International Journal of Natural and Social Sciences
ISSN: 2313-4461

Risk factors associated with disease of tilapia (*Oreochromis niloticus*) in cage culture systems

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ARTICLE INFO

Article history

Accepted 19 Nov 2016
Online release 21 Dec 2016

Keyword

Tilapia
Disease
Mortality
Risk factor
Cage culture
Bangladesh

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ABSTRACT

An investigation was carried out to know the factors associated with the outbreaks of tilapia (*Oreochromis niloticus*) disease in cage culture systems in the river Dakatia and Dhonagoda in Chandpur districts of Bangladesh. The study was based on 4 focus group discussions (FGD) during two disease prone seasons. During the FGD sessions, data were collected from cage operators of South Torpurchandi, Roghunathpur, Icholi Ghat and South Motlob Feri Ghat adjacent fishermen community areas through FGD. Almost 30 cage operators participated in each of four focus group discussion. Moreover, data were gathered by spot visit, and interviewing cage operators both face to face and over mobile phone. Following FGD, among the total 120 cage culture systems only 11 affected culture systems were found vulnerable during visit and 90 affected fish were captured and investigated to diagnose the disease. Following clinical signs such as, sluggish movement, loss of appetite, spinning, spine displacement, darkening of skin, scale loss, eye protrusion & opaqueness, swollen abdomen and hemorrhages at the base of fins & in opercula were recorded. The cage operators reported 22-30% mortality and morbidity in their culture systems. Disease occurred during the onsets of summer and winter when temperature fluctuates suddenly compared to optimum temperature identified during FGD and spot visit. In cages, 140 to 200g sized fish were found more susceptible to disease outbreaks. Morbidity and mortality rate varied with season, location, cage setting, management practice etc. Cage crowding high stocking density, poor water flow, insufficient water depth, lack of disinfection and drying of cages before restocking, poor cleaning of cages during culture period, entry of huge domestic waste through sluice gate etc. were identified to enhance the risk of disease outbreaks based on the study. Therefore, the knowledge and understanding of the above risk factors could be useful in minimizing the chances of disease outbreaks in cage culture systems in Bangladesh.

INTRODUCTION

Culture of many fish species in cages has been practiced for several years in different countries worldwide. The cage culture of finfish, especially freshwater cage farming is becoming more popular because of many economic advantages associated with it. Moreover, tilapia culture in cage has been found quiet resilience to adverse climatic changes. As a result, Tilapia (*Oreochromis mossambicus*) cage culture has gained great popularity in certain parts of Bangladesh such as Dakatia river in Chandpur, different rivers in Laxmipur and Kapati lake in Rangamati as evidenced by the growing number of Tilapia fish cage farmers in the country. During 1999 to 2007, there was a tremendous progress in tilapia farming in this country (Hossain 2009). Although, operationally Tilapia cage culture has a number of advantages and profitability but farmers are now facing serious losses due to mass mortality of Tilapia in cages for unknown disease outbreaks especially at Dakatia river in Chandpur.

In the context of declining trends both in inland and marine capture fisheries, aquaculture is the most promising option for increasing fish production. In addition to earning profit, aquaculture offers a tremendous opportunity for improving livelihood and nutrition of the resource-poor rural people in the Bangladesh. In Bangladesh, freshwater aquaculture systems mainly revolve around the polyculture of various species of carps (both Indian and Chinese carps) and in varying combinations and densities

How to cite this article: Bosu A, Haidar MI, Flura, Rahman MA, Khan MH and Mahmud Y (2016). Risk factors associated with disease of tilapia (*Oreochromis niloticus*) in cage culture systems. International Journal of Natural and Social Sciences, 3(4): 68-74.

depending on the availability of seed. A mass involvement of rural communities in carp and shrimp culture is also difficult due to limited water and financial resources. Under such conditions, progressive farmers and entrepreneurs have been looking for alternative species which can maximize production and profit. Among them, the tilapia is the best candidate, due to several desirable characteristics such as easy seed production, prefer all kind of supplementary feeds, can be cultured at high stocking density, can be cultured in saline water (salinity 12 – 15 ppt), high yield, resistance to poor water quality and disease, tolerance of wide range of environmental condition, ability to convert efficiently the organic and domestic waste and low cost feed, can be profitably cultured in seasonal ponds and small ditches, canals close to the homesteads, rapid growth rate and tasty flavor, high demand in local market, suitable for cage culture, climate resilient etc. (Hussain, 2009).Disease outbreaks can occur more often when fish are raised under intensive culture conditions and can pose problems in cage culture. Increased production under high density can create conditions conducive to outbreaks of infectious diseases and an increase in prevalence of parasites. Infectious diseases in fish culture are not only augmented by waste pollution, but exacerbated by crowding, handling, temperature and biofouling. Therefore, our main aims of these studies are to collect the current information on Tilapia diseases outbreak in cages, including epidemiology, as well as the risk factors associated with the diseases outbreak in Tilapia cage culture systems.

