

THESIS

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An appraisal of common infectious diseases of small ruminants encountered at zone II veterinary clinic, Potiskum, Yobe State, Nigeria: Economic and Public Health implications

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DEDICATION

This thesis is dedicated to the God Almighty for His grace upon my life and to my family for their continuous support, prayers and encouragement during my overall stay and study in Budapest.

TABLE OF CONTENTS

DEDICATION	iii
LIST OF FIGURES.....	vi
LIST OF TABLES	vii
LIST OF ACRONYMS AND ALTERNATIVE NAMES.....	viii
CHAPTER 1: INTRODUCTION.....	1
1.1. Background of the study	1
1.2. Statement of the problem.....	2
1.3. Research objective	2
1.4. Research questions	3
1.5. Limitation of the study	3
CHAPTER 2: LITERATURE REVIEW.....	4
2.1. Overview.....	4
2.2. Small ruminants.....	5
2.3. An Outlook of Small Ruminant Production	5
2.4. Common diseases of Small Ruminants	7
2.5. Infectious Diseases of Small Ruminants.....	7
2.6. Economic and public Health Implications of Small Ruminant Infectious Diseases....	9
CHAPTER 3: MATERIALS AND METHODS.....	12
3.1. Study Area.....	12
3.2. Data Source and Methodology.	14
3.3. Statistical Analysis.....	14
CHAPTER 4: RESULT.....	15

CHAPTER 5: DISCUSSION, CONCLUSION AND SUMMARY.....	19
5.1. Discussion.....	19
5.2. Conclusion.....	20
5.3. Summary.....	24
REFERENCES	25
ACKNOWLEDGEMENTS.....	33
Appendix 1: Electronic Licence Agreement and Copyright Declaration form.....	34
Appendix 2: Supervisor counter-signature form.....	36

List of figures

Figure 1: Map of Nigeria.	1
Figure 2: Goats ready for distribution to rural farmers and IDPs in Fika during the Livestock Restocking Program by FAO in 2017.....	6
Figure 3: Goats showing typical signs of PPR.....	10
Figure 4: Goat pox.....	11
Figure 5: A map showing the location of Potiskum, the study area in north-eastern Nigeria.....	12
Figure 6: Potiskum Cattle/Livestock Market.....	13
Figure 7: Goats Vaccinated against PPR.....	22
Figure 8: Vaccination of a Cow against Vaccine Preventable diseases	23

List of tables

Table 1: Specie distribution of Small Ruminants diagnosed with infectious disease(s) at the
Zonal Veterinary Clinic, Potiskum from January 2016 to December 2020.....15

Table 2: Infectious diseases of sheep diagnosed at the Zonal Veterinary Clinic, Potiskum
from January 2016 to December 2020.....17

Table 3: Infectious diseases of goats diagnosed at the Zonal Veterinary Clinic, Potiskum
from January 2016 to December 2020.....18

List of acronyms and alternative names

OIE: World Organisation for Animal Health

PPR: *Peste des petits ruminants*

NBS: National Bureau of Statistics

GDP: Gross Domestic Product

FMARD: Federal Ministry of Agriculture and Rural Development

FAO: Food and Agricultural Organization

IDPs: Internally Displaced Persons

CCPP: Contagious Caprine Pleuropneumonia

USD: United States Dollars

USD PPP: United States Dollars Purchasing Power Parities

EIDs: Emerging Infectious Diseases

FAO GPS: Food and Agricultural Organization Global Perspectives Studies

NVRI: National Veterinary Research Institute

ESGPIP: Ethiopian Sheep and Goat Productivity Improvement Program

Orf: Contagious Ecthyma

Candidiasis: Thrush

Blackleg: Blackquarter

CHAPTER 1: INTRODUCTION

1.1 Background of the study

Nigeria is a country located in Western Africa bordering Cameroon, Chad, Niger, Benin and the Gulf of Guinea (Figure 1)

Figure 1: Map of Nigeria (Source: World factbook 2020)



It is the most populous country in Sub-Saharan Africa with an estimated population of 191 million (51 percent male, 49 percent female), an estimated growth rate of 2.43 percent per annum and a high dependency ratio [number of people of non-working age in relation to the number of people of working age] of 88 percent (NBS, 2016). In 2017, 49.5 percent of Nigeria's population lived in urban areas, growing substantially from 17.3 percent in 1968. The size of the middle class was estimated at around 20 percent of the population in 2013 (Corral et al., 2017). Nigeria's economy is the largest in Sub-Saharan Africa yet heavily reliant on oil as its main source of foreign exchange earnings (World factbook 2020). The global fall in oil prices has forced the Nigerian Government to refocus its priorities on five core sectors with agriculture being the foremost. In 2016, Nigeria's agriculture as a major engine for economic growth and livelihoods, was reported to have provided employment to about 70 percent of the active population in the country. The livestock sector is an integral part of agriculture and vital to the socio-economic development of the country, contributing about 3-4 percent to the Gross Domestic Product (GDP) and 15 percent to the agricultural value added (FMARD, 2016). The sector also plays a vital role in employment and income generation, and it is a key source of food (FAO, 2019).

Nigeria is one of the top four leading livestock producers in Sub-Saharan Africa with a national livestock population estimated to consist 16 million cattle, 52.5 million goats, 33 million sheep, 6.6 million pigs, 19000 camels and 166 million chickens (FAO, 2009). More recent estimates indicated that Nigeria's national herd had increased to 18.4 million cattle, 43.4 million sheep, 76 million goats and 180 million poultry (FMARD, 2017).

Production of ruminant animals plays a critical role on the country's economy through the provision of meat, milk, manure, draught power (cows), hides and valuable source of income and livelihood for the rural populace. There has been a rising demand for meat (Mutton, Chevron and beef) and milk which are the major sources of animal protein in the country. The domestic supply of animal protein is observed to grow at 1.8% per annum while the overall demand is estimated to grow at 5.1% annually. Despite the significance of ruminant animals and the ever-increasing need for animal products, the ruminant animal production subsector is bedeviled by among many others, the frequent occurrence of diseases. Livestock diseases continue to pose a major threat to the agricultural industry, as well as the world food supply at large (Boshra et al., 2013). They tend to have a dramatic impact on food production and cut off food supply chains (Ilbery, 2012). Consequently, a devastating effect on the livelihood and resilience of communities is felt (FAO, 2013a).

