



Research Article

Parasitological contamination of two water sources in
Adamawa-North Senatorial zone, Adamawa State, Nigeria

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ABSTRACT

This study examined the parasitological contamination of well and river water sources, which are among the significant sources of water in the Adamawa-North Senatorial Zone. Water samples were collected aseptically from upstream and downstream of 4 rivers and 32 hand-dug wells between June 2019 to April 2020. The samples were examined for parasitic contamination by sedimentation and staining methods. A total of 149 (58.2%) parasites belonging to six species were detected. Of these, 85(66.4%) and 64(50.0%) were from river and well sources respectively. The parasites detected includes a trematode (*Fasciola hepatica*), a protozoan (*Giardia lamblia*), and four nematodes (*Strongyloides stercoralis*, *Ascaris lumbricoides*, *Trichuris trichiura*, and *Ancylostoma duodenale*). *Ascaris lumbricoides* was the most abundant parasite detected with a prevalence of 21.9%, and the least was *F. hepatica* (3.1%). The overall prevalence was higher in rainy season 85(66.4%) than in dry season 64(50.0%) but with no statistical difference ($P=0.335$). River water had the highest number of parasites in both rainy 47(73.4%) and dry seasons 38(59.4%). Also, river water in both dry and rainy periods had the highest number of *A. lumbricoides*, *A. duodenale*, *T. trichiura*, and *F. hepatica*. The highest number of *S. stercoralis* was detected only in the dry season of river water. Well water harbored the highest number of *G. lamblia* in dry and rainy seasons. Furthermore, *A. lumbricoides* was also highest in well water during the dry period. Based on Local Government Area (LGA), Mubi-North LGA had the highest number of parasites, but with no statistical difference from those of the other 3 LGAs ($P=0.312$). As observed in this study, the high prevalence of contamination by parasitic organisms of public health importance is of alarming concern. This is because there is no provision of pipe-borne water in the study area, and the available major sources of water may not be suitable for domestic use due to their high parasitic content.

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INTRODUCTION

Water is essentially a basic resource required by all life forms for sustenance and continuing maintenance of the balance of bodily fluids (CDC, 2013; Gyang *et al.*, 2017). Water for domestic activities could be obtained from sources such as well, rivers, streams, boreholes, dams, lakes, municipal water supply, and rain (Ani and Itiba, 2015). When water becomes contaminated by parasites, it can cause a variety of illnesses such as amoebiasis, cryptosporidiosis, guinea worm infection, and schistosomiasis (CDC, 2013; Gyang *et al.*, 2017). Unfortunately, water consumers are usually not aware of the potential health risks associated with exposure to water-borne contaminating organisms (Ani and Itiba, 2015). Despite all advocacy and policies on the provision of potable water for human consumption, studies have it that nearly 2 billion people around the globe still use water sources of questionable quality which are responsible for more than half a million diarrhoeal death per annum. It is also reported that parasitic protozoa are among the principal organisms responsible for waterborne diarrhoeal disease (Lim and Nissapatom, 2017). A number of outbreaks of diarrhoea involving parasitic organisms have been documented, most of which were reported in developed countries. This may be attributed to well-established surveillance and reporting systems in these countries (Efstratiou *et al.*, 2017). In developing countries however, a lack of surveillance and reasonable record system in addition to the scanty or ineffective methods of detecting waterborne parasitic infections may have contributed to scanty reports of waterborne parasitic organisms across the region (Karanis *et al.*, 2007; Baldursson and Karanis, 2011). Reports from various quarters showed that parasitic infections play a considerable part in the burden of infectious diseases across the Globe. Although the developing world suffers most of the infections and death due to parasitic

diseases, the industrialised world also is hit substantially with illnesses associated with parasitic organisms. For example, it was reported that the diseases caused by parasitic infections in 2004 were far beyond that caused by other organisms even in developed countries (Fletcher *et al.*, 2012).

