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Full Length Research Article

ASSESSMENT OF KNOWLEDGE, ATTITUDE, AND PRACTICES (KAP) AMONG RURAL RESIDENTS BORDERING MAIRUA RESERVOIR AND ITS IMPLICATIONS ON FISH PARASITES AND WATER QUALITY IN FUNTUA, KATSINA STATE, NIGERIA

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ABSTRACT
This study investigated the knowledge attitude and practices, KAPs among rural residents bordering Mairua reservoir and its implications on fish parasites and water quality**.** Cross sectional questionnaire studies were carried out among 120 respondents inhabiting at Mairua communities between June and August 2024, using questionnaire. Simple random sampling was used to select study respondents. The collected data was entered into Microsoft excel and transferred to SPSS version20 for analysis. Descriptive statistics was used to analysed collected data. Of the total 120 survey respondents, (94.2%) of the respondents were males, while (5.8%) of the respondents were females. while more than half of the respondents were married (60.8). In term of level of education majority of the respondents having Quranic education only (31.7%) as the highest level education attained. More than half of the roles of the respondent's in house hold revealed 64.2% respondents were father's role in house hold. A greater proportion of the respondents 75 (62.5%) stated that the primary purpose of the Mairua reservoir is Drinking. Regarding types of manure/chemical used in the farmland, 60.0% of the respondents had used fertilizer in their farmland. 74.2% of the respondents known that fish parasites reduce fish growth, yield, aesthetic value, marketability and palatability. Almost half of the respondents (36.7%) can consume smoked/undercooked fish. Majority of the respondents 36.7% had buy fish from fish market regularly. 40.0% of the respondents had washed their clothes in/near the reservoir regularly. Almost half of the respondents (49.2%) had use chemical in their farmland regularly. These discoveries discovered knowledge, attitude and practice of the communal in the region to water quality management and fish parasites was not okay. Consequently, more development of water quality management methods will be vital.

Keywords: Assessments, Attitude, Fish parasites, Practices, Residents, Rural, water quality

INTRODUCTION

Fish and its products provide almost more than half of the protein consumption for over 400 million persons in the poorest nations of Asia and Africa (Obiero *et al.,* 2019). Wild capture of freshwater fish is a major source of revenue for rural livelihood (Cojocaru *et al.,* 2022). The healthiness of a water environment is extremely depended on the water quality parameters of the water body (Rameshkumar *et al.,* 2019). Variations in fish inhabitants can be pointers of water ecosystem health (Daniel and Elliot, 2021). The existence and richness of fish species can be connected to the water quality parameters (Daniel and Elliot, 2021). Poor water quality is known to disturb fish communities by impacting home, nourishment accessibility, as well as dissolved oxygen levels, which in turn affect their development potential and multiplicative abilities (Shetty *et al.,* 2015). Certain anthropogenic activities have been well-known to promote water quality decline in aquatic environment. These activities comprise agriculture, application of manures, fertilizers, herbicides as well as pesticides, animal husbandry, fish farming, wrong irrigation practices, deforestation, indiscriminate release of industrialized wastes in addition to home sewage, mining, and entertaining actions (Khatri and Tyagi 2015). Generally, it has been stated that the physico-chemical parameters of numerous reservoirs have been affected harmfully by exogenous as well as endogenous factors (Obisesan and Christopher, 2018; Sojka *et al.,* 2018). The importance of physicochemical parameters in freshwater ecosystems cannot be overemphasized since they not only influence, to a large extent, fish survival but also dictate their richness and distribution (Nyanti *et al.*, 2018). Ecological conditions influence fish distributions, communities and seasonal movements. Decline water quality due to ecological upset threatens the stability of the biotic integrity and therefore hampers the ecosystem services and functions of the water ecosystems (Yusuf *et al.,* 2022). Understanding the magnitudes of ecological changes has become a major task in recent years in numerous fields of science. Parasitology is among the most delicate topics concerning the effects of global changes, from the time when precise forecasts about the growth of parasites and their hosts may be vital to take right actions to avert widespread infections. Furthermore, an increasing number of assessments have highlighted the possible influence of climate change on parasitism (Morley and Lewis, 2014). Human actions as well as poor ecological conditions habitually subject fish to parasitic and other infections (Biu et al., 2014).

Fish serve as hosts for a wide-range variety of taxonomically diverse parasites (Barber *et al.,* 2020). They are typically infested with four groups of helminths, viz., trematodes, cestodes, nematodes, and acanthocephalans. An infective disease named zoonosis is transmitted from animals to human being (Han *et al.,* 2016; Alsulivany *et al.,* 2024). Various animals that cause diseases, comprising fungal, viruses, bacteria, and parasites, know how to spread from animals to persons by a variety of ways, such as bites from animals, consumption, injured or wound up skin, as well as insects, and relations between human and

animals i.e. Inhalation in respiratory particles or contacting the skin or slimy tissues) (Gauthier, 2015; Alsulivany *et al.,* 2024). The acuteness of water zoonotic diseases mostly varies on the immune structure. On the other hand there are principally two means that these diseases may have emotional impact human being. Firstly, they consume undercooked fish as well as drink water or other liquids contaminated with fish faeces or slimy. Secondly, if you have open injuries or skin abrasions as well as come into contact with a transmissible agent (Raissy, 2017; Alsulivany *et al.,* 2024). 46% of the zoonotic diseases from fish are transmitted orally, as well as 15% are transmission via numerous means. Skin interactions while handling fish contributes to 19% of spread, however drinking water contaminated by infested organism's reports for 24% (Raissy, 2017; Alsulivany *et al.,* 2024).

