Impact of Flooding on the Spread of Water-Borne Diseases in the Communities Living in Riverine Areas, Adamawa State

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Abstract
Flooding can potentially increase the spread of water-borne diseases. The relationship between flooding and outbreaks of infectious diseases is likely to be high. Flooding has a wide range of health consequences such as injury, an outbreak of gastroenteritis, respiratory infections, poisoning, communicable diseases, epidemic diseases such as cholera, diarrhea, and dengue fever, poor mental health, and disability, among others but in this study, we focus solely on infectious diseases. Six (6) communities were selected for the study based on accessibility. The communities are; (Ribadu, Rugange, Koh, Boranji, Murgarang, Ngwalang), Three hundred (300) households were randomly selected; 50 from each community. From each household, the heads were presented with the copy of the questionnaire to fill. In any household where the head is not literate, the content of the questions will be read to the respondent for guidance. This is continued until a sample size is obtain. Water sample was collected for isolation and identification of water-borne diseases in the affected communities. The findings of the research show that all the 300 households selected for the study were successfully interviewed using a structured questionnaire with a household response rate of 100 percent. Households whose Houses were affected by the Flood, revealed that Koh community of Girei local government has the highest proportion of houses impacted by the floods with (70.0 percent) of houses completely affected, followed by Ngwalang community of Numan local government (60.0 percent). However, Rugange community of Yola south local government was most partially impacted by floods with (40.0 percent) having their house affected. Households toilet system in the research communities, shows that majority of the households has no toilet system with (55.3 percent) and preferred open defecation, followed by (33.0 percent) households that managed pit toilet system and few of the respondent with flushed type (6.3 percent), bucket type (5.4 percent). Households sources of water is from the River with (44.7 percent). Distribution of Households by Type of Disease Outbreak Due to Flood(s), the types of diseases experienced by households after the 2024 flood, Water-borne diseases, such as cholera, dysentery, and typhoid (78.3 percent), followed by air borne diseases with 13.7 percent and the lowest Climate related diseases with 8.0 percent, were most commonly reported. Pathogens and Pollutant Isolated and identify in the research Communities through the major sources of water (River) are Shown in Table 10, which leads to the spread of diseases among the households in the riverine communities in Adamawa State.

Key words: *Community, disease, riverine, outbreak, pathogen, pollutant, infection, disability*

INTRODUCTION

In recent years, flooding was the most common type of disaster globally, responsible for almost half of all victims of natural disasters and for economic losses of nearly US $185 billion (EM-DAT, 2019). Floods lead to tremendous losses of property, infrastructure, business and increased risk of diseases. Floods are also the most frequent natural disasters, affecting over 2.8 billion people in the world and causing over 200 000 deaths over the past three decades. The World Health Organization categorized the 2012 flood disaster in Nigeria as the worst flood to have hit the country in the past 50 years. Flooding events are expected to increase in frequency and intensity due to rising sea levels and more frequent and extreme precipitation events (IPCC, 2007, Ramin and McMichael, 2009). In addition, increasing levels of urbanization mean that more people will be exposed to flooding events (Du et al., 2010). It is t

hought that floods will increase the global burden of disease, morbidity, mortality, and social and economic disruptions, and will place continuing stress on health services, especially in low-resource countries. It is in these countries where most major floods occur and where vulnerability is the highest (Abaya et al., 2009, Ahern et al., 2005, Assanangkornchai et al., 2004, Fundter et al., 2008). Health consequences of floods depend on geographic and socio-economic factors, as well as the baseline vulnerability of the populations affected (Ahern et al., 2005, Du et al., 2010). The characteristics of floods and their significant impact on human health over the last decade have been examined in epidemiological studies conducted in both high and low-resource countries.