Several studies reported that the most common parasitic diseases from water sources responsible for diarrhoea are giardiasis and cryptosporidiosis which are caused by *Giardia lamblia* and *Cryptosporidium parvum* respectively (Lane and Lloyd, 2002; Richard *et al.*, 2016; Lim and Nissapatom, 2017). Other parasites frequently detected in water include *Acanthamoeba* spp., *Entamoeba histolytica*, *Balantidium coli*, *Naegleria* spp., *Ancylostoma duodenale*, *Ascaris lumbricoides* (Kumar *et al.*, 2014; Lim and Nissapatom, 2017).

People in the Adamawa-north senatorial zone (comprising Mubi-North, Mubi-South, Maiha, Michika, and Madagali Local Government Areas) relied wholly on alternative water sources such as those from well, river/streams, and borehole, due to lack of potable water supply usually from Government. These sources of water may be contaminated by parasites of public health importance due to the indigent nature of the surrounding sources. More so, water from these sources are most times consumed raw without further treatment; this may constitute nuisance to the health wellbeing of the public. Therefore, this study examined the parasitological contamination of well and river water sources, which are among the major sources of water in Adamawa-north Senatorial zone.

MATERIALS AND METHODS

Study Area

The study area was Adamawa-north Senatorial zone commonly known as Mubi region. Mubi region comprises of five (5) local government areas namely; Madagali, Michika, Mubi south, Mubi North and Maiha with a land size of

4,493.815k/m² and a population of 682, 026. Mubi zone is located between latitudes 9° 30' and 11° 00'N of the equator and between 13° 00' and 14° 00'E of the Greenwich meridian. The area has a tropical wet and dry climate. Dry

season last for minimum of six (6) months (November – March), while the wet season spans between May and October. The mean annual rainfall ranges from 700mm to 1050mm (Tula *et al.*, 2022).

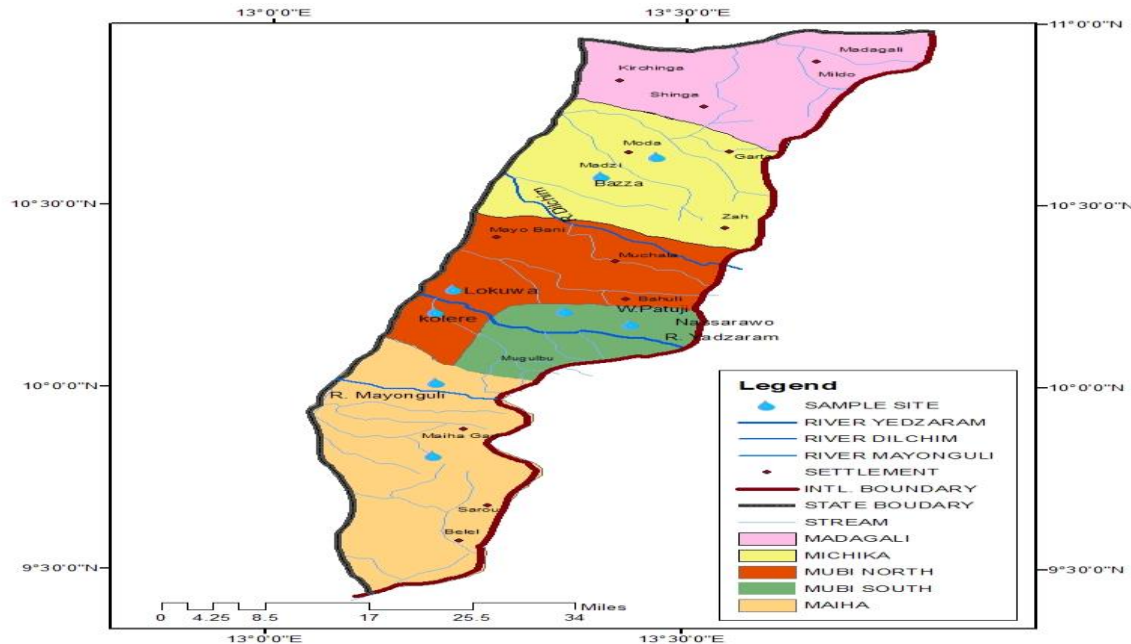


Figure 1: Map of the study area showing sampling sites

Sampling plan

From each ward, water from four (4) wells was chosen at random and sampled in duplicates in both dry and rainy seasons. A river/stream was also selected from each Local Government Area for sampling. For each river/stream, two samples were collected at random (upstream and downstream) in quadruples for both the dry and rainy seasons.

