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Assessment of Knowledge of Zoonotic Risk and Preventive Health Practices of Livestock Farmers in Rural Communities of Northern Nigeria

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Abstract- Background: ***Zoonotic diseases are diseases that are transmissible between animals and humans. Livestock farming is a point of interaction between man and animals. Understanding the zoonotic risks and preventive health behaviour towards zoonotic infections helps build a healthy human community. Method: We conducted a questionnaire-based cross-sectional evaluation of the zoonotic risk and preventive health practices of livestock farmers in the rural communities of Northern Nigeria involving 400 livestock farmers. Results: About 49.6% and 45.7% had good knowledge of risk and preventive health practices. Majority of the respondents were males (81.8%), 46 – 55 years (26%), primary school certificate holders (33.8%) married (78.5%) and ruminant farmers (43.3%). The farmers major source of information on zoonotic diseases was mass media (91.8%). About 88% put their infected animals under observation (88.0%). Only 49.6% with good preventive practice of "Always" washing their hands". Conclusion: The study revealed that the rural livestock farmers in the region have poor knowledge of zoonotic risk and preventive health practices. We advocate massive community awareness campaign through mass media, government information organs and religious fora to break the zoonotic infection cycles and improve the health of the people of Northern Nigeria towards national development.***

Keywords: Zoonoses, Knowledge, Practice, Livestock Farmers, Public Health

I. INTRODUCTION

Zoonotic diseases are diseases that are transmissible from animals to man [WHO, 2004]. The occurrence of the disease is facilitated by the closeness of animals to man through hunting, livestock rearing, sporting and trades. Livestock is a major contributor to food security, poverty alleviation and sustainable livelihoods in both rural and urban areas [Akash etal., 2022]. However, diseases and parasites are serious constraints to rural livestock production in communal areas and where livestock-wildlife interactions are common [Ngoshe et al., 2022]. About 75% of the diseases in humans are zoonotic while 3 in every 4 emerging infectious diseases in humans are estimated to have been transmitted from animals [Milbank and Vira, 2022]. Most domestic and wild animals are regarded as veritable reservoirs of infectious pathogens. These pathogens generally live in the digestive systems of animals as commensals from where they sometimes become pathogenic when infecting vulnerable humans. Recurring cases of zoonotic diseases impact heavily on humans as global health risks [Esposito et al., 2023]. A global annual estimate of 2.5billion health related cases resulting in 2.7million deaths have been documented [Horefi, 2023]. Multiple disease burdens with concomitant coinfection of tuberculosis, malaria and HIV occur in 25% zoonotic diseases infections in developing and low-income countries [Horefi, 2023]. Such concurrence and multiplicity of diseases increase the susceptibility of the individuals at risk to zoonosis thereby facilitating its spread in the community. A good understanding of the knowledge, attitudinal disposition of livestock handlers in managing livestock is vital to mitigating the risks associated with zoonosis in the context of recent rise in cases of zoonotic outbreaks.

Factors of population growth, urbanization, political and social disruption, agriculture and livestock

intensification, deforestation, and climate change have been attributed to making Africa, a hot spot for zoonotic emergence [Edward et al., 2024]. More than 70% of the currently emerging diseases such as HIV/AIDS, influenza, West Nile virus encephalitis, SARS, Ebola virus disease, Marburg virus disease and hantavirus pulmonary syndrome are zoonotic while in poultry, zoonotic diseases may include such diseases as avian influenza, Newcastle disease, avian tuberculosis, cryptococcosis, histoplasmosis, salmonellosis, cryptosporidiosis, campylobacteriosis, and colibacillosis [Rahman et al., 2020]. Varieties of pathogens cause zoonotic ailments and are broadly classified based on aetiology as bacteria, viruses, fungi, helminths and protozoa [Rahman et al., 2020].

Food handling practices provide avenue for zoonotic disease transmission [Ehuwa et al, 2021]. Various strategies have been employed in preventing zoonosis depending on the nature of the pathogen involved while at community and personal levels, several practices have been adopted to reduce the impact of such diseases [Rahman et al., 2020]. Appropriate guidelines have been in place to reduce the risk of contracting zoonotic infections through the consumption of foods such as milk, vegetables, meat, eggs and consumption of water [Vourc'h, et al., 2022]. Various education approaches such as hand washing after touching animals and in many human communities, behavioural changes have been advocated to reduce the spread of zoonotic diseases [Vourc'h, et al., 2022, Rahman et al., 2020].

