Egyptian Journal of Aquatic Biology & Fisheries
Zoology Department, Faculty of Science,
Ain Shams University, Cairo, Egypt.
ISSN 1110 – 6131
Vol. 28(5): 1793 – 1806 (2024)
www.ejabf.journals.ekb.eg

Survey of Fish Diseases in Basrah Province Farms During 2018-2020

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ARTICLE INFO
Article History:
Received: Dec. 15, 2023
Accepted: Aug. 3, 2024
Online: Oct. 19, 2024

Keywords:
Cultured fishes,
Diseases,
Fresh waters,
Basrah,
Iraq

ABSTRACT

During this study, which spanned from January 2018 to December 2020, fish diseases were investigated, resulting in the recording of 68 disease cases. Of these, 35 were attributed to bacterial gill disease, 15 to skin ulcer disease, 12 to intestinal inflammatory disease, four to high ammonia disease, and two cases of fin rot. Health problems were documented in 39 fish farms over the three-year period, with cases involving 26 ponds covering a total area of 75.05 dunams (1 dunam = 0.25 ha), three fish farms with 10 cages totaling 468m³, and 10 farms employing semi-closed systems with a total area of 1,437.8m³. The highest prevalence of disease (29 cases, or 42.64%) was recorded in 2018. The disease cases were described, and the results were chronologically organized by type of infection, method of fish farming, and the distribution of disease cases across the districts of Basra Governorate.

INTRODUCTION

Fish farming is one of the economic activities that have witnessed a steady rise in the last ten years in Iraq generally and in Basrah Province particularly due to the government support and the role played by the academic institutions in spreading the knowledge culture in this field, in addition to the farmers' desire to diversify the source of income. The increase in this type of aquaculture, with the lack of administrative experience for many farmers, is certainly accompanied by the emergence of many problems, most notably health problems, to the extent that it has become a real challenge to the success and development of the projects. Furthermore, countless infectious and non-infectious disease threats, which cause direct losses and limit fish farming activity, are present in the aquatic environment **(Terech-Majewska, 2016)**. Some studies have been conducted on pathological factors in fish farms in Basrah Province, through which a number of pathogens were recorded, but they are generally few, and they are mostly diagnostic studies, including those of **Saleh (1997)**, **Shamshoom *et al.* (1998, 1999)**, **Al-Duboon *et al.* (2006)**, **Jassim (2007)**, **Al-Taee *et al.* (2009)**, **Mhaisen *et al.* (2010)**, **Al Shammari (2017)** and **Al-Taee *et al.* (2017, 2024)**.

Diseases are one of the most important factors that reduce fish production, whether in farming systems or in the natural environment, and since they have a significant impact on the production, consumption, trade and practice of fish farming, it is necessary to investigate the true cause of these diseases **(Hossain *et al*., 2011)**.

The current study aimed to monitor, examine, and diagnose disease agents, identify the most common diseases, and analyze their patterns of spread. In addition, it investigated the causes of these diseases and documented findings to help identify ways to prevent such issues. This study serves as a continuation of the previous research conducted by **Jassim (2019)**.

MATERIALS AND METHODS

The pathological cases of the common carp *Cyprinus carpio* samples were recorded over a period of three years (2018, 2019 and 2020). They were collected by two ways. The first one was through the samples brought to the laboratory by fish farmers, where they were visually examined to record observations followed by laboratory diagnosis, while the second way was by sampling using a hand net through periodic field visits to fish farms facing health problems. The examination of the fish was conducted by applying diagnostic tests based on the anatomy and microscopical examination of the affected organs. Data documented the gross pathological conditions and general information about each culture through the form below:

No.	Date	Farm owner's name	Location	Type of ponds	Area	Density fishes	Disease status (diagnosis)	Notes

The gross pathological cases were described, and the causes of disease emergence were diagnosed. A portable ammonia photometer was used to test ammonia levels. The results were chronologically organized for each disease case, along with the type of infection and the method of fish culture.

RESULTS

Health problems were recorded upon examining 39 fish farms in three years' time (16 farms in 2019, 12 farms in 2019, and 11 farms in 2020). They included 26 earthen farms with a total area of 75.05 dunum, three fish cages with a total number of 10 cages and a total area of 468m^3, and 10 semi-closed system farms with a total area of 1437.8m^3 (Tables 1, 2 and 3). The number of earthen farms that were exposed to health problems in

2018 was 12 farms with a total area of 43 dunum, and seven farms in 2019 with a total area of 13.8 dunum, while seven farms were recorded in 2020 with a total area of 18.25 dunum. The highest fish farming density was 2218 fish/dunum in 2020, while the lowest fish farming intensity was 958.76 fish/dunum in 2018.