1.2 Statement of the problem

A considerable number of families in the rural areas of Nigeria depend on small ruminant animals (sheep and goats) production to feed themselves and educate their children or wards. However, when they lose their animals, they lose their source of livelihood and are caused to migrate to the urban areas where they experience peri-urban poverty, overcrowding and sedentary lifestyles. Consequently, they contribute to environmental degradation and unsustainable land use as they turn to the selling of firewood, charcoal and grass (FAO, 2013a)

1.3 Research objective

- To assess and determine the occurrence of common infectious diseases of small ruminants in the study area
- To examine the possible economic and public health implications of the common infectious diseases of small ruminants in the study area

1.4. Research questions

- What are the common infectious diseases of small ruminants in the study area?
- Could there be economic and public health implications of the common diseases of small ruminants in the study area, if any?

1.5. Limitation of the study

- Diagnoses of diseases in the clinic under study are mostly tentative – based on physical examination, clinical signs and symptoms. Laboratory diagnoses are seldom conducted.

CHAPTER 2: LITERATURE REVIEW

2.1. Overview

The livestock sector is considered critical to providing food security, avenues for income generation, improving the livelihoods of rural dwellers and offering poverty alleviation strategies that can help the poor to break the cycle of poverty (FAO/OIE, 2012). The FAO/WFP special report on crop and food security assessment mission to South Sudan observed that livestock is an essential part of livelihoods in rural areas and that sales of sheep and goats serves as an important source of earnings that chiefly determine pastoralists' capacity to buy food items (FAO/WFP 2019). Livestock production has been identified as a significant source of income for the rural poor in developing countries (Delgado et al. 1999), enabling the poor and landless farmers to earn income using public common-property resources such as open range lands. Consequently, livestock farming is found to boost the livelihoods of the poor throughout the developing world (Delgado et al. 1999; Perry et al. 2002), as well as provide income, quality food, fuel, draught power, building material and fertilizer, hence contributing to household livelihood, food security and nutrition (FAO, 2009). Nigeria's total production of milk, meat and eggs amounts to 0.5 billion liters, 1.4 and 0.6 million metric tons per year, respectively. Importation of food amounts up to 3-5 billion USD per year, out of which milk accounts for 1.3 billion USD (NLTP, 2019). In West Africa, goat meat and mutton account for about 25 percent of all meat produced in 2010 (FAO, 2010). For example, in West African countries with large populations of small ruminants, such as Mali and Nigeria, goat meat and mutton constitute about one third of the national meat production. Along with geographical distribution, there is a marked increase in demand for mutton meat. The consumption of mutton in sub-Saharan Africa is predicted to increase by 137 percent from the year 2000 to 2030 (FAO, 2013b). The aforementioned dynamics mean that small ruminants play a vital role as an important livelihood and food security asset that needs to be maintained and protected in agrarian communities around the world (FAO, 2013a). The entry or presence of any small ruminant disease within these settings can be devastating for the livelihoods and resilience of these communities. Infectious diseases like PPR can result in huge losses due to mortality in susceptible flocks from 10 to 100 percent and morbidity from 50 to 100 percent (Bourdin, 1983; Roeder, 2012). The OIE/FAO report on global PPR control and eradication found that *Peste des Petit Ruminant*

(PPR) alone costs an estimated total of US \$1.2 to 1.7 billion each year globally (OIE/FAO, 2015).

“Infectious diseases refer to those diseases caused by an infectious agent or its toxic products. This agent can be transmitted by an infected person, an animal or a reservoir directly or indirectly through a vector which may be an alternate host” (Krämer et al., 2009). Infectious diseases of small ruminants, such as contagious ecthyma and listeriosis may pose a zoonotic risk.

About 330 million people worldwide rely on sheep and goats for their livelihood, so understanding how major livestock diseases spread is critical (Herzog et al., 2019)

2.2. Small Ruminants

Small Ruminants comprising of the Sheep and goats are ungulates, "hooved" animals that are members of the order Artiodactyla (even-toed ungulates, or animals with cloven hooves), sub-order Ruminantia (ruminants, or cud-chewing animals) and family Bovidae. Members of the Bovidae group of mammals are distinguished by characteristics such as an even number of toes, a compartmentalized forestomach, and horns. These animals are obligate herbivores and, as adults, derive all their glucose from gluconeogenesis. The subfamily Caprinae includes sheep and goats. The genus and subgenus *Ovis* include domestic sheep as well as wild Asian and European sheep species. Domestic sheep are *Ovis aries*. The sub-genus *Pachyceros* includes the wild North American species as well as snow sheep (*Ovis nivicola*) of northeastern Siberia. *Capra hircus* is the domestic goat that originated from western Asian goats. *Capra pyrenaica* (Spanish goat), *Capra ibex* (goats of the Red Sea and Caucasus area), and *Capra falconiere* (wild goat of Afghanistan and Pakistan) are other members of the genus (Delano et al., 2002).

2.3. An outlook of Small Ruminant Production

It is estimated that about 50% of the population of sheep and goats is found in the arid regions of the world, which indicates their versatility and possible tolerance to rising temperatures (Gowane et al, 2017). These small ruminants are known to produce a wide range of products including meat, milk, fiber, and hide and act as a buffer to environmental fluctuations, reducing financial risks for farmers. Globally, the contribution of milk from goats (3.4%) and sheep (3.4%) is much lower than that of cattle (85%) (Geros & Skoet, 2012), but 80% of the total goat

population is distributed in the tropical areas of Asia and Africa, meeting the dairy demands of low-income communities (Silanikove et al., 2010). In 2013, the global sheep and goat population produced more than 13 million tons of meat and 28 million tons of milk (FAO, 2013b). Furthermore, the production of goat and sheep milk has increased over the last two decades, by 1.3%/annum and 1.7%/annum, respectively (FAO, 2013b). Small ruminants also display relatively good feed conversion efficiency and thermotolerance (Sejian et al., 2010), with goats (Figure 2) being adapted best to tropical environments (Silanikove et al., 2010).