Livestock rearing is the dominant occupation of the people of the Northern Nigeria where 85% of the rural households keep poultry and 81% keep small ruminants [Garba, 2022]. The Northern Nigeria is often regarded in Nigeria as the least educationally advanced region with the citizens having access to minimal agricultural, medical, veterinary and information infrastructure.

The livestock population in Northern Nigeria consists of cattle, small ruminants and poultry. Many villages and settlements emerge in the region due to the necessity to find water, pasture and security for these livestock. These settlements often lacking in basic human health and veterinary support leading to impaired health of the farmers and animals and reduced animal production. Deficit modern livestock management systems increase the likelihood of exposure to zoonotic pathogens and zoonotic diseases outbreaks. Poor farm practices such as poor biosecurity measures have often been significantly associated with diseases in farms [Keutchatang et al, 2021, Rahman et al., 2020]. Closeness to animals and occupational practices of livestock farmers are also regarded as risks of contracting zoonotic diseases [Adeiza et al., 2024, Rahman et al., 2020], in addition to awareness and attitude of the farmers towards zoonotic risk behaviours contribute to chances of getting zoonotic diseases [Adeiza et al., 2024, Vourc'h, et al., 2022].

Many suspected zoonotic diseases such as rabies, Newcastle Diseases, Tuberculosis, leptospirosis, anthrax abound in Northern Nigeria with little or no documentation about the knowledge gaps and preventive health practices amongst farmers in rural communities to measure its zoonotic risks, prevention and its public health implication to national development. This work is therefore novel on the subject matter in the study area.

We undertook this study therefore to assess the zoonotic risk attitudes and preventive health practices of rural livestock farmers towards zoonotic diseases in Northern Nigeria so as to use the information gained thereof to formulate an effective policy development, local awareness and educational concept towards national development.

II. MATERIALS AND METHODS

Study Duration and Location

This descriptive cross-sectional study spanned a period of 3 months (June, 2025 – August, 2025). The study was conducted in purposively selected 40 rural farm settlements (Exclusively on livestock farming) in Northern Nigeria which comprised of 19 states and the Federal Capital Territory of Nigeria making a total of 20 study units in this survey.

Ethical Approval

Ethical approval was deemed not necessary for this study as the study was based on questionnaire.

All participants were informed of the study's objectives, assured of confidentiality, and provided verbal or written consent prior to participation.

Geographical Areas of Study

Northern Nigeria, the area of this study, has a size of 692,826 km^2 (70% of the land mass of Nigeria) with a population of 128.1m according to Anon [Ripples, 2013]. It is located on latitude 110 19' 48" (11.330) north, longitude of centre 60 53' 24". The area is bordered to the south by the Gulf of Guinea (Atlantic Ocean), west by the Benin Republic, Cameroon to the east, Chad and the Niger Republic to the north. The region is a typical tropical savannah vegetation region with relatively high temperature of up to 40^0C at a mean of 27^0C in the year. Tropical savanna ecozone is a humid tropical forest with an annual rainfall of 1600– 300mm. The choice of the study area was due to the favorable climate of warm forest and woodland of the cold south and the hot north that favors livestock farming, the predominant occupation of the people in the area and the fact that the region is the hub of livestock trade in the country which portends a likelihood of a relationship between livestock keepers and animal diseases.

Target Population

The target population included men and women involved in livestock farming within the study area. A total of 40 livestock farms comprising of two (2) equally selected from each of the 20 study units comprising of the 19 northern states and Federal Capital Territory. Rurality of the selected sampling unit in this study is as defined by Chigbu [2013]. Affiliation with livestock farming activities as an owner, worker and livestock keeping with a minimum of 5-year residency in the village marks eligibility for enlistment in this study, while the village settlement must primarily be for livestock rearing enterprise. Teenagers of under 15 years of age, visitors and farmers that have not lived in the community for up to 5 years were excluded from the study.

