owners revealed that vaccination against brucellosis was not carried out in their herds but some of the herd owners allow their cattle to be vaccinated during the annual vaccination exercise organized by the State Government. Calf hood vaccination has been shown to minimize losses and reduce prevalence of Brucellosis (Radostits *et al*., 2007). In Nigeria today, vaccination against brucellosis is done on request, it is not practice as a routine (U.S. Abdullahi (2014) personal communication), however some countries like South Africa, Botswana and Namibia vaccinate against brucellosis routinely (Brucella Workshop in Africa, 2013).

Majority of the respondents are full time farmers and fur that majority of them were males. This is because most of the female in the study area engaged in rearing small animals, while males engaged in cattle herding. However, the herd owners lack knowledge on the zoonotic character of brucellosis or it's symptoms in humans. Most of the respondents were adult and are married. They had no formal education and the type of labour employed were mostly family responsibility.

Majority of farmers mixed their cattle with other species of animals which result in inter specie transfer and the major clinical signs as indicated by the respondents were abortion, retained placenta, repeat breeders, hygroma .the method of treatment employed by the farmers were mostly by State veterinary services.

The capability of rapidly diagnosing the diseases and identifying its causative agent is critical to combat diseases and halt epidemics (Li *et a*l, 2014, Cui *et al.*, 2013). Recent

technological developments of new, rapid diagnostic test that hold promise for the improved management and control of infectious disease (Wadhwa *et al*, 2012). Although there have been developed a sensitive ELISA test, ethanol vortex enzyme-linked immunusorbed assay (EVELISA), using ethanol extract of mycobacterium SPP especially for Johne's disease (Wadhwa *et al*., 2013) and molecular phylogenetic analysis (Kumar *et al*., 2013) should be carried out in developing nations.

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CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1 Conclusion

From the study it was concluded that:-

1) The main livestock kept by pastoralists in the study area in order of decreasing Importance included cattle (4), sheep (3), goats (2) and chickens (1).
2) The diseases commonly encountered as recognized by the respondents included Brucellosis (*Bakale*), Trypanosomosis (*Samore*), Contagious Bovine Pleuropneumonia *(Ottu*) and Foot and Mouth Disease (*Bauru*).
3) Morbidity and mortality rates of Brucellosis were 4.67% ± 3.21% and 5.67% ± 2.08% respectively. While those for Trypanosomosis were 3.00 % ± 1.00% and 22.33% ± 4.93% respectively.
4) The respondents/ Informants could recognize signs of the four diseases as for example they could recognize Brucellosis by its signs that included hygroma *(Kumburin kafa*), while FMD that could recognize it by lesions in the mouth and legs and Trypanosomosis by alopecia and CBPP by distension of the neck.
5) The informants associated cattle diseases with seasons as they associated Brucellosis, FMD, Trypanosomosis to be seen mostly in June, September and January of each year while CBPP was seen mostly in June each year.
6) The overall seroprevalence of Brucellosis was 9.6% using c-ELISA and 10.7% using RBPT with the seroprevalence highest in cattle older than 10years old with seroprevalence of 25% in this age group and least in cattle 1 to 5 years old with seroprevalence of 6.8%.

6.2 Recommendations

The following recommendations are suggested;-

1. Participatory epidemiology in rural communities should be incorporated into Yobe State and national disease surveillance system.
2. Existing veterinary knowledge amongst the rural farmers is low; there should be more veterinary outreach to the rural people to tap some of this indigenous information.
3. It is recommended that isolation and characterization of the *Brucella* should be done and further serological survey involving risk groups such as the cattle rearers, veterinarians, butchers, etc., should be carried out, in order to assess the occurrence of the disease in humans.