Figure 2: Goats ready for distribution to rural farmers and IDPs in Fika during the Livestock Restocking Programme by FAO in 2017 (Photo credit: Mohammed Ajiya Idriss)

2.4. Common diseases of small ruminants

The major setbacks hampering the productivity of the livestock sector in most sub-Saharan countries are diseases, poor nutrition, poor breeding policies and poor management. The common diseases which affect sheep and goats in sub-Saharan countries are *Peste petitis ruminants* (Figure 3), Contagious Ecthyma, Goat Pox (Figure 4), Sheep Pox, Pneumonia, Anthrax, Blackquarter, Foot rot, Caseous Lymphadenitis, Helminthosis and Brucellosis, among others (Kambarage and Kusiluka, 1996). Ibrahim et al. (1999) identified PPR, Pneumonia, CCPP, Haemonchosis and Liver Flukes as Diseases of Economic Importance in Small Ruminants in sub-Saharan Africa. Kardjadj (2017) identified PPR, Sheep/Goat Pox, Foot and Mouth Disease, Bluetongue, Rift Valley Fever and Brucellosis as the main infectious diseases threatening Algeria's small ruminant population. Wahab et al. (2019) named Septicemia, Pasteurellosis, Foot rot, Tetanus, PPR, Orf, Sheep Pox as Common diseases seen in small ruminants in Ibadan, South Western Nigeria. Odo (2003) identified Mange, PPR, Orf, Helminthiasis, Tick and Flea infestations, Abortion/stillbirth and Premature delivery as the diseases commonly affecting goats in South Eastern Nigeria. Peter et al. (2015) named Mastitis, Listeriosis, Tetanus, Metritis, Foot rot, Arthritis, Septicemia, PPR, Orf (Contagious Ecthyma), Pneumonia and Pox as commonly occurring diseases of small ruminants in Maiduguri, North Eastern Nigeria.

2.5. Infectious Diseases of Small Ruminants

Depending on the aetiologic agents involved, the infectious diseases of small ruminants can be grouped as:

1. Bacterial diseases: Tetanus, Mastitis, Blackquarter, Listeriosis, Foot rot,
2. Viral diseases: PPR, Contagious ecthyma, Sheep/Goat pox, CCPP,
3. Fungal diseases: Candidiasis, Cryptococcosis,
4. Parasitic diseases: Helminthoses,

Some of these diseases form part of the most important diseases identified by OIE and hence are classified under LIST A (The diseases under this list were formerly identified as List A and List B diseases before they were merged a few years ago). The definition of List A diseases is:

“Transmissible diseases which have the potential for very serious and rapid spread, irrespective of national borders, which are of serious socio-economic or public health consequence and which are of major importance in the international trade of animals and animal products”.

List A diseases are:

Foot and mouth disease	Vesicular stomatitis
Swine vesicular disease	Rinderpest
Peste des petits ruminants	Contagious bovine pleuropneumonia
Lumpy skin disease	Rift Valley fever
Bluetongue	Sheep pox and goat pox
African horse sickness	African swine fever
Classical swine fever	Highly pathogenic avian influenza
Newcastle disease	

Source: OIE ([OIE-Listed diseases 2021: OIE - World Organisation for Animal Health](#))

2.6. Economic and Public Health Implications of Small Ruminant Diseases

Infectious diseases of sheep and goats, some of which are zoonoses, can have large economic impacts. These impacts can include large production losses, dramatically increased mortality and morbidity (especially in young animals) as well as markedly reduced reproductive performance (Sewell and Brocklesby, 1990; Cleaveland et al., 2001). Morbidity losses include severe weight loss, reduced reproductive capability and reduced milk production. Other losses associated with infectious diseases like PPR are the costs to bring the disease under control at both national and household levels.

Some of these diseases can have considerable effects on human health and society, including threatening human wellbeing globally (Madkour, 2001; Freedberg et al., 2003; Chakraborty et al., 2014). The prevalence of such infectious and economically important animal diseases in Ethiopia, for instance, was discovered to exclude the country from profitable international markets thereby greatly reducing the country's foreign exchange earnings (ESGPIP, 2008). According to FAO, PPR can result in huge losses due to mortality in susceptible flocks from 10 to 100 percent and morbidity from 50 to 100 percent with significant economic, food security and livelihood impacts (FAO, 2013a). FAO's State of Food Security and Nutrition in the World (SOFI) document observed that out of Nigeria's 190 million people, 102 million are estimated to live under the poverty line. Most of the poor live in rural areas. Undernourishment affects 11.5 percent of the population, with wasting and stunting in children under 5 years of age being at 10.8 and 43.6 percent, respectively (SOFI, 2018). It is estimated that Nigeria's population will grow swiftly and transform extensively in the next three decades. Between 2015 and 2050 the population will double to almost 400 million and the number of people living in urban areas will triple from the current 94 million to 280 million. GDP per capita will almost triple up to around 7 137 USD PPP. As a result of these changes, the demand for livestock products will rise exponentially: projections suggest that poultry meat, beef and milk consumption will grow by 253, 117 and 577 percent, respectively (FAO GPS, 2018). Due to the projected growth in Human and Animal Populations, the future will be characterized by an increased risk of outbreaks of emerging and re-emerging infectious diseases (EIDs), including zoonotic diseases.

The growing animal and human populations, in fact, will result in novel interactions between humans, animals and wildlife. This holds particularly true along value chains serving expanding urban and peri-urban areas. There will be increased risk of livestock-driven antimicrobial resistance in humans, with the associated negative impact on society. Either because of stiffer competition or because of the increased risk of zoonotic diseases, farmers will be tempted to imprudently use antibiotics not only to treat sick animals but also as growth promoter and/or for prophylaxis (FAO, 2019).



Figure 3: Goats showing typical signs of PPR (Photocredit: Oryemjames Benjamin)



Figure 4: Goat pox (Photo credit: Ahmed Abdulkadir Gamawa)

CHAPTER 3: MATERIALS AND METHOD

3.1. STUDY AREA

The study area is Potiskum town of Potiskum Local Government Area of Yobe State, Nigeria (Figure 5). It is located between longitude $11^{\circ}43'N$ and latitude $11^{\circ}04'E$. The mean temperature in Potiskum is about $37^{\circ}C$. The highest temperature of $42^{\circ}C$ is normally experienced in April, while minimum temperature (about $30^{\circ}C$) is normally recorded in December (Iloeje, 1977). About 713 mm precipitation falls annually. The profile of the soil is poorly developed, and it has a low water retention capacity (Price et al., 1990). Potiskum has an average relative humidity of 39.5% (Eludoyin et al., 2014). It has an area of 559 square kilometers (216 sq. miles) and a population of 205,876 at the 2006 census. Majority of the inhabitants are farmers keeping livestock and producing Maize, Sorghum, Cowpea, Beniseed etc. The town is strategically located as a center of commerce, learning, spiritual and cultural revival with one of the biggest livestock markets (Figure 6) in sub-Saharan Africa (Okpachu et al. 2017).