Sample Size Calculation

Sample size was calculated by simple random method using the Open-Source Epidemiologic Statistics for Public Health tools (Open Epi) version 2.3.1 software for percentage frequency in a finite population. With power of expected proportion set at 50%, 5% degree of precision and 95% confidence level, 384 was obtained in the survey. This figure was marked up by 10% for precision leading to 422 participants to be enlisted in the survey. A successful pilot study using 5% (22) of the sample size, was conducted to test the reliability of our method. This leaves an effective 400 sample size to be used in this survey. Equal number of participants (20) in a multi-stage sampling approach involving states and local government areas were selected from each of the 20 study units. Snowball sampling, an exponential discriminative sampling technique was adopted using the available veterinary drug shops, mosques and churches in each state to reach out to the original livestock owners and workers in the rural communities. This is because the veterinary drug shops, mosques and churches are common places where most of the rural livestock farmers meet to either buy veterinary preparations, buy feeds for their animals and pray to God in line with their faiths. Referral was continued until we got the required number of participants from the settlements in each state.

Questionnaire

A well-structured, closed-ended questionnaire based on previous literatures relevant to the study and written records at the veterinary shops in the area was used in this study. Precision and data enhancement of the questionnaire was according to Thrusfield et al [2018]. The questionnaire was written in English language and translated into Hausa, a major indigenous language spoken in the area of the study, for ease of communication. The questionnaire was divided into 5 parts. Part 1 asked 6 questions about the socio-demographic characteristics of the participants. The characteristics included age and sex of the participants, type of livestock on the farm, level of education of the participants [In Nigeria, education is divided into primary, secondary (junior and senior secondary) and tertiary levels]. Part 2 asked 12 questions on the sources of participants' information about zoonotic diseases. The proportion of participants depending on each source for information was measured. In part 3, we asked 13 questions. The responses to these questions were used to evaluate the knowledge of zoonotic risk attitude of the participants

bordering on practices that they perceive as likely to expose them to zoonotic infections. The questions were graded in accordance with Adeiza et al [2024] with a maximum score of "2" for participant who answered "Sure", "0" for "Disagree" while "1" was for "Unsure" as response. The maximum score was 13 points. Scores less than or equal to 50% (1–7 score), 51%–77% (8–10) and 78%–100% (11–13 score) were considered poor, moderate, and full knowledge respectively. Part 4 dealt with the actions taken by the participants when their livestock was sick or dying in numbers. The frequencies of each action based on the proportion of the participants undertaking the action was measured. Part 5 had 15 set of questions used to evaluate the knowledge of the farmers on preventive health practices against zoonotic diseases. The questions were graded using numeric scoring system as previously used by Adeiza et al. [2024] with a maximum score of "2" for questions on practices that had "Always" as response, "1" for "sometimes" while "0" is for those that answered "never" as response. The maximum point was 15. The questionnaire was reviewed and validated through cross-checking and authentication by two senior subject academic experts in the faculty for its design, content, relevance, understanding, reliability and simplicity to enable the participants answer them in 20minutes. The reliability of the questionnaire was 0.81 (Cronbach's alpha). The questions were then modified according to their observation, recommendations and suggestions.A total of 22 of the farmers were randomly selected and pre-tested on the questionnaire as a pilot study. Focus study approach was used in the pre-test to assess the convenience and interpretation of the questionnaire.

The obtained individual scores from the questionnaire were converted to percentages of the total score obtainable. Individual and collective participant scores less than 50% (1–15), 51%–77% (16–23), and 78%–100% (24-30) were considered to have poor, moderate, and full knowledge of preventive health practices respectively. Two trained veterinary assistants were employed to supervise the administration of the questionnaire to the participants in each of the study units. Participation in the survey was voluntary in accordance with Geneva convention [WMA, 2013].

Some of the participants signed their signatures on the data collected from them while other collections were based on verbal consent as the participants showed unwillingness to append their signatures even after being assured of the confidentiality of their participation.

Statistical analysis

Questionnaires were checked for proper completion by the participants. Questionnaires with >20% unanswered questions were rejected. Data were summarized in a Microsoft Excel 2016 spreadsheet, exported, and analyzed using SPSS version 25. Descriptive statistics were used to analyze variables with frequencies and proportions predominantly used to describe the data. Independent variables were created from the socio-demographic, farm characteristics, attitude and prevention practices. To create outcome variables, a unique score card was used for the responses. Each study participant was assigned a score that reflected the stringency of his or her response. To measure responses to these independent factors, the scoring system ranged between the 0 and 2 points for knowledge of zoonotic risks and preventive health practices.

