Preliminary Survey on the Health and Management Practices Among Small-scale Cage Tilapia Farmers on Lake Volta

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Research Article

Keywords: health, tilapia, farmers, Cage culture, Lake Volta

Posted Date: June 15th, 2022

DOI: https://doi.org/10.21203/rs.3.rs-1751258/v1

Abstract

The study investigated the health and management strategies adopted by fish farmers on Lake Volta to control disease outbreaks. 30 fish farmers were randomly selected within stratum II of the Lake Volta and interviewed using semi-structured questionnaires and oral discussions to collect information on their knowledge, experiences and measures used in controlling the spread of fish diseases. Farmers face challenges including poor water quality and seed and incidence of diseases. 56% of farmers reported they have experienced up to 70% losses of their fish due to diseases. 80% of farmers use antibiotics, herbs and probiotics as a treatment regimen to control diseases. Farmers expressed low confidence in using expert advice in the control of diseases. For better management of fish health, it may be necessary to develop a comprehensive fish health management plan by the collaborative efforts of stakeholders in the management of disease incidence in the aquaculture industry in Ghana.

Introduction

Fish is a major source of protein to about 60% of Ghanaians and it is consumed by all people across all races irrespective of socio-economic status and income levels (Akuffo et al. 2020; Mingle et al. 2021). Ghana's main sources of fish supply are from capture fisheries (i.e., Marine, natural lakes, ponds, rivers, dams and reservoirs) and from culture fisheries (i.e., mainly cages mounted in various water bodies and ponds).

In Ghana, cage aquaculture has been reported to be the largest producer of aquaculture seafood (Amenyogbe et al. 2018; Hasselberg et al. 2020) and about 80% of the production comes from cage fish farms on Lake Volta. Cage culture has rapidly expanded attributable to reasons such as flexibility in setting up and dismantling of holding facility, low cost compared to construction ponds, simplified husbandry practices and simplified harvesting (Chitmanat et al. 2016; Roriz et al. 2017). However, over the last six years there have been reports indicating that the number of operational cages on the Lake Volta is on the decline with records of abandonment of about 1200 cages owing to the occurrence of fish diseases (Mantey et al. 2020) most of which is largely unreported and therefore unattended to.

Despite the numerous reports of the declining fish production from Cage fish farms on the Lake Volta, largely missing is information on fish health and management by fish farmers practicing cage aquaculture on the Lake Volta. The study aims to provide information on fish health and management strategies adopted by fish farmers over these years of devastating fish health. It is hoped that the information provided in this article will help create awareness for policy advocates to devote more attention to help boost the production of fish in Ghana.

Methodology

The study was conducted on sampled cage farms within stratum II of Lake Volta within the Akosombo Dam at 6°17'57.7"N 0°03'19.6"E (designated as upstream) through the area between the Akosombo Dam

and Kpong Dam at 6°07'12.4"N 0°07'31.4"E (Designated as midstream) and those after the Kpong Dam to the Akuse area at 6°06'02.3"N 0°09'26.2"E (designated as downstream). Ten (10) small-scale cage fish farmers (i.e., those have between 1–10 cages each of dimensions 6 m x 6 m x 6m) were selected randomly in each of the designated sites and data on the views of farmers were solicited using a semi-structured questionnaire and supplemented with oral discussions and observations. The questionnaire centered on farmers' demographic characteristics, disease problems encountered in the culture of fish, and management strategies employed to prevent disease occurrence and spread in check. Data obtained were coded and incorporated into a computerized database and analyzed using a statistical package for social sciences (SPSS) and represented as percentages in tables and charts (i.e bar and pie charts).

Results

Socio-economic characteristics of fish farmers

The ages of cage fish farmers in the Lake Volta ranged between 20 and 50 years with a majority between 41-50 years (Fig. 1 A). About 78% of Aquaculture holders were married and the rest are single (Fig. 1B). The fish farmers in the study area had one form of formal education or the other, while the other a paltry 11% had no formal education (Fig. 1C).

Challenges of small-scale fish farmers on the Lake Volta

Cage fish farmers face varied challenges in the conduct of their farm operations. These challenges include; poor water quality, low/poor quality seed, high cost of feed, theft, incidence of diseases and predation (Fig. 2). Among these challenges, a quarter of the respondents cited the incidence of diseases as one of the challenges. When respondents were asked to rank these challenges based on severity, almost 80% ranked incidence of diseases as very severe, while 30% said poor water quality or theft were the less severe challenges faced (Table 1).

