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Short Communication

African catfish *Clarias gariepinus* farming practices in North and South 24 Parganas districts of West Bengal, India

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Abstract

Clarias gariepinus is widely cultured due to its tolerance to environmental extremes, high production and good feed conversion rate. This communication describes the farming practices of *C. gariepinus* in North and South 24 Parganas districts of West Bengal. *Clarias gariepinus* is cultured in ponds of 0.1–0.75 ha, where fingerlings were stocked at a density of 860–1150 cubic m^{-1}. The current practices of seed transportation were stressful to fish as the majority of the farmers noticed 5–10% mortalities, despite the use of antibiotics. Acclimatization of seeds was practiced by the majority of farmers before stocking. Different feeds including slaughter-house wastes and dead poultry were supplied. Multiple stocking and harvesting were a common practice. Major problems identified were insufficient feed, disease, transport, poor seed quality and lack of financial support. The survival percentage was poor, as 88% of the farmers recorded <40–50% survival at harvest. Dropsy was the most common disease and had a significant impact on economy. Antibiotics or other aquadrugs were frequently used for treatment, although the success varied. In general, the *C. gariepinus* farming has helped to recycle the wastes generated in and around metropolitan Kolkata and adjacent municipalities into wealth, but it suffers from management issues and huge economic losses. This calls for immediate attention from researchers, administrators and extension personals.

Keywords: *Clarias gariepinus*; aquaculture; seed transportation; fish diseases; aquadrugs

1 | INTRODUCTION

Catfish are currently produced worldwide in various production systems ranging from very low yielding extensive to high yielding intensive systems. The most notable is the United States, where channel catfish, *Ictalurus punctatus* is cultured on a commercial scale. The wide-spread interest in commercial catfish farming was largely generated by the development of a multimillion-dollar catfish farming industry in the Southern USA (Pillay and Kutty 2005). For example, Vietnam has intensified the catfish farming and about 90% of *Pangasius* production comes from this country (Singh *et al.* 2009). India occupies the second position in aquaculture production and contributes about 5.43% to global production (Rizvi *et al.* 2015). Indian fishery sector is the source of livelihood for 14.5 million people and contributed more than Rs. 37870.90 crore in 2016-17 (1 US$ = 68 Rs) through export of marine products (Anon 2017). India produces a wide range of aquaculture products such as carp, tilapia, catfish, oys-

ters, mussels, sea bass and shrimp. In recent years, catfish farming is gaining popular throughout India and adjacent countries because of several advantages over traditional species used in aquaculture (e.g. Galib *et al.* 2013; Aktar *et al.* 2014). In India, among the different species of catfish, *Clarias batrachus*, *C. gariepinus*, *Heteropneustus fossilis*, *Pangasius pangasius*, *P. hypophthalmus*, *P. sutchi*, *Ompok pabda* and *Wallago attu* are notable (Ayyappan *et al.* 2011).

The farming of catfish in India particularly in the states of Andhra Pradesh and West Bengal has grown in recent years. The annual aquaculture production of catfish has been estimated to be over 200000 ton in the country (Singh *et al.* 2009). Andhra Pradesh holds the first position in cultured catfish production and West Bengal is one of the leading producers of cultured catfish since 2008 (DAHDF 2014). *Clarias gariepinus* is regarded as an excellent aquaculture species, not only for their tolerance to environmental extremes but also due to their high annual production and good feed conversion rate (FCR). Production of *C. gariepinus* in Zambia indicated that a standing crop of 65–100 ton ha^{-1} with FCR up to 1.05 is attainable using experimental least cost diets containing 38% crude protein (Uys and Hecht 1988). Due to their high nutritive value and consumer acceptance, catfish including *C. gariepinus* have created a great demand in West Bengal. This communication describes the farming practices of African catfish *C. gariepinus* in North and South 24 Parganas districts of West Bengal, India.