III. RESULTS

Socio-demographic characteristics of respondents showed that majority of the farmers in the study 102 (25.5%), were within the age range of 46 – 55 years (Figure 1).

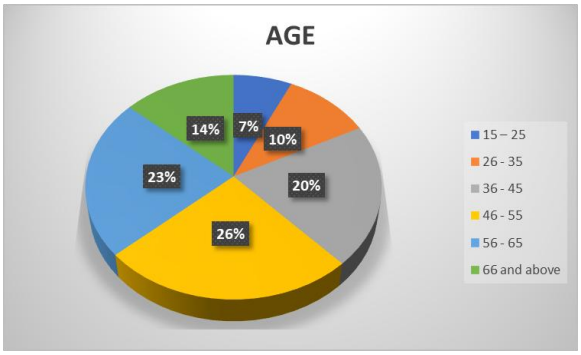

Figure 1: Pie chart showing age distribution of rural livestock farmers in northern Nigeria

A total of 173 (43.3%) of the participants were into ruminants' production (Table 1). The study had more responders, 327 (81.8) and responders of married status, 314 (78.5). The responding farmers were majorly of primary school education 135 (33.8%),

using mostly traditional methods 316 (79%) of farming (Table 1).

Variables		No of Participants	Proportion
Types of farming	Ruminants	173	43.3
	Mixed Farming	94	23.5
	Poultry	71	17.8
	Others	42	10.5
Marital Status	Married	314	78.5
Sex	Males	327	81.8
	Females	73	18.3
Educational level	Primary	135	33.8
	Secondary	106	26.5
	Tertiary	63	15.8
	Non-formal	96	24.0
Type of Farming	Mechanised	84	21.0
	Traditional	316	79.0

On the source of information to the participants, almost all the participants in this survey (91.8%), claimed "Mass media (Radio/Television, Cinema show)" as their source of information on zoonotic disease outbreaks.(Table 2).

Table 2: Sources of information on zoonotic diseases in northern Nigeria to the rural livestock farmers

Sources of information on zoonotic diseases outbreaks	Frequency	Proportion (%)
Local Government Administration	101	25.3
Ministry of Health officials/Community Health Workers	86	21.5
Village Heads/Elders/Political Leaders	256	64
Veterinary officers/Agric Extension workers	243	60.8
Agro-veterinary shops	291	72.8
Mosques/Churches	306	76.5
Village produce markets	268	67
Social gatherings (Weddings, Naming, graduations)	182	45.5
Eating/drinking joints	97	24.3
Mass media (Radio/Television, Cinema show)	367	91.8
Social media	295	73.8
Others (Fellow Farmers, Posters, Public Address System)	311	77.8

Figure 2 detailed the practices of the farmers that could expose them to infections. A total of 323 (80.8) agreed on "Not Deworming", 197 (49.3%) agreed on "poor hygiene leading to infestation and infection", 237(59.3%) agreed on "Eating un-inspected and infected meat", 226 (56.5%) disagreed on consumption of un-boiled milk, 310 (77.5%) agreed on consumption of game animals, 256 (64%) agreed on "Not vaccinating livestock", 301 (75.3%) agreed on "Poor waste disposal", 176 (44%) agreed on "Contact with infected products" and 296 (74%) agreed "Handling of infected carcasses" as practices that expose farmers to zoonotic infections, 249 (62.3%) disagreed on crowding, 202 (50.5) disagreed on "Consumption of improperly cooked meat", 318 (79.5%) was not sure on "Feeding dogs with carcasses" and 274 (68.5%) disagreed on close contact with livestock. Of the three options to the 13 questions posed to the 400 participants to test their knowledge towards these practices, 49.6% gave full responses, 31.1% were moderate while 19.2% were poor. On the

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overall, only 45.7% (<50%) of the population had good knowledge of zoonotic risk practices towards zoonotic diseases (Figure 2).