MATERIALS AND METHODS

The present study is based on FGD, interview based epidemiological studies and telephonic conversation with tilapia cage operators from four different locations in Chandpur region. In addition, DoF officials, BFRI tilapia group, WorldFish experts and relevant stakeholders were also interviewed for gathering information.

Primary data was collected through questionnaire survey and focus group discussion (FGD). Secondary data were obtained from government and non-government organizations. For questionnaire interview, a set of prepared preliminary questionnaire was focused mainly on general tilapia cage farming characteristics, culture practices, duration, water quality, disease surveillance and risk factors, source and management aspect of fry and feed, disease signs and symptoms, control measures, treatment, biosecurity and hygiene standards. The preliminary questions then were tested at the field level and then final set questionnaire was developed. Four FGDs were conducted with farmers. The clinically observed fish photos were taken by camera to store the disease evidence from the study areas. After collection of data from the study areas, data were coded and entered into a computer for further use. The data were aggregated and sorted carefully before making tabular forms. The data were then tabulated in the computer and raw data were entered in the spread sheet of the Microsoft Office Excel program to analyze. The data were analyzed by using tabular and descriptive statistical techniques.

RESULTS

Cage culture in Chandpur region

Cage culture is very popular technology for growing tilapia in Chandpur region. Chandpur is blessed with potential rivers such as the Meghna, Padma and Dakatia. These huge water bodies are suitable for cage culture. Our team visited areas where cage culture is being practiced since last few years.

Culture area

Cage culture has gained momentum in the river sytems of Bangladesh due to a number of advantages as discussed before. In Chandpur region, most of the farmers are practicing tilapia culture in cages mainly in the river Dakatia and Dhonagoda river. In spite great potentiality, cage operators are often facing serious losses when mortality occurs due to various unidentified diseases with variable symptoms and clinical signs.

Number of cages in cluster

It varies with location and finalcial capacity of cage operators. Generally, a cage operator places around 50 to 80 cages in a location or in a cluster.

Cage size and stocking density

Most of the cages were around 10-20×8-10×5-6.5 m^3 in size. Stocking density was maintained usually range between 750-1200 fingerlings per cage per cycle. In case of one cycle culture system in a year, the culture period was August to May. Majority of the cage operators practice two production cycle in a year. February-June is considered for 1st cycle and the 2nd one is during August-December.

Mesh size of net

Farmer's preferred stocking size of fingerlings is 15-20 grams and the mesh size is around 2cm. A finer meshed net (locally called Rachel net) of 0.5 meter height is attached to the upper inner side of cages to protect the floating feed pellets escaping out. A larger meshed (5 cm) net is used to cover the cages on top to protect from birds e.g. pelicans, eagles and others.

Mortality rate and pattern

Most of the farmers reported that tilapia morbidity and mortality in cages ranged between 22-30%. Disease mainly occurs in the month of October to December. A few cage operators mentioned that average 8047 (16%) piece of tilapia died due to disease during October in their farm. The highest mortality was found 442 tilapia/day with an average of 270 fish. During the month of November the number of dead fish was 7059 (17%) and highest mortality was found 387/day, with the average of 235 fish/day. Most of the farmers informed us that almost 140-200gm fishes are generally susceptible for being diseased.

Seasonality of disease

Disease occurred during winter and late winter when temperature fluctuates suddenly compared to optimum temperature. Most of the farmers reported that during the start of winter, disease occurrence is high and feed uptake became minimum compared to those of summer. Farmers mentioned that when mortality starts, they reduce feed supply consequently results reduced mortality rate but never stop. Some cage operators mentioned that during the monsoon when water level get increased some domestic waste and effluents from the local areas flow through the cages along with tidal waves. They claimed that those were the probable source of pathogen responsible for disease outbreaks.

Clinical signs

Clinical signs were recorded as spinning, scale loss, eye protrusion, hemorrhages at the base of the fins and in the opercula, erratic swimming, etc. during recent period.

Treatment

Farmer used antibiotic, chemicals and drugs when disease occurred. But they did not get any effective result due to treatments. They informed DFO office, SUFO (Senior upazilla fisheries officer) and other NGOs to get rid of these hazard. Unfortunately due to lack of skill, unavailability of diagnostic facilities they were unable to identify the causative agents and factors associated with the disease.

