Parasitic Disease Management Strategies in the Carp Hatcheries of West Bengal, India

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ABSTRACT

Aquaculture is one of the fastest growing food producing divisions in the world with around 10% growth rate. Carp culture is the most significant practices in India with its 85% share. In recent years, the supply of seed has been found inadequate and become a major constraint in developing carp culture. In West Bengal two major seed producing districts are North 24-Parganas and Bankura which contribute about 31% and 20% of the total seed production in the state respectively. There are around 588 numbers of private hatcheries dealing with Indian major carps at present in West Bengal. The majority of freshwater fishes carry heavy infestation of parasites in the hatchery system itself. They are mainly grouped as protozoan, helminths and crustacean parasites. In case of protozoan diseases, most important diseases are *Ichthyophthiriasis*, *Trichodiniasis* and *Sporozoan* infestation. Among the helminths *Dactylogyrosis* and *Gyrodactylosis* infestation are found to be very severe along with *Diplostomum* giving the black colouration on the body surface. The crustaceans are found to be very much associated with hatcheries. The main species of crustacean are namely *Argulus* sp. and *Lernae* sp. The factors that normally influence the incidence of parasite populations are found to be water quality and temperature. Consequently diseases are more frequent in winter season and after striping when the fish become weak. Therefore proper health management procedures should be followed with appropriate control measures to boost up the seed production industry near future.

Key words: Hatchery, seeds, protozoa, helminths, crustacean.

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INTRODUCTION

A fish hatchery is a place for artificial breeding, hatching and rearing through the early life stages of animals, finfish and shellfish in particular. The most important group of cultured fish in Asia is the carps, including common carp, Chinese carps and Indian major carps. The major technical requirements for carp culture are the seeds (fry and fingerlings), feed, technical know-how and marketing and distribution systems, but the key factor is the seed of the cultured species. Carp culture is an ancient practice in China and the emigrants from China introduced it into several southwest Asian countries whereas the indigenous system of Indian carp culture is seen to have existed in eastern parts of the Indian subcontinent in the eleventh century AD[1]. Traditional aquaculture practices for carp in India utilized wild fry and fingerlings caught from natural waters. In recent years, this supply has been found inadequate and become a major constraint in developing carp culture. The situation has arisen partly because the requirements for need are increasing as carp culture develops, and partly because naturally available seed supplies are declining due to pollution, overfishing and alterations in river flow patterns. This problem is gradually being overcome through the use of hatcheries which ensure dependable production of seed.

FISHERIES SCENARIO IN WEST BENGAL

West Bengal is one of the leading fish producing states in the country having the record of the largest producer of fish seeds. In the inland fishery sector, West Bengal accounts for 30% of the all India fish production, whereas its share of the all India fish seed production is 62%. Total fish production in the state has increased from 14.71 lakh tonnes in 2007-08 to 14.84 lakh tonnes in the year 2008-2009 (Table 1). Fish seed production has increased from 14,000 million in 2008-09 to 15,000 million in the year 2009-10 (Fig. 1).

Table 1. Fish production trend in West Bengal in last five years

Sl No.	Fish Production (lakh tons)	2004-05	2005-06	2006-07	2007-08	2008-09
1	Inland Fish	10.350	10.900	12.150	12.530	12.95
2	Marine fish	1.795	1.600	1.540	1.520	1.890
3	Total	12.15	12.50	13.69	14.05	14.84
4	Demand	12.09	12.31	13.00	13.46	14.44
5	Gap	(+)0.06	(+)0.20	(+)0.69	(+)0.59	(+)0.40