The number of cage farms was only one in 2018 that included six cages with a total area of 288m^3, whereas two farms were registered in 2019 including four cages, with a total area of 180m3 (Tables 1 and 2). The highest fish farming density was 29.1 fish/m3 in 2019. For semi-closed farms, there were 10 farms that included three farms in both 2018 and 2019 and four in 2020 with a total area of 1437.8m^3, and the highest fish farming density was 79.24 fish/m^3 in 2019 (Tables 1, 2, 3).

Regarding the distribution of ponds, the highest number of farms experiencing health problems was recorded in the Al-Hartha district (18 farms), followed by the Al-Qurna district (nine farms). The Shatt al-Arab and Abul-Khaseeb districts each reported five affected farms, while the Al-Zubair district had two farms with health issues.

During this study, 68 disease cases were recorded, including 35 instances of bacterial gill disease, 15 of ulcerative skin disease, 12 of intestinal inflammatory disease, four owing to high ammonia disease, and two cases of fin rot (Table 4). The current study found that the majority of health problems in fish farms in Basrah Province were attributed to bacterial diseases, accounting for 94.1%.

Bacterial gill disease

The bacterial gill disease was considered the most virulent disease due to the high percentage of its occurrence on the fish farms. It caused the highest mortality rates on the fish farms during the three years of study. It should be noted that 90% of those cases were completely treated with the antibiotic (Oxytetracycline at a concentration of 50%), when food was cut off from three days to a week during the treatment. Skin ulcer disease was often associated with this disease, especially in earthen ponds, which was recorded in a high percentage (Table 4 & Fig. 1). Bacterial gill disease causes damages of varying severity to the gill tissues, causing damage and hyperplasia of the epithelial tissues, necrosis and severe inflammation of the gill tissues, thus affecting the functional efficiency of these tissues and leading to suffocation of fishes to a degree that depends on the amount of damage. Infected fish gradually lose their appetite, eventually reaching a point of complete refusal to feed in severe cases. Observations from the infected farms revealed that the fish tended to group in small numbers gathering near the water source during the early morning and evening hours. Infected fish swam slowly and tended to make bubbles at the surface, which is a natural reaction when oxygen levels in the water are low. However, in this case, the problem was linked to poor respiratory efficiency due to the infection.

Fish in the severe stages of infection lost their responsiveness to external stimuli and became so sluggish that they could be caught by hand. Fifteen cases of this disease were recorded in 2018: 11 in earthen ponds, three in semi-closed systems, and one in cages (Table 4). In 2019, the number of cases decreased to 11, with six on earthen ponds, three in semi-closed systems, and two in cages (Table 4). By 2020, infections further declined to nine cases, with five on earthen ponds and four in semi-closed systems. The infection was observed in most months, except during the hot months of June, July, and August, with the highest incidence recorded in March (Table 5 & Fig. 2).

Skin ulcer disease

This disease was recorded as the second most prevalent, causing significant damage to the skin of infected fish. Initially, the infection presented as discoloration (darkening) due to tissue damage and scale loss. This progressed to minor bloody hemorrhages in the form of small spots, which eventually developed into severe bleeding, resulting in medium and large ulcers. In the final stage, the internal tissues became exposed, and in some cases, the bones could be seen through the skin with the naked eye.

Mortality from this disease was considerably lower than that from bacterial gill disease and typically occurred after an extended period. Treatment for this disease is much simpler and involved the use of the antibiotic oxytetracycline at a concentration of 50%, along with a one-week cessation of feeding. This disease was recorded over seven months, with a total of 15 cases; the highest prevalence occurred in March and May (Table 5 & Fig. 2).

In 2018, the disease was observed across all aquaculture systems, with three cases on earthen farms and one case in cages and another in semi-closed systems. In 2019, it was again recorded in all types of aquaculture, with five cases on earthen farms and one case each in cages and semi-closed systems. However, in 2020, it was only recorded in three earthen ponds (Table 4).