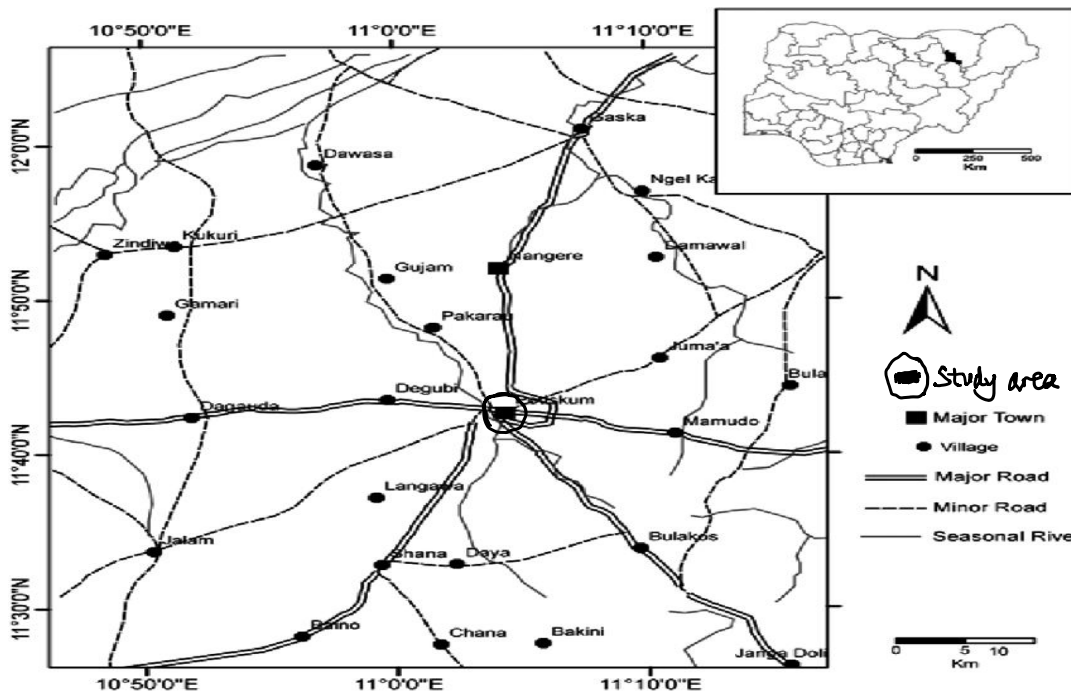


Figure 5: A map showing the location of Potiskum, the study area in north-eastern Nigeria (Source: Naibbi A. et al., 2014)



Figure 6: Potiskum Cattle/Livestock Market (Picture Credit: Omale John Achimugu)

3.2. DATA SOURCE AND METHODOLOGY

This study was based on the clinical record of sheep and goats presented to the Zone II Veterinary clinic, Potiskum, Nigeria from January 2016 to December 2020. These records were obtained from the clinic's clinical record books. Diagnoses were made based on history, clinical examinations and/or laboratory findings. Data obtained from the clinical records were studied and statistically analyzed.

3.3. Statistical Analysis

The data obtained was entered into Microsoft Excel spread sheet, summarized and presented in tables, and analyzed using basic descriptive statistics

CHAPTER 4: RESULT

The result of this study showed that a total of 3469 small ruminant animals were diagnosed with one infectious disease or another at the Zone II Zonal Veterinary Clinic, Potiskum Nigeria during the period of January 2016 to December 2020. Out of these, 1638(47%) were sheep and 1831(53%) were goats (Table 1).

Table 1: Specie distribution of Small Ruminants diagnosed with infectious disease(s) at the Zonal Veterinary Clinic, Potiskum from January 2016 December 2020

Specie	n	%
Sheep	1638	47
Goats	1831	53
Total	3469	100

Common infectious diseases diagnosed at the clinic were grouped based on etiology in concordance with Abiola et al., (2016), as Viral (PPR, Orf, Sheep pox, Goat pox), Bacterial (Tetanus, Mastitis, footrot, Listeriosis, Metritis, Blackleg, CCPP, Enterotoxemia, Caseous lymphadenitis), Fungal (Candidiasis/thrush, Cryptococcosis) and Parasitic (helminthosis). Table 2 shows the infectious diseases of sheep diagnosed at the Zone II Zonal Veterinary Clinic, Potiskum Nigeria from January 2016 to December 2020. These include: PPR (47.3%), Helminthosis (31.6%), Footrot (5.5%), Mastitis (4%), Sheep pox (4%), Orf (2%), Listeriosis (1.8%) and Tetanus (1%).

The annual distribution of infectious diseases of sheep diagnosed at the Zonal Veterinary Clinic, Potiskum Nigeria from January 2016 to December 2020 showed that the highest number 379 (23%) of sheep infectious diseases was recorded in the year 2018 while the lowest 276 (17%), was in the year 2020.

Similarly, like table 2, Table 3 shows the infectious diseases of goats diagnosed at the Zone II Zonal Veterinary Clinic, Potiskum Nigeria from January 2016 to December 2020. These include: PPR (71.2%), Helminthosis (14.6%), Goat pox (6.5%), Mastitis (2.5%), Footrot (1.3%) and Tetanus (1.1%)

Also, the annual distribution of infectious diseases of goats diagnosed at the Zonal Veterinary Clinic, Potiskum Nigeria from January 2016 to December 2020 showed that the highest number

421 (23%) of goat infectious diseases was recorded in the year 2017 while the lowest 314 (17%), was in the year 2020.

Table 2 and Table 3 revealed that PPR was found to be more frequent in goats (71.2%) than sheep (47.3%), Footrot was more frequent in sheep (5.5%) than goats (1.3%), Goat/Sheep pox was more frequent in goats (6.5%) than sheep (4.0%) and Helminthoses was more frequent in sheep (31.6%) than goats (14.6%).