Perceived causes of diseases on small-scale cage fish farms

Cage fish farmers on Lake Volta attributed the causes of diseases on their farm's to be pathogens and environmental-related. The perceived pathogens reported to be associated with disease outbreaks include: bacteria, virus, fungi, while poor water quality was identified as an environmental variable associated with disease outbreaks. Fish farmers believed that among the pathogens, bacteria is most widespread (22.2%) and the least are virus (11.1%) and fungi (11.1%) causes of diseases on their farms (Fig. 3). Though this was the case, a combination of pathogens and poor water quality (33.3%) had multipliers effects and aggravated the incidence of diseases on their farms (Fig. 3).

Nature of disease occurrence

Fish of all sizes, thus fry, juveniles and adults suffered some form of diseases with many accompanying signs as shown in Table 2. The most commonly reported sign associated with juvenile and adult fish was

reported as swollen belly (25%). Also prominent was abnormal swimming (12.5%) behaviors exhibited by most fish which in some cases could concurrently occur with signs of swollen bellies in affected fish.

Associated factors with disease occurrence

Dry and wet seasons were reported to be the seasons, mostly associated with severe disease incidence while low and high temperature were the least associated factors associated with disease occurrence (Fig. 4)

Losses associated with disease occurrence

The incidence of diseases in fish farms caused economic losses of 30 % to 100 %. From stocking to harvest, a majority of farmers (56% of respondents) lost up to 70% of their stock, while about 11% of farmers lose about 30% or 100% of their stock (Fig. 5).

Measures taken to control disease outbreaks

Fish farmers in the quest to prevent and cure the disease outbreaks in their farms resorted to the use of chemicals such as formalin, disinfectants and antibiotics (i.e., tetracycline and amoxicillin) and biological products such as herbs and probiotics as a treatment regimen to control disease outbreaks. A few resorted to removing and burying of dead fish in nearby bushes whiles others resorted to other methods (Fig. 6: A & B) while others dispose off dead fish into adjoining waters.

Discussion

According to Mba (2010), Ghana's age structure is classified as youthful and that is characteristic of a developing country. Data from this study showed that on Lake Volta, a majority of cage fish farmers are youth because they are in the age range of 20–50 years (Fig. 1A). Similar age ranges have been reported in earlier studies (Karikari et al. 2016). A population in the age range of 25–50 years could be described as a productive age (Edet et al. 2018). This age bracket of cage fish farmers discovered on Lake Volta in fish farming is a strong indication of good potential for economic development for the country. It was found that a majority of the cage fish farmers are married; this may imply that engagement in this economic activity comes with a certain level of responsibility (Fig. 1B) as explained by Edet et al. (2018). Therefore, boosting the industry in the form of support by government and other stakeholders would impact many lives as families are involved. Also, with almost all of the fish farmers attaining some level of education reiterates the fact that fish farming is highly technical (Fig. 1C); therefore, it would require some form of formal education to understand and embrace its technicality for a successful undertaking (Edet et al. 2018).

Many debilitating forces frustrate the efforts of cage fish farmers on the Lake Volta as presented in Fig. 2. As have been pointed out in earlier reports (Karikari et al. 2016; Amenyogbe et al. 2018) many challenges plague the fish farming industry in Ghana. From the data shown in this study many of the problems have remained unsolved. However, it seems the main setback farmers are overly concerned

about is the incidence of fish diseases (Table 1) which they indicated as the most devastating and likely to cause a total shut down of the fish farming industry if immediate measures are not put in place collectively by all concerned stakeholders.

The most predominant signs reported to be associated with fish were; swollen belly, abnormal swimming, necrosis on the skin and fins, white spots on skins and fins and exopthalmia which occurs in both juveniles and adult's fish (Table 2). Sadly, with the observed signs mentioned above, farmers are unable to determine the exact cause/s and as a result are unable to prescribe an appropriate treatment regimen. This might be the reason why they adopt and treat diseases using inappropriate methods, making the situation worse as was earlier reported (Chitmanat et al. 2016). The data of this study further suggest that with the associated signs, most cage fish farmers have been experiencing fish losses over the past three years (last quarter of 2018 – date) up to about 70%. This has impactful economic and social consequences and might buttress reasons for the abandonment of many cage farms in some areas, leaving only a few who are resilient as have been reported (Mantey et al. 2020; Asmah et al. 2021). With the current extent of losses of fish on cage farms on Lake Volta, punitive measures are urgently needed to curb any ramifying/cascading economic and social impacts that may arise (Ali et al., 2020; Tavares-Dias & Martins, 2017). In this light it may be necessary to launch an investigation into the underlining causes of mortality and to suggest short and long-term remedies that could be employed to control further disease spread.