Intestine inflammatory disease

Twelve epidemic cases were diagnosed, and this disease caused deaths at varying rates. Infected fish exhibited reduced feeding behavior and swam slowly and unsteadily. Clear signs of the disease included abdominal swelling and redness around the anus. As the infection progressed, yellow liquid mixed with blood would exude from the abdomen when pressure was applied. Additionally, bubbles in the abdomen could be felt by gently pressing on the belly.

Microscopic examination of the intestine revealed hemorrhagic spots of varying severity. Initially, these appeared as very small spots under the stereomicroscope, but

they increased in number and severity as the infection advanced, eventually leading to complete ulceration of the intestine. The intestinal lining appeared red due to bleeding. Farms became more susceptible to losses when this infection occurred alongside bacterial gill disease.

In 2018, eight cases were recorded, all on earthen farms. In 2019, two cases were documented—one each in cages and semi-closed systems. In 2020, two additional cases were reported, again on earthen farms, bringing the total to 12 infections over three years (Table 4). The infection was observed only during the first five months of the year, with the highest incidence occurring in March, April, and May (Table 5 & Fig. 2).

Fin rot

This disease was recorded on one of the earthen pond farms in November 2018 and 2019 (Table 4 & Fig. 2). The fins of the infected fish were worn out at different levels, some of them were completely corroded. It should be noted that the most affected fins are the dorsal and caudal fins. Infected fish in the late stages of infection partially lost their appetite and swam slowly, but in general, the disease progress can be observed as a slow type that allows the time to treat the problem using oxytetracycline at a concentration of 50%, with cutting off feeding for five days.

High ammonia

High ammonia disease was recorded in one farm using semi-closed systems in 2019 (one case) and in three cases in 2020 (one in earthen ponds and two in semi-closed systems) (Table 4). Although ammonia levels fluctuated throughout the day, they generally exceeded permissible limits, leading to small but consistent daily fish deaths. Infected fish exhibited a loss of appetite and appeared lethargic, often resting just below the water column. Some fish also displayed a loss of balance.

This condition was documented only in October and November of both 2019 and 2020 (Table 5).

Table 1. Details of the diseased fish farms in Basrah Province during 2018

Type of aquaculture	Farm number	Total area	Density of aquaculture	Site			
				Al-Haritha district	Shatt Al-Arab district	Al-Qurna district	Abule Al-Khaseeib district
Earthen ponds	12	43 dunum	958.76 /dunum	8	1	3	0
Cages	1	6 (180m^3)	25.5 /m^3	0	0	0	1
Semi-closed systems	3	546 m	30.5/m^3	1	1	1	0
Total	16	-	-	9	2	4	1

Table 2. Details of the diseased fish farms in Basrah Province during 2019

Type of aquaculture	Farm number	Total area	Density of aquaculture	Site			
				Al-Haritha district	Shatt Al-Arab district	Al-Qurna district	Abule Al-Khaseeib district
Earthen ponds	7	13.8 dunum	2000/ dunum	3	0	3	1
Cages	2	4 288 / m^3	29.1/ m^3	0	0	2	0
Semi-closed systems	3	323,3 m^3	79.24/ m^3	1	1	0	1
Total	12			4	1	5	2

Table 3. Details of the diseased fish farms in Basrah Province during 2020

Type of aquaculture	Farm number	Total area	Density of aquaculture	Site				
				Al-Haritha district	Shatt Al-Arab district	Al-Qurna district	Abu le Al-Khaseeib district	Al-Zubair District
Earthen ponds	7	18.25 dunum	2218 /Dunum	4	1	0	2	0
Semi-closed systems	4	568.58 / m^3	12.75/ m^3	1	1	0	0	2
Total	11	-	-	5	2	0	2	2

Table 4. The number of disease cases in different sites of Basrah Province during 2018, 2019 and 2020

Year	Type of aquaculture	Number of cases	Diseases				
			Bacterial gill disease	Ulcer disease	Intestine inflammatory disease	High ammonia	Fin rot
2018	Earthen ponds	23	11	3	8	0	1
	Cages	2	1	1	0	0	0
	Semi-closed systems	4	3	1	0	0	0
2019	Earthen ponds	12	6	5	0	0	1
	Cages	4	2	1	1	0	0
	Semi-closed systems	6	3	1	1	1	0
2020	Earthen ponds	12	5	3	2	1	0
	Semi-closed systems	6	4	0	0	2	0
Total		69	35	15	12	4	2