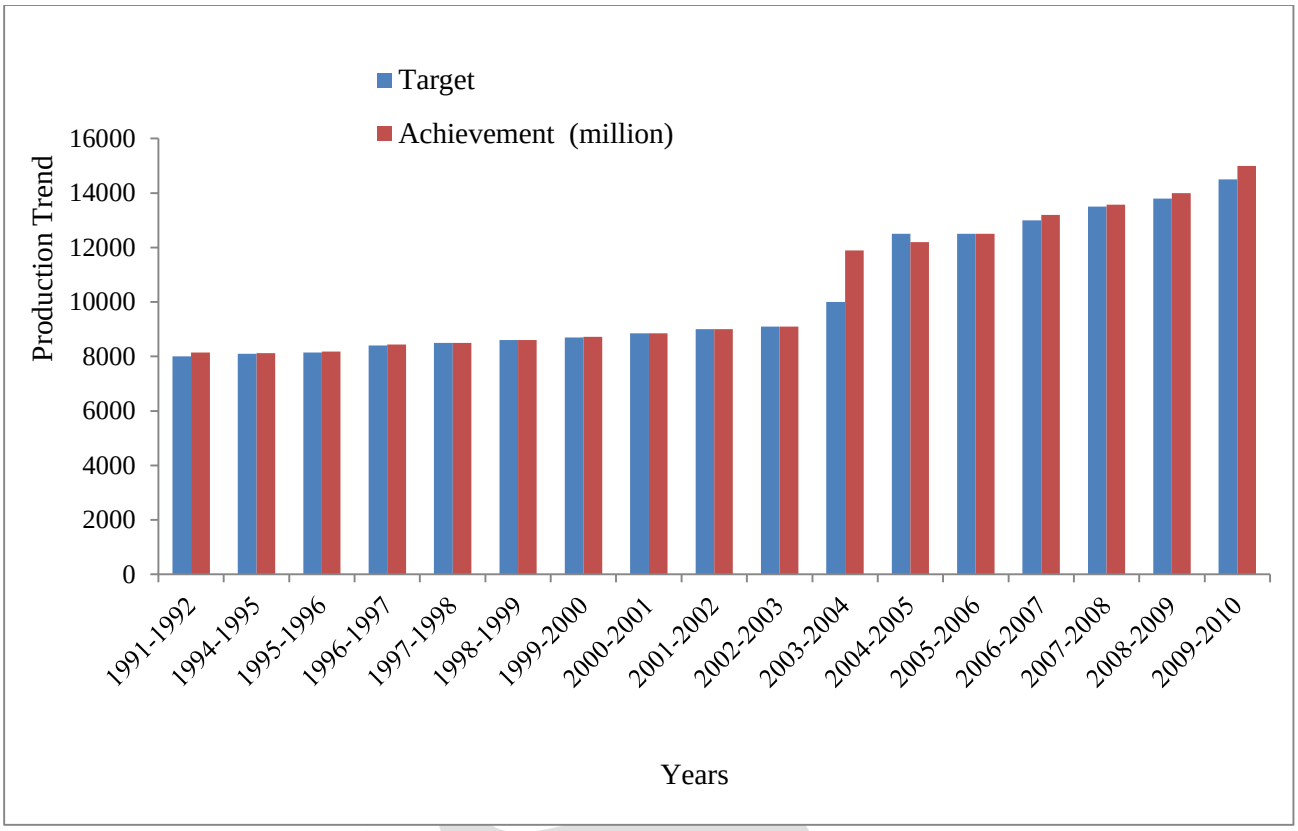

Fig. 1 Fish seed production trend in West Bengal

HATCHERY SCENARIO IN INDIA

The general methods for producing carp seed in hatcheries are based on research conducted in India as well as in other Asian countries and Europe. Differing local conditions preclude the direct transfer of technology. Moreover most of the developing countries have encountered problems in their hatchery programs. The problems include poor gamete quality, lack of standardized methods for inducing spawning and high mortality after hatching. India uses a polyculture system comprising the three major carps, catla *(Catla catla)*, rohu (*Labeo rohita)* and mrigal *(Cirrhinus mrigala);* the Chinese carps, silver carp *(Hypophthalmichthys molitrix)*, grass carp *(Ctenopharyngodon idella)* and the common carp *(Cyprinus carpio)*. Seed production is found to be basically from riverine collection, bundh breeding and hypophysation in modem hatcheries. The hatchery systems in use include indoor glass-jar and polyethylene systems, Chinese circular concrete tanks and an earthen pot system for rural use (which produces eggs at Rs 500/million). In West Bengal two major seed producing districts are North 24-Parganas and Bankura (Table 2) which contribute about 31% and 20 % of the total seed production in the state respectively. There are around 142 numbers of Indian Major Carp (IMC) hatcheries in North 24-Parganas in contrast of 279 hatcheries in Bankura district. There are around 588 numbers of private hatcheries dealing with Indian major carps at present (Table 3).