Table 2: Specific Infectious diseases of sheep diagnosed at the zonal Veterinary Clinic, Potiskum Nigeria from January 2016 to December 2020

Infectious disease	2016	2017	2018	2019	2020	Total	%
VIRAL							
PPR	109	152	183	200	131	775	47.3
ORF	15	3	8	3	4	33	2.0
Sheep pox	22	11	18	3	11	65	4.0
BACTERIAL							
Tetanus	2	6	2	4	2	16	1.0
Mastitis	8	14	24	8	11	65	4.0
Blackleg	1	1	1	0	2	5	0.3
CCPP	0	0	0	0	0	0	0
Enterotoxemia	1	2	2	1	4	10	0.6
Enzootic Balanoposthitis	4	2	1	2	2	11	0.7
Metritis	0	3	1	1	0	5	0.3
Listeriosis	3	7	5	11	4	30	1.8
Footrot	14	38	27	10	1	90	5.5
Caseous Lymphadenitis	1	0	1	1	3	6	0.4
Pasteurellosis	0	0	0	0	1	1	0.1
FUNGAL							
Candidiasis	0	0	0	0	0	0	0
Cryptococcosis	0	0	3	2	4	9	0.5
PARASITIC							
Helminthosis	109	94	103	115	96	517	31.6
Total	289	333	379	361	276	1638	100.0

Table 3: Specific Infectious diseases of goats diagnosed at the zonal Veterinary Clinic, Potiskum Nigeria from January 2016 to December 2020

Infectious disease	2016	2017	2018	2019	2020	Total	%
VIRAL							
PPR	259	291	247	285	222	1304	71.2
ORF	8	4	1	0	0	13	0.7
Goat pox	23	10	26	23	37	119	6.5
BACTERIAL							
Tetanus	4	5	3	8	1	21	1.1
Mastitis	10	10	12	7	7	46	2.5
Blackleg	0	0	0	0	0	0	0
CCPP	2	0	1	3	4	10	0.5
Enterotoxemia	0	0	0	0	0	0	0
Enzootic Balanoposthitis	1	0	0	0	0	1	0.1
Metritis	1	2	2	0	0	5	0.3
Listeriosis	2	4	0	3	0	9	0
Footrot	3	12	5	4	0	24	1.3
Caseous Lymphadenitis	0	0	0	0	0	0	0
Pasteurellosis	0	0	0	0	0	0	0
FUNGAL							
Candidiasis	3	3	1	3	2	12	0.7
Cryptococcosis	0	0	0	0	0	0	0
PARASITIC							
Helminthosis	43	80	48	55	41	267	14.6
Total	359	421	346	391	314	1831	100.0

CHAPTER 5: DISCUSSION, CONCLUSION AND SUMMARY

5.1. DISCUSSION

This study revealed more goats (53%) than sheep (47%) were diagnosed with infectious diseases at the Zone II Zonal Veterinary Clinic Potiskum Nigeria from January 2016 to December 2020. The possible explanation for this may be due to the fact that the Clinic is located in a peri-urban setting. Rural and peri-urban farmers prefer to rear goats on account of their low cost of production, prolificacy, capacity to adapt to hot environment through dynamic feeding behavior, fast reproduction cycle and growth rate (Tsegaye et al., 2013). This finding corroborates the finding made by Abiola et al., (2016) whose study revealed more cases of goat than sheep at the University of Ibadan veterinary teaching hospital. However, the finding is in contrast with that of Peter et al., (2015) whose study at the state veterinary hospital, Maiduguri, Nigeria recorded more cases of sheep than goats. It is also in contrast with the finding of Unigwe et al., (2016) who had earlier reported that more cases of sheep were presented to Mokola veterinary hospital between July 2009 and June 2013. The present study showed that PPR is the most common infectious disease of sheep and goats diagnosed at the Zone II Zonal Veterinary Clinic Potiskum. This agrees with the report of Diallo et al., (2007) that PPR disease is enzootic in several countries of West Africa, contributing to high economic loss in small ruminant production. The result of this study also showed that PPR is more frequent (nearly twice frequent) in goats (71.2%) than in sheep (47.3%). This corroborates the findings of previous studies which showed that goats are more susceptible to PPR infection than sheep (Abd el-rahim et al, 2010; Farougou et al, 2013; Victor et al, 2017; Fentie et al, 2018). The higher number of goats than sheep affected with the disease may also be due to the larger population of goats compared to sheep in the study area. PPR is a highly contagious disease and can result in huge losses due to mortality in susceptible flocks from 10 to 100 percent and morbidity from 50 to 100 percent (Bourdin, 1983; Roeder, 2012). It is therefore a major concern among rural farmers who rely on small ruminants as sole source of income (Emikpe & Akpavie, 2011). The second most common infectious disease of sheep and goats diagnosed at the Zone II Zonal Veterinary Clinic Potiskum is Helminthosis (31.6% in sheep; 14.6% in goats). This finding revealed that Helminthosis is more frequent in sheep than goats and agrees with the finding by Ola-Fadunsin et al. (2017) in their study which showed Helminthosis to be 78.8% in sheep and 52.9% in goats. The higher

frequency of the disease in sheep than in goats can be said to be as a result of the grazing habit of the sheep where they graze closer to the ground thereby getting exposed to parasites. Parasitism has been reported as one of the major issues posing serious concern in ruminants in developing countries especially where nutrition and sanitation are poor (Odoi et al., 2007). The current study also identified Footrot, Sheep/goat pox, Mastitis, Orf, Listeriosis and Tetanus as the more commonly diagnosed infectious diseases of small ruminants at the Zone II Zonal Veterinary Clinic Potiskum. This is consistent with a previous study by Kambarage and Kusiluka (1996) which identified same as the common diseases of Sheep and Goats in Sub-Saharan Africa. It is also consistent with the findings of Wahab et al., (2019) and Peter et al. (2015). The higher frequency of foot rot in sheep (5.5%) than goats (1.3%) observed in this study is in tandem with Bitrus et al. (2017) who observed that foot rot is mostly seen in sheep than in goats. This may be due to the higher susceptibility of sheep than goat to footrot (Aguiar et al. 2011). The present study showed that goat/sheep pox is more frequent in goats (6.5%) than sheep (4%). This is most likely due to the fact that livestock farmers in the study area keep more goats than sheep. The frequent occurrence of economically important diseases like PPR and diseases with zoonotic potentials like Contagious Ecthyma (Orf), as observed in this study, can have negative economic and public health implications. The year-wise distribution of infectious diseases as shown in Table 2 and Table 3 gives a better understanding of infectious disease patterns which showed that diseases like PPR and Goat/Sheep pox were endemic throughout the years. Table 2b and Table 3b revealed that the lowest number of both Sheep and goat diseases was recorded in 2020. This can be attributed to the lockdown and economic shutdown occasioned by the COVID-19 Pandemic.