2 | METHODOLOGY

A cross-sectional, interview-based survey was conducted in North and South 24 Parganas districts of West Bengal, India for 20 months between October 2007 and May 2009. Based on the information collected from the catfish seed suppliers, a total of 24 locations, comprising 12 locations from each district, with a potential for catfish farming were identified. From each location two catfish farmers were randomly interviewed to collect data for the present study. The locations which had cluster of catfish farms, one additional farmer was interviewed. The total catfish farmers interviewed were 52. Personal observations were also taken into consideration. The methods described by Thrusfield (1995) were followed for the development of the questionnaire. Questionnaire for catfish farmer was designed to record information in a standard format with in-built error checks. Closed questions were used, wherever possible, to give data in a yes/no or categorical format to facilitate ease of analysis. Attempts were made to make wording unambiguous, brief, polite and non-technical. The questionnaire was prepared in English and the respondents were interviewed in Bengali. Before starting the survey, the questionnaire was pre-tested at least two times by interviewing target people to identify ambiguous and irrelevant questions.

After the completion of the interview, the catfish from each farm/pond were examined for the gross and clinical signs of diseases and other abnormalities. The behavioural abnormalities, gross and clinical signs were recorded on the fish sampling sheet. Microsoft Excel™ spreadsheet was used to enter the information collected through interview. From the collected data, 24 variables were selected for further evaluation. The frequency of a particular variable was divided by the total number of respondents (N = 52) in that particular category and expressed in percentage.

3 | RESULTS AND DISCUSSION

In West Bengal, a variety of freshwater catfish are commercially cultured and among them, *C. gariepinus* and *P. pangasius* are the most common. *Clarias gariepinus* is cultured by both small-scale and large-scale farmers. The *C. gariepinus* farmers of North and South 24 Parganas districts operating small-scale aquaculture had only one pond (7.69%); while the large-scale aquaculture farmers had up to or above 8 ponds. These ponds are locally called “chamber” and about 23.08% of the farmers had four ponds.

Nursery rearing was common. All the respondent farmers, except two, had nursery ponds ranging from 1 to 5. The size of the ponds was in the range of 0.1–0.75 ha. The fish were segregated and stocked in different ponds according to size. In catfish culture, hatcheries and fish seed agents are playing a vital role in the supply of seeds, locally known as “pin”. The catfish seeds were procured from a variety of sources such as seed market, fish seed agents or directly from the hatchery. Hatchery (69.23%) was the most common source followed by agents (23.08%) and seed market (7.69%). Fingerlings (5–10 g) were the preferred size for the majority of the farmers (76.92%) followed by fry (40–50 mg; 23.08%) as the fingerlings are hardier than fry during transportation as well as during culture operation. According to them (69%), the seeds from the hatchery are of good quality in terms of disease resistance, survival and growth rate. However, few of them (23.08%) procured seeds from agents because of the faith they have in them for years. The farmers transported the fry or fingerlings by truck (69.23%) and van (30.77%) using large containers (Table 1). Mortality of catfish seeds during transportation was significant, as 15.38% of the farmers faced mortalities above 10% (Figure 1). These observations on mortality during transportation indicated that the current method of transportation is stressful to fish seeds, resulting in immunosuppression and mortalities. Jhingran (1991) pointed out the role of high carbon dioxide tension and/or deficiency of oxy-

gen in the transporting medium, toxicity of accumulating wastes like ammonia and other metabolites in the medium; hyperactivity, strain and exhaustion of the fish, infection contacted during transport; physical injuries, predation etc. during seed transportation. Avoidance of stress and conditioning of fish seeds are, therefore, essential to minimize the mortality during and immediately after transportation.

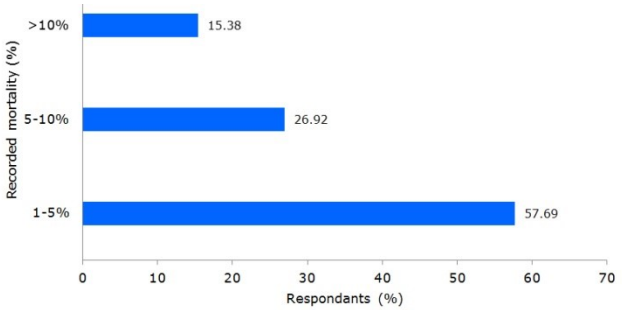

FIGURE 1 Records of catfish seed mortality during transportation (*N* = 52)