Fish farmers on Lake Volta are aware of the general causes of the fish diseases and mortalities as they indicated the causes to be pathogen and environmentally related (Fig. 3); however, it is disturbing to note that they are unable to substantiate and attribute the causes of diseases and mortalities to specific factors. The ability of farmers to recognize the causes of their farm problem could serve as a yardstick to sharpen their knowledge and skills through refresher training courses to enable them further diagnose more accurately possible causes of diseases and mortalities. A majority of fish farmers believed bacteria and poor water quality are the principal causes of the huge fish diseases and mortalities. Although farmers believe they can do little to mitigate the effects of poor water quality, they resort to the use of unsupervised chemicals and antibiotics in an attempt to prevent and cure diseases that they assumed to be caused by bacteria. This presents a worrying situation as farmers have resorted to treating their disease crops blindly as they have no evidence of the kind of causative agents they were dealing with. Attitudes such as those exhibited by farmers could have more devastating negative consequences for the present industry. Issues relating to the development of resistant strains to the antibiotics and chemicals used will emanate strongly as have been reported (Agoba et al. 2017a, b; Ministry of Health 2017).

Although the fisheries commission of Ghana began mass vaccination of fish on cage farms on Lake Volta in January 2019 in an attempt to control disease outbreaks (Prime New Ghana 2019), not many fish farmers have embraced the vaccine intervention. Our interaction with farmers revealed that they have some concerns regarding the rollout of the vaccine; these include non-effectiveness of the vaccine against co-infectious and high mortality in vaccinated fish as have being reported (Ramírez-paredes et al. 2020) and discoloration of vaccinated fish which they indicated reduces the market value of their fish

after harvest. The concerns raised by farmers in this study have been reported earlier (Adams 2019). Although vaccine administration in fish culture may present some potential in curbing disease occurrence and spread, for the aquaculture industry in Ghana to grow, there may be the need to roll out low cost but effective vaccines and those whose administration/delivery may be simpler, for instance vaccines with oral routes of administration (Nayak 2020).

In an attempt to prevent or reduce losses in fish, farmers resorted to regularly checking and removing dead fish from the cages and disposing of them in nearby bushes and sometimes burying them. However, a majority disposed of dead fish by dumping it into the open water; this could be a source of reinfection. Regarding interventions, farmers in Lake Volta resorted to the use of chemicals and biologicals which seem to be the tradition in aquaculture as have been previously reported (Ali et al., 2016). Among the chemicals and biologicals used, antibiotics, particularly amoxicillin and tetracycline were seen on some farms and corroborated by some farmers as widely used, while a few farmers reported to use undisclosed feed additives, herbal extracts, disinfectants and probiotics. The interventions used by cage farmers as found in this study have been reported (Chitmanat et al. 2016; Agoba et al. 2017b); however, the challenge to the use of chemicals or biologicals among farmers has to do with the appropriateness of intervention and dose challenges.

Regulatory bodies like Fisheries Commission (FC), Food and Drugs Authority (FDA), Environmental Protection Agency (EPA) and Water Resources Commission (WRC) have been set up to sensitize farmers and enforce laws regulating the use of chemicals or biologicals in fish farmers and seafood production. However, there are still high disregards for laws by farmers as the data from our study showed that a few cage fish farmers on Lake Volta use help from fish extension agents or reach out to regulatory bodies for chemical or biological prescriptions while a majority practice self-medication for reasons of lack of confidence in fish extension agents and regulatory bodies. Similar findings have been reported (Ntsama et al. 2018). Part of the reason for the widespread indiscriminate use of chemicals and biologicals in fish farms might be attributed to low confidence, particularly in institutions like the Aquaculture Research and Development Centre (ARDEC) and FC which farmers claimed did not provide concrete solutions to lessen their plight on deterioration of fish health. However, our interaction with ARDEC and FC gave us the impression that farmers may not clearly know the roles played by these institutions in the industry. In light of these revelations, it is suggested that for harmonious fish farming and related activities all relevant actors (fish farmers, ARDEC, FC, FDA, EPA and WRC need to collaborate effectively by working as partners with mutual benefits.