Table 5. Monthly changes of the infection for the three years in Basrah Province

Month	Bacterial gill disease	Ulcer disease	Intestine inflammatory disease	High ammonia	Fin rot
January	1	0	1	0	0
February	5	2	1	0	0
March	7	3	3	0	0
April	5	2	3	0	0
May	4	3	3	0	1
June	0	0	0	0	0
July	0	0	0	0	0
August	0	0	0	0	0
September	3	1	0	0	0
October	4	1	0	2	1
November	5	2	0	2	0
December	1	1	1	0	0
Total	35	15	12	4	2

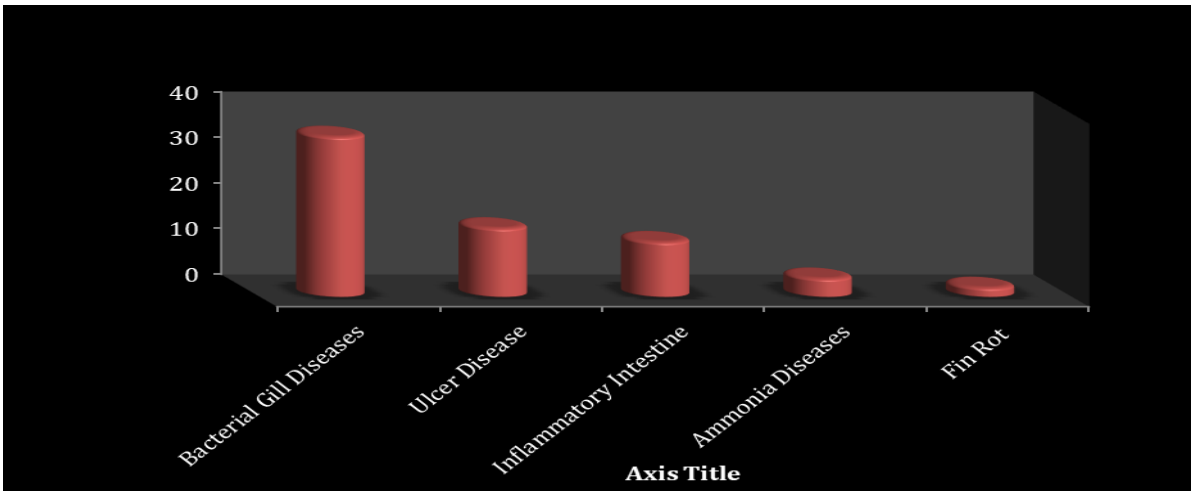

Fig. 1. The percentage infection of each disease to the total number of pathological cases in Basrah Province during 2019,2019 and 2020