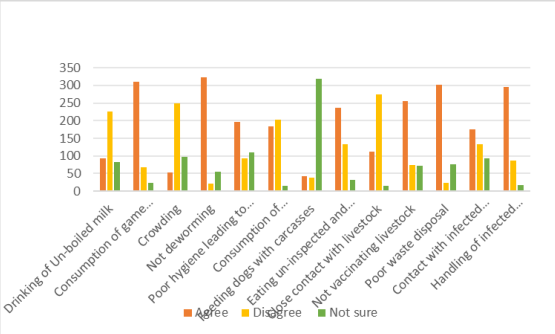

Figure 2: Histogram showing the zoonotic risk attitude of farmers on practices that could expose them to zoonotic infections

Farmers response to an outbreak of a zoonotic infection on their farms showed that about 353 (88%) of the farmers "put their animals under observation" while 326(81.5%) isolate the affected animals just as 347(86.7%) simply slaughtered the affected animals for consumption. About 231(57.8%) of the participants pray that the animals get better while 307(76.8%) slaughter the animals for sale. Close to half of the participants, 173(43.3%) report cases of infections to Veterinary officers just as about a fourth of the participants, 94(23.5%) report to Agro-veterinary shops. Furthermore, a little over 1/5th of the participants, 83(20.8%) take samples of/from dead animals to the laboratories while a substantial 298(74.5%) use herbs to treat their animals. Two-third 269(67.3%) of the participants buy drugs without prescription to treat their sick animals. A substantial portion of the farmers 327(81.8%) "consult experienced farmers" as their first reaction to an infection in their farms (Figure 3)

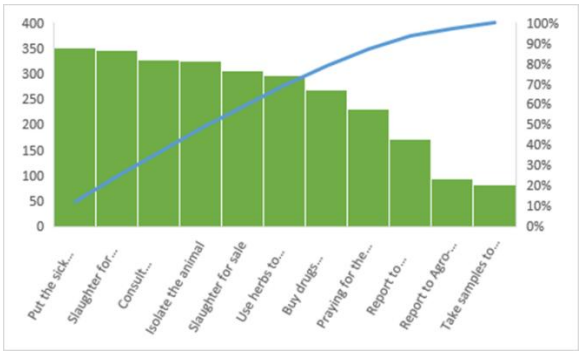

Figure 3: Histogram showing responses of farmers to an outbreak of a zoonotic infection on their farms

In terms of the preventive health practices of the participants in this study, preponderant of the rural livestock farmers in Northern Nigeria, 80.3% and 46% "Always" wash their hands and undertake constant vaccination of their livestock respectively. On the other hand, 46.5%, 69.0%, 59.5%, 44.8% and 44.0% of the farmers "sometimes" wear boots, frequently sanitise their equipment, avoid handshake, frequently visit veterinary doctor or technicians and undertake proper disposal of their carcasses as their preventive measures against zoonotic infections. Majority of the farmers, 47.0%, 59.0%, 56.5%, 64.3%, 74.8%, 46.6%, 80.0%, 70.0%, 85.0% "Never" used hand gloves, footbaths, routinely change their working apparels/clothes, face masks, frequently undertake environmental sanitation, constantly immunise children against zoonosis, wild birds and reptiles' control, observed appropriate social distancing in crowded areas and never avoid crowds respectively as preventive measures of zoonotic infections (Table 3).

Of the three options to the 15 questions posed to the 400 participants to test their preventive health attitude towards zoonotic infections, only 20.3% gave full responses, 33.6% were moderate while 29.4% had poor responses. On the overall, 45.7% (<50%) of the population had good knowledge of zoonotic risk practices towards zoonotic diseases.

Table 3: Evaluation of livestock farmers preventive health measures/practices against zoonotic disease outbreak in the rural livestock farming communities in northern Nigeria

Preventive Health Practices	Always (%)	Sometimes (%)	Never (%)
Use of hand gloves	26(6.5)	186(46.5)	188(47)
Washing of hands frequently	321(80.3)	67(16.8)	12(3)
Wearing of boots	128(32)	186(46.5)	86(21.5)
Use of footbath	73(18.3)	91(22.8)	236(59)
Routine change of working apparel/clothes	7(1.8)	167(41.8)	226(56.5)
Frequent sanitisation of equipment	53(14.0)	276(69)	71(17.8)
Frequent environmental sanitization	7(1.8)	94(23.5)	299(74.8)
Constant vaccination of livestock	184(46)	74(18.5)	142(35.5)
Constant immunization of children against zoonosis	82(20.5)	132(33.0)	186(46.6)
Control of wild birds and reptiles	58(14.5)	24(24)	318(23.9)
Observance of appropriate social distancing in crowded area	41(3.1)	79(5.9)	280(21)
Avoidance of handshake	0	238(17.9)	162(12.2)
Avoidance of crowds	11(0.9)	49(3.7)	340(25.5)
Proper disposal of carcasses	137(10.3)	176(13.2)	87(6.5)
Frequent visit to Vet doctor or Technician	74(18.5)	179(44.8)	147(36.8)

