State of the art of carp spawn production and transportation at Ramsagar, Bankura District, West Bengal, India

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Tricycle motor trolley carrying spent major carps to broodstock pond.

Tradition of carp seed production in West Bengal

For the last five decades or so, West Bengal has held the glory as the leading state in India for fish seed production and supply (major carp fry; 22-25 mm). It has presently 454 private and six state government carp hatcheries, respectively. Undoubtedly, the success of commercial freshwater fish culture is due to the availability of adequate quantities of healthy and pure seed, fry and advanced fry of the major carps, *Labeo bata*, pangas catfish and air-breathing catfishes. The author once again presents this information after a previous discussion[1] to uphold the lesser-known contribution of elderly and progressive fish breeders in rural West Bengal. These people have achieved excellence and are producing good quality fish seed using scientific methods, catering to the requirements and demand of fish culturists within West Bengal and other states by virtue of honesty, skill, and experience. Significantly, they are trying to keep up their vocation and this tradition during aberrant weather, cyclonic storms, COVID-19-induced nationwide lockdowns, bad road conditions linking hatcheries proper to the main highway for fish seed and broodstock transportation, and other obstacles.

Carp spawn production at Ramsagar Gram Panchayat

The 15-18 days old carp fry are produced in earthen nursery fishponds, beginning from stocked spawn, induced-bred 72-75 hours old 7-8 mm stage produced and supplied from hatcheries. From an article published twenty years back[2],

we come to know about the prominence and repute of carp spawn production in large and commercial scale achieved at three distinct towns in West Bengal, namely Ramsagar in Bankura, Naihati in North 24 Parganas and Kalna in Purba Bardhaman districts. Villages in Ramsagar contribute 65-70% of the total carp spawn produced in West Bengal every year. Most of the villages, namely Barpetya, Hetamuya, Jadabnagar, Shinghati, Teliberia, Baruipara, Mouchura, Sinpur, Surmanagar, Sinargoria, Kalyari within the jurisdiction of Ramsagar Gram Panchayat under Onda Community Development Block and Police Station in Bankura, West Bengal collectively form a cluster, i.e., an effective centre of carp spawn production activity. In each of these villages, from 3-20 of hatcheries exist.

Eminent fishery experts in West Bengal Dr Punyabrata Das and the Late Prof. Nihar Ranjan Chatterjee emphasised the use of matured brooders of proper age and size in hatcheries and the renewal of broodstock major carps of either or both sexes (or its exchange with that of another hatchery owner at a distant village) every year to prevent inbreeding and the occurrence of low-quality fish seeds. Indeed, on 7-8 May, 2022, the author learnt that such recommended practices are followed by fish breeders and hatchery owners at Barpetya and other places in Ramsagar; many of them possess a good understanding of inbreeding and its unwanted impacts. It is noteworthy that in these hatcheries, forced release of fish gametes (stripping method) is completely avoided, only fish pituitary extract is used for hormonal injection to brooder

View of 72 hours old Catla catla spawn.

carps and no cross breeding is practiced among parents of related but different carp species. Only 100% pure spawn of the economically important carps are produced here, namely *Labeo rohita*, *Catla catla*, *Cirrhinus mrigala*, *Ctenopharyngodon idella*, *Hypophthalmichthys molitrix* and *Labeo bata*, all separately, while that of *Puntius sarana*, *Puntius javanicus* and *Cyprinus carpio* are produced on a small scale.

Pituitary extract administered to brooder Cirrhinus mrigala.

Presently, out of a total of 125-130 functioning private carp hatcheries in Ramsagar Gram Panchayat owned by the same number of professional fish breeders, 30 are situated in close proximity at Hatibari and Barpetya villages and near or beside the Birai River where carp spawn production is done on a large scale. This cluster area is known by the name 'Gufu road'. These two villages are located beside Birai River, one of the main tributaries of Dwarakeswar River, that further forms one of the two major rivers in Bankura. Dwarakeswar River originates near Mukutmonipur in Purulia District. At the 'hatchery hub' in these two villages, there are presently 30 large carp hatchery owners - cum - large-scale carp breeders. All of these hatcheries have been accredited and registered by the West Bengal State Fisheries Department. Each outdoor hatchery comprises 4-7 circular concrete egg incubation-cum-hatching units. About 60% of the total spawn production in this Gram Panchayat is done every year in these two villages. In addition to above, a few other fish hatcheries work on a small scale in Hatibari, Barpetya, Hetamuya villages collectively. Sri Biswanath Dey, Sri Pintu Nayek, Sri Monosa Ram Dey are three such progressive fish breeders, amongst others, with whom author made on-site conversation. Gufu road will be an 'eye opener' site for many less-educated youths and aqua-entrepreneurs in adjacent states of West Bengal who are interested to do carp seed production. They will gain clear practical knowledge and encouragement if they visit there.