Table 2. Fish seed production trend in different district of West Bengal

Sl. No.	Districts	Fish Seed (million)
1.	Darjeeling	0
2.	Jalpaiguri	200
3.	Cooch Bihar	150
4.	Uttar Dinajpur	140
5.	Dakshin Dinajpur	400
6.	Malda	275
7	Murshidabad	425
8	Nadia	1900
9	Birbhum	250
10	Burdwan	850
11	Hooghly	1150
12	Howrah	300
13	North 24-Parganas	4650
14	South 24-Parganas	160
15	Purulia	270
16	Bankura	3000
17	Paschim Midnapore	400
18	Purba Midnapore	480
	Total	15000

Table 3. Distribution of hatcheries in West Bengal

Sl. No.	District	IMC Hatchery (G)	IMC Hatchery (Private)	Prawn Hatchery	Ornamental Hatchery
1	Darjeeling	0	0	0	0
2	Jalpaiguri	0	7	0	2
3	Cooch Bihar	0	15	0	0
4	Uttar Dinajpur	1	17	0	0
5	Dakshin Dinajpur	0	11	0	0
6	Maldah	1	7	0	0
7	Murshidabad	0	18	0	0
8	Nadia	1	10	0	2
9	Birbhum	0	7	0	0
10	Barddhaman	1	14	0	0
11	North 24 Parganas	0	142	0	0
12	South 24Parganas	0	3	3	0
13	Hooghly	1	10	0	0
14	Howrah	0	8	0	0
15	Purulia	0	3	0	0
16	Bankura	0	279	0	0
17	Purba Medinipur	1	19	8	0
18	Paschim Medinipur	0	28	0	0
	Total	6	588	11	4

DISEASE IN CARP HATCHERY

Disease is one of the major problems associated with aquaculture. This has become a limiting factor in enhancement of fish production, where producers, traders and consumers are mostly affected resulting in heavy economic losses. In recent years, the intensification of aquaculture system has led to major problems in outbreaks of fish diseases, high stocking densities, excess feeding and artificial fertilizations are common husbandry practices followed in intensive culture systems. These offer an ideal environmental condition for the growth of different types of fish pathogens and as a result the host organism suffers from stress. Healthy state of any population depends on the control of disease and maintenance of a good relationship between living creatures and their environment[2]. Thus, fish become more susceptible to various infectious organisms such as protozoa, helminths, crustacean, bacteria, fungus and virus. Fish may be affected externally as well as internally. Depending on the nature and severity, the disease may cause mass mortality or small-scale mortality and can even reduce the growth of the fish population. The risk of disease induced mortality is equally serious in carp hatcheries and in early spawn rearing systems. The immature immune system in fish makes the early developmental stages more susceptible to infectious diseases. The immune system plays an important role in defense mechanisms in fish and it helps in combating against some fish pathogens in water. Therefore, proper care should be taken during the hatching and early larval stages to protect them from any external factors which can suppress the activity of the immune system. One of the important external factors is the deterioration of water quality. These create maximum stress to the fish and suppress the immune system, resulting in a reduction in resistance of the fish and consequently fish become susceptible to pathogens present in water. Thus, one of the important aspects is to maintain a stable environment to avoid stress to the fish. Moreover, farmers should watch the health condition of fish at all levels and take prophylactic measures before disease outbreak.

PARASITIC DISEASES IN CARP HATCHERY

A majority of freshwater fishes carries heavy infestation of parasites which cause deterioration in the food value of fish and may even result in their mortality. The parasitic infestation is greatly influenced by the season, which basically interferes with the ecology and physiology of the fish. During the breeding season of fish lesser number of parasites invades the host because of the presence of the oestrogen[3]. The common fish diseases which arc found in carp hatchery, nursery and rearing systems are discussed below in brief.