5.2. Conclusion:

It is evident from this study that PPR, Helminthosis, Footrot, Mastitis, Sheep/Goat pox, Listeriosis, Contagious Ecthyma (Orf) and Tetanus are the common infectious diseases of Small Ruminants in the study area. Hence, it is imperative that special focus be directed towards putting in place proper animal management to curtail the effect of these infectious diseases. Veterinary services should be strengthened and made more accessible and affordable to rural farmers. Routine mass vaccination against vaccine preventable diseases (Figure 7 and Figure 8) like PPR should be entrenched. Institutions like the NVRI should be further supported by

Government to enhance their capacity to produce effective vaccines against such diseases. Rural and peri-urban farmers should adopt best management practices so as to minimize the susceptibility of their flocks to diseases. Similar and more extensive studies should be conducted in other areas within Yobe State of Nigeria to provide more insight into the distribution of infectious diseases affecting small ruminants within the State. These, when done, will provide the necessary data that can help policy makers and Veterinarians in the formulation and implementation of policies towards curtailing infectious diseases of small ruminants thereby preventing the economic and public health impacts they may cause.



Figure 7: Goats Vaccinated against PPR (Photo credit: Ibrahim Maraya)



Figure 8: Vaccination of a Cow against Vaccine Preventable diseases

5.3. Summary

Infectious diseases are those diseases caused by an infectious agent or its toxic products. This agent can be transmitted by an infected person, an animal or a reservoir directly or indirectly through a vector which may be an alternate host. This study sought to assess and determine the common infectious diseases of small ruminants encountered at the Zone II Zonal Veterinary Clinic, Potiskum Nigeria. It was carried out based on the clinical record of sheep and goats presented to the Zonal Veterinary clinic, Potiskum, Nigeria from January 2016 to December 2020. These records were obtained from the clinic's clinical record books. A total of 3469 small ruminant animals were diagnosed with one infectious disease or another during the period of January 2016 to December 2020. Out of the 3469, 1638(47%) were sheep and 1831(53%) were goats. The common infectious diseases diagnosed in these small ruminants were PPR (47.3% for sheep and 71.2% for goats), Helminthosis (31.6% for Sheep and 14.6% for goats), Footrot (5.5% for sheep and 1.3 for Goats), Mastitis (4% for sheep and 2.5% for Goats) Sheep/Goat pox (4% for sheep and 6.5% for Goats), Orf (2% for sheep and 0.7% for Goats), Listeriosis (1.8% for sheep and 0.5% for Goats) and Tetanus (1% for sheep and 1.1% for Goats). In 2020, the lowest number and percentage of both Sheep (276; 17%) and goat (314; 17%) infectious diseases was recorded at the clinic. This can be attributed to the lockdown and economic shutdown occasioned by the COVID-19 Pandemic. The common occurrence of the economically important diseases like PPR and diseases with zoonotic potentials like contagious Ecthyma (Orf) can have negative economic and public health implications.

References

- Abd el-rahim, I., Sharawi, S., Barakat, M., Bonazza, V., & El-nahas, E. (2010). An outbreak of peste des petits ruminants in migratory flocks of sheep and goats in Egypt in 2006. *Revue Scientifique Et Technique De L'oie*, 29(3), 655-662. doi: 10.20506/rst.29.3.2004
- Abiola, O., Olaogun, S., Emedoh, O., & Jeremiah, O. (2016). A Retrospective Study of Ruminant Cases Presented Between 1996 and 2005 at the Veterinary Teaching Hospital, University of Ibadan, Ibadan, Nigeria. *International Journal of Livestock Research*, 6(7), 16. doi: 10.5455/ijlr.20160706092259
- Aguiar, G., Simões, S., Silva, T., Assis, A., Medeiros, J., Garino Jr, F., & Riet-Correa, F. (2011). Foot rot and other foot diseases of goat and sheep in the semiarid region of northeastern Brazil. *Pesquisa Veterinária Brasileira*, 31(10), 879-884. doi: 10.1590/s0100-736x2011001000008
- Bitrus, A., Abba, Y., Jesse, F., Yi, L., Teoh, R., Sadiq, M., Chung E. L. T., Mohd L., Mohd A. & Haron A. (2017). Clinical management of foot rot in goats: A case report of lameness. *Journal of Advanced Veterinary and Animal Research*. 4, 110-116. Retrieved 23 April 2021, from https://www.researchgate.net/publication/315350780_Clinical_management_of_foot_rot_in_goats_A_case_report_of_lameness
- Boshra, H., Truong, T., Nfon, C., Gerds, V., Tikoo, S., & Babiuk, L. et al. (2013). Capripoxvirus-vectored vaccines against livestock diseases in Africa. *Antiviral Research*, 98(2), 217-227. doi: 10.1016/j.antiviral.2013.02.016
- Bourdin, P. (1983). History, epidemiology and economic significance of PPR in West Africa and Nigeria in particular. In Hill, D. H. ed. *Peste des petits ruminants (PPR) in sheep and goats*. Proceedings of the international workshop held at IITA, Ibadan, Nigeria, 24-26 September 1980. *International Livestock Centre for Africa (ILCA), Addis Ababa, Ethiopia.*, Pp. 10-11. Retrieved from http://www.ilri.org/infoserv/webpub/fulldocs/Peste_des/History.html

- Chakraborty, S., Kumar, A., Tiwari, R., Rahal, A., Malik, Y., & Dhama, K. et al. (2014). Advances in Diagnosis of Respiratory Diseases of Small Ruminants. *Veterinary Medicine International*, 2014, 1-16. doi: 10.1155/2014/508304
- Cleaveland, S., Laurenson, M., & Taylor, L. (2001). Diseases of humans and their domestic mammals: pathogen characteristics, host range and the risk of emergence. *Philos. Trans. Biol. Sci.*, 356(1411), 991-999.
- Corral Rodas, P., Molini, V., & Oseni, G. (2017). No Condition is Permanent: Middle Class in Nigeria in the Last Decade. *The Journal of Development Studies*, 55(2), 294-310. doi: 10.1080/00220388.2017.1366453
- Delano, M., Mischler, S., & Underwood, W. (2002). Biology and Diseases of Ruminants: Sheep, Goats, and Cattle. Doi:10.1016/B978-012263951-7/50017-X.
- Diallo, A., Minet, C., Goff, C., Berhe, G., Albina, E., Libeau, G., & Barrett, T. (2007). The threat of *peste des petits ruminants*: progress in vaccine development for disease control. Retrieved 2 April 2021, from <https://www.semanticscholar.org/paper/The-threat-of-peste-des-petits-ruminants%3A-progress-Diallo-Minet/53b6b32aafc16d29b09a6357e405b115014afd0b>
- Delgado, C., Rose grant, M., Seinfeld, H., Ehui, S., & Courbois, C. (1999). Livestock to 2020 the next food revolution. Food, Agriculture, and the Environment Discussion Paper 28. Washington, D.C. *International Food Policy Research Institute (IFPRI)*. Retrieved from <http://www.ifpri.org/publication/livestock-2020>
- Eludoyin, O., Adelekan, I., Webster, R., & Eludoyin, A. (2014). Air temperature, relative humidity, climate regionalization and thermal comfort of Nigeria. *International Journal Of Climatology*, 34, 2000-2018.