The farmers used to buy fry or fingerlings and transport the same for a distance of about 10 km to >50 km, mostly beyond 50 km (50%). During transportation of fry or fingerlings, many of the farmers (73.08%) used either 4 ppm acriflavine or 0.5 g red soil L^{-1} water, locally known as 'lal jal'. This red soil water was used to minimize the physiological activity and temperature of the seed carrying water, although the mechanism of action and scientific basis is, by and large, unknown. It is basically a mixture of red soil and some riverbed soil, although the composition of the mixture is unknown. About 27% of the farmers used aquadrugs such as terramycin, revitol and pentamycin (**Table 1**). But, none of them uses anaesthetics during the transportation of catfish seeds. The chemicals used during transport were reported to be beneficial by way of decreasing the rate of oxygen consumption and reducing the rate of excretion of carbon dioxide, ammonia and other toxic wastes, controlling the excitability of the fish and thereby reducing chances of injury and reducing the time required for handling them (Jhingran 1991).

A common trend in catfish farming was stocking the seeds at high densities in grow-out ponds. About 58% of the farmers stocked fingerlings in the range of 860 – 1000 per m^3 and 57.69% of the farmers stocked fry at the rate of 1550–1850 cubic m^{-1} (Table 1). The unique characteristic of the farmers of these two districts was repeated stocking of catfish seeds (84.61%), *i.e.*, multiple stocking and harvesting. In most of the hatcheries, the seeds were nursed for about 15–20 days before being sold. The usual stocking densities in the nursery, rearing and stocking ponds with normal productivity status are 6 million spawn ha^{-1}, 0.3 million fry ha^{-1} and 5000 carp fingerlings ha^{-1}, respectively for carps (Jhingran 1991). But, in catfish farming system, the fish were usually stocked at very high densities similar to those observed in carp farming (Abraham *et al.* 2010; 2011–12). It is being done mainly to achieve maximum production and to compete in a highly competitive market often ignoring the productivity status of the ponds.

The majority of the farmers (73.08%) considered that they received good quality seeds; whereas 27% of the farmers complained about seed quality particularly those procured from a local non-organized source. The farmers graded the seeds from reputed hatcheries as either good or average quality and those from the non-reputed hatchery as bad quality. Seed acclimatization was done by 73% of the farmers before stocking. Besides, about 31% of the farmers treated the seeds with salt or potassium permanganate; while the rest (69%) did not treat the seeds before stocking. Acclimatization is the process of adjusting shortly to the new environment when a fish stock is released to a new environment from another environment. Stocking the fish seeds without acclimatization may lead to environmental shock and stress. This sudden stress impairs the normal homeostatic mechanism of fish and the pathogens get a chance to cause disease. About 58% of the farmers noted negligible or no mortality during acclimatization and about 27% of the farmers recorded mortalities up to 5% (Figure 2).

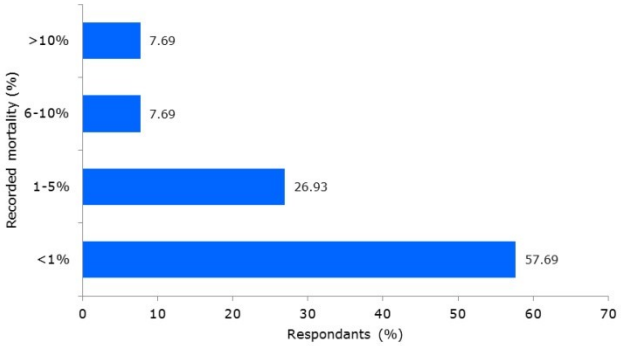

FIGURE 2 Records of catfish seed mortality during acclimatization and stocking (*N* = 52)