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APPENDICES

Appendix 1

Checklist for participatory disease surveillance of Brucellosis

A. Existing Veterinary Knowledge

1. What are the different livestock species kept?
2. Which of these species is more in terms of population? (proportional pilling)
3. Why do we raise/ rear cattle?
4. What are the different cattle diseases (local names) affecting this community?
5. Have you seen this disease before (clinical case definition with pictures of signs)?
6. How do you recognize Brucellosis?
7. Can the disease be transmitted to other cattle and how?
8. How do you treat this disease?
9. Can human contact this disease and how?

B. Ranking and Scoring

1. Simple ranking
    1. Ranking exercise of livestock population
    2. Ranking exercise of livestock based on family income
    3. Ranking exercise base on immediate family needs

11 Pairwise ranking

1. Comparing importance among different cattle diseases.

111 Proportional pilling

1. Livestock population

2. Exercise on cattle disease importance to livelihood.
3. Exercise to demonstrate impact of cattle disease on flock size.
4. Which of the cattle disease occurs most often?

iv. Scoring method

1. Disease matrix impact scoring of cattle disease and clinical signs

C. Visualization tools

I. Seasonal calendars

1. Seasonal calendar exercise.

2. What are different seasons in local names?

3. What are seasonal local factors? (Weather, outbreaks, farming practices,

Availability of grains, cattle population).

4. Which season do you have more outbreaks of brucellosis?

5. Seasonal scoring of cattle disease using counters.

ii. Participatory mapping

1. Mapping exercise of key features related to the site of PE (E.g. resting points, public building, cattle market, farms, lakes, rivers, trade route)

Iii Transect walking

Direct walking to observe community life, production system.

APPENDIX II:

Clinical case definition of brucellosis for this study

Disease of cattle affecting all ages with followings

1. Abortion
2. orchitis
3. Repeat breaders
4. Hygroma
5 .Retained placenta
6. Weak calves
7. Stillbirth

With or without

1. High morbidity and mortality
2. Abortion

APPENDIX III:

DEPARTMENT OF VETERINARY OUBLIC HEALTH AND PREVENTIVE MEDICINE, FACULTY OF VETERINARY MEDICINE, AHMADU BELLO UNIVERSITY ZARIA

QUESTIONNAIRE ON EPIDEMIOLOGICAL STUDIES OF BRUCELLOSIS IN CATTLE IN NGURU LGA YOBE STATE, NIGERIA

This questionnaire is design to study the epidemiology of brucellosis in cattle in Nguru LGA Yobe State. Name or identity of the owner is not required in this questionnaire, all the information gathered will be used for the purpose.

INSTRUCTION: Please kindly the information to the best of your knowledge where necessary.

A Pastoralist Demographic Data

1 Marital status: Married ☐ Single ☐

2 Age Adult ☐ Young ☐

3 Number in the family: ……

4 No of: Male ☐ Female ☐

5 Number of children: ……..

6 No of children: Male ☐ Female ☐

B Educational Background:

1 Formal education: ☐

2 Informal education: ☐

3 None: ☐

C Type of labour employed

1 Family responsibility: ☐
2 Head of the family ☐
3 Children: ☐
4 Hired laborers: ☐

D Location of the herd: ……

E Herd profile

1. Number of male animals: ……
2. Number of female animals: ……..
3. Number of adults animals: …….
4. Number of young animals: …….
5. Other animal species in herd:

Camel	☐
Horses	☐
Chicken	☐
Goats	☐
Sheep	☐
Dogs	☐

F Herd Medical History

1 History of Vaccination in the last One Year: Yes/No

If yes,	*Brucella* vaccine	☐
	Black quarter vaccine	☐
	Anthrax spore vaccine	☐
	Haemorrhagic septicaemia vaccine	☐
	Others specify	☐
	None at all	☐

2 Is there outbreak of the following in the last one year?

Abortion	☐
Retained fetal membrane	☐
Repeat breeders	☐
Orchitis	☐
Hygroma	☐

G Availability of veterinary services Yes/ No

If yes,	State veterinary hospital	☐
	Local veterinary clinic	☐
	Private veterinary services	☐
	None at all	☐

Thank you for cooperation.