'Ramsagar-produced spawn' holds the fame of fast growth rate in fish culture ponds and high survivability. Rajendrapur-Battala fish seed market at Naihati, North 24 Parganas, is presently the largest fish seed wholesale market in eastern India and 70% of the seed sold here is supplied from villages in Ramsagar Gram Panchayat. But it is under-recognised. Many customers (fish farmers) in this market coming from different places in North and South 24 Parganas and Nadia districts (these places are nearer to Naihati than Ramsagar and good linkages exists with the former in terms of distance; the distance between two towns is 150-160 km) believe that all carp spawn available and meant to be sold here are produced in carp hatcheries situated at Naihati, which sometimes become more focused. According to Sri P. Nayek, it will be good if carp spawn produced at Ramsagar and sold at Naihati fish seed market are promoted under the name of Ramsagar-produced seed. Some fish farmers in these districts come to Ramsagar to procure carp spawn directly from people like Sri Biswanath Dey (Sri Dey), Sri Nayek and others.

Progressive fish culturists and fish breeders from each and every state in India (even from Gangtok, Meghalaya) have visited these two villages at Ramsagar Gram Panchayat. A considerable numbers of families and a large part of the inhabitants in Ramsagar Gram Panchayat are involved in carp spawn production commercially; this practice is expanding and developing as successful business enterprise and about 80% people in this Gram Panchayat depend directly or indirectly on carp spawn production business as source of livelihood. Customers within and outside West Bengal trust in the superior quality of Ramsagar-produced carp spawn. Jharkhand fish farmers have been buying spawn from here for the last 20-25 years.

Carp spawn packing and transportation from Ramsagar Gram Panchayat

Purba Medinipur is the leading district in production of table size major carp in West Bengal, and quite a few fish seed traders and fish farmers here procure carp spawn from Ramsagar. Seed goes to West Godavari, Rajahmundry, Ahmedabad, Pune and other districts in India by air from Dum Dum airport in Kolkata. Seed goes to all over West Bengal and all over India except Jammu and Kashmir, Himachal Pradesh, and a few north-eastern states, supplied to Andhra Pradesh, Madhya Pradesh, Chattisgarh and other states.

For long distance inter-district transport, and also to places in neighbouring states Odisha, Jharkhand and Bihar by roadway or railway (150-500 km; 3-8 hours journey), 25,000-35,000 carp spawn are kept in each oxygenated polythene packet containing 10-12 litres of water. For shorter distance transport of 25-40 km up to 100 km to adjacent districts, 50,000-70,000 are kept in each packet. Advanced hatchlings 48-60 hours old are preferred for long distance transport and normal 72–75-hour old spawn for shorter distances. A delivery vehicle (but not meant for it) such as Maruti Suzuki Omni can hold and transport 40-42 of such fish seed packets. Mini and larger-sized pick-up trucks (Mahindra Bolero pick-up van) with an open cargo area are also used. It takes 18-25 hours to transport carp spawn to places in Gujarat, Andhra Pradesh by train; the much faster air route is preferred which takes around 2 hours. In each cardboard carton containing oxygenated packet with 3 litres water, only 5,000-6,000 60 hour old spawn are kept and such cartons are dispatched to Dum Dum airport for aerial transport. A single medical-grade oxygen cylinder (46 litre capacity) can fill 280 spawn packets, each containing 10-12 litres of water.

Injection of oxygen into spawn packets.

Sri Tapas Bauri at Barpetya Notun Pally Perar Par is not a fish breeder but involved only in oxygen packing and transportation of carp spawn after buying the same from some hatchery owners, opined that a standard spawn measuring cup ('bati' in Bengali vernacular) of 135 ml water holding capacity holds 25,000-35,000 carp spawn. This measurement is normally followed while packing the hatchery-produced spawn for transportation. Thus two bati refers to 50,000-70,000 spawn (48-72 hours old). Sometimes the water is increased up to 15 litres in packets during long distance transport by road. Spawn contained in a single bati are divided into four parts in separate containers during aerial transport. Quite a few rural youths like Sri Bauri are seriously in such ancillary activities at these two villages, working in small temporary mud-built huts with thatched roof in fields.