Sample collection

Well water

One hundred and twenty-eight (128) water samples from 32 hand-dug wells (64 samples each for the dry and rainy seasons) were randomly collected in 500ml sampling bottles. To achieve this, a weight was tied to each of the bottles and was lowered in to draw water out of the wells. After the bottles were filled and drawn, they were recapped cautiously, labelled, and conveyed to the Microbiology/Parasitology

laboratory of Biological Science Technology Department, Federal Polytechnic Mubi, Adamawa State in an ice-cold box and analysed within six hours(h) after collection (APHA, 2011).

River/Stream water

A total of 128 (64 samples for the dry and rainy seasons each) water samples from 4 rivers were collected in 500ml sampling bottles. Sampling bottles were dipped into the water bodies; after the bottles were filled, they were removed, capped, marked properly, and conveyed to the Microbiology/Parasitology Laboratory of Biological Science Technology Department, Federal Polytechnic Mubi, Adamawa State in an ice-cold box for parasitological studies (APHA, 2011).

Assessment of water samples for parasite

The occurrence of parasites in the collected water samples was detected by centrifugation,

staining, and microscopy methods. Collected water taken to the laboratory was subjected to centrifugation for 5 minutes at 3,000 rpm thereafter the supernatant was decanted carefully. For each sample, two slides were prepared. A clean pipette dropper was used to dispense 1-2 drops of the deposit on each microscopic slide. One slide was treated with Lugol iodine and examined, whereas the other was viewed without staining (Bakir *et al.*, 2003; Pam *et al.*, 2018). Slides were observed using X10 and X40 objective lenses for the presence of parasites cysts or ova (Odikamnoru *et al.*, 2016)

Statistical analysis

Simple percentage was used to present the data in tables. The non-parametric Mann-Whitney test, and least significance difference (LSD) were used to analyse the data. All data were analysed using SPSS Statistics for Windows, Version 17.0 (Chicago; Inc.). Data were considered statistically significant when $p < 0.05$

RESULT

A total of 149 parasites were detected from the 256 water samples analysed for the presence of parasitic organisms, with an overall prevalence of 58.20% as shown in Table 1. Of these, 85(66.41%) and 64(50.0%) were from river and well sources respectively. Though the number (%) of parasites in river water was arithmetically higher than the ones of the well water but with no statistical difference ($P=0.295$). The parasites detected includes a trematode (*Fasciola hepatica*), a protozoan (*Giardia lamblia*), and four nematodes (*Strongyloides stercoralis*, *Ascaris lumbricoides*, *Trichuris trichiura*, and *Ancylostoma duodenale*). More so, *A. lumbricoides* was the most abundant parasite detected with a prevalence of 21.9%, followed by *S. stercoralis* (14.1%) and the least was *F. hepatica* (3.1%).

The result in Table 2 showed the prevalence of parasites based on the season of sampling. The overall prevalence was higher in rainy season

85(66.4%) than in dry season 64(50.0%) but with no statistical difference ($P=0.335$). *Ascaris lumbricoides* ($P=0.174$) and *F. hepatica* ($P=0.393$) were both arithmetically higher in the rainy season than in the dry season but with no statistical difference each. On the contrary, the number of *G. lamblia* ($P=0.005$), *A. duodenale* ($P=0.046$), and *T. trichiura* ($P=0.039$) were significantly higher in the rainy period than in the dry period. However, the number of *S. stercoralis* was statistically higher in the dry than in the rainy season ($P=0.047$).

River water had the highest number of parasites in both rainy 47(73.4%) and dry seasons 38(59.4%). Also, river water in both dry and rainy periods had the highest number of *A. lumbricoides*, *A. duodenale*, *T. trichiura*, and *F. hepatica*. The peak occurrence of *S. stercoralis* was detected only in the dry season of river water. Well water harboured the highest number of *G. lamblia* in both dry and rainy seasons. Furthermore, *A. lumbricoides* was also peak in well water during the dry period (Table 3).