Table 1
Disease occuring season in selected locations of Chandpur.

Season	South Tarpurchandi	Roghunathpur	Icholi ghat	South matlab	Total	Average (%)
Winter and late winter	7	6	19	10	42	35%
Early winter	13	15	6	17	51	42.5%
summer	1	1	0	2	4	3.3%
Rainy season	9	8	5	1	23	19.2%
Total	30	30	30	30	120	100%

Table 2
Epidemiology of tilapia cage in Chandpur.

Epidemiological Characteristics	Affected cages	Unaffected cages	Comments
Cage size	10-12×8×5 to 20×10×6.5 m^3	15×8×5 to 20×10×6.5 m^3	Smaller size cages are considered risk for disease
Number of cages	<50-80	50-60>	Not considered a risk for disease
Arrangement of cages	Mostly parallel	Mostly parallel some Zig-zag	More water flow and more hygenic in unaffected zig-zag-cages
Distance between cages	3- 7 inches	4-6 inches	No remarkable differences observed between two groups
Quality of fry	Apparantly healthy	Apparantly healthy	Apparantly healthy fry might contain pathogen in dormant condition
Stocking density	1000-1300/cage	800-1000/cage	Low stock density could be safer for tilapia
Quantity of feed	As required	As required	--
Affected culture cycle	Both winter and summer cycle	Both winter and summer cycle	Risk both in cold and hot season
Depth of water	6-10 feet	10-15 feet	Lower depth could be risk for disease
Water flow	Poor	Satisfactory	Insufficient water flow might increase risk of disease
Source of fry	Local private and govt. hatchery,	Local private and govt. hatchery	No difference found
Cleanliness of cages	Clean Irregularly/Clean monthly	Fortnightly /monthly	Might have little risk for disease
Removal of dead fish	no	Sometimes or not	Might be a potential risk for disease
Huge domestic waste	Pass through cages	Little or no access of domestic waste	Might be a potential risk for disease
Apply antibiotics in feed	Sometimes, when infected	Not applied	Not effective against disease
Workers assigned to specific cages	A very little maintenance of self hygiene	Most workers maintain self hygiene	It increases risk of disease

Epidemiological study

The study is based on previous information, FGD with cage operators, cage visit, interviewing cage operators over telephone. During epidemiological conversation and data coolection from farmers, they were confused about improved vs poor health and farm mangement practices. Case- control studies are capable of comparing categorical, binary (yes/no) and continuous data for measuring association between exposure factor and the outcome variable (Thrusfield, 1995).

Risk factors associated with diseases

Connection between farms

In the study area it was observed that that around 87.5% of tilapia cage culture farms were attached by another farms within 5-10m area and 12.3%

farms were separated by adjacent farms within 10-20m area in same condition. Farmers didn't check water quality parameters during the culture period never and ever. Waterborne contamination with potentially harmful organisms might be possible in these farms.

Connection of cages to outside environment

Sometimes it has been found that tilapia cage farms are located in a close attachement with sliuce gate or outside drainage system where waste materials with polluted water directly fallen down. Due to these waste materials and contaminated water cage operators meet with unwanted loss by fish mortality in their cages.

Pre-stocking management

A set of question were asked to the cage operators regarding different aspects of cage system preparation before stocking fry into the cages. Little management including net drying, use of disinfectant and others measures were undertaken by the cage operators. Removal of water hyacinth (39.7%) arround the cages, net drying used in cage (74.9%), disinfected the drums used in cage (18.1%), washing or disinfect the feeding bowls or drums (7.9.0%) and fencing around cages with bamboo pools were not as expected level in the farming area.

Fish stocking

Appropriate stocking density of fish was not followed by the farmers. Most of the farmers(78.6%) stocked tilapia in a stocking density 1000-1200 fry/cage and others (21.4%) stocked 750-1000 fry/cage. These stocking densities were much higher than recommended density.

Fish feeding

It was observed that majority of the farmers did not feed their fish according to actual requirement. They used about two times more feed than requirement. Most of the tilapia cage culture farms used to do like that.

Presence of predatory birds and animals

Chil or Kite bird, *pankouri* or little black cormorant, herons, kingfisher, snake and water fowls were commonly found around farms. These birds could act as carriers of disease to other farms. Farmers tried to control predatory birds by hanging polythene rope over the cages.

Lack of cage hygiene

Farmers had no concern about hygiene of farm. No farm was found using any foot bath before entering into their farms for fish feeding. During the Removal of dead fish from the cages no farm workers were found using either any protective cloth, gum boot or hand gloves, even they are reluctant to removal of dead fish from their cages. Majority farmer never washed their fish farming tools except sun drying.