FBZPs (Fish-borne zoonotic parasites) have been segment of the foodborne zoonotic diseases and are frequently endemic in some areas of the Globe (Odoh *et al.,* 2019). Up to date, FBZPs Fishborne zoonotic parasites have appeared as most important food safety alarm which can enforce important public well-being as well as financial influences (FAO and WHO, 2022). Helminthes are amongst the most well-known infectious agents that have disturbed and still touch human inhabitants, predominantly in low income, marginalised, as well as resource-constrained areas of the globe. They are commonly discovered in all freshwater fishes around the Globe (Zinabu *et al.,* 2023). Fish act as intermediary host for numerous of the cestodes, nematodes, as well as trematodes (Odoh *et al.,* 2019). Nematodes of the Anisakidae family have the skill to infest a wide-ranging of aquatic hosts (Ángeles-Hernández *et al.,* 2020). They are generally parasitized in the body cavity, mesenteries, guts, and flesh of fish whereas the adult in the gut of piscivorous birds, remarkably pelicans, cormorants, herons, and darters. The family has a significant financial and people health influence. They are diverse in their dispersal (Zinabu *et al.,* 2023). Infectious larval stage three (L3) of *Contracaecum* spp. of parasite may be parenthetically taken by human being via consumption fresh/raw or underdone/uncooked fish, which could cause *anisakidosis* (Younis *et al.,* 2017). Fishborne zoonotic trematodes (FBZT) are similarly very significant and can infest human being through the ingesting of uncooked/raw or poorly cooked fish. Trematodes *Clinostomum* spp. appears in estuarine system and freshwater bodies worldwide as well as has a complicated lifespan (lifecycle). Fish are intermediary hosts for dissimilar *Clinostomum metacercariae*. These parasitic worms can cause *clinostomiasis* (Laryngopharyngitis disease) in general public (peoples) as well as results in mortalities from asphyxiation. *Clinostomum metacercariae* can be detected on the stomach, intestine, gills, skin, muscle, or other organs of amphibian and fish (Zinabu *et al.,* 2023). Fishborne zoonotic parasites (FBZPs) are habitually abandoned in numerous food safety control practices, even though they can set up severe human being healthiness problems. In 2012, the WHO estimated that there were nearly 56 million incidents of parasitic infestations due to the ingestion of fish products. Fishborne zoonotic parasites (FBZPs) are categorized amongst the top foodborne parasitic worms worldwide (FAO and WHO, 2022; Zinabu *et al.,* 2023). As estimated by the WHO (World Health Organisation), the number of individuals presently infested with fishborne trematodes lonely surpasses 18 million, besides numerous more are at threat. Persons who consume fresh, lightly salted, lightly smoked, lightly dried, as well as cured fish are the greatest at threat (Hazarika and Bordoloi, 2022). A number of the fish parasitic worms that are zoonotic especially helminthes such as anisakid nematodes Anisakis simplex; *Pseudoterranova decipiens*, cestodes of the genus *Diphyllobothrium spp*. and digenetic trematodes of the families *Heterophyidae, Opisthorchiidae* and *Nanophyetidae* (Robert, 2012). Fishborne zoonotic trematodes (FZT) are transferred by fish and fish products, as well as play the part of a most important public health problem. Individuals become infested with Fishborne zoonotic trematodes after consumption undercooked or raw freshwater fish having transmittable metacercariae. Eggs of gastrointestinal flukes are difficult to separate from those of liver flukes, frequently triggering inaccurate and misdiagnosis approximations of the occurrence of both trematode classes (Hung *et al.,* 2015). The worldwide number of individuals at this time infested with small liver flukes only surpasses 45 million. The approximations of vulnerable inhabitants for *clonorchiasis* and *opisthorchiasis* are 601 million and 80 million, respectively. In cases of small intestinal flukes, an approximated 40 to 50 million individuals are infested with one or numerous species, with more than half a billion at threat of infestation. Estimates of individuals infested with small liver flukes were 2 million, with unknown millions infested with intestinal flukes. The number of infested individuals with intestinal flukes is understood to be higher than the number of individuals infested with small liver flukes (Hung *et al.,* 2015). Furthermore, zoonotic transmission of fish parasitic worm to man can similarly take place via unintentional consumption (Chibwana *et al.,* 2020) or eating of uncooked or inappropriately roasted infested fish, as detected by Wang *et al.* (2018). General public who work with fish or else are engaged in fish related occupations must need to know about zoonotic illnesses as well as how to stop them. Ever since it is not easy to restrict all relations with water as well as fish inside fish farming structures, decreasing the threat of zoonotic diseases is vital. Several parasitic worm species, numerous infectious to human being, may possibly be discovered in numerous types of eatable fish (Alsulivany *et al.,* 2024). In the developing countries where fish parasites infestations are widespread, precautionary chemotherapy is the important approach for morbidity control. On the other hand, indigenous knowledge, attitudes, and practices (KAP) of parasitic worms, and water quality parameters are poorly understood, even though such information is essential for sustainable as well as preventable control (Acka *et al.,* 2010). The survey designed to scrutinize socio-demographic characteristics of respondents in Mairua reservoir bordering communities, Knowledge of the respondents on fish parasites and its implications on the water body, Attitude of the respondents to the water body and Practices of the respondents that might have implications on the water body.

MATERIALS AND METHODS

Description of the study area

Mairua reservoir is situated at latitude 11°34' to latitude 11°36' 0 N of the equator and longitude 7°14' to longitude 7°15'E of Greenwich meridian and at about 733 metres above sea level of Funtua Local Government Area of Katsina state. The reservoir cut across farmlands, residential and industrial areas with several farmlands and commercial activities taken place along its bank with both residential and municipal wastes into the reservoir (Uba *et al.,* 2021). The area falls under the Northern-Guinea Savannah Zone, with a vegetation consisting of broad-leaved species with tall tussock grasses of guinea affinities mixed up with

fine-leaved species of thorny trees with continuous short and feathery grass cover (Onamade, 2014).

Study Design and Period
A communities-based cross-sectional survey were carried out from June to August, 2024 at Dukke and Mairua communities bordering Maria reservoir in Funtua Local Government area of Katsina State, Nigeria (Adugna *et al.,* 2022).

Sources Population and Study Population
The sources Populations are Dukke and Mairua communities bordering Maria reservoir in Funtua Local Government area of Katsina State, Nigeria (Adugna *et al.,* 2022). The survey populations are all inhabitants/population in the research vicinities during the study period (Adugna *et al.,* 2022).

Sample size and Sampling Methods
Principally, Dukke and Mairua communities were among the villages carefully chosen for the survey due to their frontline site on the major reservoir, inhabitants' compactness/dynamics as well as their movement to towns for marketing. Dukke and Mairua communities were carefully chosen by simple random sampling. In Dukke and Mairua communities' fishermen, farmer's fish traders and civil servants were carefully chosen purposively based on nearness to the reservoir. From the families either the wife's or husbands were carefully chosen as survey participant (Adugna *et al.,* 2022).

Questionnaire survey
An in depth interviews using structured a questionnaire was carry out with the survey participants to gather a useful information about the participant life styles, implications of fish parasites and water quality. The questionnaire has four major section namely, Demographic and socioeconomic characteristics of respondents in Dukke and Mairua, Knowledge of the respondents on fish parasites and implications on the water body, Attitude of the respondents to the water body and Practices of the respondents that might have implications on the water body. Finally, they were asked the impact of reservoir on their lives. The questionnaires were administered through face-to-face interview. Moreover, field observation was undertaken as strengthening part of the questionnaire survey (Kiprono, 2017). A total of 120 questionnaires were administered in Dukke and Mairua rural communities bordering Mairua reservoir in Funtua, Katsina.

Data Management and Analysis
The data was cautiously cleaned as well as managed appropriate before coding and cautiously inserted into Microsoft Excel and exported to SPSS (version 20) statistical package software for analysis. Descriptive statistics was done to present data using tables and frequencies and proportions were used to summarize variables.

RESULTS
Socio-demographic characteristics of study respondents
A total of 120 persons were include in the study, out of which 30 (25.00%) of the respondent were aged between 21-30 years, followed by 28 (22.3%) of the respondent were aged between 10-20 years, followed by 25 (20.83%) of the respondents were aged between 41-50 years, among the total of the respondents, 19 (15.83%) were within 31-40 years, 12 (10.00) were within 15-60, 5 (4.17) were within 61-70 and 1 (0.84%) above 71 years as shown in table 1. Gender participation 113 (94.2%) of the respondents were males, while 7 (5.8%) of the respondents were females. while more than half of the respondents were married 73(60.8), followed by singles with 36 (30.00%) of the respondents, followed by divorced 6(5.0%) of the respondents, while the least of the respondents were widowed 5(4.1%) as shown in table 1. The survey conducted among household sizes in Mairua and Dukke in Funtua. Based on the outcomes of this study, 73 (60.83%) of respondents revealed a household size of 1-10 individuals, followed by 36 (30.00%) of respondents showed 11-20 household size, followed by 9 (7.5%) of respondents showed 21-30 household size, whereas 2 (1.67%) showed a household size of 31 above as shown in table 1.