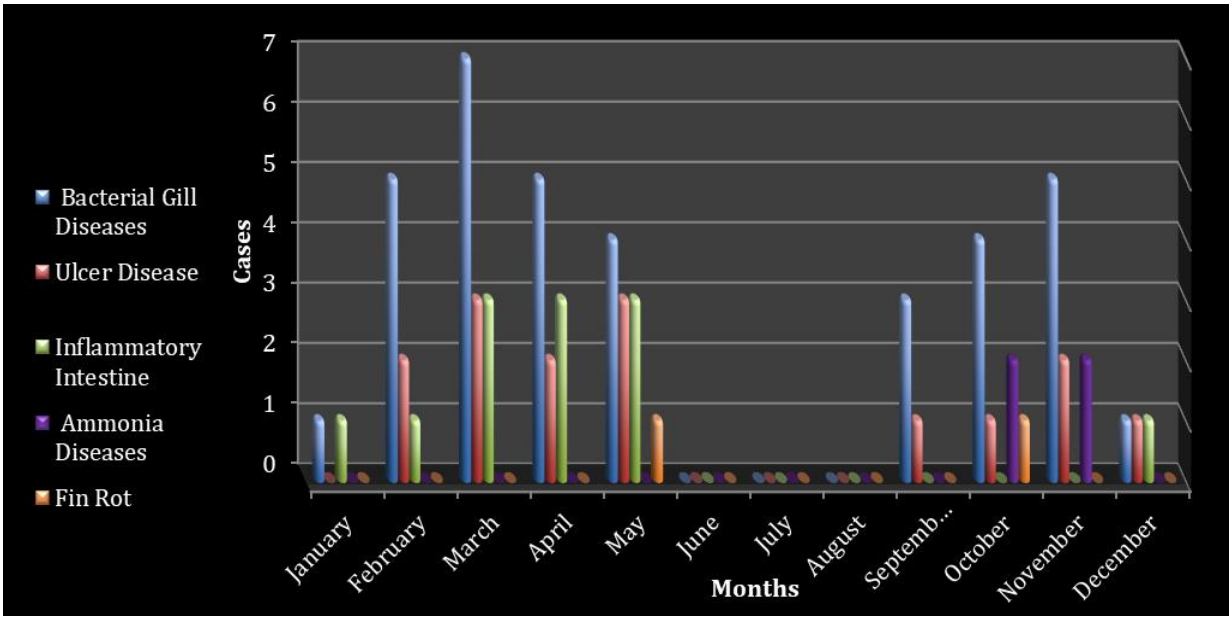

Fig. 2. Monthly changes in diseases for the three years in Basrah Province

DISCUSSION

Since the current study is an extension of **Jassim (2019)** study, the present results were discussed in light of comparison between both studies. Disease cases of the current study are less than those recorded in 2019 study, and the probable reason is due to the fact that the operating farms have clearly decreased in number. In this study, health problems were recorded on 39 earthen farms, 10 farms with a semi-closed system and three cage farms compared to 46 on earthen farms, 15 in cage farms and 10 on farms with a semi-closed system.

The recorded diseases were somewhat similar to the diseases recorded in the study of **Jassim (2019)**, but the infection prevalence was different. Bacterial gill disease was recorded at a prevalence of 51.47%, followed by skin ulcer disease at 22%, intestinal inflammatory disease at 17.64%, high ammonia disease at 5.88%, and fin rot disease at 2.94%. In comparison, the previous study reported prevalence rates of 42.1% for bacterial gill disease, 30.52% for skin ulcer disease, 14.73% for intestinal inflammatory disease, and 1.05% for high ammonia disease, with the same percentage for fin rot.

The causes of these health problems are largely consistent with those identified in the previous study. The primary issues stemmed from mismanagement and poor design, which were attributed to the lack of experience among workers in the field. These factors led to a series of health problems, with direct and indirect effects on the fish farming sector.

The direct damage was represented in the loss of fishes due to mortality, which sometimes reached 70%. In term of indirect effects, it was through the impact of diseases on the growth rates, and therefore the economic feasibility of the project became at stake,

in addition to material losses represented in the therapeutic efforts. Among the indirect effects is the long-time duration required for aquaculture season to produce marketing weights, resulting from the effect of these diseases on the growth rates, which means spending additional time, effort, and money to sustain and continue the work.

The highest number of disease infections were recorded on fish farms in 2018 (29 cases), then 22 cases in 2019, while the lowest numbers of disease cases were recorded in 2020 (18 cases). The main reason for this decrease is due to the outbreak of the COVID 19 pandemic in 2020, which reduced the activity of people.

Bacterial gill disease

This disease was evaluated as the most dangerous to the fish farming sector during the current study and the previous study by **Jassim (2019)**. It caused significant damage, as evidenced by high mortality rates compared to other diseases, with a prevalence of 51.47%, higher than the 42% recorded in the previous study. The disease was observed across all fish farming systems throughout the three years of study.

The large number of pathological cases can be attributed to several factors, many of which were previously documented and contributed to the occurrence of infections, including:

1. Transporting infected fish from other provinces for aquaculture purposes.
2. Transporting fish in an unscientific manner, at high densities and under stressful sanitary conditions.
3. Failure to change feeding sites in earthen ponds, creating an environment conducive to bacterial growth. This is particularly concerning as most fish bacteria are opportunistic. In cages, similar issues arise because cages remain in the same location for several seasons, leading to the accumulation of feed remains and waste.
4. Accumulation of feed due to the continuous provision of food at high rates, especially when fish appetite decreases owing to lower temperatures or disease.
5. Use of spoiled feed resulting from poor storage practices.
6. Abruptly reducing water levels by more than 50% of normal, which has a close relationship with the emergence of this disease. This forces fish to the bottom feeding areas, where they are directly exposed to thriving bacteria. Additionally, this practice negatively impacts fish immunity due to stress.