Conclusion

This study demonstrates that small-scale cage fish farming on Lake Volta in Ghana is largely practiced by the youth aged between 20–50 years, most of which have attained at least basic education. Small-scale cage fish farming on Lake Volta is severely affected by the occurrence of fish diseases believed by farmers to be caused by pathogens whose spread is fuelled by poor water quality. Disease outbreaks in cage fish farms results in up to 70% economic losses. Most fish farmers have resorted to the use of

unsupervised chemicals and biologicals to control disease outbreaks on their farms based on their intuition and recommendation from their colleagues' farmers.

Declarations

Acknowledgments

The authors wish to thank International Foundation for Science for supporting us with funds to carry out this study. We would like to thank Prof. Elliot Haruna Alhassan and Dr. Daniel Nsoh Akongyuure for providing support in the form of documentation for release of funds and travel for the data collection in the field. We are also indebted to Mrs. Janet Anchirinah, Centre Manager, Fisheries Commission Akosombo for allowing the team interact with fish farmers in the study area.

Authors' contributions

E.D. Abarike conceived the idea, designed the questionnaire and drafted the manuscript. R.A. Atuna analyzed the data. S.O. Dandi and S. Agyekum collected data gathered data from the field as well as entered the data into the analytical software for data analysis P. Appenteng, led the team to the field for data collection, E.H. Alhassan and D.N. Akongyuure proofread the manuscript.

Compliance with ethical standards Submission declaration and verification

This article to be considered for publication has not been published previously and is not under consideration for release elsewhere.

Conflict of interest

The authors declare that they have no conflict of interest.

Ethical approval

This article does not contain any studies with animals performed by any of the authors

Funding

The study was supported by the International Foundation for Science of grant number **I2-A-6542-1**

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Tables

Table 1: Magnitude of severity of problems

	Problems faced by farmers					
	Poor water quality	**Low/poor quality seed**	**Expensive feed**	**Theft**	**Incidence of disease**	**Predation**
Not severe	10	10	0	10	0	10
Moderately severe	20	10	40	20	10	20
Severe	10	10	20	0	10	0
Very Severe	20	0	0	0	60	0
Total percentage in terms of severity	60	30	60	30	80	30

Table 2: Signs of diseases and type of fish affected

Common disease signs	Percentage occurrence	Stage of growth of affected fish
Swollen belly	25.0	Juveniles and Adults
Abnormal swimming	12.5	Juveniles
Reduced growth rate	9.4	Fry, Juveniles and Adults
Necrosis on the skin and fins	9.4	Fry, Juveniles and Adults
White sports on the skin and scales	9.4	Adults ('size 1')
Sadden dead	9.4	Juveniles and Adults
Presence of parasites	9.4	Juveniles and Adults
Exophthalmos	6.3	Adults
Isolation	3.1	Fry, Juveniles and Adults
Red sport on skin and scales	6.3	Juveniles