Table 1 shows the occupations recognized by respondents were primary and secondary occupation. The most important occupation of respondents were associated to fishing (52.5%), fish trader were (15.8%), farmer category were (15.0%), 10% of the respondents were students, while 6.7% category of the respondents were civil servant. In term of secondary occupation fish trader was the major secondary occupation (35.8%), 29.2% representing farming, 14.2% category fishing,10.8% category of the respondents representing other category (crypto/mining), followed by 6.7% category student, while the least category civil servant were (3.3%) of the respondents is outline in table 1 below. Regarding to the year spent in the locality a majority of the respondents (34.16%) surveyed had been a part of their communities for more than 1-20 years, followed by (25.83%) respondents while the least were (0.83%) as shown in table 1 below. In term of level of education majority of the respondents having Quranic education only (31.7%) as the highest level education attained. 30.8% of the respondents attained secondary education, followed by (20.0%) of the respondents attained primary education only, A level/Associated degree and Bachelor degree representing (10.04%), while 7.5% of the respondents had no formal and formal education as shown in table 1 below. In term of respondent's roles in the household, the survey conducted among household roles in the survey areas indicate that more than half of the roles of the respondents in house hold revealed 64.2% respondents were father's role in house hold, followed by Adult daughter/son (32.5%) respondents, while Mother house hold roles (3.3%) respondents as outline in table 1 below.
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Table 1: Socio-demographic characteristics of respondents in Mairua and Dukke fishing villages

Variable	Categories	Frequency	Percentage
AGE	10-20	28	23.33
	21-30	30	25.00
	31-40	19	15.83
	41-50	25	20.83
	51-60	12	10.00
	61-70	5	4.17
	71 above	1	0.84
	Total	**120**	**100.0**
GENDER	Male	113	94.2
	Female	7	5.8
	Total	**120**	**100.0**
Marital Status	Married	73	60.8
	Single	36	30.0
	Divorced	6	5.0
	Widowed	5	4.1
	Total	**120**	**100**
Household size	1-10	73	60.83
	11-20	36	30.00
	21-30	9	7.5
	31 above	2	1.67
	Total	**120**	**100.0**
Primary occupation	Fishing	63	52.5
	Farming	18	15.0
	Fish Trader	19	15.8
	Civil Servant	8	6.7
	Student	12	10.0
	Others	-	-
	Total	**120**	**100.0**
Secondary occupation	Fishing	17	14.2
	Farming	35	29.2
	Fish Trader	43	35.8
	Civil Servant	4	3.3
	Student	8	6.7
	Others	13	10.8
	Total	**120**	**100.0**
Years spent in the locality	1-20	41	34.16
	21-30	31	25.83
	31-40	14	11.67
	41-50	21	17.50
	51-60	8	6.67
	61 -70	4	3.33
	71 above	1	0.83
	Total	**120**	100.0
Educational status	Quranic	38	31.7
	Primary	24	20.0
	Secondary	37	30.8
	Tertiary	12	10.04
	Non	9	7.5
	Total	**120**	**100.0**
Respondent's role in the household	Father	77	64.2
	Mother	4	3.3
	Adult daughter/son	39	32.5
	Total	**129**	**100.0**

Sourced: Field survey, 2024

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The respond of communities on items regarding to knowledge is shown in Table 2. Respondents in the findings were similarly examined on their knowledge of the major classes of fish parasites as well as implication on the water body. A greater proportion of the respondents 75 (62.5%) stated that the primary purpose of the Mairua reservoir is Drinking, 20 respondents (16.7%) indicated that fishing is the primary purpose of the reservoir, 10.8% of the respondents indicated irrigation as the primary purpose of the reservoir. Regarding types of manure/chemical used in the farmland, 60.0% of the respondents had used fertilizer in their farmland, 25.0% of the respondents had used fish intestine as fertilizer/manure in their farmland, 9.2% of the respondents had used pesticides in their farmland, 4.2% of the respondents had used herbicides in their farmland and 1.7% of the respondents had used manure in their farmland as shown in Table 2. Table 2 has the results of the respondents knowledge of fish parasites and implications on the water body. Among the respondents, 62.5% uses the reservoir as a primary source of drinking water, while 16.7% use it primarily for fishing. The majority of the respondents (60%) farming around the water body uses fertilizer as a major chemical, while pesticide and herbicide represent 9.2% and 4.2% of chemical used respectively. A total of 60.8% of the respondents have knowledge on fish parasites while 25.8% did not. 59.3 % of the respondents take fish-born parasitic infection as a serious disease, while 21.7% did not. A total of 58.3% had known that they can be infected with parasites from fishes, while 21.7% did not. 56.7% of the respondents had known that they can be infected with parasites from eating raw or undercooked fish, while 21.7% did not. Among respondents 64.2% had known that they can be infected with parasites from wildlife and other animal, while 17.5% did not. 44.2% of the respondents not sure they can be encounter with fish parasites while 38.3% encountered with fish parasites from fish. A total of 49.2% of worms parasites were observed during rainy and dry season, while, 47.5% leeches were observed. 47.5% of the respondents had aware of the diagnosis of fish parasites, while 29.2% not sure about diagnosis of fish parasites. A total of 47.5 respondents are aware of the treatment of fish parasites, while 32.5% not sure. 54.2% of the respondents are aware that fish parasites are preventable, whereas 30.8% not sure. 52.5% of the respondents have an idea on how to protect fish from parasitic infection, while 31.7% mot sure. A total of 52.5% respondents have known the prevention methods of parasites, while, 32.5% not sure. 74.2% of the respondents known that fish parasites reduce fish growth, yield, aesthetic value, marketability and palatability, while 16.7% not sure.

Table 2: Knowledge of the respondents on fish parasites and implications on the water body

Variables	Categories	Frequency	Percentage
What is the primary purpose of the reservoir?	Drinking	75	62.5
	Irrigation	13	10.8
	Fishing	20	16.7
	Other	12	10.0
	Total	**120**	**100.0**
Type of manure/chemical you used in your farmland?	Fish intestin	30	25.0
	Fertilizer	72	60.0
	Pesticide	11	9.2
	Herbicide	5	4.2
	Manure	2	1.7
	Total	**120**	**100.0**
Did you have any knowledge on fish parasites?	Yes	73	60.8
	Not sure	16	13.3
	No	31	25.8
	Total	**120**	**100.0**
If yes, do you take fish-born parasitic infection as a serious disease?	Yes	71	59.2
	Not sure	23	19.2
	No	26	21.7
	Total	**120**	**100.0**
Do you know you can be infected with parasites from fishes?	Yes	70	58.3
	Not sure	24	20.0
	No	26	21.7
	Total	**120**	**100.0**
Do you know you can be infected with parasites from eating raw or undercooked fish?	Yes	68	56.7
	Not sure	26	21.7
	No	26	21.7
	Total	**120**	**100.0**
Do you know you can be infected with parasites from wildlife and other animal?	Yes	77	64.2
	Not sure	22	18.3
	No	21	17.5
	Total	**120**	**100.0**
Have you ever encountered fish parasites in your fish?	Yes	46	38.3
	Not sure	53	44.2
	No	21	17.5
	Total	**120**	**100.0**