Based on Local Government Area, Mubi-North LGA had the highest number of parasites, but with no statistical difference from those of the other 3 LGAs ($P=0.312$). The abundance of *A. lumbricoides* was not significantly different ($P=0.082$) in Mubi-South, Michika, and Maiha LGAs but significantly lower than that of Mubi-North ($P=0.000$). Furthermore, *S. stercoralis* was not significantly different in Mubi-North, Mubi-South, and Michika ($P=0.106$) but statistically higher than that of Maiha ($P=0.045$). The number (%) of *A. duodenale* ($P=0.212$), *G. lamblia* ($P=0.205$), *T. trichiura* ($P=0.214$), and *F. hepatica* ($P=0.206$) each were not significantly different in all the LGAs (Table 4-7).

In Mubi-North, 56 parasites belonging to 6 species were detected with a prevalence of 87.5%. Of these, 29(90.6%) and 27(84.4%) were from the rainy and dry seasons respectively. The parasitic organisms include; *Ascaris*

lumbricoides, *Strongyloides stercoralis*, *Giardia lamblia*, *Trichuris trichiura*, *Ancylostoma duodenale*, and *Fasciola hepatica*. The parasites were more detected in the Yadzaram river than well water samples but with no statistical difference in both rainy (P=0.565) and dry (P=0.466) seasons. *Ascaris lumbricoides* was the most predominant parasitic organisms detected in both water sources and seasons (Table 4).

In Mubi-South, 34 parasites were detected with a prevalence of 53.1%. Of these, 19(59.4%) and 15(46.9%) were from rainy and dry seasons respectively. The parasites were detected more from Yadzaram river water samples than well water samples but with no statistical difference in both rainy (P=0.391) and dry (P=0.796) seasons. The result also showed that *A. lumbricoides* and *Ancylostoma duodenale* were the most common parasites detected in the rainy season, while *S. stercoralis* was the most detected parasite in the dry season in both water sources (Table 5).

Parasitic examination of water sources from Michika LGA showed that 32 parasitic organisms were detected in both water sources with a prevalence of 50%. Of these, 20(62.5%) and 12(37.5%) were from rainy and dry seasons respectively. In the dry season, however, *G. lamblia*, *T. trichiura*, and *F. hepatica* were not detected in both water sources. *Ancylostoma duodenale* (21.9%) was the most detected parasite in the rainy season especially from well water sources, while *S. stercoralis* (21.9%) was the most prevalent parasite in the dry season from both water sources (Table 6).

Twenty-seven (27) parasites were detected from the water sources in Maiha LGA with a prevalence of 42.2%. Out of these, 17(53.1%) were from the rainy season, while 10(31.3%) were from the dry season. The results further showed that *A. lumbricoides* was the most dominant parasitic species detected in both the seasons and water sources (Table 7).

Table 1: Prevalence of parasites based on water sources

Parasites	Water sources		Total (n=256)
	River (n=128)	Well n=128)	
<i>Ascaris lumbricoides</i>	30(23.4)	26(20.3)	56(21.9)
<i>Strongyloides stercoralis</i>	21(16.4)	15(11.7)	36(14.1)
<i>Giardia lamblia</i>	6(4.7)	8(6.3)	14(5.5)
<i>Ancylostoma duodenale</i>	15(11.7)	11(8.6)	26(10.2)
<i>Trichuris trichiura</i>	7(5.5)	2(1.6)	9(3.5)
<i>Fasciola hepatica</i>	6(4.69)	2(1.6)	8(3.1)
Total	85(66.4) ^a	64(50.0) ^a	149(58.2)

Legend: Values with the same superscripts from each parameter are not significantly different (p>0.05)

Table 2: Prevalence of parasites in different water sources based on the season of sampling

Parasites	Rainy season (n=128)	Dry season (n=128)	P – value
<i>Ascaris lumbricoides</i>	32(25.0)	24(18.8)	0.174
<i>Strongyloides stercoralis</i>	12(9.4)	24(18.8)	0.047
<i>Giardia lamblia</i>	11(8.6)	3(2.3)	0.005
<i>Ancylostoma duodenale</i>	18(14.1)	8(6.3)	0.046
<i>Trichuris trichiura</i>	7(5.5)	2(1.6)	0.039
<i>Fasciola hepatica</i>	5(3.9)	3(2.3)	0.393