- Emikpe, B., & Akpavie, S. (2011). Clinicopathologic effects of *Peste des petits ruminants* virus infection in West African dwarf goats. *Small Ruminant Research*, 95(2-3), 168-173. Retrieved from https://www.researchgate.net/profile/Benjamin-Emikpe/publication/251605857_Clinicopathologic_effects_of_Peste_Des_Petit_Ruminant_Virus_infection_in_West_African_dwarf_goats/links/59df1c16aca27247d7aa7f3c/Clinicopathologic-effects-of-Peste-Des-Petit-Ruminant-Virus-infection-in-West-African-dwarf-goats.pdf
- Ethiopia Sheep and Goat Productivity Improvement Program (ESGPIP). (2008). *Sheep and Goat Production Handbook for Ethiopia*. USAID and MoARD..
- FAO. (2002). Improved animal health for poverty reduction and sustainable livelihoods. FAO Animal Production and Health Paper 153. Rome.
- FAO. (2009). The state of Food and Agriculture. Livestock in the balance. Rome: Food and Agricultural organization.
- FAO. (2010). FAO statistical databases. Rome. Retrieved 2 April 2021, from <http://faostat.fao.org/site/569/default.aspx#ancor>
- FAO, & OIE. (2012). 2nd Global conference on Foot and mouth disease control. Bangkok, Thailand 27-29 June 2012.
- FAO, & WFP. (2019). (Food and Agricultural organization/World Food Program) crop and food security assessment mission to South Sudan. Food and agricultural organization; World food program, special report, Rome. Retrieved from [Special Report - FAO/WFP Crop and Food Security Assessment Mission to South Sudan](#)
- FAO. (2013a). Supporting livelihoods and building resilience through *peste des petits ruminants* (PPR) disease control. Retrieved 2 April 2021, from <http://www.fao.org/docrep/017/aq236e/aq236e>
- FAO. (2013b). Faostat Database. Food and Agriculture Organization of the United Nations: Rome, Italy; Volume 1.

- FAO. (2018). Global Perspectives Studies (GPS)| Food and Agriculture Organization of the United Nations. Retrieved 2 April 2021, from <http://www.fao.org/global-perspectives-studies/en/>
- FAO. (2019). The future of livestock in Nigeria. Opportunities and challenges in the face of uncertainty. Rome: ISBN 978-92-5-131661-0.
- Farougou, S., Gagara, M., & Mensah, G. (2013). Prevalence of peste des petits ruminants in the arid zone in the Republic of Niger. *Onderstepoort J Vet Res*, 80(1). doi: 10.4102/ojvr.v80i1.544
- Fentie, T., Teshome, Y., Ayele, B., Molla, W., Fenta, N., & Nigatu, S. et al. (2018). Sero-epidemiological study of peste des petits ruminants in small ruminants in Amahara region, Ethiopia. *Comparative Clinical Pathology*, 27(4), 1029-1036. doi: 10.1007/s00580-018-2697-2
- FMARD. (2016). The Agriculture Promotion Policy (2016 – 2020); Policy and Strategy Document. FMARD, Abuja.
- FMARD. (2017). Animal population data. Federal Ministry of Agriculture and Rural Development. Abuja.
- Freedberg, I., Eisen, A., Wolff, K., Austen, K., Goldsmith, L., & Katz, S. (2003). *Fitzpatrick's Dermatology in General Medicine* (6th ed., pp. 1918-1921). New York: McGraw-Hill.
- Gerosa, S., & Skoet, J. (2012). Milk availability: trends in production and demand and medium-term outlook. Retrieved 2 April 2021, from <https://ideas.repec.org/p/ags/faoaes/289000.html>
- Gowane, G., Gadekar, Y., Prakash, V., Kadam, V., Chopra, A., & Prince, L. (2017). Climate Change Impact on Sheep Production: Growth, Milk, Wool, and Meat. *Sheep Production Adapting to Climate Change*, 31-69. doi: 10.1007/978-981-10-4714-5_2

- Herzog, C., de Glanville, W., Willett, B., Kibona, T., Cattadori, I., & Kapur, V. et al. (2019). Pastoral production is associated with increased *peste des petits ruminants* seroprevalence in northern Tanzania across sheep, goats and cattle. *Epidemiology and Infection*, 147. doi: 10.1017/s0950268819001262
- Ibrahim, H., Tembely, S., & Roger, F. (1999). *Diseases of economic importance in small ruminants in sub-Saharan Africa* (p. 44). Nairobi: International Livestock Research Institute.
- Ilbery, B. (2012). Interrogating food security and infectious animal and plant diseases: a critical introduction. *The Geographical Journal*, 178(4), 308-312. doi: 10.1111/j.1475-4959.2012.00483.x
- Iloeje, N. (1977). *A geography of Nigeria*:. Longman ltd.
- Kambarage, D., & Kusiluka, L. (1996). Diseases of small Ruminants in Sub-Saharan Africa: A Handbook. Retrieved 2 April 2021, from <https://assets.publishing.service.gov.uk/media/57a08dbfed915d3cfd001bba/R5499-Diseases-of-Small-Ruminants.pdf>
- Kardjadj, M. (2017). An epidemiological overview of small ruminant diseases in Algeria. *Revue Scientifique Et Technique De L'oise*, 36(3), 997-1006. doi: 10.20506/rst.36.3.2731
- Krämer, A., Akmatov, M., & Kretzschmar, M. (2009). Principles of Infectious Disease Epidemiology. *Modern Infectious Disease Epidemiology*, 85-99. doi: 10.1007/978-0-387-93835-6_5
- Madkour, M. (2001). *Madkour's Brucellosis* (p. 306). Berlin, Heidelberg: Springer Berlin Heidelberg.
- Naibbi, A., Baily, B., Healey, R., & Collier, P. (2014). Changing Vegetation Patterns in Yobe State Nigeria: An Analysis of the Rates of Change, Potential Causes and the Implications for Sustainable Resource Management. Retrieved 2 April 2021, from <http://www.scirp.org/journal/ijg>