A. Protozoan Diseases

Ichthyophthiriasis: The causative agent is *Ichthyopthirius multifiliis* (Fig. 2). Fry and fingerlings of Indian major carps are affected in nursery and rearing ponds. This is an obligatory parasite. It is spherical in shape and the cilia are evenly distributed over the whole surface. The large horse-shoe shaped macronucleus is visible under the microscope. The infected fish becomes covered with small white spots in the skin, fins and gills which are nodular in form. *Ichthyophthiriasis* is fatal to fish of all sizes. Chronic infection will cause serious damage to the skin, fin and gills; corneal infection impairs vision[4, 5]. The infective stage invades the integumentary epithelium and becomes established in the basal layer of the epithelium just above the basal membrane. Cellular damage in low to moderate with infections remains restricted to the infected site.

Trichodiniasis: Trichodiniasis is caused by *Trichodina* spp (Fig. 3). Fry and fingerlings of Indian major carps and exotic carps are affected. These protozoa occur in the skin and gills of

host fishes. Smears from the skin and gills are examined under microscope and can be seen as round "saucer shape" with fringe of cilia around the perimeter. There are several degrees of adaptation of trichodinids to their piscine hosts: ubiquitous species, of an opportunistic nature, which are always found in the fish skin but never on the gills (*T. pediculus* and *T. acuta*); other ubiquitous species occur both on gills and skin (*T. heterodentata*); additional, seemingly ubiquitous, widespread species appear to have a variable degree of predilection for one fish family.

Sporozoan diseases: Myxosporidia are the most common of fish sporozoa. All organs and tissues are possible sites of infection. The infective stage of the myxozoan diseases is the matured myxozoan spore (Fig. 4). Myxosporea cause histozoic and coelozoic infections. The spore structure forms the basis for identification of different species. Damage to the gills by dense infestation resulted in respiratory problems; fish shows swimming behavior near the surface with distended operculi[6]. Severe disaggregation of the respiratory epithelium is caused by *Sphaerospora* sp. infections of carp and goldfish gills[7].

Other Protozoan Diseases: Host specific species are associated with a wide range of fish species from most families. Opportunistic species i.e. *Ichthyobodo necator*, *Chilodonella* spp. (Fig. 5), and some species of *Trichodina*, *Ambyphrya* and *Scopulata* are particularly common in juvenile carps. These ectoprotozoans are cosmopolitan or trans-continentally dispersed via translocation of their cultured fish hosts (carps). Ectoparasitic protozoa are variable in their effect on their hosts. Pathological effects are density dependent, when both the size of the parasite population and the nature of the tissue responses are modulated by the physiological (clinical) condition of the fish. Hostile environments (stressful conditions) compromise the fishes' capacity to counteract the infection.

B. Helminth Diseases

Many of the helminth parasites have complicated life cycles requires one or more intermediate host for completing its life cycle. However, skin fluke, *Gyrodactylus* and gill fluke, *Dactylogyrus* need not require an intermediate host (Fig. 6).

Dactylogyrosis and Gyrodactylosis: These worms mainly affect to the skin or gill with their attachment organs and parasites the host. Mostly fry and fingerlings of Indian major carps in the nursery and rearing ponds are affected. In dactylogyrosis, the colour of the gills fades and there is excessive secretion of mucus. In gyrodactylosis, there is fading of the normal body colour, small spots of blood on the body surface may be seen. The dropping of scales and excessive mucus secretion may also occur. These worms can be seen with the naked eye or with the help of magnifying lens.

Black spot disease: Metacercarial larval stage of the species *Diplostomum* (Fig. 7) is responsible for this particular disease. Fry and fingerlings of catla, rohu and mrigal and silver carp in nursery and rearing ponds are affected. Black ovoid patches are visible on the body surface of the affected fishes. These are pigmented patches overlaying cysts of the metacercarial larvae. Number of cysts may be few to hundreds.

C. Crustacean Diseases

Argulosis: This disease is caused by *Argulus* sp (Fig. 8) and commonly known as "Fish louse". The larvae and adults of *Argulus* are parasitic to fish. This parasite penetrates the upper layers of the host's skin and feeds on blood and body fluids. Fry, fingerlings and adults of Indian major carps are affected. Affected fishes become restless with erratic swimming movements.

Attachment sites show signs of ulceration. Adult parasite is oval, flat, and transparent to whitish in color with two conspicuous black spots. The species can be seen quite clearly with the naked eye.