The farmers used different feeds during various stages of catfish culture. In fry stage, they used either egg custard at four eggs 50 L^{-1} especially during transportation and CP aqua pellet feed at 55–90 g cubic m^{-1}, and broadcasted thrice daily in ponds. The fingerlings were fed with high protein diet, *i.e.*, minced meat containing prawn head, snail and finfishes (*Johnius* spp., *Setipinna* spp., *Harpadon* spp., *Mystus* spp., etc.) at the rate of 135–240 g cubic m^{-1}, twice or thrice daily. The farmers also used boiled dead poultry and *Johnius* spp. at the rate of 350–600 g cubic m^{-1}, twice or thrice daily for adult catfish (Table 2). Catfish can effectively use up to 80% of the dietary metabo-

lizable energy for growth, which can be comparable to that of non-air-breathing fish fed the same diet (Viveen *et al.* 1985).

The harvesting frequency ranged from twice a week to quarterly. About 46% of the farmers harvested the fish twice in a week after two months of initial stocking; about 38% of the farmers harvested weekly, and 7.69% of the farmers harvested either monthly or quarterly (Table 1). The high harvesting frequency was mainly due to the high market demand for both sub-adults and adults. The survival percentage was poor, as 65.38% of the farmers recorded only 40–50% survival rate at harvest (Figure 3). This may be due to the poor water quality maintenance, high stocking density, non-adoption of scientific management practices and use of chicken offal and snails as feed, which may enhance the bacterial load and the chances of disease occurrence. Also, the chances of cannibalism could not be ruled out.

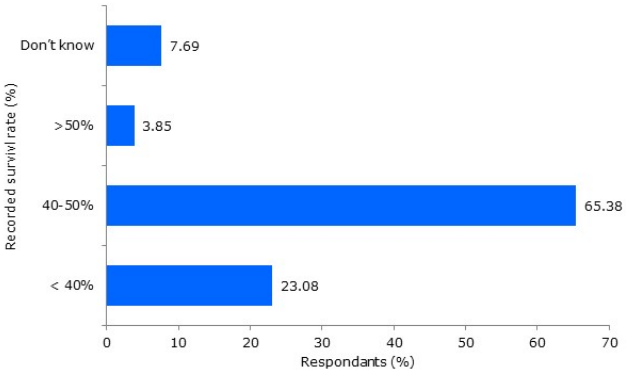

FIGURE 3 Survival rate recorded by the catfish farmers at harvest (*N* = 52)

Marketing of harvested fish was found to be in an organized way, as about 58% of the farmers sold their products to the middleman who was either the large-scale catfish farmers of the same locality or agents from far off place. About 23% of the farmers sold their harvest in the local or nearby market, locally known as "arat" (Table 1). The farmers usually sell around 500–1500 kg sub-adult catfish (of 300–400 g) or adults (of >1 kg) at each harvest.

Among the various problems, insufficient feed, disease, transport and poor seed quality were the major ones (Figure 4). About 38% of the farmers acknowledged unavailability of good quality feed as one of the major problems because of the voracious feeding nature of the species. Also, they had to procure wastes from hotels and slaughterhouses in and around Kolkata and nearby municipalities, as well as trash fish, *i.e.*, meat containing prawn head, snail, finfishes, entrails of poultry, skin and feather wastes as feeds at higher prices (usually Rs. 18–20 kg^{-1}) depending on the market demand. Further, the cost incurred for grinding the feed in a grinder, which works on diesel, add an extra burden to the farmers.

Table 1: Particulars of the farming practices, harvest and marketing of African catfish, *Clarias gariepinus* (N = 52)