Figures

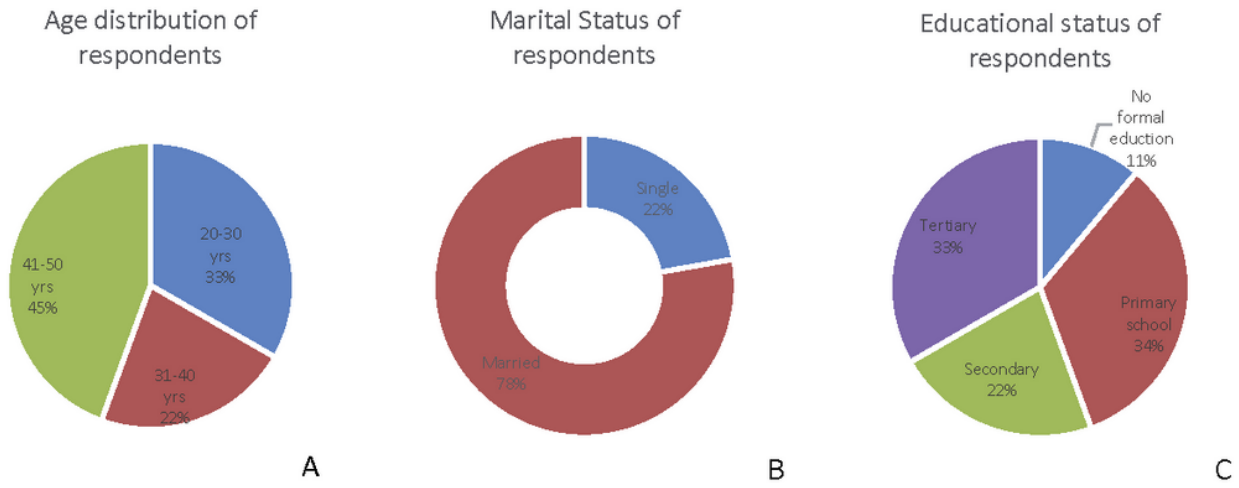

Figure 1

(A, B & C): Demographic characteristics of respondents

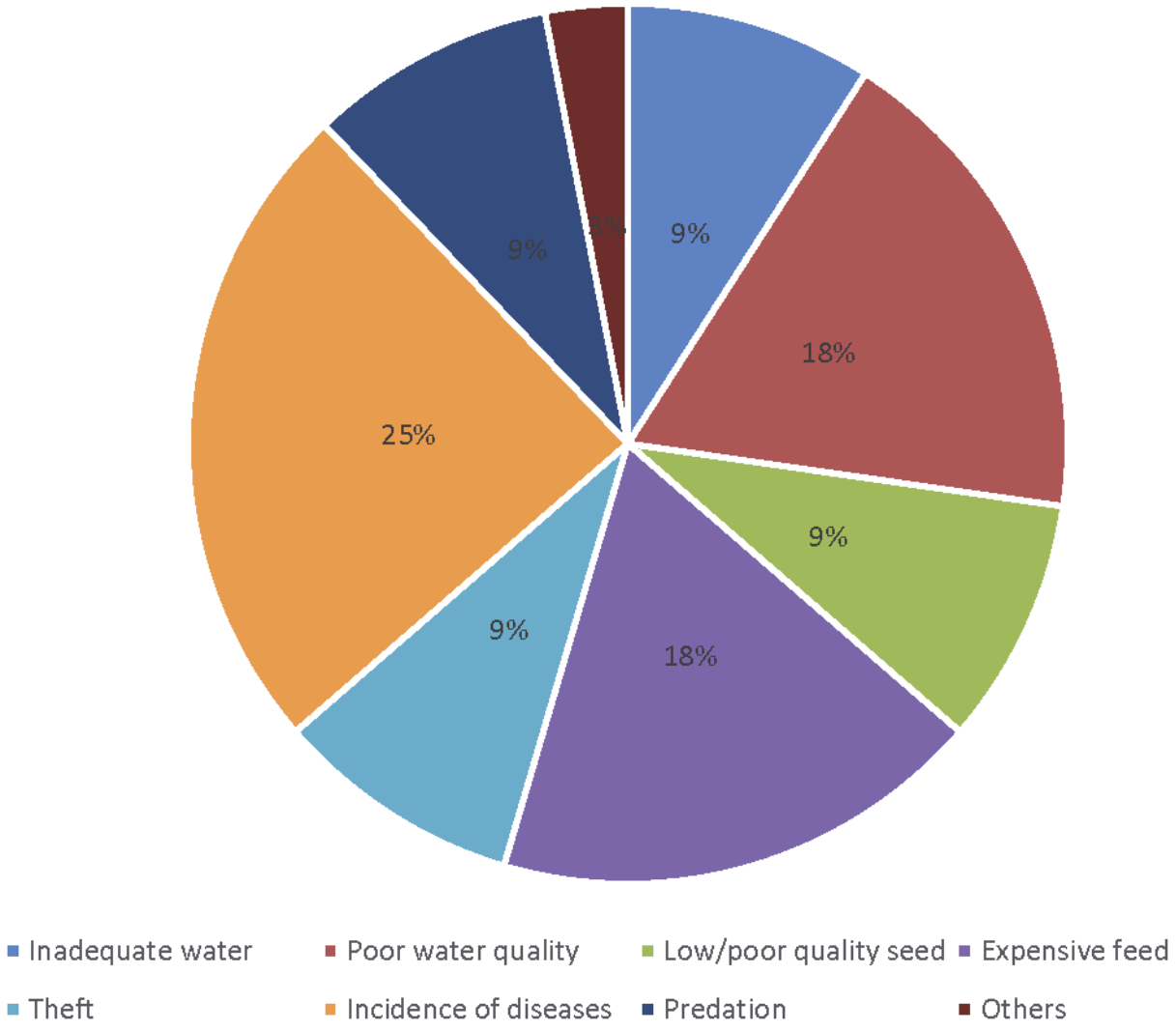

Figure 2

Problems faced by small-scale cage fish farmers on Lake Volta.

