International Journal of Latest Research in Humanities and Social Science (IJLRHSS)
Volume 03 - Issue 02, 2020
www.ijlrhss.com || PP. 07-12

Rejuvenation of fish breeding and hatching of Indian major carps by using the special type of soil in some areas of Bankura district: A novel technology

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Abstract: The characteristic regional soil for enhancing spawning and hatching of special type of bundhs of Simlipal and Pachmura regions have been studied. Bundh breeding technology of fish is one of the most dependable and traditional source of natural fish seed production. The analysis of the soil indicated the presence of some mineral such as silicon, iron and titanium as compare to the soil of other places and regions. The mineral components of the special soil provide more oxygen supply to the water as well as fish seed and facilitating the buoyancy of fertilized eggs. The said soil showed the water parameters became more congenial for fish spawning and hatching. The present study will open new avenue of fish culture in facilitating enhanced spawning and hatching.
Keywords: Bundh breeding, Fertilized egg, Soil, Aquaculture. Spawner .

Introduction

Fish is the dependable source of animal protein in our protein starved country which also contains essential amino acids and minerals. Indian major carps like catla, rohu and mrigal are river spawners, having semi-floating, non-adhesive eggs (Sinha, 1986). As the fish seed is the major input for fish farming, there is always an increasing demand of quality fish seed. The seed required for cultural practice had been contributed through bundh breeding of Bankura and Medinipur district (Khanna, 1992) due to the presence of undulating terrain with immense catchment area. Bundhs are specialized pond having proper embankment to receive large quantity of rain water after heavy shower. The topography of the land has a vast role to play in the location of bundh. The peculiarity of the soil in such bundh offers buoyancy to the fertilized eggs and therefore, the eggs remain floating which enhancing hatching proportion. Otherwise the fertilized eggs settle at the bottom and hatching is impaired (Chattopadhyay*et. al.* , 2013).

Therefore, the present investigation has been carried out to analysis the quality and chemical constituent of soil in the bundh as well as physico-chemical parameters of water and their role in spawning and hatching of fertilized eggs of fish.

Materials and Methods

Quality production of fish seed mainly depends upon the physic-chemical parameters operating in an aquatic environment of Bundhs. Water sampling was done in everymonths between May 2015 to July 2018 from selected bundh at Simlipal and Panchmura at Bankura district in West Bengal. A Celsius thermometer (scale ranging from 0°C to 100°C) was used to measure surface water temperature, pH of the water was measured by using a digital electrode pH meter (Systronics, Sys-335). pH of the soil sample was estimated by calorimetric method (Pandey and Kuruvila, 1968). The transparency of water was measured by 'Sechi disc' method (Welch, 1962). The string was tied with the Sechi disc at its centre. The disc was dipped into water and the depth at which it disappears (d_1) was noted. Again it was lifted upward and the depth at which it reappears (d_2) was noted. The final transparency value was calculated by using formula {(d_1 + d_2) / 2 cm}. Dissolved oxygen (DO_2) was measured by modified Winkler's method [6]. The hardness of the water samples was calculated by the following formula (Titrant volume × 1000)/ 50 ppm (Kudersia, 1980). Alkalinity was measured following the standard method as recommended by APHA (1989).

SEM-EDX (Scanning electron microscopy in combination with energy dispersive x-ray spectroscopy) analysis of bottom soil of Bundh : To determine the actual chemical changes and minerals of the soil, studies involving SEM-EDX analysis were done. For SEM-EDX analysis, soil collected from specific field of Simlipal and Panchmura ad was analysed by ZEISS (GEMINI) SIGMA S-300 machine (Fig.1).

Observation

Analysis of water parameters in Bundhs: Considering the importance of physic-chemical parameters in the water and specific type of soil in different amount were applied in three experimental bundhs. Bundh no. 1 considered as control where no special coil was applied but in Bundh no. 2,3 and 4 special soil supplied at the rate of 540 kg,1080 kg and 1620 kg respectively. The study of water parameters in bundhs were recorded in 0 days, 7 days and 14 days respectively.

Water parameters measurement during '0' day :

Water parameters	Bundh 1	Bundh 2	Bundh 3	Bundh 4
Water temperature (□C)	22	20	22	22
pH	6.2	6.2	6.2	6.2
Transparency	85	320	750	950
DO (ppm)	6.8	7.5	8.0	8.2
Hardness (ppm)	110	230	300	360
Alkalinity (ppm)	46	56	60	64

Water parameters measurement during '7' day :

Water parameters	Bundh 1	Bundh 2	Bundh 3	Bundh 4
Water temperature (□C)	20	21	21	22
pH	6.5	7.0	7.0	7.2
Transparency	108	540	800	1000
DO (ppm)	7.0	7.2	8.0	7.8
Hardness (ppm)	180	240	750	880
Alkalinity (ppm)	52	58	58	60