Variable	*Description*	*Percentage*
Number of grow-out ponds	1	7.69
	2	15.38
	3	19.23
	4	23.08
	5	15.38
	6	11.54
	7	3.85
	≥ 8	3.85
Number of nursery ponds	0	3.85
	1	7.69
	2	19.23
	3	30.77
	4	34.62
	≥ 5	7.69
Source of fish seeds	Bought from market	7.69
	Bought from hatchery	69.23
	Bought from agent	23.08
Type of seed	Fry	23.08
	Fingerlings	76.92
Mode of transportation	Van	30.77
	Truck	69.23
Distance transported (km)	<10	15.38
	10–25	34.62
	>50	50.00
Chemical use during transport	Red soil water	73.08
	Antibiotics	26.92
Stocking	Single	15.38
	Repeated	84.61
Stocking rate (per cubic metre)	Fingerlings	
	860–1000	57.69
	1000–1150	26.92
	>1150	15.38
	Fry	
	<1550	26.92
	1550–1850	57.69
	>1850	15.38
Quality of fish seed	Good	73.08
	Average	26.92
Acclimatization of fish seed	Yes	73.08
	No	26.92
Treatment before stocking	Yes	30.77
	No	69.23
Harvest frequency (after two months of initial stocking)	Twice in a week	46.15
	Weekly	38.46
	Monthly	7.69
	Quarterly	7.69
Mode of marketing	Wholesale to market	23.08
	Retail / direct	19.23
	Wholesale to middleman	57.69

The voracious nature and high cannibalistic nature of the catfish, *i.e.*, especially the adults, compel the farmers to go for high feeding rate (350–600 g cubic m^{-1}), and thus,

the farmers are bound to stock sufficient feeds in advance. The feed was the major cause of concern (Boon *et al.* 1987), who reported that high feeding level in *C. gariepinus* results in lower losses. In *C. gariepinus* the complete development of the digestive tract takes place within seven days after hatching (Verreth *et al.* 1992) and, therefore, it requires a high rate of feeding initially. Such practice may have an adverse effect on the seeds during the initial phase of culture. High feeding, especially during first two months after hatching, may result in mortalities up to 70% in *C. gariepinus* (Boon *et al.* 1987).

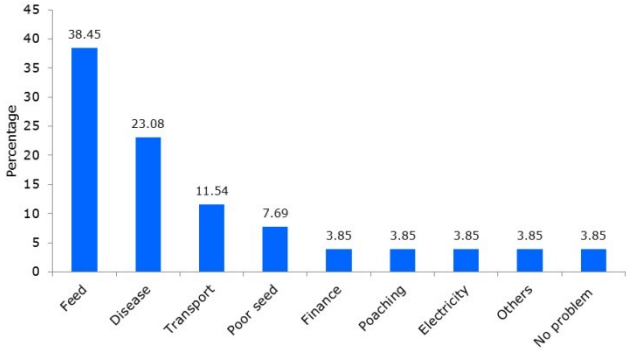

FIGURE 4 Problems encountered by the catfish farmers (*N* = 52)

The farmers also expressed their desire to know the proper chemicals or drugs to control the diseases in fry and fingerings. Thus, diseases seemed to be one of the major problems of catfish farmers. Disease occurrence was, however, regarded as a second-ranked problem as different diseases were reported under field conditions. The disease was only a secondary or tertiary problem in several Asian countries (Brown and Brocks 2002; Phan *et al.* 2002; Mohsin *et al.* 2012a, 2012b) as in the present study. On the other hand, Phan *et al.* (2002) reported disease (65.8%) as the major problem in hatchery of North Vietnam. High stocking density, high organic content and poor water quality management may be cited as the prime reasons behind disease occurrence (Meyer and Bullock 1973; Zheng *et al.* 2004; Abraham *et al.* 2010; 2011–12). Boon *et al.* (1987) reported that high fish densities, high feeding level and mismanagement enhance ordinary infections and disease in *C. gariepinus* culture.

About considerable number of farmers faced transportation problem due to bad roads, and complained about poor seed quality due to lack of renowned hatchery nearby. Procuring seeds from far off hatcheries have created some intrinsic problems to the farmers as they have to travel a long distance, incur high transportation cost and encounter practical difficulties in collecting the seeds from those hatcheries as and when required. Many farmers were forced to avail loan from private sources with high-interest rates. Lack of technical expertise or knowledge on fish farm management was also found to be a common problem in several Asian countries (Brown and Brocks 2002; Mohsin *et al.* 2012a).