The highest prevalence of this disease was noted in earthen ponds, where bacterial levels from decomposing food are higher than in cage and semi-closed systems, thanks to water currents that help disperse bacteria. **Noga (2010)** indicated that bacterial gill disease is primarily caused by poor management, with risk factors including low oxygen levels, high turbidity, high ammonia levels, and overcrowding.

Skin ulcer disease

This disease was recorded in high rates in earthen ponds compared to other aquaculture systems. All the farms that were affected had poor water quality, and in a few cases, the infection occurred after fish transfers for a period from 15-20 days, as the transportation of fishes at high densities caused partial or total scraping of the mucous layer as a result of friction and facilitated the spread of the bacterial pathogens to the skin. For fish cages, the infection was mostly as a result of using nets with knots that sometimes enter inside the cage because the nets were not fixed well, which leads to the removal of the mucous layer or causing minor wounds that are a gateway to infection. Infection with this disease in semi-closed systems was due to the accumulation of feed residues and fish wastes as a result of the inefficiency of the water circulation mechanism or a defect in the efficiency or design of the mechanical filters.

Intestine inflammatory disease

The prevalence of infection was recorded at 21.7%, lower than the previous findings of 30.5%. The highest rates of infection were observed in earthen ponds (Table 4) compared to other aquaculture systems. In this study, the prevalence of intestinal inflammatory disease was 17.39%, which is higher than the previous record of 14.73%. Several factors contributed to the spread of diseases in culture systems:

1. Use of poorly stored feed.
2. Feeding moldy bread, which was closely associated with increased infection rates.
3. Providing rotting grains due to prolonged soaking.
4. Continuing to feed fish at low temperatures, leading to the accumulation of uneaten feed, which serves as a food source for bacterial growth. This, in turn, increased bacterial levels and the likelihood of infection.

Fin rot

This disease was recorded only twice in the earthen ponds exclusively, and it is the least bacterial disease in this study and the previous study. It was observed that this disease appears with severe cases of ulcer disease and bacterial gill disease, as the fish swims slowly.

Mhaisen *et al.* (2010) reported only a few types of bacterial and fungal pathogens recorded in some cultured fishes in Basrah Province. Studies in this field are very limited, including the study of **Saleh (1997)**, **Shamshoom *et al.* (1998, 1999)**, **Al-Taee *et al.* (2009)**, **Al-Shemmari (2017)** and **Al-Shammari *et al.* (2019)**. The mentioned bacterial diseases (bacterial gill disease, ulcer disease, inflammatory intestine disease and fin rot disease) constituted the main problem facing fish farms in the current study, as they were reported in 64 cases out of the 69 states, which is a clear indication of the importance of these pathogens and their role in affecting fish farming in Basrah Province.

High ammonia disease

This disease has been mostly reported on fish farms that used semi-closed system culture. This disease is expected in such high-density aquaculture systems where the water is partially recycled and therefore high ammonia is produced by respiration and waste materials decomposition. Once the pond water was replaced with fresh water, the fish returned to normal state.

The current study agrees with **Jassim (2019)** regarding that, most of these health problems were caused by the lack of experience of workers in this field, which resulted in bad management that clearly appeared through the health problems which were easy to avoid and prevented. In Basrah Province, most workers of fish farms had only an intermediate education or were illiterate **(Jassim, 2019)**. This coincides with a general lack of experience in fish farming **(Jassim *et al.*, 2013)**. Data in the study of **Al-Mukhtar *et al.* (2005)** support this observation, noting that only 13.3% of fish farms were managed by specialists, while the remainder were overseen by investors. This finding aligns with the studies conducted by **Jabir *et al.* (2008; 2010)** in the provinces of Maysan and Dhi Qar, which also highlighted the farmers' lack of experience.

As shown in Fig. (2), diseases were recorded with higher rates in spring and autumn, periods marked by significant changes in water temperature. Outbreaks of infections are particularly common in spring and early summer when water temperatures rise **(Aziz & Abdullah, 2021)**. This result is consistent with findings from the previous study **(Jassim, 2019)** and aligns with most research in this field.

CONCLUSION

Based on the findings of the current study, it was concluded that, the experiences of fish farming workers are still average. Additionally, most of the recorded fish diseases are caused by mismanagement. It is worthy to note that bacterial diseases are the most common dangerous ones recorded during the current study. Further research is recommended for the sustainability of fish farming at the site under study.

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