In Adamawa State, water levels started rising on Thursday, October 5 (2023), leading to severe flooding that caused significant infrastructure damage, including roads, shelter facilities, health facilities, IDP sites, schools, and other community facilities across 14 out of 21 LGAs in Adamawa State. On Saturday, 7 October 2023, the National Emergency Management Agency (NEMA) issued an alert over the threat of rapid flooding along the River Niger and River Benue Basin, owing to the release of water from the Lagdo Dam in the Republic of Cameroon, calling for the immediate activation of an emergency response plan in the following states: Adamawa, Benue, Taraba, Nasarawa, Kogi, Anambra, Edo, Delta, Rivers, and Bayelsa. According to the latest Adamawa State Emergency Management Agency (ADSEMA) report, the floods have caused a large-scale displacement of more than 8,504 households (51,043 individuals), the majority of whom are women, children, and the elderly, currently living in 11 temporary settlements across Yola South, Yola North, Lamurde, Madagali, and Demsa LGAs. 33 casualties were reported. (ADSEMA 2023)

The actual scale of the catastrophe is still unpredictable, as the situation is still closely being monitored. The flood exacerbated humanitarian needs, with individuals, mainly women and children, being exposed to undignified living conditions and sleeping in open or crowded spaces, exposing them to protection and health risks. Waterborne disease can be caused by protozoa, viruses, bacteria, and intestinal parasites. Some of the organisms are remarkable for their role in the outbreak of waterborne disease include Cholera, Amoebic dysentery, Bacillary dysentery (shigellosis), Cryptosporidiosis, Typhoid, Giardiasis, Paratyphoid, Balantidiasis, Salmonellosis, Campylobacter enteritis, Rotavirus diarrhea, E. coli diarrhea, Hepatitis A, Leptospirosis and Poliomyelitis Njiru *et al* (2016). From the research to be conducted the above-listed diseases are

predominant waterborne diseases associated with flood disasters. This study needs to review flood disasters in Adamawa state, and how to be managed the mentioned waterborne diseases.

Statement of the Problems

The flood-affected communities living in the riverside area are being displaced out in the open or in overcrowded shared spaces and require protection services. More than thirty-three (33) families who lost their loved ones, and many others got injured, thus the need for specialized protection services. Child Protection and Gender-Based Violence remain key concerns, sources of water in the affected location have been contaminated, posing significant health risks to the affected population. Latrines have become filled up with water due to flooding, creating unsanitary conditions and further health hazards. Oladokun, and Proverbs. (2016)

Flooding has a wide range of health consequences such as drowning, injury, an outbreak of gastroenteritis, respiratory infections, poisoning, communicable diseases, epidemic diseases such as cholera, diarrhea, and dengue fever, poor mental health, and disability, among others but in this study, we focus solely on infectious diseases. According to the current study will be carried out three components are essential for most infectious diseases: an agent (or pathogen), a host (or vector), and a transmission environment. Cifuentes, E., (2002). Flooding alters the balance of the environment and often creates a conducive environment (breeding ground) for the development of pathogens and vectors. The diseases that are most likely to be affected by flooding are those that require vehicular transfer from host to host (waterborne) and or a host/vector as part of its life cycle (vector-borne). Furthermore, flooding may hinder access to and provision of urgent medical services to suppress the spread of infectious diseases leading to a wider spread. In light of the increased threat of flooding due to amplification by climate change, there is a need for a better understanding of the association and underlying dynamics of outbreaks of infectious diseases following flooding to inform policy. Nigerian cities are characterized however by poor infrastructure which impacts livability and sustainability. The lack of relevant legal and policy frameworks is another indication of the low importance given to controlling and managing flooding in Nigeria at all three levels of federal, state and local governments and to date, little to no effort has been shown by the government to solve this problem (Cirella and Iyalomhe (2018; Okoye (2019). This study will review the Impact of Flooding on the Spread of Water-Borne Diseases in the Communities Living in Riverine Areas in Adamawa State.

Objective of the study

The specific objectives of the study are to:

1. Determine the impact of flooding on the quality of water sources in the affected areas by testing the present of pathogens and pollutants.
2. To raise awareness among community members about the risks associated with water-borne diseases during and after flooding.