Among the different diseases (Figure 5) dropsy was the most common and had an impact on catfish farmers' economy. Affected catfish were found floating on the water surface with belly upward and thus fall prey to birds. Loss of pigmentation over the lesion and on incision emanation of foul smell was also noticed. Meyer and Bullock (1973) recognized such conditions in *Ictalurus punctatus*. A similar condition was also noticed in *C. gariepinus* caused by *Edwardsiella tarda* (Abraham *et al.* 2015; Abraham and Ritu 2015). The high incidence of dropsy may be due to the poor water quality management, which often results in high pathogenic load. No fruitful treatment was available yet and, hence, it was considered by the majority of the farmers as a major disease. In recent years, diseases due to antibiotic-resistant motile aeromonads in *C. batrachus* fingerlings (Paul *et al.* 2015) and *Stenotrophomonas maltophilia* in fry (Abraham and Adikesavalu 2016) and juveniles (Abraham *et al.* 2016) with dropsy have been documented. The next most frequently encountered disease was spinning movement especially during fry and fingerling stages of catfish and is locally known as “Ghurni". A vertical hanging condition was encountered among the fry and fingerlings of catfish during the winter season. The fish were found hanging listlessly from the water surface with the reddish operculum and anorectic condition. The catfish were also seen rolling on the water surface near the pond periphery. This condition is locally known as “Fatna rog”. According to them, no proper aquadrugs are presently available in the market to combat the aforesaid diseases.

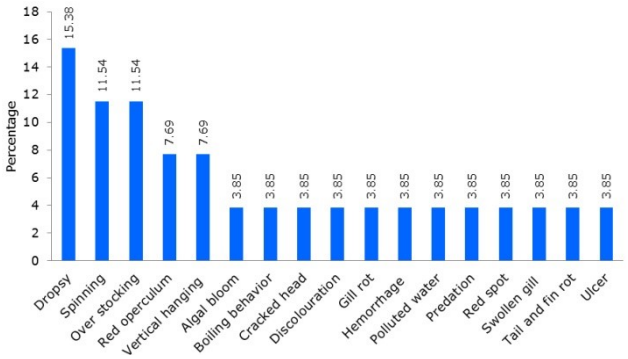

FIGURE 5 Frequency of diseases and abnormalities that caused production loss (*N* = 52)

Besides these, reddish operculum, cracked head syndrome, ulcer, gill rot, tail and fin rot were also observed. Other problems encountered by the catfish farmers were algal bloom, predation and water pollution (Figure 5). Another abnormality noticed in fry and fingerlings, especially during transportation, was boiling behaviour, locally

known as "Chora phuta" followed by death with erected fins and upright tail within few minutes. Churning of water or addition of common salt during transportation was usually practised by the farmers to overcome this problem with the insignificant result. It may be due to a sudden fluctuation in the environmental parameters, most probably the temperature, and therefore, it calls for stress reduction during seed transportation. About 4% of the farmers reported the occurrence of cracked head condition especially among the adult catfish with fragile frontal bone. Viveen *et al.* (1985) in Israel reported that broken head disease occurs mainly among brood catfish in ponds without vegetation leading to inflammation of the skull due to the accumulation of organic matter in the arborescent organ. A similar condition of fish known as the cracked head syndrome attributed to vitamin-C deficiency was found in *C. batrachus* and *C. macrocephalus* (Kabata 1985).

TABLE 2 Feeds used by catfish farmers

Stage	*Feed*	*Quantity*
Fry	Egg white (transportation)	4 eggs 50 L^{-1}
	CP Aqua pellet feed (ponds)	55–90 g cubic m^{-1}; 3 times day^{-1}
Fingerling	Wastes from hotels and slaughterhouses in and around Kolkata and nearby municipalities; minced meat containing prawn head, snail and finfishes	135–240 g cubic m^{-1}; 2–3 times day^{-1}
Adult	Boiled dead poultry and *Johnius* spp.	350–600 g cubic m^{-1}, 2–3 times day^{-1}