III. DISCUSSION

In this study, we evaluated the zoonotic risks and preventive health practices of livestock farmers in the rural communities of Northern Nigeria. A total of 400 farmers participated in this study. The response rate to our questionnaire was 100%. In the overall, the farmers were found to have poor zoonotic risk and preventive health attitudes towards zoonotic infections. Poor knowledge of farmers in this study may be due to their low-level education as majority of the participants have only primary school certificates. People with limited education have generally been known to misunderstand questions due to their low level of conceptualization often leading to uninformed behaviour and responses [Buisman et al., 2013]. The result of poor knowledge obtained in this study is consistent with the outcome of the study by Obi in Awka North and South Local Government Areas, Southeastern Nigeria [Obi, 2016], Alemayehu et al. [2021] on small scale livestock farmers in South Africa and Sadiq et al. [2021] on zoonotic diseases amongst livestock farmers in Ethiopia. In contrast, good knowledge of zoonotic disease risks was recorded in the studies of Bhattacharyya et al. [2019] in West Bengal, India, Özlü et al. [2020] in Turkey, and Fesseha and Abebe [2020] in Southern Ethiopia. The disparity in the results may be due to the differences in the level of primary health care approach, access to information and extension services, cultural practices and educational exposure of the farmers.

The middle-aged farmers of 46 – 55 years were the highest responders in this study. This reflects the nature of demography of farmers in the third world who, in middle age, mostly save to invest in farming towards post-retirement from formal works (Government retirement age in Nigeria is between 60 and 70 years). Although we did not measure the level of knowledge of farmers based on age in this study, our result suggests an agreement with Akash et al. [2022] who reported progressive increase in knowledge of knowledge of zoonotic risk and

preventive health practices in farmers with the younger ones having lowest ostensibly due to the lack of interest of the younger farmers in livestock farming as their focus is more on schooling and employment [Mthi et al., 2020]. Most of these middle age farmers double as farm owners and workers. This is because they most of them lack enough finance to hire people of qualified experience hence their inability to acquire sound training or even hire good managers of requisite trainings that have full knowledge of zoonotic disease and adopt scientific zoonotic preventive health practices in the management of their farms.

The participants were mostly married males that majorly keep ruminants using traditional farming methods. Males dominated were major responders in this study probably due to the fact that livestock rearing is still basically a male dominated enterprise in the developing countries [Adeiza et al., 2024]. The survey also revealed that most of the farmers employed traditional methods in their enterprise likely due to their limited capital, exposure and knowledge that consigns them to little investment in technology.

Scientifically acclaimed practices that could facilitate zoonotic infections including drinking of un-boiled milk, crowding and poor hygiene leading to infestation and infection [Espisito et al., 2023], consumption of improperly cooked meat, contact with infected products and contact with livestock [Adeiza et al., 2024] were subjected to knowledge test of the participants in this study. On drinking of un-boiled milk, crowding, consumption of improperly cooked meat and close contact with livestock, majority of the participants had only moderate knowledge of their zoonotic risk. Consumption of improperly cooked meat and un-boiled milk is a routine practice in Nigeria and Zimbabwe [Owusu-Kwarteng, 2020, Obi, 2016] as cultural habits. They routinely form part of the traditional menu in the areas. The practices were encouraged, more by the absence of comprehensive marketing infrastructure that makes the farmers to absorb all the losses in the event of their livestock. To minimise their losses, the farmers in most cases, slaughter their animals pre-emptively without veterinary inspection for immediate consumption, to minimise their losses in the absence of an off-taker for their products. We suggest a sustained public health awareness campaign through seminars, mass media and religious houses to discourage the farmers from these practices so as to protect them from zoonotic infections. Some of the participants in this study demonstrated good knowledge of zoonotic risk associated with consumption of game animals, not deworming, eating un-inspected carcasses, not vaccinating livestock, handling of infected carcasses and poor waste disposal. Proper waste disposal, a bio-security measure, is defined by OIE-FAO [2009] as measures that reduce the risk of the introduction and spread of disease agent. Generated waste contaminates farm environments with microbes of environmental and public health importance [Yadav et al., 2024, Keesing and Ostefeld, 2021]. In this study, the participants showed full knowledge of proper waste disposal which may be ascribable to an aftermath of the rigorous awareness campaign following Avian influenza and Covid-19 outbreaks. The campaign may also have generated a substantial awareness on the participants leading to the full knowledge on some of the other measures tested.