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Which parasites in your observation do you think were common during rainy and dry seasons?	Leeches	57	47.5
	Worms	59	49.2
	Lice	4	3.3
	Total	120	100.0
Are you aware of the diagnosis of fish parasites?	Yes	57	47.5
	Not sure	35	29.2
	No	28	23.3
	Total	**120**	**100.0**
Are you aware of the treatment of fish parasites?	Yes	57	47.5
	Not sure	39	32.5
	No	24	20.0
	Total	**120**	**100.0**
Are fish parasites preventable?	Yes	65	54.2
	Not sure	37	30.8
	No	18	15.0
	Total	**120**	**100.0**
Did you have any idea on how to protect fish from parasitic infection?	Yes	63	52.5
	Not sure	38	31.7
	No	19	15.8
	Total	**120**	**100.0**
Did you know the prevention methods of parasite?	Yes	63	52.5
	Not sure	39	32.5
	No	18	15.0
	Total	**120**	**100.0**
Do you know that fish parasites reduce fish growth yield, aesthetic value, marketability and palatability?	Yes	89	74.2
	Not sure	20	16.7
	No	11	9.2
	Total	**120**	**100.0**

Sourced: Field survey, 2024

Table 3 has the results of Attitude of the respondents to the water body. 80% of the respondents strongly agree the reservoir has water quality issues, while 12.5% agree reservoir has issues. A total of 79.2% of the respondents strongly agree there is fluctuations in the water quality of the reservoir with season, however 10.83% of the respondents are neutral. A table 3 show that 71.7% of the respondents strongly agree there is fluctuation in the water quantity of the reservoir with season; on the other hand 14.2% are agreed. A total of 75.0% of the respondents strongly agree reservoir water is a concern for health, while 14.2% are agree. Majority of the respondents (80.8%) strongly agree reservoir impact the health and well-being of their community, however 10% are neutral. A total of 63.2% of the respondents strongly agree that they are willing to support management efforts in the reservoir, while 20.0% are agreed. Table 3 shown that 35.8% of the respondents disagree that there is regular information about managements or conservation efforts, while 25.8% are neutral. A higher proportion (45.0%) of the respondents strongly disagree with current reservoir management practices are adequate, however 31.7 disagree. A total of 40.0% of the respondents strongly disagree reservoir management practices is sufficient, while 24.2% disagree. Majority of the respondents (60.8%) strongly agree that reservoir management's priorities community needs, while 16.7% of the respondent's agree. 28.3% of the respondents strongly agree that inhabitants are involved in any decision making processes related to reservoir managements, while 23.3% of the respondent was disagree. A total 55.8% strongly agree that there are several sources of entering pollutants/sewage in to the reservoir, however 22.5% of the respondents agree. A total of 70.0% of the respondents strongly agree pollutant/sewage exposure is harmful to the water body and users, while 11.7% are neural. 62.5% strongly agree fish parasites are threat to financial income, however 30.8% of the respondents agreed. As shown in table 3, 45.0% of the respondents agree that they often encountered dead fish during fishing, while 43.3% strongly agree dead fish are encountered during fishing. A higher proportion (58.3%) of the respondents strongly agree that there had seen the changes in the local ecosystem or biodiversity, while 30.0% agree. Majority of the respondents (57.5%) strongly agree that fish parasites are threats to the abundance and variety of native fish species, while 31.7% agree are threats to the abundance and variety of native fish species.

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Table 3: Attitude of the respondents to the water body

Variable	Strongly agree N (%)	Agree N (%)	Neutral N (%)	Disagree N (%)	Strongly disagree N (%)
The reservoir has water quality issues?	97(80)	15(12.5)	4(3.3)	3(2.5)	1(8)
There are fluctuations in the water quality of the reservoir with season?	95(79.2)	9(9.75)	10(10.83)	5(4.2)	1(8)
There are fluctuations in the water quantity of the reservoir with season?	86(71.7)	17(14.2)	8(6.7)	7(5.8)	2(1.7)
The reservoir water quality is a concern for your health?	90(75.0)	17(14.2)	6(5.0)	5(4.2)	2(1.7)
The reservoir impact the health and well-being of your community	97(80.8)	6(5.0)	10(8.3)	4(3.3)	3(2.5)
Are you willing to support management efforts in the reservoir?	76(63.2)	24(20.0)	5(4.2)	7(5.8)	8(6.7)
There is regular information about reservoir management or conservation efforts?	12(10.0)	19(15.8)	31(25.8)	43(35.8)	15(12.5)
The current reservoir management practices are adequate?	8(6.7)	7(5.8)	13(10.8)	38(31.7)	54(45.0)
Your understanding of reservoir management practices is sufficient?	25(20.8)	5(4.1)	12(10.0)	29(24.2)	49(40.0)
Reservoir management prioritizes community needs?	73(60.8)	20(16.7)	8(6.7)	11(9.2)	8(6.7)
Inhabitants are involved in any decision-making processes related to reservoir management?	34(28.3)	18(15.0)	20(16.7)	28(23.3)	20(16.7)
There are several sources of entering pollutant/sewage in to the reservoir?	67(55.8)	27(22.5)	12(10.0)	11(9.2)	3(2.5)
Pollutant/sewage exposure is harmful to the water body and users?	84(70.0)	13(10.0)	14(11.7)	4(3.3)	5(4.2)
Fish parasites are threat to financial income?	75(62.5)	37(30.8)	2(1.7)	2(1.7)	4(3.3)
Dead fish are often encountered during fishing?	52(43.3)	54(45.0)	9(7.5)	1(0.8)	44(3.3)
There are changes in the local ecosystem or biodiversity?	70(58.3)	36(30.0)	2(1.7)	9(7.5)	3(2.5)
Fish parasites are threats to the abundance and variety of native fish species?	69(57.5)	38(31.7)	5(4.2)	6(5.0)	2(1.7)