Literature Review

The Center for Research on the Epidemiology of Disasters (CRED) defines a flood as “a significant rise of water level in a stream, lake, reservoir or coastal region” EM-DAT (2009). More colloquially, flooding is the “presence of water in areas that are usually dry” Jonkman & Kelman. (2005). The events and factors that precipitate flood events are diverse, multifaceted, and interrelated. Weather factors include heavy or sustained precipitation, snowmelts, or storm surges from cyclones whereas important human factors include structural failures of dams and levees,

alteration of absorptive land cover with impervious surfaces and inadequate drainage systems. Geographic regions such as coastal areas, river basins and lakeshores are particularly at risk from storms or cyclones that generate high winds and storm surge Hunt. (2005). Environmental/physical land features including soil type, the presence of vegetation, and other drainage basin characteristics also influence flood outcomes Tobin & Montz, (1997).'

Waterborne diseases are caused by drinking water mostly contaminated by human or animal excrement which contain pathogenic micro-organisms. Globally, waterborne diarrhea illness is leading among diseases that cause mortality and morbidity, killing 1.8 million people and causing approximately 4 billion cases of illness annually United Nations (2014). Poor sanitation, inadequate safe drinking water and poor hygiene practices are major attributable factors to waterborne diseases occurrence, (Nyagwencha et al 2017), Njiru., Stanley&Baraza, (2016), Abdulkadir, & Anandapandian, (2013) Cifuentes, (et al2002). Besides, WHO estimates that, 6.3% of all deaths are caused by limited access to safe drinking water, improved sanitation facilities and hygiene practices as well as water management that reduce transmission of waterborne illness Pruss et al (2008). According to UNICEF/WHO (2012). 780 million of the total global population do not have access to safe water, and an estimated 2.5 billion people in developing world live without access to adequate sanitation. However, supply of clean drinking water is one of the main challenges facing most of the African countries today Naik, (2017). In Africa, it is estimated that only 22% of the population has adequate sanitation facilities Batterman (2009). Additionally, 28% of the population of sub-Saharan Africa defecates in the open and an additional 23% use "unimproved" sanitation facilities that do not ensure hygienic separation of human excreta from human contact, Institute of Medicine (US) Forum on Microbial Threats (2009). Moreover, even where clean water and flush toilets are available in Africa, lack of hygiene awareness continues to result in outbreaks of water related diseases. In the Kenyan context, waterborne diarrhea diseases have been reported to be among the major public health problems. This is mostly associated with poor environmental sanitation, poor hygiene practices as well as poor supply of safe and clean drinking water WHO (2008).According to the World Health Organization, diarrheal disease accounts for an estimated 4.1% of the total daily global burden of disease and is responsible for the deaths of 1.8 million people every year. Further estimates suggest that 88% of that burden is attributable to unsafe water supply, sanitation and hygiene and is mostly concentrated on children in developing countries [WHOUNICEF 2000, WHO 2005 & Pruss et al 2008]. Most waterborne diseases are often transmitted via the fecal-oral route, and this occurs when human faecal material is ingested through drinking contaminated water or eating contaminated food which mainly arises from poor sewage management and improper sanitation.

In developing countries, flooding results from climate change, excessive precipitation, building on waterways, sea-level rise, soil moisture regime, dam operations, especially along borders, uncontrolled rapid population growth, inadequate preparedness, and lack of political will Adetunji & Oyeleye, (2013), Hunt, (2005). Flooding has both natural and human causes Abolade, Muili, & Ikotun, (2013). MacLeod et al. (2021). Identified excessive levels of precipitation as the main natural cause of flooding, caused by climate change. Tramblay et al. (2021). Link flood occurrence to maximum level of soil moisture rather than maximum precipitation.

This paper focuses on flooding in Nigeria. Effective flood risk management requires understanding available data, and prediction of extreme weather events. There is still much effort

needed. Mashi et al. (2019). Reviewed Nigeria's emergency management legislation and found it lacking in terms of development of action plans, empowering resource mobilization, risk management strategies and in specifying responsibilities of stakeholders.
The Nigeria Hydrological Services Agency in its annual flood outlook Nigeria Hydrological Services Agency, (2020). Defines the major causes of flooding in Nigeria as follows: soil moisture, extreme weather conditions owing to climate change, how dams are functioning, especially those close to the country's borders, and topography. Adegboyega et al. (2018). Identify changes in land use, such as urbanization, as a trigger to urban flooding. Abolade et al. (2013). Find extreme precipitation to be a natural cause.