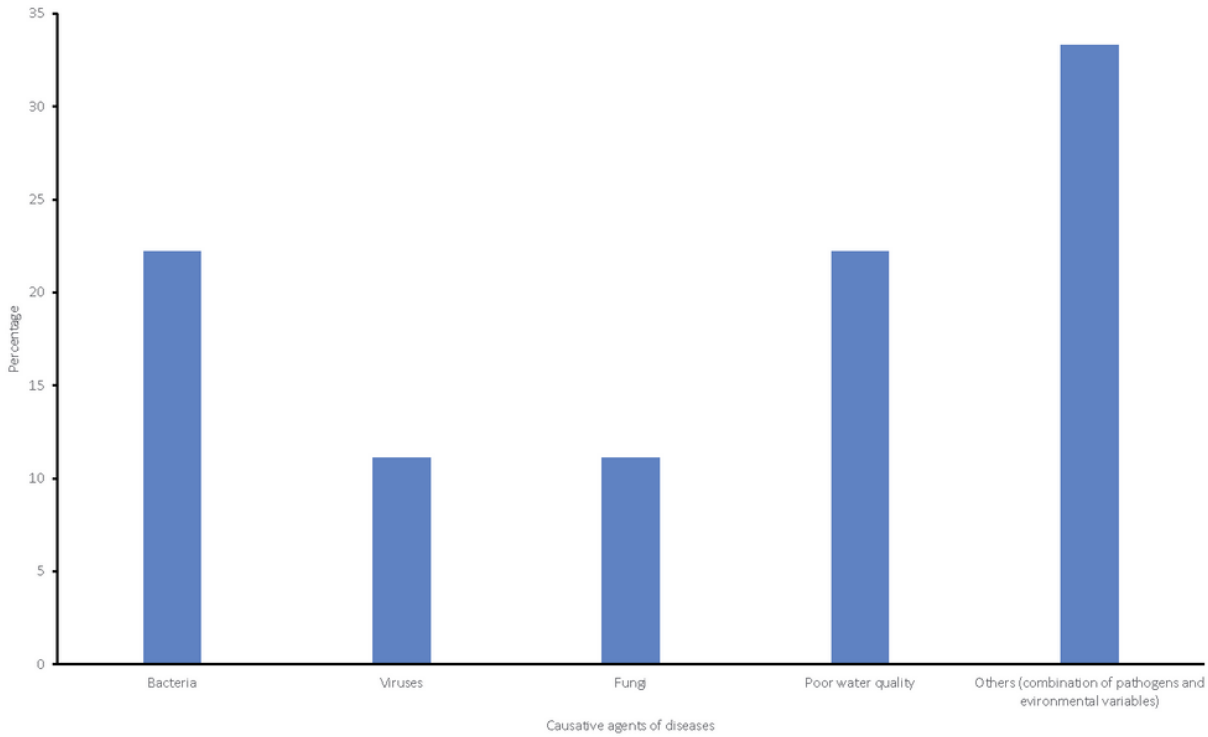

Figure 3

Causative agents of diseases on small-scale cage fish farms

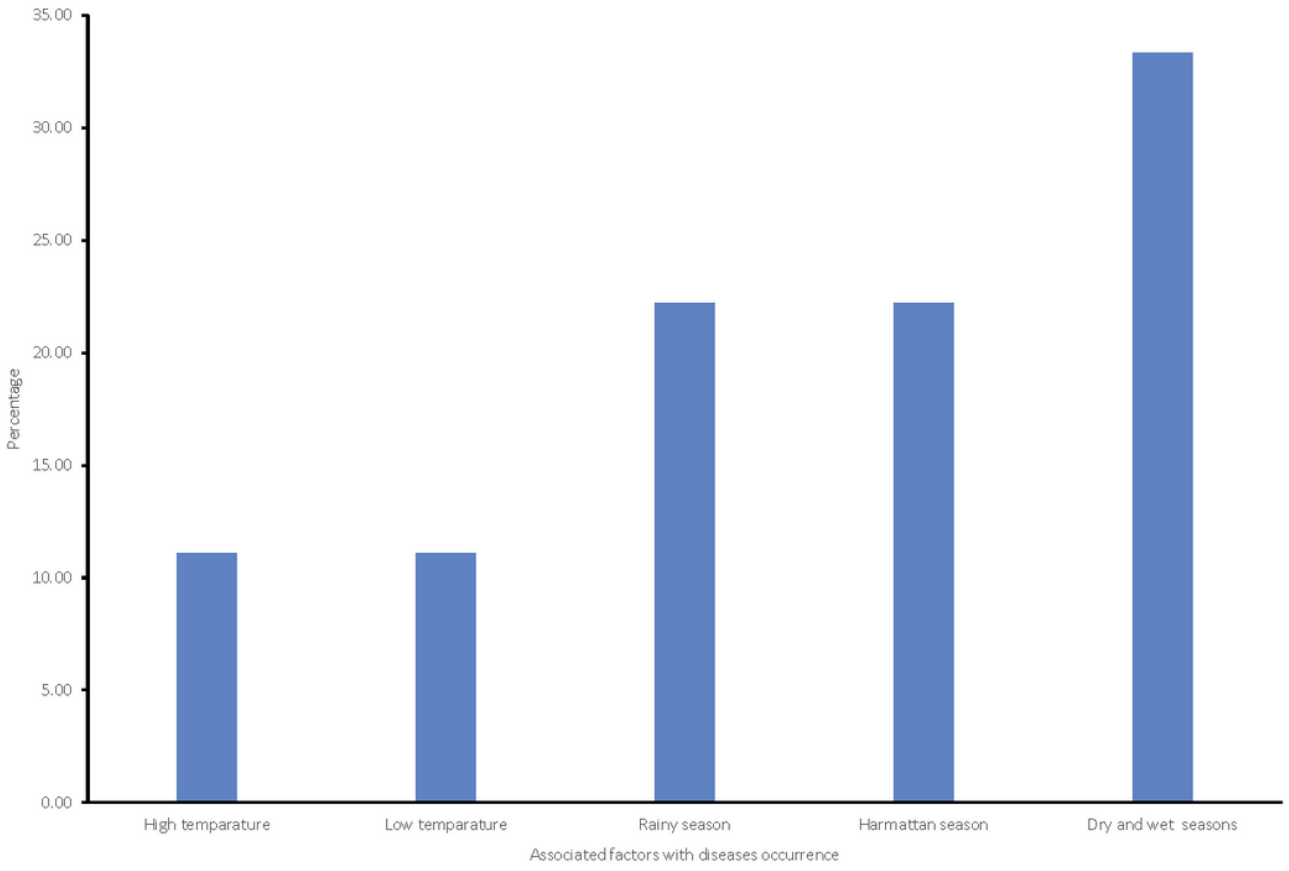