Sourced: Field survey, 2024

Table 4 has the results of Practices of the respondents to the water body. Almost half of the respondents (36.7%) can consume smoked/undercooked fish regularly, but only 24.2% consume smoked/undercooked fish occasionally, followed by often 23.3% and the least 7.5% rarely. Most respondents (49.2%) had never consumed raw fish, while 18.3% had consumed raw fish occasionally. A higher proportion of the respondents (38.3%) had bought fish from reservoir however 18.3% had buy fish from reservoir rarely. Majority of the respondents 36.7% had buy fish from fish market regularly, while 29.2% occasionally. 40.0% of the respondents had washed their clothes in/near the reservoir regularly, but 25.8% of the respondents often. Table 4, shows that 40.0% of the respondents had swim/bathing in/near the reservoir regularly, but 25.8% of the respondents often. Of the total study respondents (54.2%) had never defecated in/around the vicinity of the reservoir, while 21.7% rarely defecated in/around the vicinity of the reservoir. With regard to domestic waste dispose in/near the reservoir, 33.3% of the respondents had rarely dispose your domestic waste in/near the reservoir, while 26.7 % had never dispose your domestic waste in/near the reservoir. Half of the

respondents (50.0%) had fetch water for cooking/drinking from the reservoir regularly, while 17.5% had fetch water for cooking/drinking from the reservoir rarely. A higher proposition of the respondents (42.5%) had participated in farming of crops around the vicinity of the reservoir regularly, whereas (19.2%) had never participated in farming of crops around the vicinity of the reservoir. Almost half of the respondents (49.2%) had use chemical in their farmland regularly, while 20.0% had use chemical in their farmland occasionally. A total of 30.8% of the respondents had allow open grazing around the vicinity of the reservoir regularly, however 21.7% had allow open grazing around the vicinity of the reservoir rarely. 35.0% of the respondents had experienced diarrhoea and abdominal discomfort after eating fish from the reservoir occasionally, while 22.5% had rarely experienced diarrhoea and abdominal discomfort after eating fish from the reservoir. A higher proposition of the respondents (40.0%) had never participated in reservoir clean-up initiatives or conservation activities, whereas 27.5% had participated in reservoir clean-up initiatives or conservation activities occasionally. With regard change of water usage, 42.5% of the respondents had change their water usage habits in response to reservoir management efforts occasionally, while 18.3% of the respondents had change their water usage habits in response to reservoir management efforts rarely. 30.3% of the respondents had use water from the reservoir regularly, while 31.7% of the respondents had use water from the reservoir often.

Table 4: Practices of the respondents that might have implications on the water body

Variable	Regularly N (%)	Often N (%)	Occasionally N (%)	Rarely N (%)	Never N (%)
Do you consume smoked/ undercooked fish?	44(36.7)	28(23.3)	29(24.2)	9(7.5)	10(8.5)
Do you consume raw fish?	7(5.8)	19(14.2)	22(18.3)	15(12.5)	59(49.2)
Do you buy fish from reservoir?	31(25.8)	17(14.2)	46(38.3)	22(18.3)	4(3.3)
Do you buy fish from fish market?	44(36.7)	21(17.5)	35(29.2)	19(15.8)	1(0.8)
Do you wash your clothes in/near the reservoir?	48(40.0)	31(25.8)	4(3.3)	18(15.0)	19(15.8)
Do you swim/bathing in/near the reservoir?	21(7.5)	34(28.3)	26(21.7)	16(13.3)	23(19.2)
Do you do open defecation in/around the vicinity of the reservoir?	14(11.7)	5(4.2)	10(8.3)	26(21.7)	65(54.2)
Do you dispose your domestic waste in/near the reservoir?	26(21.7)	10(8.3)	12(10.0)	40(33.3)	32(26.7)
Do you fetch water for cooking/drinking from the reservoir?	60(50.0)	16(13.3)	5(4.2)	21(17.5)	18(15.0)
Do you participate in farming crops around the vicinity of the reservoir?	51(42.5)	10(8.3)	20(16.7)	16(13.3)	23(19.2)
Do you use chemicals in your farmland?	59(49.2)	13(10.8)	24(20.0)	4(3.3)	20(16.7)
Do you allow open grazing around the vicinity of the reservoir?	37(30.8)	18(15.0)	20(16.7)	26(21.7)	19(15.8)
Do you experienced diarrhoea and abdominal discomfort after eating fish from the reservoir?	20(16.7)	13(10.8)	42(35.0)	27(22.5)	18(15.0)
Do you participate in reservoir clean-up initiatives or conservation activities?	3(2.5)	5(4.2)	33(27.5)	21(25.8)	48(40.0)
Do you change your water usage habits in response to reservoir management efforts?	14(11.7)	14(11.7)	51(42.5)	22(18.3)	19(15.8)
How do you use water from the reservoir?	40(33.3)	38(31.7)	27(22.5)	8(6.7)	7(5.8)

Sourced: Field survey, 2024

DISCUSSION

This survey presents the first report of lack of knowledge, attitude and practices (KAP) on fish parasites and water quality parameters in Funtua, Katsina, Nigeria. Lack of knowledge, attitude and practices (KAP) on fish parasites and water quality parameters is one of the major courses for transmission of infectious diseases. A cross sectional survey was conducted to assess knowledge, attitude and practices (KAP) on fish parasites and water quality parameters among rural residents in Mairua area in Funtua, Katsina State, Nigeria. The age range of the respondents between 10 and 71 years, with a higher proportion of them (25.00%) fell between 21 and 30 years, followed by (23.33%) fell between 10 and 20 years. This finding is in disagreement with the finding of with the finding of (Adugna *et al.* 2022) who reported (25.2%) fell

between 23-33 years. Results showed that majority of the respondents (94.2%) were males, while only 5.8% were females, though generally fish farming is dominated by male in Nigeria but the extreme domination in the study area can be attributed to the peculiarities of the study area where the females are known to stay more indoor (Dauda and Yakubu, 2013; Dauda *et al,.* 2015). This findings supported the results of Dauda et al. (2015); Adugna *et al*. (2022) and Ngoshe *et al.* (2023) who reported 88.6% male and 11.4% females; 65.4% male and 34.6% female and 82.2% male and 17.0% female respectively. Also this finding is in disagreement with the finding of Berhe *et al*. (2020) who reported 75.9% females and 24.2% males. While Chaisiri *et al.* (2019) reported gender participation was balanced (49.6% was males 50.4% was females). Most of the respondents in this study were 60.8% were married, 30.0% single and 5.0% divorced this is line with the finding Berhe *et al*. (2020) who stated 72.8% married, 12.3% single and 6.3% divorced. More than half of the respondents in this study 60.83% had family size 1-10, followed by 30.0% had family size 11-20. This finding is in agreement with the finding of Berhe *et al*. (2020) who reported (40.6%%) 1-10 and (53.1%)11-20 house hold size. In terms of primary occupation of the respondents in this study, all respondents were asked about primary occupation and 52.5% stated that that fishing as their primary occupation in their surroundings, fish trading (15.8%), farming (15.0%), while 10.0% students. This finding is in disagreement with the results of Berhe *et al*. (2020) who reported (89.4%) farmers and 2.8% merchant. The respondents were asked about secondary occupation in their surroundings, 35.8%, less than half, of respondents stated that fish trading as their secondary occupation in their surroundings and 10.8% other (mining/crypto) as their secondary occupation in their surroundings. This study showed that 34.16% of the respondent spent 1-20 years in their locality and (25.83%) 21-30 years in their locality. In our study, majority of the respondents (31.7%) had Qur'anic education, followed by 30.0% had secondary education, while 7.5% had unable to attend any school. This is in agreement with the finding of Berhe *et al*. (2020) who reported (89.4%) who reported (41.7%) of the respondents were able to read and write while this finding is in disagreement with the finding Adugna *et al*. (2022) who report that of most of the participants had no formal education (61.7%) which is comparable to an additional survey done in Ethiopia (Akalu *et al.,* 2020) while Tesfaye, *et al.,* (2023) reported 24% of the respondents none .