Table 3: Prevalence of parasites based on water sources and season

Parasites	Rainy season			Dry season		
	River (n=64)	Well (n=64)	Total (n=128)	River (n=64)	Well (n=64)	Total (n=128)
<i>Ascaris lumbricoides</i>	18(28.1)	14(21.9)	32(25.0)	12(18.8)	12(18.8)	24(18.8)
<i>Strongyloides stercoralis</i>	5(7.8)	7(10.9)	12(9.4)	16(25.0)	8(12.5)	24(18.8)
<i>Giardia lamblia</i>	5(7.8)	6(9.4)	11(8.6)	1(1.6)	2(3.1)	3(2.3)
<i>Ancylostoma duodenale</i>	10(15.6)	8(12.5)	18(14.1)	5(7.8)	3(11.5)	8(6.3)
<i>Trichuris trichiura</i>	5(7.8)	2(3.1)	7(5.5)	2(3.1)	-	2(1.6)
<i>Fasciola hepatica</i>	4(6.3)	1(1.6)	5(3.9)	2(3.1)	1(1.6)	3(2.3)
Total	47(73.4)	38(59.4)	85(66.4)	38(59.4)	26(40.6)	64(50.0)

Table 4: Prevalence of parasites in different water sources in Mubi North

Parasites	Rainy season			Dry season		
	River (n=16)	Well (n=16)	Total (n=32)	River (n=16)	Well (n=16)	Total (n=32)
<i>Ascaris lumbricoides</i>	7(43.8)	6(37.5)	13(40.6)	6(37.5)	5(31.3)	11(34.4)
<i>Strongyloides stercoralis</i>	2(12.5)	3(18.8)	5(15.6)	5(31.3)	3(18.8)	8(25.0)
<i>Giardia lamblia</i>	2(12.5)	1(6.3)	3(9.4)	1(6.3)	1(6.3)	2(6.3)
<i>Ancylostoma duodenale</i>	3(18.8)	2(12.5)	5(15.6)	-	1(6.3)	1(3.1)
<i>Trichuris trichiura</i>	1(6.3)	1(6.3)	2(6.3)	2(12.5)	-	2(6.3)
<i>Fasciola hepatica</i>	1(6.3)	-	1(3.1)	2(12.5)	1(6.3)	3(9.4)
Total	16(100)	13(81.3)	29(90.6)	16(100)	11(68.8)	27(84.4)

Table 5: Prevalence of parasites in different water sources in Mubi South LGA in relation to season

Parasites	Rainy season			Dry season		
	River (n=16)	Well (n=16)	Total (n=32)	River (n=16)	Well (n=16)	Total (n=32)
<i>Ascaris lumbricoides</i>	5(31.3)	3(18.8)	8(25.0)	3(18.8)	2(12.5)	5(15.6)
<i>Strongyloides stercoralis</i>	2(12.5)	1(6.3)	3(9.4)	5(31.3)	2(12.5)	7(21.9)
<i>Giardia lamblia</i>	1(6.3)	1(6.3)	2(6.3)	-	-	-
<i>Ancylostoma duodenale</i>	3(18.8)	1(6.3)	4(12.5)	1(6.3)	2(12.5)	3(9.4)
<i>Trichuris trichiura</i>	1(6.3)	-	1(3.1)	-	-	-
<i>Fasciola hepatica</i>	-	1(6.3)	1(3.1)	-	-	-
Total	12(75.0)	7(43.8)	19(59.4)	9(56.3)	6(37.5)	15(46.9)