- NBS. (2016). "Nigeria Poverty Profile 2016 Report". Retrieved 2 April 2021, from <http://www.tucrivers.org/tucpublications/Nigeria%20Poverty%20Profile%202010.pdf>.
- NLTP. (2019). National Livestock Transformation Plan (NLTP) 2019-2028. *Strategy Document, National Economic Council*.
- Odo, B. (2003). Comparative study of some prevalent diseases of ecotype goats reared in southeastern Nigeria. *Small Ruminant Research*, 50(1-2), 203-207. doi: 10.1016/s0921-4488(03)00101-9
- Odoi, A., Gathuma, J., Gachuri, C., & Omore, A. (2007). Risk factors of gastrointestinal nematode parasite infections in small ruminants kept in smallholder mixed farms in Kenya. *BMC Veterinary Research*, 3(1), 6. doi: 10.1186/1746-6148-3-6
- OIE/FAO. (2015). Global Strategy for the Control and Eradication of PPR. World Organisation for Animal Health, United Nations Food and Agriculture Organisation.
- OIE Listed Diseases. (2021). Retrieved 2 April 2021, from <https://www.oie.int/animal-health-in-the-world/oie-listed-diseases-2021/>
- Okpachu, S., Madu, U., & Okpachu, G. (2017). Assessment of rural farm household poverty: Evidence from Potiskum Local Government Area of Yobe State, Nigeria. *Sky Journal Of Agricultural Research*, 6(2), pp. 022-027. Retrieved from <http://www.skyjournals.org/SJAR>
- Ola-Fadunsin, S., & Ibitoye, E. (2017). A retrospective evaluation of parasitic conditions and their associated risk factors in sheep and goats in Osun state, Nigeria. *Sokoto Journal Of Veterinary Sciences*, 15(3), 15. doi: 10.4314/sokjvs.v15i3.3
- Perry, B., Randolph, T., McDermott, J., Sones, K., & Thornton, P. (2002). *Investing in animal health research to alleviate poverty* (p. 148). Nairobi, Kenya: ILRI (International Livestock Research Institute).

- Peter, I., Dauda, Y., Thlama, P., Ndahi, J., Madziga, H., Stephen, J., & Mustapha, A. (2015). A Retrospective Study of Small Ruminant Diseases Identified at the State Veterinary Hospital Maiduguri, Nigeria. Retrieved 2 April 2021, from http://nexusacademicpublishers.com/table_contents_detail/11/564/html
- Price, S., Justice, C., & Los, S. (1990). *Remote sensing of the sahelian environment. A review of the current studies and future prospects*. Technical center for agriculture and co-operation.
- Roeder, P. (2012). *Establishing a systematic global programme for the eradication of PPR (FAO internal report)*.
- Sejian, V., Maurya, V., & Naqvi, S. (2010). Adaptability and growth of Malpura ewes subjected to thermal and nutritional stress. *Tropical Animal Health and Production*, 42(8), 1763-1770. doi: 10.1007/s11250-010-9633-z
- Sewell, M., & Brocklesby, D. (1990). *Handbook on Animal Diseases in the Tropics*. Baillière Tindall.. Baillière Tindall.
- Silanikove, N., Leitner, G., Merin, U., & Prosser, C. (2010). Recent advances in exploiting goat's milk: Quality, safety and production aspects. *Small Ruminant Research*, 89(2-3), 110-124. doi: 10.1016/j.smallrumres.2009.12.033
- SOFI. (2018). The State of Food Security and Nutrition in the World 2018. Building climate resilience for food security and nutrition. Retrieved 2 April 2021, from <http://www.fao.org/3/i9553en/i9553en.pdf>
- Tsegaye, D., Belay, B., & Haile, A. (2013). Prevalence of Major Goat Diseases and Mortality of Goat in Daro-Labu District of West Hararghe, Eastern Ethiopia. *Journal of Scientific And Innovative Research*, 2(3), 665-672.
- Underwood, W., Blauwiekel, R., Delano, M., Gillesby, R., Mischler, S., & Schoell, A. (2015). Biology and Diseases of Ruminants (Sheep, Goats, and Cattle). *Laboratory Animal Medicine*, 623-694. doi: 10.1016/b978-0-12-409527-4.00015-8

- Unigwe, C., Ogbu, U., Balogun, F., Orakwue, O., Nwufoh, O., & Nwachukwu, B. (2016). Prevalence of Small Ruminant Diseases/Disorders at Mokola Veterinary Hospital, Ibadan, Nigeria. *Journal of Biology, Agriculture and Healthcare*, 6(1), 107-112. Retrieved from https://www.researchgate.net/publication/340809588_Prevalence_of_Small_Ruminant_DiseasesDisorders_at_Mokola_Veterinary_Hospital_Ibadan_Nigeria
- Victor I., Akuve B., Buba E., & Helen A. O. (2017). Risk Factors Associated with Peste des Petits Ruminants (PPR) in Sheep and Goats in Makurdi, Benue State. *Archives on Veterinary Science and Technology*, 2(4), AVST-120. doi: 10.29011/2637-9988/100020
- Wahab, Y., Akinlabi, E., & Raheem, K. (2019). A Five-Year Retrospective Study of Small Ruminant Cases Presented to the State Veterinary Hospital, Ibadan Nigeria. *International Journal of Environment, Agriculture and Biotechnology*, 4(5), 1382-1386. doi: 10.22161/ijeab.45.14
- World Factbook. (2020). Nigeria. Retrieved 2 April 2021, from <https://www.cia.gov/the-world-factbook/countries/nigeria/>

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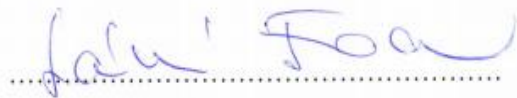
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Appendix 4.

I hereby confirm that I am familiar with the content of the thesis entitled “An appraisal of common infectious diseases of small ruminants encountered at zone II veterinary clinic, Potiskum, Yobe State, Nigeria: Economic and Public Health implications” written by Mr. Idris Ibrahim Fika which I deem suitable for submission and defence.

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