This study revealed that the farmers mostly depend on mass media (Radio, Television), mosques and churches as their main sources of information on zoonotic disease outbreak. Electronic and social media platforms have lately been identified as instruments of speeding up dissemination of information about global zoonotic illnesses [Kanchan and Gaidhane, 2023]. A mix of television, radio, print, and internet media, informal gathering and traditional dissemination facilities are important for enhancing public awareness and education according to [Pitakpon and Susilo, 2023]. The high reliance on radio as a means of receiving information on zoonotic diseases in this study, is similar to the study of Musallam et al. in Jordan [Musallam and Au-Shehada, 2015] where radio was the highest instrument of dissemination of information and sensitization on zoonotic diseases. The use of community-specific messaging improves intervention knowledge and acceptance during a disease outbreak [Gyapay et al., 2023]. Governments at all levels are the only institutions duly equipped to enact policies that can synergise all information channels targeting communities with vulnerabilities. Unfortunately, this study revealed a communication gap from government information channels leaving the farmers to depend majorly on informal avenues of religious gatherings, mass media, traditional and

political leaders, agro-veterinary shops and produce markets for information on zoonotic diseases. Although, a little more than 60% of the farmers source their information from veterinary officers/Agric extension officers, there does not appear to be commensurate access to information from their counterparts in Ministry of Health and community health workers who had better training on the human side of the zoonotic disease outbreak management and much worse the local authorities in the area. This is evident from the disheartening information gap between the farmers and local authorities in the area from the meagre 25.3% and 21.5% of farmers respectively who source their information on zoonotic disease outbreak from the local government authorities and ministry of health officials/community health officials. These agencies which are statutorily responsible for policy formulation, dissemination and implementation at the local level showed minimal reach to the farmers in this study. Robust collaboration between the veterinary and medical communities should be encouraged as such collaboration is said to be essential for effective management of zoonosis [Jause et al., 2023].

This survey revealed that most farmers put their animals under observation when sick and some further isolate them, a little less than half of the population report to veterinarians, much less take samples to the laboratories. Almost ¾ of the farmers "treat their animals with herbs" and more worrisome $3/5^{th}$ buy drugs without prescription" to treat their animals when sick. Some also go the unorthodox way of "pray for the animal" to heal their animals when sick. Treatment of animals by praying to heal a sick animal may be because of the farmers dismal knowledge of the risk pathway of zoonotic diseases and its prevention. The probable perception of most rural dwellers of veterinary medical care as elitist, expensive and out-of-reach may also have contributed to such habit. Furthermore, most of the rural farmers in rural areas of Northern region typically embrace livestock farming as a cultural and hereditary vocation based substantially on traditional knowledge and beliefs for subsistence. The government at various levels need to do more in terms of farmers awareness and veterinary education towards changing these perspectives to a more business-oriented way of profit-making and public health. There is also an urgent need for strengthening of veterinary infrastructures and extension education in the rural communities for easier access of the farmers to these facilities.