Majority of the farmers (50%) attempted disease treatment. Emergency harvest, water exchange and no feeding were also common. The farmers attempted treatment using disinfectants along with veterinary-grade chemicals or drugs, although with varied success (Figure 6). Antibiotics or other aquadrugs were the most frequently used in catfish farming than carp farming (Abraham *et al.* 2010). The incidences of multiple antibiotic-resistant bacteria in the catfish hatcheries are also quite common in West Bengal (Bharathkumar and Abraham 2015). Metacid-50 was used only by experienced farmers (Table 3) because of the fact that an overdose of this aquadrug may lead to mass mortality. It was generally applied at 0.7–1 g cubic m^{-1} followed by no feeding for two successive days. The use of chemotherapeutic agents in Indian aquaculture is huge and the antibiotics like chloramphenicol, furazolidone, nalidixic acid, neomycin, sulphamethoxazole etc. have already been banned. The oxytetracycline and Romet-30 are the only antibacterials approved by the USFDA for use in the US and in most European countries for aquaculture purposes (Hernandez 2005).

TABLE 3 Aquadrugs used by the catfish farmers

Chemical / Brand name	*Dose*
Becosul (ml cubic m^{-1})	0.12–0.16
Revitol (ml cubic m^{-1})	0.12–0.16
Meriquin (Enrofloxacin oral solution; ml cubic m^{-1})	0.12–0.16
Parovit-12 (tablet/25 cubic m^{-1})	1
Enrocin (ml kg^{-1} feed)	2
Terramycin (tablets kg $fish^{-1}$ day^{-1})[a]	4
Metacid 50 (g m^{-3})[b]	0.7–1.0
Endrocin (ml kg^{-1} feed)	2
Bayrocin (10 % oral solution; ml cubic m^{-1})	0.5–1.0
Pentamycin (tablets kg^{-1} feed)	4
Acriflavin (g cubic m^{-1})	4

[a] *for two alternative days;*
[b] *followed by no feeding for two days*

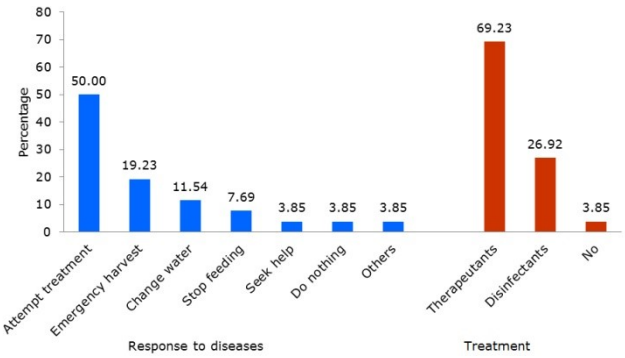

FIGURE 6 Action taken and responses of catfish farmers on disease occurrence (*N* = 52)

The contribution of West Bengal's catfish production was in the range of 13–20% of the total catfish production of India since 2007 (DAHDF 2014). During 2010 and 2011 catfish production in West Bengal has seen a slight reduction and picked up subsequently. Nevertheless, its contribution in India's total catfish production has declined from 20.42% in 2008 to 13.26% in 2012 (Figure 7). In general, the *C. garipinus* farming in West Bengal has brought the majority of the derelict water bodies under culture and also helped recycle wastes into wealth, but it suffers from management issues and huge economic losses. This calls for immediate attention from researchers, administrators and extension personals to resolve the management issues and promote diversified aquaculture.

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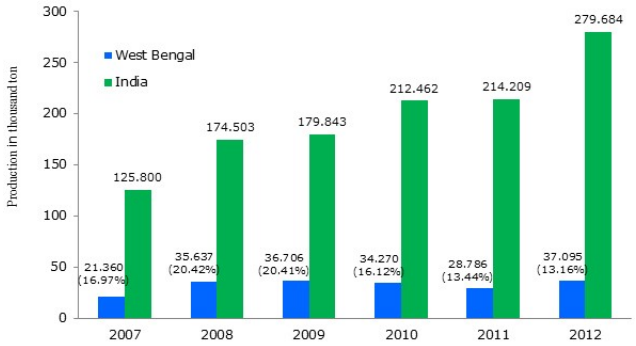

FIGURE 7 Inland catfish production in West Bengal, India from 2007 to 2012 (Source: DAHDF 2014)

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