Table 6: Prevalence of parasites in different water sources in Michika

Parasites	Rainy season			Dry season		
	River (n=16)	Well (n=16)	Total (n=32)	River (n=16)	Well (n=16)	Total (n=32)
<i>Ascaris lumbricoides</i>	3(18.8)	2(12.5)	5(15.6)	1(6.3)	2(12.5)	3(9.4)
<i>Strongyloides stercoralis</i>	1(6.3)	1(6.3)	2(6.3)	4(25.0)	3(18.8)	7(21.9)
<i>Giardia lamblia</i>	1(6.3)	2(12.5)	3(9.4)	-	-	-
<i>Ancylostoma duodenale</i>	3(18.8)	4(25.0)	7(21.9)	2(12.5)	-	2(6.3)
<i>Trichuris trichiura</i>	1(6.3)	1(6.3)	2(6.3)	-	-	-
<i>asciola hepatica</i>	1(6.3)	-	1(3.1)	-	-	-
Total	10(62.5)	10(62.5)	20(62.5)	7(43.8)	5(31.3)	12(37.5)

Table 7: Prevalence of parasites in different water sources in Maiha LGA

Parasites	Rainy season			Dry season		
	River (n=16)	Well (n=16)	Total (n=32)	River (n=16)	Well (n=16)	Total (n=32)
<i>Ascaris lumbricoides</i>	3(18.8)	3(18.8)	6(18.8)	2(12.5)	3(18.8)	5(15.6)
<i>Strongyloides stercoralis</i>	-	2(12.5)	2(6.3)	2(12.5)	-	2(6.3)
<i>Giardia lamblia</i>	1(6.3)	2(12.5)	3(9.4)	-	1(6.3)	1(3.1)
<i>Ancylostoma duodenale</i>	1(6.3)	1(6.3)	2(6.3)	2(12.5)	-	2(6.3)
<i>Trichuris trichiura</i>	2(12.5)	-	2(6.3)	-	-	-
<i>Fasciola hepatica</i>	2(12.5)	-	2(6.3)	-	-	-
Total	9(56.3)	8(50.0)	17(53.1)	6(37.5)	4(25.0)	10(31.3)

DISCUSSION

The high prevalence (58.20%) of parasitic organisms detected in two sources of water in the study area is alarming and corroborates previous studies in Nasarawa and Ebonyi States (Ani and Itiba, 2015; Pam *et al.*, 2018). This perhaps implies that such water sources are not safe for consumption without proper treatment and the populace around the study area may be predisposed to water-borne diseases especially those caused by parasitic organisms.

The prevalence of parasites in relation to sources of water showed that rivers/streams recorded a higher number of parasites than well water sources. This result corroborates the report of previous studies in Nasarawa State (Pam *et al.*, 2018; Pam *et al.*, 2019). This may be because streams/rivers are open water bodies often polluted with sewage and faecal material as a

result of refuse dumps, indiscriminate defecation in and around the water bodies, discharge of wastewater from households, and abattoirs. Contrary to the finding of this study, however, another study reported a high prevalence of parasites in well water samples than in rivers or streams (Odikamnoru, *et al.*, 2016; Gyang *et al.*, 2017).

In this study, well water also recorded a high prevalence of parasites. This observation corroborates previous reports (Nwidemia *et al.*, 2016) that suggested that wells may be more susceptible to contamination due to an influx of runoff water especially if the wells are open, shallow, or have been inundated by flooding water for a while. Contamination of wells may also occur due to the proximity of wells to toilet facilities or septic tanks and or lack of toilet facilities which is common in rural areas.

The most prevalent parasite detected in this study was *A. lumbricoides*. This agrees with a previous study in Jos, Plateau State (Chollom *et al.*, 2013) but is contrary to other studies which reported that *Strongyloides stercoralis* (Odikamnor, *et al.*, 2016), Hookworm (Pam *et al.*, 2018), *G. lamblia* (Nwidembia *et al.*, 2016; Gyang *et al.*, 2017), *E. histolytica* (Jarallah, 2016) were the most prevalent parasites encountered in Ishieke Ebonyi State, Doma LGA in Nassarawa State, Ebonyi LGA, Lafiya in Nassarawa State and Iraq respectively. The disparity in the most prevalent parasites as observed in these studies might be due to differences in geographical locations and parasites prevalence in the area.