Flooding is the most common disaster in Nigeria. The majority of Nigeria's states are increasingly suffering from annual flooding during the rainy seasons caused by increased precipitation linked to climate change (Aja and Olaore (2014). Unlike some natural disasters, rainfall flooding can be controlled with proper planning and the provision of necessary infrastructure (Agbonkhese et al. (2014). Satterthwaite (2017). Nigeria's flooding is mainly human induced with current poor urban planning practices and inadequate to non-existent environmental infrastructure contributing to and exacerbating the issue. The absence of a national Flood Risk Management (FRM) strategy or comprehensive flood risk maps, for example, are indicators of the lack of attention paid to Nigeria's flooding problem (Oladokun and Proverbs (2016). This suggests designing and implementing adequate FRM strategies comprising proper spatial planning and infrastructure would help in controlling the floods which adversely impact Nigeria's sustainable development (Ouikotan et al. (2017).

METHODOLOGY

Study Area

Adamawa state is located in the North eastern part of Nigeria which has a boundary with the Republic of Cameroun where river Benue joins Lagdo Dam, through which the Benue river passed through seven (7) local government areas of the state and through the neighboring Taraba State of Nigeria. The State has communities settling in the river bank of the Benue who are predominantly fishermen, farmers and Herdsmen enjoying their economic activities and business at the River side. The climatic condition of the area is tropically humid with two prevailing seasons; the rainy season ranging from the months of May to October and the dry seasons spanning from November to April.

Research Design

The study adopted field survey design to collect relevant data and to carry out laboratory analysis on the existing water-borne diseases that affects the health of an individual in the community by obtaining community sources of water as well as data from Primary Health Care Facilities in selected coastal communities along the river Benue.

Population of the Study

The population of the study comprised every house hold living in the riverine communities, information on the history about the waterborne diseases will be collected using questionnaires and health data bank from the PHC in all the study communities.

Research Instrument

The instrument is going to use for this research will be designed questionnaire titled: Impact of flooding on the spread of water-borne diseases on the communities living in the riverine area in

Adamawa State. The questionnaire will be structured into two parts. The Part A contains items on the community sources of water, while Part B contains items on the awareness of the health impacts of waterborne diseases and laboratory analysis and result will be use.

Validity and Reliability of instrument

The questionnaire will be verified and certified okay by experts in the field of public health. The questionnaires were first tested on a pilot scale around some households 1 km adjacent to the study area. The scores were analysed using t-test. The data was significant at p = 0.05 and confirmed the instrument to be reliable.

Method of Data Collection

The Six (6) communities is going to be selected for the study based on accessibility. The communities are; (Ribadu, Rugange, Koh Boranji, Murgarang, Ngwalang), Three hundred (300) households will be randomly selected; 50 from each community. From each household, the head will be presented with the copy of the questionnaire to fill. In any household where the head is not literate, the content of the questions will be read and the respondent is guided. This continued until a sample size is obtained. Sample size is determined as per Daniel (cited in Ebenezer et al, 2015). In the same community, the health data on water borne diseases will be sought from the existing PHC facility data bank through the permission of the Medical director. Water sample will be collected for the isolation of pathogens and pollutants in the affected communities.

Method of Data Analysis

Data arising from the study will be verified for accuracy using the 2016 version of Microsoft office excel. Thereafter, it will be subjected to SPSS (version 20.0) for descriptive and analytical statistic. Descriptive statistics like percentage is use to express the frequency occurrence of an event. Significant differences between variables will be determined in ANOVAs at a confident level of 0.05.

RESULT

Household respond rate

Table 1: Number of Household by Interview result and responses rates by Gender (%)

	Ngwalang community (Numan LGA)	Murgarang community (Demsa LGA)	Mboranji community (Yola north LGA)	Rugange community (Yola south LGA)	Koh community (Girie LGA)	Ribadu community (Fufore LGA)	TOTAL
Households sampled	50	50	50	50	50	50	300.0
Household responses rate	100	100	100	100	100	100	100.0

Gender of Household							
Male	35	38	40	32	34	31	210
Female	15	12	10	18	16	19	90

All the 300 households selected for the study were successfully interviewed using a structured questionnaire with a household response rate of 100 percent. The high response rate obtained was due to the household awareness that was conducted alongside the survey. The total sample distribution by communities, along with gender distribution is provided in Table 1.