Water parameters measurement during 14' day :

Water parameters	Bundh 1	Bundh 2	Bundh 3	Bundh 4
Water temperature (□C)	22	23	24	24
pH	7.0	7.0	7.0	7.2
Transparency	110	250	570	950
DO (ppm)	6.8	8.4	8.4	9.0
Hardness (ppm)	450	530	620	720
Alkalinity (ppm)	55	62	57	55

Different mineral elements constituent in soil samples by SEM-EDX analysis :

Minerals	Yellow soil collected from 8 ft. below	Whitish soil collected from 12 ft. below	Ground soil
Aluminium (Al)	7.70	3.90	5.98
Silicon (Si)	23.65	21.08	12.60
Calcium (Ca)	0.25	0.20	0.15
Titanium (Ti)	0.74	0.51	0.18
Iron (Fe)	4.98	2.37	3.56

In the present study the bundhs measuring about 52 ft. length × 32 ft. width × 5 ft. depth have been selected having slope gradient from one end to other so that at the upper end water depth is 4 ft. while it is 5 ft. at the lower end and having an embankment. The bottom of the bundhs were provided with sandy soil (Fig. 2). The water in the bundhs was supplied from nearby canal with the help of motor pump. The water level in the bundhs are maintained at 3 ft. at the upper and 4 ft. at the lower end. The water capacity of the bundh ranged from 68.7 gallon to 70 gallon. The flowing water moves towards the lower end of bundh and the fish farmers take the advantage to mix special soil collected from about 10 ft. below the surface soil from nearby field rich in special soil (Fig. 3). The required amount of soil i.e. 540 kg, 1080 kg and 1620 kg is placed at the opening of inlet drain, so that the soil is drained into the bundhs (Fig. 4). As soon as the preparation of bundhs are completed the farmers collect brood Indian major carps from nearby stocking pond (Fig. 5). The male fish (30

pieces) and female fish (60 pieces) are injected. After injection the brooders are released into the bundh. Rapid movement followed by splashing of water is indicative of sporting mode of breeders in the shallow region of the bundh (Fig. 6). After spawning the fertilized eggs are collected after 4 hours. The special soil is then mixed into the hatching bundhs and the mixing process continues at an interval until hatching. After 2nd day of experiment the fertilized eggs produced ('c') comma shaped embryo within the egg shell. The hatchlings are transferred to hatching bundhs. Hatchling bundhs are earthen pits and walls are plastered by mud and the sizes vary from 30 ft. × 12 ft. × 4 ft. ,25 ft. × 8 ft. × 4 ft.The water level of the hatching bundhs are approximately 2.5 ft. to 3 ft. As soon as the fertilized eggs are released into hatching bundh, special soils are sprinkled into water of the bundhs. From the 4th day onwards hatchling from different hatching bundhs are collected into earthen hatching hapa.

Discussion

Sustainability in aquaculture is primarily dependent on the steady supply of quality fish seed. Several traditional technologies were in practice in seed production sector, out of which bundh breeding is considered as one of the most dependable source in captivity. Fish breeding and hatching are mainly determined to a great extent by the nature, properties of bottom soils and water quality. Fish farmers of Panchmura area of Bankura district were being involved in fish seed production through traditional bundh breeding using characteristic regional soil in breeding as well as hatching bundhs. The fish farmers without knowledge of the chemical properties of regional soil use this soil to increase fertilization rate. In this endeavour the farmers mix the regional special soil with the water of the bundh at the onset of fish breeding and before releasing the egg into the hatching bundh. In usual practice of hypophysation, after hatching the fertilized eggs settle down at pond bottom and maximum mortality occurs. On the other hand the present observation indicates that the special soil increases fertilization rate by offering extra buoyancy to the fertilized eggs remain floated for a longer period. The concentration of silicate in pond water believed to be controlled by redox potential through reduction of ferric silicate in the surface layer of bottom mud (Jhingran,1977). In addition the soil also increases fertilization process by removing the adhesive glue from the surface of unfertilized eggs and allows the sperm to entry through the egg membrane inside the egg. The soil probably bring congenial changes in pH and other chemical characteristics of water for increased hatching. The present study indicates that the special soil of Panchmura region is rich in silicon. The oxygen holding capacity of silicon is maximum which is envisaged from the molecular configuration of silicon (Chattopadhyay*et. al.*, 2013). Therefore, it is obvious that soil rich in silicates, supply more oxygen at soil water interface for better survival of the fertilized eggs and hatchlings. Ghorai*et. al.* (2016) opined that the role of silicate not only as oxygen enhancer in fish pond but also stimulates both the male and female fishes in spawning with in fertilization and hatching. According to Saha*et. al.* (1957), the factors which stimulate the fish to spawn is produced when water comes in contact with dry soil. The factor has been identified as an oil "petrichor" obtained by steam distillation of silicate minerals and rocks. Fish are known to possess a remarkable sense of odour perception and the aroma of "Petrichor", according to him, works as stimulus for spawning. In the present study it has been found that the pH ranging from 6.5 to 7.0 i.e. almost neutral water is favourable to induce spawning in carps by creating condition for successful fertilization. In 1957 Saha*et. al.* advocated that several bundhs of Bankuranand Midnapore are helped by the flood water to lower down alkalinity and pH to favourable limits. Milt stripped out from the brood fish indicated at pH 6.8, while the pH of the egg cell fluid collected just after liberation was found to be 6.3. Boyd (1995) emphasized that neutral to slightly alkaline pH for bottom soil of laterite zone is found to be good productivity of fish pond.