Figure 4

Factors associated with disease occurrences on small-scale cage fish farms

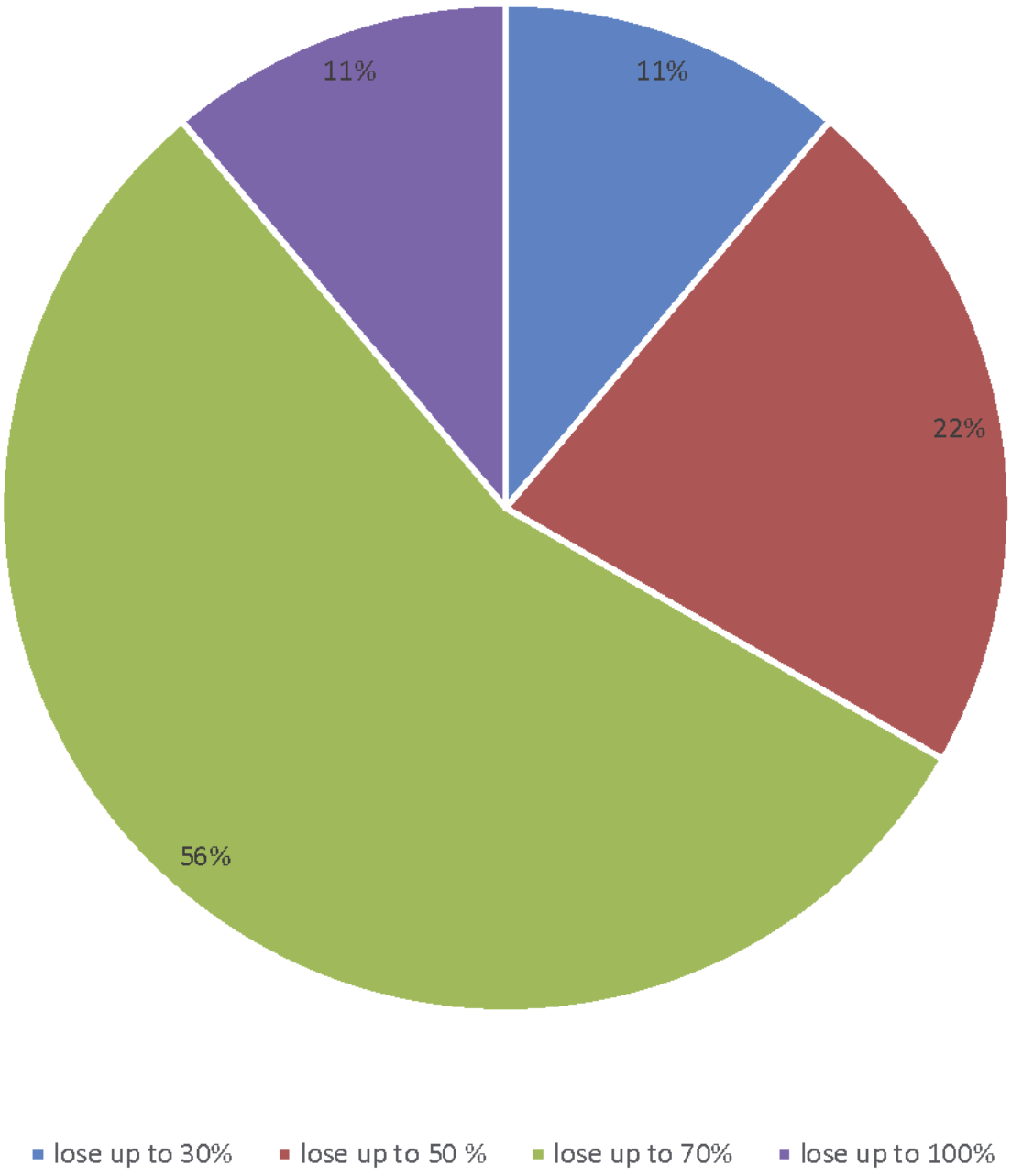

Figure 5