Lernaeosis: Lernaeosis is caused by *Lernae* sp (Fig. 9). The adult female is parasitic, has anchor like appendages at the anterior end and egg sacs at the posteriror end. The parasite burrows deep into the body fluids. Fingerlings and adults of catla, rohu and grass carp are affected in the culture ponds. At initial stage fish become restless and try to rub its body against the sides and bottom of the pond due to irritation. Heavily infested fishes become moribund with erratic movement. Infestation with this parasite is easily diagnosed.

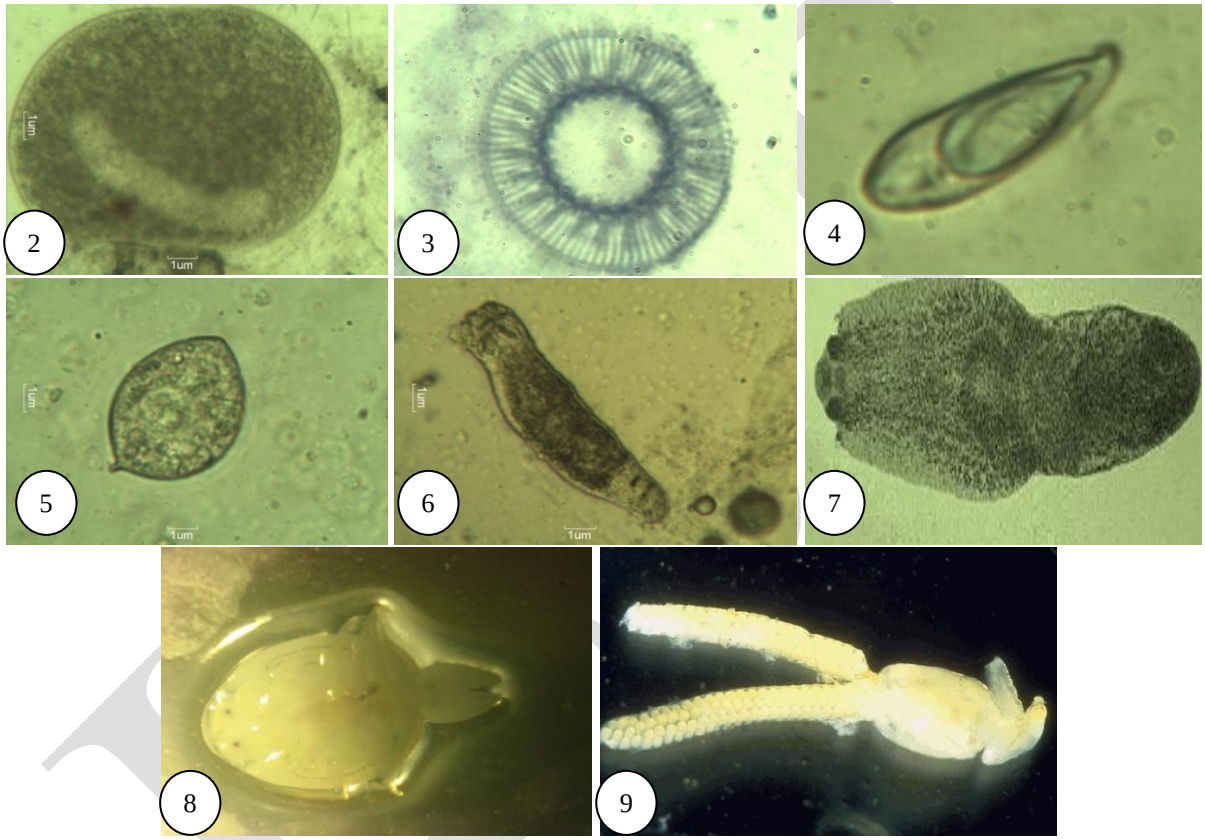

Fig. 2. *Ichthyopthirius multifiliis*- causative agent of Ichthyophthiriasis
Fig. 3. *Trichodina* sp- causative agent of Trichodiniasis
Fig. 4. Matured myxozoan spore with polar capsule
Fig. 5. *Chilodonella* sp- commonly found in hatcheries
Fig. 6. *Dactylogyrus* sp- commonly found in hatcheries
Fig. 7. Metacercarial larval stage of *Diplostomum* sp. found in hatcheries
Fig. 8. *Argulus* sp- commonly found in hatcheries
Fig. 9. *Lernae* sp- causative agent of Lernaeosis