Impact of Flood on Housing

Table 2: Households whose Houses were affected by the Floods

Communities	Completed (%)	Partially (%)	Not at all (%)
Ngwalang	60.0	32.0	8.0
Murgarang	20.0	30.0	50.0
Boranji	14.0	20.0	56.0
Koh	70.0	20.0	10.0
Rugange	30.0	40.0	30.0
Ribadu	16.0	24.0	60.0
Total	36.7	27.7	35.6

Table 2, shows that (35.6 percent) of respondents reported that their house was physically not affected by the floods, with (27.7 percent) indicating being partially affected and (36.7percent) reporting being completely affected. Disaggregation by communities revealed that Koh community of Girei local government had the highest proportion of houses impacted by the floods with (70.0 percent) of houses completely affected, followed by Ngwalang community of Numan local government (60.0 percent). However, Rugange community of Yola south local government was most partially impacted by floods with (40.0 percent) having their house affected, Ribadu community of Fufore local government has no flood effect at all with (60.0 percent) and Borangi community of Yola North (56.0 percent).

Duration of the Flood episodes (in Days)

Table 3: Distribution of Households and length of Floods, in Days

	1-10 days	11-20 days	21-30 days	31 days and above
Communities				
Ngwalang	42.0	30.0	16.0	12.0
Murgarang	56.0	20.0	14.0	10.0
Koh	60.0	22.0	10.0	8.0
Boranji	30.0	60.0	6.0	4.0

Rugange	50.0	24.0	16.0	10.0
Ribadu	40.0	30.0	18.0	12.0
TOTAL	46.3	31.0	13.3	9.3

Table 3: Shows the length of floods in the communities, in days were 46.3 percent of households experienced floods for 1-10 days, while another 31.0 percent experienced floods for 11-20 days. Variations across communities are observed, with a majority of households in Koh and Boranji experiencing floods that lasted for 1-10/20 days respectively, while in Ngwalang and Murgarang, a few experienced floods for more than 31 days.

Toilet System used in the Flood Communities

Table 4: Households Toilet system in the affected communities (%)				
	Pit Toilet	Flushed Toilet	Bucket type Toilet	No Toilet System
Communities				
Ngwalang	30.0	6.0	10.0	54.0
Murgarang	20.0	0.0	12.0	68.0
Koh	26.0	4.0	6.0	64.0
Boranji	36.0	20.0	4.0	40.0
Rugange	40.0	4.0	0.0	56.0
Ribadu	46.0	4.0	0.0	50.0
TOTAL	33.0	6.3	5.4	55.3

Table 4: Shows that majority of the households in the research communities has no toilet system with (55.3 percent) but preferred open defecation, followed by (33.0 percent) households that managed pit toilet system. Disaggregation from the communities, Murgarang in Demsa with the high response with (68.0 percent) and Koh in Girie with (64.0 percent), Boranji in Yola North has the lowest with (40.0 percent).

Households Sources of Water

Table 5: Households Sources of Drinking Water					
Communities	River (%)	Borehole (%)	Stream (%)	Wells (%)	Others (%)
Ngwalang	30.0	40.0	10.0	20.0	-
Murgarang	50.0	10.0	20.0	16.0	4.0
Boranji	40.0	30.0	16.0	8.0	6.0
Koh	56.0	20.0	6.0	14.0	4.0
Rugange	42.0	22.0	10.0	20.0	6.0
Ribadu	48.0	18.0	4.0	24.0	6.0
TOTAL	44.7	23.3	11.0	17.0	4.0

Findings shows that the Households sources of water in the research communities was highly depended on River water, with (44.7 percent) followed by Borehole water with (23.3 percent), Well water have (17.0 percent). Disaggregate on each community shows that Koh community of Girie with (56.0 percent) dependent on River water, followed by Murgarang community of Demsa with (50.0 percent) and Ribadu community of Fufore with (48.0 percent). The high proportion of Households that take their drinking water from Borehole is Ngwalang community of Numan with (40.0 percent) as shown in Table 5 above.