The wanton use of drugs without prescription, absence of modern veterinary infrastructures and competent veterinary practitioners, failure of appropriate veterinary drug regulatory mechanisms and institutions could lead to abuse of medication and drug resistance, a malaise already bedevilling the world especially the sub-Saharan Africa [Belachew et al., 2021]. There is the need for stricter measures and strengthening of the governmental institutions involved in the use and sales of veterinary drugs and medicaments in the study area. A very worrisome scenario from this study is the fact that sick animals were more often slaughtered for sale by 76.8% of the farmers while a much higher proportion of the farmers (86.8%) slaughter their sick animals for consumption. Slaughtering of sick animals for sale or consumption are practices that portend significant build up of reservoir and spread of zoonotic pathogens in the population thereby ensuring the recurrence of their zoonotic infections. Outbreaks of diseases like rabies, anthrax and brucellosis have been ascribed to slaughtering of diseased animals for consumption [38, 39]. Since majority of the farmers in the area operate on small scale due to inadequate capital for expansion, it is not unlikely that the fear of the loss of their little capital may have pushed them to slaughtering for sale or consumption of their sick animals. Considering the potentialities of these practice of selling out or slaughtering of sick animals to unsuspecting public in the spread of zoonotic infections, the need to enforce an insurance policy for farms by the government cannot be over-emphasized. In most countries of the third world, payment of indemnity for losses by insurance and governmental institutions for carcass condemnation is a rarity. We advocate a set-up of farmers cooperative societies with an objective of underwriting and sharing losses due to infection, disease and mortality. This may go a long way in allaying the fear of losses by the farmers which probably push them into slaughtering their sick animals for sale and/or consumption.

Some measures have been scientifically proven to be preventive in terms of control and prevention of zoonotic infections when proactively applied. In this

study, our attempt to assess the level of compliance with these measures revealed a substantially poor adherence by the participants as only about a quarter of the farmers claimed to uphold such preventive measures. In the overall, the farmers showed poor preventive habits against zoonotic infection transmission with only 45.7% of the farmers having full knowledge of the preventive practices. These comprise of a dismal 20.2% of the farmers "Always" upholding some of the preventive measures, 33.6% sometimes while a little less than half of the population "never" applied the measures. The survey shows such measures as washing of hands frequently and constant vaccination of livestock which are preventive health practices according to Carpenter et al. (2022) and NICE (2017) as "Always" practiced by majority of the participants. On measures as "wear boots", "frequently sanitise their equipment", "avoid handshake", "frequently visit veterinary doctor or technicians" and "undertake proper disposal of their carcasses", which are all preventive against zoonotic infections, majority of the participants only "sometimes" while in yet other measures as wearing hand gloves [NICE, 2017], applying footbaths, routinely change their working apparels/clothes, face masks, frequently undertake environmental sanitation, constantly immunise children against zoonosis, control of wild birds and reptiles, observed appropriate social distancing in crowded areas and never avoid crowds [NICE, 2017], preponderant of the participants "Never" practise them. Frequently washing hands after touching livestock was always upheld by majority of the participants, probably due to the traditional culture that encourages washing of hands as an aftermath of handling animals in the study area. While hand wash is a good preventive health practice, it has been postulated that the use of detergents makes the practice more effective. We however did not investigate the use of detergents in this study. Observance of routine vaccination as upheld by majority of the farmers in this study may be due to the periodic general campaign adopted by local authorities for prevention of zoonotic infections.

The study gives us an understanding of the zoonotic risks and practices of the rural livestock farmers that have facilitated presence of zoonotic pathogens in rural communities of Northern Nigeria. Addressing changes in the attitude and practices of the farmers will help to improve productivity and efficiency through reduced zoonotic infections and budgetary allocation to its health sector. The outcome will also help add information to the library of the subject matter and provide a template for understanding the zoonotic risk and preventive health behaviours of the rural livestock farming communities in the Northern region of Nigeria.

IV. LIMITATIONS

The relatively small sample size against the large population size of farmers in the study area and limited resources at our disposal for this survey were our limitations to generalising conclusions on the results of the study. Caution were also applied in interpreting the results from this study as the study was cross sectional. Snowball sampling technique may also have limited us to only the farmers known to the veterinary shops, mosques and churches thereby limiting our sampling. Poor infrastructure and farmers/herder's crisis in the study area also limited our reach to the remote settlements in the study area.

V. CONCLUSION

This study has shown the rural livestock farmers in the Northern Nigeria to have poor knowledge of risk practices and preventive health attitude towards zoonotic diseases. This may be an indication of dismal sensitization of the farmers through appropriate information strategies. The poor knowledge of zoonotic risk practices and preventive health behaviours in the area may have helped sustain a cycle of zoonotic infections in the area posing challenges to public health and national development. We advised a sustained health education, robust extension services and public awareness campaign utilizing mass media and religious houses to encourage behavioural changes in the rural livestock farmers in the Northern Nigeria towards breaking the zoonotic infection cycles in the region.

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