According to Sri Dey, each such bati holds 35,000-45,000 carp spawn at its maximum capacity with the lowest possible amount of water, as it is sold to customers. At Sri Dey's hatchery site and of the others, one full bati carp spawn holding this much amount is kept in one oxygenated polythene packet during transportation during the night hours to Purba Medinipur or adjacent district, with 10 litres water in each. For such places, another larger bati is also sometimes used which is 1.5 times more voluminous than the previous one. In one packet, 1.5 bati carp spawn is sometimes kept, i.e., 80 packets received by a farmer of three species of Indian major carp will hold 120 bati spawn in total (approximately).

The 135 ml capacity spawn measuring cup ('bati') left and 1.5 times larger bati right.

Empty cement packets or bags (50 kg bags, INR 4-5 per bag) made of polypropylene polymer are used to wrap the oxygenated spawn-loaded polythene packets, one in each, during transportation within West Bengal. Auto showers, sprinklers, forced jets of water ejected from the metal mouth of rubber pipes – all are kept in constant operation over the egg incubation-cum-hatching pools as aeration devices until harvest of spawn and sale. In the early morning, the

Sri Tapas Bauri's cottage for carp spawn packing.

Shiromoni Express coming from Purulia arrives at Ramsagar station at 5.35am and carp spawn are individually loaded in cement bags in the vendor compartment for transportation to Purba Medinipur and Howrah districts on the train route. A daily super-fast deluxe night service bus 'Nightingale' going towards Kolkata city and Sealdah arrives at Ramsagar bus stop on the national highway at 4.00am. Spawn-loaded cement packets are loaded into the bus also, for transport to Kolkata. There is a special compartment in the Shiromoni Fast Passenger train (now Express) meant for transportation of carp spawn.

Before the COVID-19 lockdown period, a great numbers of fish farmers carrying carp spawn in large aluminium hundi (with continuous surface water splashing with right and left palm) and oxygenated cement bags could be found in early morning at Ramsagar railway station, frequently numbering more than local passengers availing the train service. For a fish breeder, each polythene packet costs INR 8-10. Before transportation, for the convenience of customers, oxygen-inflated cement bags carrying carp spawn are marked as yellow bags for *C. catla*, white bags for *L. rohita* and white bags with blue knots of durable string for *C. mrigala* (supposedly). When felt necessary, oxygenated packets are filled with glucose water before introducing carp spawn into it. Polythene packets are loaded inside cardboard cartons for long distance transport.

Hatchery structure at Barpetya and Hatibari villages

Both Birai River water and/or 60-90 m deep underground water are pumped using electric motors and submersible pumps (shallow tube wells) respectively and taken into carp hatchery complexes for storage and use. Concrete rectangular chambers and earthen ponds of 120-280 m^2 area and 0.9-1.0 m water depth serve as reservoirs to hold the brooders. Water is pumped from the river to concrete water reservoirs, and passed into each of the concrete and circular carp egg incubation-cum-hatching chambers or cisterns (familiar Chinese model) kept in operation, where fertilised eggs are placed. Each of the largest egg incubation-cum-hatching units has a 6.1 m outer diameter and produces 180-220 bati (each 135 ml capacity) spawn in one single operation of a particular carp species, which becomes ready for harvest and packing. In comparison, smaller units each of 4.6 m diameter produce 90-150 bati spawn. Water from the central outlets of egg incubation-cum-hatching units is released into the river, where it is made available to local agriculturists to irrigate their vegetable farming lands free of cost. Carp broodstock ponds of hatchery owners are generally located 2.5-3 km distance from the hatchery proper.

In the main fish breeding and carp spawn production season that lasts from 15th March till 15th July every year, 200-300 bati carp spawn are produced every day on average from all egg incubation-cum-hatching units in one hatchery. In the 30 hatcheries, spawn production continues till end of July every year but is extended till end of August in other hatcheries. Injected brood fishes of both sexes of a particular carp species are released in small-sized 60-140 m^2 earthen or concrete water bodies (breeding chambers) having 1 m depth. Broodstock harvested from ponds are maintained for a brief period before injection in such concrete impoundments

Water-filled packets at hatchery site ready for holding spawn.

Putting spawn inside polythene packets during daytime.

Oxygenating spawn packets.

with continuous aeration. Fish breeders have made and run the artificial sprinklers and auto-shower systems over egg incubation-cum-hatching pools and fish breeding chambers using simple indigenous technology. The single dose of fish pituitary extract is administered and induced only to 50% of the male fishes in a single operation by some progressive fish breeders and are released with non-injected male fishes; this is sympathetic breeding. Neither overhead water storage tanks nor circular concrete carp breeding pool (Chinese

Oxygenated spawn packets ready to be loaded on the Shiromoni Express train at Ramsagar station.

structure) exist in hatcheries here at Ramsagar. All circular egg incubation-cum-hatching pools have been constructed and operate at 1.22 m below ground level whereas, contrastingly, they are constructed above ground level at Naihati.