Proportion of Households whose Access to Health Care Facilities were Affected by the Floods

Table 6: Distribution of Households Whose Health Care Facilities Were Affected By The Flood(S)

Communities	Physically Affected (%)	Partially Affected (%)	Not Affected (%)
Ngwalang	80.0	13.7	6.3
Murgarang	52.1	37.9	10.0
Koh	75.0	20.0	5.0
Boranji	10.0	20.0	70.0
Rugange	65.5	25.5	9.0
Ribadu	35.1	40.9	24.0
TOTAL	53.7	26.3	20.0

Findings show the proportion of households who reported that their health facilities were physically affected (53.7 percent) and partially affected with (26.3 percent) by the 2024 floods, as shown in Table 6. Disaggregation by communities revealed that Ngwalang community had the highest impact from the flood with 80.0 percent of respondents who had their facilities affected, followed by Koh community (75.0 percent) while the lowest figure was recorded in Boranji community (10.0 percent).

Experience of Disease Outbreak Due to the 2024 Flood

Table 7: Households that Experienced Outbreaks of Disease in their Community Due to the 2024 Flood(s)

Communities	Yes (%)	No (%)
Ngwalang	70.0	30.0
Murgarang	56.0	44.0
Koh	60.0	40.0
Boranji	30.0	70.0
Rugange	24.0	76.0
Ribadu	40.0	60.0
TOTAL	46.7	53.3

During the 2024 floods, about 46.7 percent of the respondent experienced disease outbreak in their communities and 53.3 percent of the respondent did not experienced any of the disease outbreak due to floods in their respective communities. The proportion of those reporting disease outbreaks was highest among respondents in Ngwalang (70.0 percent) and lowest in Rugange (24.0 percent), as shown in Table 7.

Type of disease experienced by households during the 2024 floods

Table 8: Distribution of Households by Type of Disease Outbreak Due to the 2024 Flood(s)

	Water borne diseases (%)	Air borne diseases (%)	Climate related diseases (%)
Communities			
Ngwalang	82.0	12.0	6.0
Murgarang	78.0	10.0	12.0
Koh	86.0	10.0	4.0
Borangi	70.0	20.0	10.0
Rugange	80.0	12.0	8.0
Ribadu	74.0	18.0	8.0
TOTAL	78.3	13.7	8.0

Table 8 shows the types of diseases experienced by households after the 2024 flood. Water-borne diseases, such as cholera, dysentery, and typhoid (78.3 percent), followed by air borne diseases with 13.7 percent and the lowest Climate related diseases with 8.0 percent, were most commonly reported.

Health care services received by households in the affected communities.

Table 9: Distribution of Households that Received Health Care Services (%)

	Hospital	Clinic/Health post/Primary health care	Pharmacy	Chemist shop (Drug shop)	Maternity home	Consultant home	Patients home	Traditional healers' home	Faith based home
Communities									
Ngwalang	16.0	24.0	10.0	20.0	10.0	0.0	0.0	10.0	10.0
Murgarang	20.0	26.0	6.0	30.0	8.0	0.0	0.0	6.0	4.0
Koh	10.0	30.0	4.0	20.0	10.0	2.0	0.0	16.0	8.0
Boranji	30.0	26.0	10.0	14.0	4.0	1.0	1.0	8.0	6.0
Rugange	34.0	20.0	16.0	14.0	10.0	2.0	1.0	2.0	1.0
Ribadu	14.0	30.0	6.0	20.0	4.0	1.0	1.0	14.0	10.0
TOTAL	20.7	26.0	8.7	19.7	5.8	1.1	0.5	9.3	8.2

Table 8 reveals that most households received health care services in the clinic/ health post/primary health care system in their Communities (26.0 percent) and Hospital in the nearby town (20.7 percent). This trend was highest in Koh and Ribadu communities at 30.0 percent.

Isolation and Identification of Pathogens and Pollutant in the Research Communities

Water samples was collected from the research communities' sources of drinking water which happen to be from the river with (44.7 percent) see table 5 above, using sterile specimen bottle. Water sampled was tested for Pathogens and pollutant in the Biology Laboratory of Federal College of Education Yola, using microscopic and culture techniques for isolation and identification of Bacteria, Virus, Fungi and Parasites.