The result of this study also showed that the nematode group had the highest number of parasites than other classes of parasites. This corroborates previous studies in Plateau (Chollom *et al.*, 2013) and Nasarawa States (Pam *et al.*, 2019). Nonetheless, another study in Nasarawa State reported a low prevalence of helminthic nematodes (Gyang *et al.*, 2017) which disagreed with the report of this study. The higher number of nematode than protozoan parasites as shown in this study suggests that parasites of nematode group are more likely found and transmitted through water than the protozoan group of parasites. To buttress this insinuation, submission from a previous study revealed that infections involving intestinal protozoa are transmitted most often by faecal-oral route, and therefore contact with water may not constitute a significant risk factor for protozoan transmission (Njambi *et al.*, 2020).

Only one protozoan parasite (*G. lamblia*) was detected in this study. The low prevalence of the protozoan in this study corroborates a previous study (Pam *et al.*, 2018) but disagrees with other findings (Jarallah, 2016; Gyang *et al.*, 2017) that recorded a higher prevalence of protozoan parasites in their studies. Studies have shown that the presence of parasitic nematode and

protozoan parasites in water sources is strongly connected to many factors such as the activities of grazing livestock in or around water sources that carry and release these parasites in their faeces, the utilization of animal dung as farmyard manures which ultimately ends in water sources. Furthermore, detection of these parasites in sources of water can be linked to unhealthy and indiscriminate defecation around water sources (Gyang *et al.*, 2017).

The high prevalence of parasitic organisms in Mubi-North LGA may not be unconnected with the population density and settlement of people around the selected study area. The study areas in this LGA are densely populated with poor access to potable water and toilet facilities. Refuse is usually dumped indiscriminately especially close to water sources. However, the lack of statistical variance in the prevalence of parasites in the selected sites or LGAs as shown in this study agrees with the reports of other studies (Gyang *et al.*, 2017; Pam *et al.*, 2018) that recorded no variation in the prevalence of parasites across their selected study areas. This observation may probably be because the water bodies in the LGAs under study are subjected to similar weather or environmental conditions and the poor sanitary posture of the populace living closer to the water sources. These attributes contribute immensely to the growth and survival of these parasites and the continuous contamination of the water sources.

The prevalence of parasites relative to the source of water and seasons showed that rivers recorded the highest number of parasites in both seasons. This observation concurs with that of previous studies (Pam *et al.*, 2018; 2019). This may not be unconnected with the fact that rivers/streams are consistently being contaminated with faecal materials and sewage due to indiscriminate defecations and dumping of refuse close to the streams. This is most often enhanced by the nature of the environment surrounding the river and or stream. It is a well-known fact that rivers

or streams are usually bordered by vegetation and the populace in the area occasionally disposes of wastes near these rivers or streams, as such polluting these water sources making them unhealthy for domestic purposes unless properly treated.

The prevalence of parasites in relation to the season of sampling alone showed a higher prevalence of parasites in the rainy than in the dry season. This may be because, during the rainy season, rivers or streams function as reservoirs that amass run-off water from several polluted sites as such stand a greater chance of being contaminated with parasitic organisms. More to this, the environmental and weather conditions that enhance the growth and survival of these parasites and or their intermediate hosts in water bodies may be optimal during the rainy period. However, the lack of substantial variance in the prevalence of parasites between rainy and dry season suggest that seasonal variations contribute little or no effect on the distribution of parasites in water bodies depending on the prevailing activities in or around the water sources.

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This finding implies that parasitic organisms are sustained by a viable environment in most rural settlements, especially in the study area where pipe-borne water, poor sewage disposal, inadequate toilet facilities, and ignorance flourish the most. This could expose the populace, and livestock to a cycle of incessant parasitic infestations, consequentially leading to low productivity and a high rate of diseases and in some instances death.

CONCLUSION

The finding of this study is of public health concern as the water sources sampled are among the major water sources available in the area, and to this study, the water sources may not be suitable for domestic purposes due to their high parasite content. Due to the prior dearth of data in the study area on the subject matter, the findings of this study contribute to knowledge on the parasitological contamination of water sources in the study area, thus supplying benchmark data for future reference. Therefore, an adequate supply of potable water in the study area is imperative to limit over-dependence on these water sources for domestic purposes by the populace.

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