DISEASES AND HEALTH MANAGEMENT

Factors that normally influence the incidence of parasite populations are water quality and temperature. However, five factors directly influence the parasite fauna of fishes like age, diet, abundance of fishes, independent number of a parasite within the fish and season[8]. It is stated that the characteristic of any water body can influence and determine its parasitic fauna and

when environmental conditions, such as water, food and temperature become favorable for mass reproduction of parasites, the disease may spread very quickly[9]. It is suggested that the treatment or control of fish parasitic disease can be best achieved, if the approach could be made through following logical patterns: (i) identifying the parasite, (ii) obtaining a thorough knowledge of the life histories which may be simple or very complicated, (iii) learning the ecological requirements of the parasite, such as host specificity, optimum temperature, pH, nutrition and other metabolic requirements, (iv) mapping the geographic range of the parasite, (v) determining the effect of immunological mechanisms of the host on the parasite (vi) studying control and treatment method[10]. The common treatment measures are given in Table 4.

Table 4. Common parasitic diseases in carp hatchery and their control measures

Types	Symptoms	Control measures
Ichthyophthiriasis	The infected fish becomes covered with small nodular white spots in skin, fins and gills.	Give malachite green bath to the infected fish at the rate of 0.15-0.20 mg/lit. of water for 1 hr. for 2-3 days. (or) Common salt (NaCl) bath: 2% NaCl: for 7 days or more.
Trichodiniasis	Grayish blue veil like coating over the body surface, darkening of the skin and excessive mucus secretion	Common salt (NaCl) bath : 2-3% conc. to the infected fish.(or) Apply potash ($KMnO_4$) at the rate of 4 mg/lit of water. (or) Give formalin treatment to the pond at the rate of 25 mg/ lit. of water.
Sporozoan diseases	Infected fish show whirling swimming action. Some time boil and cysts also seen on the body surface.	Treated the pond with mohua oil cake and lime as per the pH. Give Common salt (NaCl) treatment at 3-5% to destroy the spores and other developing stages.
Dactylogyrosis & Gyrodactylosis	Infected fish gill colour faded, secrete mucus excessively, small blood spot on the body surface, dropping of scales, etc	Apply Potash ($KMnO_4$) to the infected pond at the rate of 4 mg/lit of water. (or) Give common salt (NaCl) bath at 3-5% conc. for 10-15 minutes. (or) Give formalin bath at 110 mg/ lit. of water.
Argulosis	Affected fish becomes restless, shows erratic swimming and ulceration at the Argulus attachment sites. Argulus can be seen by necked eye.	Common salt bath at 3-5% till the fishes are in stress. (or) Apply Potash ($KMnO_4$) to the infected pond at the rate of 4 mg/lit of water.
Lernaeosis	Infected fish becomes restless and their body against pond side and bottom due to irritation.	Apply Potash ($KMnO_4$) to the infected pond at the rate of 4 mg/lit of water. (or) Common salt bath at 3-5% conc.
Cloudy Eye	Cloudy white appearance to one or both eyes.	Check for symptoms of another illness like velvet, ich, or tuberculosis. Treat with OTC medication.

CONCLUSION

Hatcheries continue to be the major source of spawn for the nurseries, while hatchery broodstocks are mostly collected from the farmer's grow-out ponds. The average survival of spawn, fry, and fingerlings in hatcheries are high, varying between 74-82%. Disease, drought and flooding are the major management problems in hatcheries. The impact of disease in hatcheries and nurseries was measured by fish mortality as well as economic loss. In comparison to other aquaculture sectors, West Bengal hatchery operators are generally aware of their problems and appear to have better access to government extension services. Hatchery owners often produce spawn three to four times by using the same broodstock. This practice appears to cause deterioration in larval quality. Inbreeding is quite common in most of the hatcheries, and hatchery owners do not exchange broodstock among themselves to maintain genetic diversity. Indiscriminate use of insecticides and pesticides as treatment measures may, in the long run, pose environmental hazards.

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