Also, study respondents were also asked about the primary purpose of reservoir in their locality and 62.5% reported the primary purpose of the reservoir is drinking and (16.7%) of the respondents indicated that fishing is the primary purpose of the reservoir. In this survey, Majority of the respondents (60.8%) have knowledge on fish parasites, while 25.8% did not, this findings is agreement with the finding of (Chaisiri *et al.,* 2019) and disagreement with the finding of (Tesfaye, *et al.,* 2023) who stated that majority of the respondents are not familiar 69% are not familiar with fish parasites, while Tesfaye, *et al.,* (2023) reported 100% of the respondents not familiar with fish parasites. In term of awareness that you can be infected with parasites from fishes, all respondents were asked and 58.3% stated that they can be infected with fish parasites from fishes, while 21.1% did not. This finding is similar with the finding of (Chaisiri *et al.,* 2019) who stated that majority of the respondents stated that they can be infected with fish parasites from fishes. Therefore, in term of awareness that you can be infected with parasites from eating raw or undercooked fish, almost all of the respondents 64.2% reported that they can be infected with eating raw or undercooked fish, while 18.35 not sure, and this finding is in agreement with the finding of (Chaisiri *et al.,* 2019) who reported (68.6–80.8%) raw fish consumption. Consequently, the general public residing nearby the locality of Mairua reservoir are under the threat of FBZP, because ingesting of undercooked or raw fish is a main source of fish-borne parasitic infestations in humans (FAO, 2021). The good news is that most food-borne diseases are preventable. Our behavior, the way we build food systems and how we organize food supply chains can prevent FBZP (FAO and WHO, 2022). To decrease the risk of fish-borne parasitic disease, fish meat must treat by blistering or cold temperatures (≥70 or−20°C for 7 days) (FAO, 2021). The knowledge from the respondents about the fact that parasites can be transferred from wildlife and other animals to human being was high (64.2%), this reports is in agreement with the finding of (Ngoshe *et al.,* 2023) who stated that 79.4%, similar to that reported from a study conducted in Erzurum, Turkey (Özlü and Ataseve*.,* 2020), and much higher than reports from studies in southern Ethiopia (Fesseha and Abebe*,* 2020), and in West Bengal, India (Bhattacharyya, 2019). Therefore, there is a need to provide training to the farmers on locally relevant aspects of disease transmission at the human livestock wildlife interface, as this could be attributed to a lack of extension programs that focused on educating the farmers on zoonosis and limited veterinary and health workers in these communities (Ngoshe *et al.,* 2023). The distribution of food-borne parasitic diseases is increased by fluctuations in human behaviour, demographics, environment, climate, land use, and trade (FAO, 2021). Furthermore, this study showed that 44.2% had not sure of encountered with fish parasites, while 38.3% encountered with fish parasites. In our almost half of the respondents 49.2% had observed worms parasites were the most common during rainy and dry seasons, while leeches 47.5% was observed. This is similar with the finding of (Tesfaye, *et al.,* 2023), who reported (47%) parasitic worms. In this present study, 47.5% aware of the diagnosis of fish parasites. Majority of the respondents 47.5% aware of the treatment of fish parasites while 31.7% not sure, this is in agreement with finding of (Phi *et al.,* 2022) who stated that 58.4% aware of the treatment of fish parasites. About the prevention methods of fish parasites 52.5% of the respondents you know the prevention methods of parasite, 32.5% not sure, this finding is in agreement with the finding of (Ngoshe *et al.,* 2023), who reported 83.5% of the respondents. However, 74.2% of the respondents know that fish parasites reduce fish growth yield, aesthetic value, marketability and palatability and finding is in agreement with the finding of (Ngoshe *et al.,* 2023), who reported 83.5% of the respondents 91.6%. Overall 80% of the respondents had strongly agree reservoir has water quality issues, this finding is similar to the outcomes of (Tesfaye, *et al.,* 2023), who reported 100% of the respondents. Ecological alteration can have emotional impact on parasite and host persons directly by altering the environmental sites in which the interaction takes place. It can harmfully affect fish host through changing its capability to manage the parasitic worms; the parasitic worms through effects on virulence, spread, or breeding; invertebrate host via increasing breeding; and human host via increasing aquatic-derived zoonosis (Tesfaye, *et al.,* 2023). There are fluctuations in the water quality and quantity of the reservoir with season, and majority of respondent's reports 79.2% and 71.7% respectively. The most prevalent of source of information about impact reservoir on the health and well-being of community among respondents to the questionnaire, was strongly agree with 80.0% of the respondents,

while 63.2% of the respondents are willing to support management efforts in the reservoir. The majority of the predominant source regular information about reservoir management or conservation efforts among respondents to the questionnaire, was disagree with 35.8% of respondents showing they had heard of the term through this channel. Respondents in this study revealed that they were very concerned on current reservoir management practices are adequate, with 45.0% strongly disagree on current reservoir management practices. A higher proportion of respondents in this survey discovered that reservoir management practices is not sufficient; with 45.0% strongly disagree on current reservoir management practices. There are several sources of entering pollutant/sewage in to the reservoir, with 55.8% strongly agree and 70.0% of the respondents strongly agree that pollutant/sewage exposure is harmful to the water body and users. There are changes in the local ecosystem or biodiversity, 58.3% strongly agree there is changes in the local ecosystem or biodiversity in the reservoir, will 57.5% of the respondents strongly agree that fish parasites are threats to the abundance and variety of native fish species in the reservoir.

The current survey is one of the few that examine local parasitological and water quality knowledge; nevertheless, this should be covered to some publics in Nigeria. The replies to questionnaires display that residents have a good level of knowledge regarding consumption of smoked/ undercooked fish, 36.7% of the respondents consume smoked/ undercooked fish regularly, this is in agreement with the finding of Chaisiri *et al.* (2019) who reported 68.6–80.8%) of the respondents. A comparable pattern was observed in the eating of raw fish regardless of the connected threats, which the indigenous communal is also aware of (Chaisiri *et al.,* 2019). The consumption of bush meat by 46.6% of participants is also an important risk factor for several zoonotic infections (Cantlay *et al.,* 2017). Buying fish from reservoir and market was viewed as a very important issue with 38.3% of the respondents buy fish occasionally from reservoir, while 36.7% of the respondents buy fish from market regularly. Also, washing clothes in/near reservoir and swim/bathing in/near the reservoir was viewed as a very important issue with, 40.0% of the respondents wash near reservoir regularly, while 28.3 % of the respondents often swim/bathing in/near the reservoir. According to respondents individual opinion and findings regarding open defecation in/around the vicinity of the reservoir and dispose of domestic waste in/near the reservoir. From a total of 120 respondents, 65 (54.2%) had never participate in defecation in/around the vicinity of the reservoir, while 40(33.3%) had rarely participate in dispose of domestic waste in/near the reservoir. Corresponding respondents individualistic view and outcomes concerning participating in fetching water for cooking/drinking from the reservoir and participating in farming crops around the vicinity of the reservoir. Out of 120 respondents, half of the respondents 50.0% had regularly fetch water from the reservoir, similarly almost half of the respondents 42.5% regularly participate in crops farming around the reservoir. 35.0% of the respondents had experienced diarrhoea and abdominal discomfort after eating fish from the reservoir, this finding is in line with the finding of (Ngoshe *et al.,* 2023). The participating of respondents in reservoir clean-up initiatives or conservation activities was assessed, 40.0% of the respondents had never participate in reservoir clean-up initiatives or conservation activities. In our findings almost half of the survey respondents occasionally (42.5%) had change water usage habits in response to reservoir management efforts, while 15.8% had never change water usage habits in response to reservoir management efforts. According to respondents personal opinion and outcomes concerning, how they use water from the reservoir, with 33.3% had regularly they use water from the reservoir.