Table 10: Pathogens and Pollutant Isolated in the research Communities

	Bacteria	Virus	Fungi	Parasite
Communities				
Ngwalang	Esch. Coli, Salmonella	-	-	G.lamblia, E. Coli
Murgarang	Shigella, Salmonella, ESch. Coli	-	-	E. Coli, S. Mansoni, E. histolytica
Koh	Salmonella, Psudomonas,	-	-	G. Lamblia
Boranji	Shigella, Salmonella,	-	-	E. Coli, E. histolytica
Rugange	Psudomonas, Esch. Coli	-	-	G. Lamblia, S. Mansoni
Ribadu	Salmonella, Psudomonas	-	-	E. Coli, S. Mansoni

Key: Esch. Coli = Escherichia Coli, E. Coli = Entermoeba Coli, G.Lamblia = Girdia Lamblia, S. Mansoni = Sistosoma Mansoni

Table 10: Shows that all the research communities has one pathogen or the other that polluted their drinking water which lead to the spread of diseases among the households in the community.

Finding:

The findings of the research show that all the 300 households selected for the study were successfully interviewed using a structured questionnaire with a household response rate of 100 percent and the number of households Male 210 and households Female 90. Households whose Houses were affected by the 2024 Flood(s), revealed that Koh community of Girei local government had the highest proportion of houses impacted by the floods with (70.0 percent) of houses

completely affected, followed by Ngwalang community of Numan local government (60.0 percent). However, Rugange community of Yola south local government was most partially impacted by floods with (40.0 percent) having their house affected, Ribadu community of Fufore local government has no flood effect at all with (60.0 percent) and Borangi community of Yola North (56.0 percent). Households Toilet system in the research communities, shows that majority of the households in the research communities has no toilet system with (55.3 percent) preferred open defecation, followed by (33.0 percent) households that managed pit toilet system. Disaggregation from the communities, Murgarang in Demsa has no toilet system happen to have high responses with (68.0 percent) and Koh in Girie with (64.0 percent), Boranji in Yola North has the lowest with (40.0 percent). Households sources of water in the research communities were highly depended on River water, with (44.7 percent) followed by Borehole water with (23.3 percent), Well water have (17.0 percent). Disaggregate on each community shows that Koh community of Girie with (56.0 percent) dependent on River water, followed by Murgarang community of Demsa with (50.0 percent) and Ribadu community of Fufore with (48.0 percent). The high proportion of Households that take their drinking water from Borehole is in Ngwalang community of Numan with (40.0 percent). Households that Experienced Outbreaks of Disease in their Community Due to the 2024 Flood, about 46.7 percent of the respondent experienced disease outbreak in their communities and 53.3 percent of the respondent did not experienced any of the disease outbreak due to floods in their respective communities. The proportion of those reporting disease outbreaks was highest among respondents in Ngwalang (70.0 percent) and lowest in Rugange (24.0 percent). Distribution of Households by Type of Disease Outbreak Due to Flood(s), the types of diseases experienced by households after the 2024 flood, Water-borne diseases, such as cholera, dysentery, and typhoid (78.3 percent), followed by air borne diseases with 13.7 percent and the lowest Climate related diseases with 8.0 percent, were most commonly reported. Pathogens and Pollutant Isolated and identify in the research Communities through the major sources of water (River) are Shown in Table 10, which leads to the spread of diseases among the households in the riverine communities.

Recommendation

The researcher made the following recommendation base on the results:

Awareness campaign on danger and effect of water borne diseases should be prioritized among the communities in the riverine areas

Health education on hygiene and sanitation practice among the households in the community by health educators should be emphasized on house to house.

Supply of quality and portable drinking water should be made necessary in the riverine communities

Health education on the method of water treatment in the riverine communities should be practiced.

Health facilities in the riverine communities should be well equipped with trained personnel.

Conclusion

The study reveals that majority of households in the research communities' has no toilet facilities and end up practicing open defecation and the major sources of drinking water is from the river without any method of treatment, no any awareness on hygiene and sanitation practice with poor or unfunctional health facilities which leads to the spread of water borne diseases during flooding in the communities living in riverine area in Adamawa State.

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