Ackowledgement

Grateful acknowledgement to Prof. S.K. Dey, Department of Zoology, Vidyasagar University and Prof. A.R. Ghosh, Department of Environmental Science, The University of Burdwan, for their valuable comments and suggestions. The authors are grateful to Mr.Homargha Das for SEM-EDX operation.

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Legends of the Figures

Fig 1: Picture of ZEISS (GEMINI) SIGMA S-300 machine with EDX facility.

Fig 2: Showing embankments of bundh having sandy bottom soil.

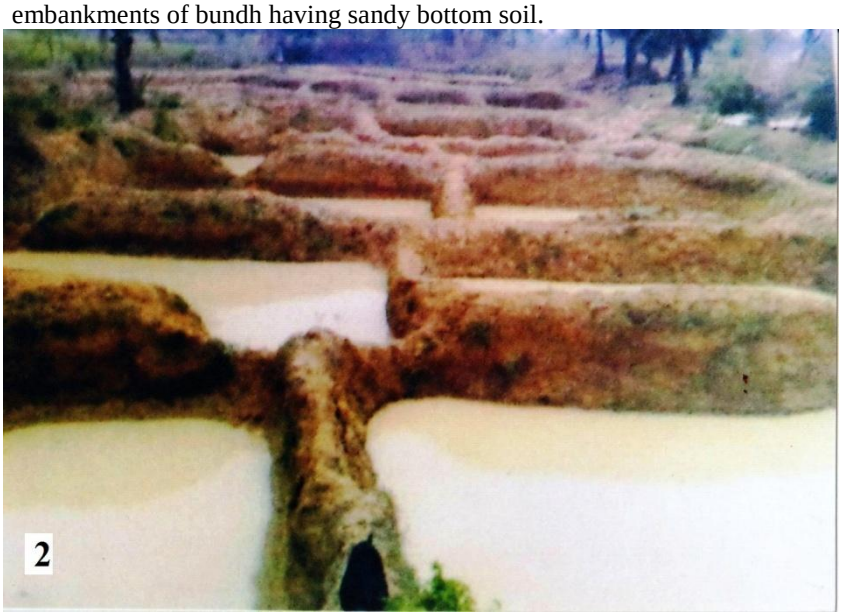

Fig 3: special soil collected from 10 ft. below surface soil.

Fig 4: Special soil deposited at the opening of bundh.

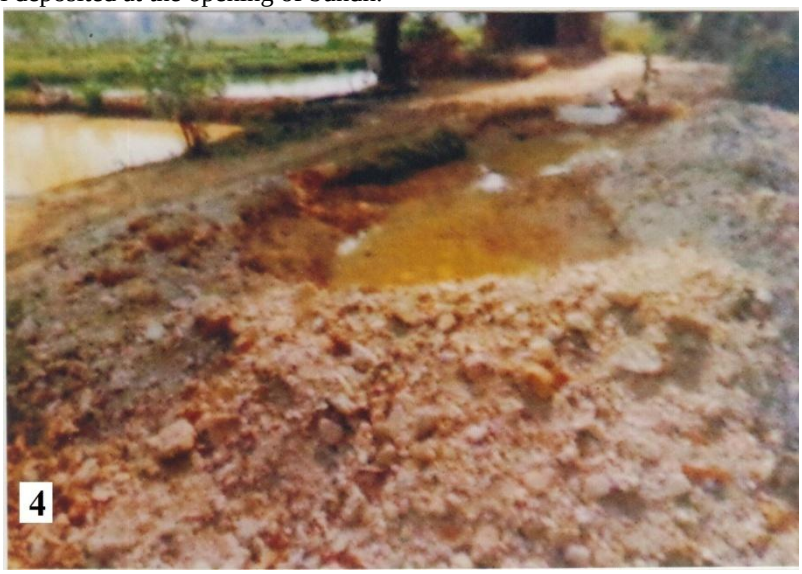

Fig 5: Stocking pond from where brooders are collected.

Fig 6: Mixing of special soil in bundh.