Conclusion

Our survey gives emphasis to the significance of studying the Knowledge, attitude and practices of local areas in order to increase, water quality monitoring, parasites control plans as well as community healthiness. The findings outcomes discovered that numerous of the survey respondents had not participated in reservoir clean-up initiatives or conservation activities. Almost half of the survey respondents occasionally had change water usage habits in response to reservoir management efforts. Leeches, worms and lice were the most commonly observed parasites during rainy and dry seasons, while fish intestine, fertilizer pesticide, herbicide and manure were the most commonly type of manure/chemical used in your farmland.

Recommendation

Authority/Government as well as corresponding organizations must provide extraordinary care to the prevention in addition to control of ecological as well as water effluence. Appropriate garbage as well as offal dumping approaches must be executed to avoid uncleanness of the reservoir surroundings as well as to breakdown the lifecycle of parasitic warms. Establishing communal familiarity/awareness on fish borne zoonotic parasites spread as well as threats connected with consumption undercooked and raw fish meat in addition to build up a system with appropriate affiliate organizations to teach legatees as well as forming awareness are vital. Execution of prevention methods relevant to most food-borne parasites comprise presentation of appropriate sanitation, fishing manners, check-up of fish meat before food preparation (cooking), appropriate storing techniques, as well as adequate food preparation (cooking) of fish prior to eating are vital. Additionally, these findings recommended additional research of molecular characterization of genus worms, leeches as well as tick to classify it to species level as well as also for the further types of fish borne zoonotic parasites.

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Availability of data and materials

Data backup the conclusions of this article are comprised in the article as well as it is supportive documents. The datasets used as well as/or analysed in the course of the findings are accessible from the corresponding author upon reasonable demand.

Conflicts of Interest

The Authors report no conflicts of interest for this work.

Author Contributions

Conceptualization, S.M.A, B.A.H and U.J; methodology, S.M.A, D.A.B and T.A.; validation, S.M.A, B.A.H and U.J; formal analysis, S.M.A, D.A.B and T.A.; investigation, S.M.A.; resources, S.M.A, D.A.B and T.A.; data curation, S.M.A and D.A.B.; writing—original draft preparation, S.M.A.; writing—review and editing, S.M.A, and U.J..

REFERENCES

Acka, C.A., Raso, G., N'Goran, E.K., Tschannen, A.B., & Bogochn, I .I. (2010). Parasitic Worms: Knowledge, Attitudes, and Practices in Western Coˆte d'Ivoire with Implications for Integrated Control. *PLoS Negl Tropical Dis*. 4(12), e910. doi:10.1371/journal.pntd.0000910.

Adugna, B., Merera, O., Negash, W., Abdulkadir, O., & Mohammed, Y. (2022). Knowledge, Attitude and Practice (KAP) Assessment on LifeStyle, Public Health Measures Practiced by Society and Their Impact to ContainCOVID-19 Transmission Among Afar Communityin Selected Parts of Afar Region, Ethiopia. *Infection and Drug Resistance*. 15, 1277–1287.

Akalu, Y., Ayelign, B., & Molla, M.D. (2020). Hospital AZ. Knowledge, attitude and practice towards COVID-19 among chronic disease patients at Addis Zemen hospital, Northwest Ethiopia. *Infect Drug Resist*. 13,19-49.

Alsulivany, B. S. A., Abdolrahman, P. M. S., Ahmed, D. V., Naif, R. O., & Omer, E.A. (2024).Transmission of zoonotic infections (bacteria, parasites, viruses, and fungi) from aquaculture to humans and molecular methods for organism identification . *Journal of Zoonotic Diseases*. 8 (5), 6-12.

Ángeles-Hernánde, C. F. R., Gómez-de Anda, N. E., & Reyes, R. (2020).Genera and species of the anisakidae family and their geographical distribution. Animals, 10(12), Article ID 2374.

Berhe, A. A., Aregay, A. A., Abreha, A. A., Aregay, A. B., Gebretsadik, A.W., Negash, D. Z., Gebreegziabher, E. G., Demoz, K. G., Fenta, K. A., & Mamo, N. B. (2020). Knowledge, Attitude, and Practices on Water, Sanitation, andHygiene among Rural Residents in Tigray Region,Northern. *Journal of Environmental and Public Health Volume.* 9, Article ID 5460168.https://doi.org/10.1155/2020/5460168 Ethiopia.

Bhattacharyya, S. (2019). A Socio-Demographic Study on Extent of Knowledge, Awareness, Attitude and Risks of Zoonotic Diseasesamong Livestock Owners in Singur, West Bengal. E. Africa School. *Journal Medical Science*. 2.

Biu, A. A., Diyaware, M. Y., Yakaka, W., & Rita, D. J. (2014). Incidence of Parasites of *Clarias gariepinus* Caught from Lake Alau, Maiduguri, Borno state, Nigeria. *Nigeria Journal of Fisheries and Aquaculture*. 2(1), 74-80.

Cantlay, J.C, Ingram, D.J & Meredith, A.L (2017). A review of zoonotic infection risks associated with the wild meat trade in Malaysia.Ecological Health 14, 361–388.

Chaisiri, K. C., Jollivet, P., Della Rossa, S., Sanguankiat, D., Wattanakulpanich, C., Lajaunie, A., Binot, M., Tanita, S., Rattanapikul, D., Sutdan, S., & Morand, A. R. (2019).Parasitic infections in relation to practices and knowledge in a rural village in NorthernThailand with emphasis on fish-borne trematode infection. *Epidemiology and Infection*. 147(45), 1–12. https://doi.org/10.1017/S0950268818002996

Chibwana, F. D., Mshana, J. G., & Katandukila, J. V. (2020). A survey of fish parasites from Pangani Catchment and Lake Kitangiri in Singida, Tanzania. *Tanzania Journal of Science*. 46(1): 42-52.

Cojocaru, A. L., Liu, Y., Smith, M. D., Akpalu, W., Chavez, C., Dey, M. M., & Tran, N. (2022). ''The Sea food'' system: Aquatic foods, food security, and the global South. *Review of Environmental Economics and Policy*, 16 (2), 306-326.

Daniel, N. A., & Elliot H.A. (2021). Variation of water quality parameters and correlation among them and fish catch per unit effort of the Tono Reservoir in Northern Ghana. *Journal of freshwater ecology*.36(1), 253–269. https://doi.org/10.1080/02705060.2021.1969295.

Dauda, A. B., Dasuki, A., & Bichi, A. H. (2015). Analysis of constraints to Aquaculture Development in Sudano-Sahelian region of Nigeria, Tropical and Subtropical Agroecosystems, 18 (2015): 189 -193.