DISCUSSION

In cage culture system tilapia farming was commonly practiced by the farmers of chandpur district, though it's now spreaded over the countries. Same cages were used for next year culture and possible disease causing risk factors were quite common found after surveying all those cages. Risk factors of tilapia in cages were addressed here through analyzing the following aspects of culture system. In addition to quantitative data that was gathered through questionnaire interview, emphasis was also given on qualitative data collected through FGD with operator.

In 2007, a severe outbreak of an unknown disease of tilapia in cages placed in the river Meghna of Gojaria, Munshigonj was investigated by Khan, (2009). Mass mortality was observed during the outbreak. The investigator physically visited the affected cages, found several floating dead fish inside cages. Sick and moribund tilapia were captured for both on the spot and clinical examination in BFRI fish disease laboratory. Relevant epidemiological and fish loss data were recorded during the field observation and sampling.

The cage operators reported that initially (2007-09), tilapia cage operators were getting good

production almost without any remarkable fish mortality due to disease. At that period they used to place very limited number of cages in a certain areas of river leaving sufficient spaces between individual cages, ensuring enough water flow, water depth, optimum stocking density etc. to prevent the spread of contaminants/pathogen from one cage to the next and so on. Eventually, the cage operators became greedy for earning more and more and at the end of each production cycle they placed new cages along the rivers without leaving sufficient space between cages. Even their neighbors and peoples from other profession accommodated their own cages in the same areas due to their free access to river. Thus they made the areas crowded, unhygienic and unfavorable for aquaculture. This situation increased stress on fish and facilitated spread of pathogen. Once a fish was affected by any pathogen, consequently spread horizontally especially toward down. Feces, scale and tissue of both infected fish and dead fish move to next down cage and ingested by healthy fish, eventually infected by the causative biological agent and so on.

Khan, (2009) carried out a case study on disease outbreak and mass mortality of tilapia in cage culture systems in the river Meghna of Gojaria, Munshigonj. During this study a few number of clinical signs were reported according to their occurrence. In case of tilapia cage culture system, pop eye (53.3%), sudden floating in water surface with open mouth (26.67%) and heamorrhage (20.0%) were the major clinical signs of diseased fish. Reddening and deep lesion over body surface, fin rot, gill rot and in some case anal protrusion was also evident as clinical signs in cage culture system. Parasitic infection was not seen regularly, in a few cases *Argulus* infestations problem in tilapia was also reported by some cage operators. 140-200g weighed tilapia were mostly infected.

It was observed that 35% tilapia cage farmers faced disease problem in winter and in late winter, while maximum 42.5% faced such problem in early winter. Some farms also noticed disease after heavy rainfall (19.2%) and during summer (3.3%).Tilapia disease was commonly occurred in winter and late winter season. After heavy rainfall disease problems occur in some ponds. Sometimes disease was seen in summer season also. FAO (1989) reported that outbreak of disease was very commonly reported after rainfall, leading to suspicious that the runoff agricultural may have been important in predisposing cause for fish disease. Farmers could be suggested to take some preventive measures at the beginning of the winter season which include, application of lime and salt, disinfecting of equipment, addition of water, etc. (Faruk et al. 2004b).

In this study it was observed that 35% tilapia cage farmers faced disease problem in winter and in late winter, while maximum 42.5% faced such problem in early winter. Some farms also noticed disease after heavy rainfall (19.2%) and during summer (3.3%). In the present study, most of the cage farms used commercial feed two times in a day. In addition, commercial feeds are usually result in over-feeding, which causes pollution from residues. Waste (uneaten feed) is much higher if commercial feeds are used, which negatively affects cage water quality.

The cages were placed in a cluster form without leaving sufficient spaces between individual cages. Cage operators claimed that 100% cages were affected with around 20 upto 80% infected fish having variable clinical signs and symptoms at different degrees. In a cluster 100% cages were found affected on random examination. Various aquatic birds were seen around tilapia cage farms in the present study. They also posed risk of disease as carrier to the fishes of different ponds or from one farm to another. Birds also act as mechanical carriers of viruses and predator damage on fish can make the fishes *Faruk et al.* 2012.

In case of cages, following epidemiological characteristics such as higher stocking density, less water flow, cleanliness of cages and in flow of wastage were observed as the most potential risk factor for disease outbreak. In addition, cages adjacent to sluice gate were found most vulnerable for disease outbreak compared distant cages and the prevalence of disease was highest when waste material were discharged by opening the sluice gate. Disease occurrence and mortality were relatively higher in those cages which were not cleaned regularly and removal of dead fishes were not ensured.

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