Percentage losses associated with disease occurrence

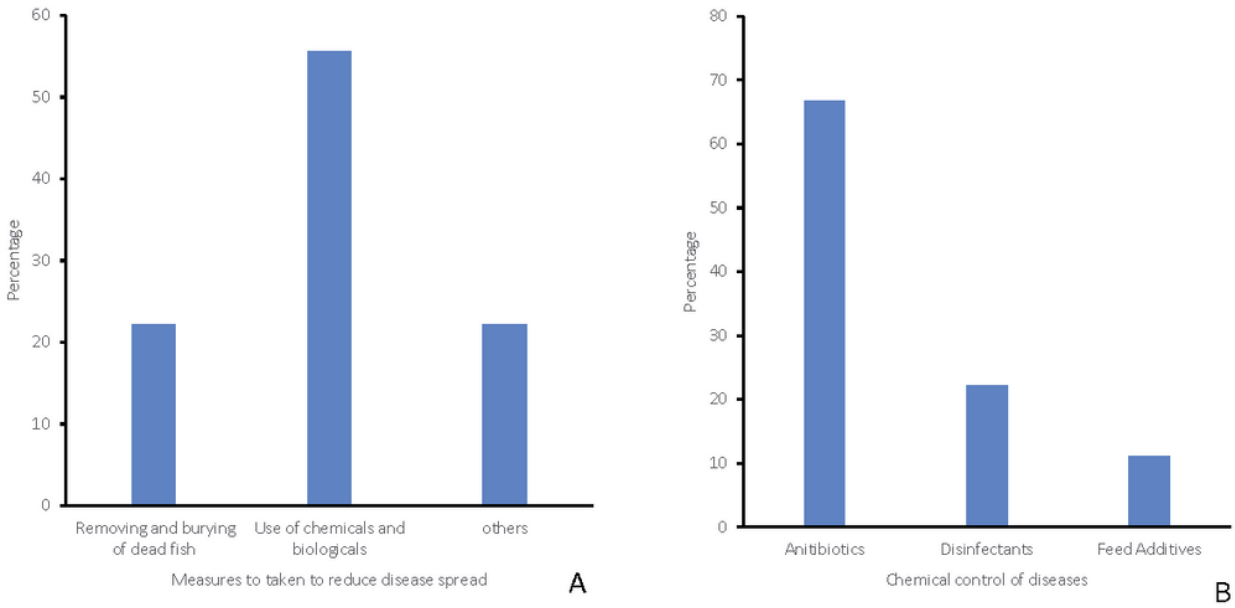

Figure 6

(A & B): Methods used by fish farmers to control disease spread on farms