Dauda, A.B., Yakubu, S.O. (2013). Fish Consumption pattern and Knowledge of Fish farming among Inhabitants of Dutsin-Ma LGA, Katsina State. *Nigerian Journal of Fisheries*. 10(1&2), 586-594.

Food and Agricultural Organization (2021). *Parasites in Food: An Invisible Threat*, Food andAgricultural Organization of the United Nations, Bangkok,Thailand, 2021.

Food and Agricultural Organization (2022). A Guide to World Food Safety Day, Food andAgriculture Organization of the United Nations and World Health Organization.

Food and Agricultural Organization and World Health Organization (2022). A Guide to World Food Safety Day, Food and Agriculture Organization of the United Nations and World Health Organization.

Fesseha, H., & Abebe, F. (2020). Assessment of community knowledge, attitude, and practice on common zoonotic diseases in Jinka town, Southern Ethiopia. *Gaze Medical Science*, 1, 18–29. [CrossRef]

Gauthier, D. T. (2015). Bacterial zoonoses of fishes: A review and appraisal of evidence for linkages between fish and human infections. *Veterinary Journal*. 203(1), 27–35. https://doi.org/10.1016/j.tvjl.2014.10.028.

Han, BA., Kramer, A. M., & Drake, J. M. (2016). Global Patterns of Zoonotic Disease in Mammals. *Trends Parasitology*.32(7),565–77. https://doi.org/10.1016/j.pt.2016.04.007.

Hazarika, A. K., & Bordoloi, B. (2022). Ichthyo-parasitological studies in North-eastern India. *Journal of Threatened Taxa*1. 4(5), 21019–21024. https://doi. org/10.11609/jot.7583.14.5.21019-21024.

Khatri, N., & Tyagi, S. (2015). Influences of natural and anthropogenic factors on surface and groundwater quality in rural and urban areas. *Frontiers Life Sciences,* 8(1),23–39.

Kiprono, S. W. (2017). *Fish Parasites* and *Fisheries Productivity in Relation to Exreme Flooding of Lake Baringo, Kenya, Kenyatta University*. 1–93, 2017.

Morley, N. J., & Lewis, J. W. (2014) Temperature stress and parasitism of endothermic hosts under climate change. *Trends in Parasitology*, *30*(4), 221–227.

Ngan, T. T. P., Thao, T. B. N., Trang, T. H. L., Dung, T. D., Marc Lenaerts, B. L., Olivier V., Pierre, D., Minna, V. G., Magda, B.B., & Dung, T. B. (2022). Foodborne zoonotic trematode infections in Yen Bai, Vietnam: a situational analysis on knowledge, attitude, and practice (KAP) and risk behaviours. *Journal of Premium Medicine Hygiene,* 63, 310-319.

Ngoshe, Y. B., Etter, E., Gomez-Vazquez, J. P,. & Thompson, P.N.

(2023). Knowledge, Attitudes, and Practicesof Communal Livestock Farmers regarding Animal Health andZoonoses in Far Northern KwaZulu-Natal, South Africa. *International Journal Environmental Research and Public Health*, 20, 511. https://doi.org/10.3390/ijerph20010511.

Nyanti, L., Soo, C. L., Danial-Nakhaie, M. S., Ling, T. Y., Sim, S. F., Grinang, J., & Lee, K. S. (2018). Effects of water temperature and pH on total suspended solids tolerance of Malaysian native and exotic fish species. *AACL Bioflux*, 11(3), 565-575.

Obiero, K., Meulenbroek, P., Drexler, S., Dagne, A., Akoll, P., Odong, R., & Waidbacher, H. (2019). The contribution of fish to food and Nutrition Security in Eastern Africa: Emerging trends and future outlooks. *Sustainability*, 11 (6), 1636.

Obisesan, K.O., & Christopher, P. (2018). Statistical models for evaluating water pollution: The case of Asejire and Eleyele reservoirs in Nigeria. *Journal Environment State*, 8(5), 12-16.

Odoh, V.U., O. O., Abuh, M. M., Haruna, M. A., Yisa, A. A., & Bids, I. W. Z. (2019). Medically important parasites of *Clarias Garipienus* (catfish) in Nigeria," *Advances in Biotechnology and Microbiology,* 15 (1), Article ID555904.

Onamade, A. (2014). Access and Utilization of Antenatal Care Services in Funtua Local Government Area, Katsina State, Nigeria. M.Sc. (Geography), Ahmadu Bello University, Zaria. P58.

Özlü, H. and Atasever, M. (2020). Atasever, M.A. Knowledge, attitude, and practices of cattle farmers regarding zoonotic diseases inErzurum, Turkey. Austral Journal Veterinary Science, 52, 79–85. [CrossRef]

Raissy, M. (2017). Bacterial zoonotic disease from fish: a review. Journal of Food Microbiology.;4(2):15–27.

Rameshkumar, S., Radhakrishnan, K., Aanand, S., & Rajaram, R., (2019). Influence of physicochemical water quality on aquatic macrophyte diversity in seasonal wetlands. *Apply Water Science,* 9 (1),12.

Shetty, A., Venkateshwarlu, M., & Muralidharan, M. (2015). Effect of water quality on the composition of fish communities in three coastal rivers of Karnataka. *Indian International Journal Aquatic Biology*, 3(1),42–51.

Sojka, M., Jaskuła, J., & Siepak, M. (2018). Heavy metals in bottom sediments of reservoirs in the lowland areaof Western Poland: Concentrations, distribution, sources and ecological risk. *Water*, 11(1),56.

Uba, S., Ajibola,V. O., Adeosun, O. S., Ikeh, D.C., Mikail, A.H., Awe, J.O., & Ruma, M. M. (2021). Quantitative Assessment of Pollution Status of Heavy metals in the water from Mairua Dam, Faskari LGA, Katsina state, Northwestern Nigeria. *Bayero Journal of Pure and Applied Science,* 14 (2): 95-100.

Wang, D., Young, N., Korhonen, P., & Gasser, R. (2018). *Clonorchis sinensis* and *clonorchiasis*: the relevance of exploring genetic variation. In Advances in Parasitology, first edition, Elsevier Limited, London, UK. 100: Pp 155-208.

Younis, A. E., Saad,A. I., & Rabei, J. M. (2017).The occurrence ofContracaecum sp. larvae (nematoda: anisakidae) in fourteleostean species from Lake Nasser, Egypt: morphological andmolecular studies. *The Journal of Basic and Applied Zoology*, 78, (1),1–13.

Yusuf, S .S., Muhammad, I., Jibrin, A., Olaleru, F., Aminu, U. I., Ahmed, A., Salim, A., Lawal, N., & Hassan, M. M. (2022). Availability and Co-Substrate Potential of Typha latifolia for Biogas Production in Funtua, Katsina state, Nigeria. *Journal of Applied Science Environment Manage*, 26 (4), 611-620.

Zinabu, T., Adem, H., Dinaol, B., & Merga, F. (2023). Assessments and Identification of Selected Fish-BorneZoonotic Parasites in Nile Tilapia and African CatfishSpecies in Lakes of Haramaya District, Ethiopia. *Hindawi Aquaculture Research.* 17, Article ID 2638123. https://doi.org/10.1155/2023/2638123