Sale price of carp spawn

Towards the middle and end of fish breeding season (from 3rd or 4th week of May till July), the sale price of a bati of *L. rohita* and *C. catla* spawn separately varies from INR 350-200 and INR 400-200 respectively. If carp spawn producers like Sri Dey and others are unable to meet customers or carp spawn purchasers (fish farmers) directly in other districts of West Bengal, then they contact intermediary persons first; these persons provide the spawn to customers known to them. Such persons, of which there are 350-400 in Bankura District, have become members of a co-operative society at Ramsagar. According to Sri Dey, in the 2nd week of March, i.e., in the beginning of season, spawn is sold to customers @ INR 900-1,000 per 135ml bati (retail price). These customers have direct contact with fish breeders here. But in Malda and other districts, people like Sri Dey sell spawn to customers via intermediary 'media' persons @ INR 1,500-1,800 per bati (including carrying cost), who receive 20% commission per bati. Thus Sri Dey gets INR 1,250-1,400 from the sale of one bati spawn to such customers. From a publication[2], we come to know that twenty years back during 2002 and little earlier, spawn was sold from Ramsagar Gram Panchayat @ INR 250-300 per bati, price falling to INR 100 per bati towards the end of season in early September. There were approximately 150 carp spawn producers using Chinese cisterns (egg incubation-cum-hatching pools).

Indian major carp spawn ready for transportation in cement bags.

Largest egg incubation-cum-hatching pools.

Natural breeding of carps

Bankura is pioneer in respect of production of fish seed of major carps by simulating natural conditions in captivity, with continuous aeration by means of overhead sprinklers[3]. After hormone injection to prospective brooders, natural breeding of carps is allowed in small earthen (some breeders say 'bundh-like') impoundments provided with water sprinkler structures. From earthen squarish or rectangular 40-120 m^2 breeding pools, fertilised eggs of a single species of carp are obtained, collected using drag-type mosquito net. Fertilised eggs are released in small rectangular 20-40 m^2 earthen hapa enclosures for incubation and hatching with no water circulation, water is intentionally and controllably made turbid to keep eggs in a suspended condition in the water column. Also, eggs are kept safe in this manner in summer months with higher water temperatures. Grown-up spawn are harvested from these rectangular mud egg hatching pits or hatching hapa using a large soft cotton cloth. In the natural carp breeding process, fertilised eggs are mostly transferred to familiar circular egg incubation-cum-hatching pools.

The earthen square-shaped carp breeding chambers with 1 m water depth (also called earthen breeding hapa) have a gentle slope at its base from one end to the other with 0.30-0.37 m more water depth towards lower end (slope). Earthen chambers have slope and embankment on four sides like that of a pond, here natural breeding or natural spawning of carps take place. After completion of one breeding (fish spawning) operation and collection of fertilised eggs of a single carp species, the entire water mass is drained out but prior to that, water (10-15 cm depth) is made turbid by pulling a thick log or tree trunk 1.5 m long and 20-15 cm diameter kept pressed over the bottom soil. This sweeping of soil and water mass is done manually and repeatedly, which helps in removal of deposited shells of fertilised and unfertilised carp eggs (if any) and undesirable organic matter accumulated over the bottom soil. Breeding or spawning of injected carps is also carried out in 40-120 m^2 small squarish or rectangular chambers having a concrete base and four sides (walls), no embankment or side slopes. These chambers also have a gentle flat slope at the base from one end to another. Some fish breeders refer to it as 'bundh breeding area'.

Mud hatchery pits are a traditional device for hatching fertilised carp eggs in Bankura (discussed above) which are dug in series, 1.5 x 1 m^2 each, and the inside plastered with red soil. During the twitching stages of embryos, fertilised eggs are collected from bundh structures and put into the hatching pits. But presently this technique is not much used.

Removal of egg shells from natural carp breeding chamber.

Sri B. Dey's small-sized egg incubation-cum-hatching pools.

Care of carp broodstock

After one spawning operation, spent fishes are harvested from square-shaped earthen and concrete fish breeding chambers, placed in water-loaded hundi (30-45 cm open mouth diameter aluminium vessel used for transporting fish spawn, fry and broodfishes, capacity 25-28 litres), loaded and carried in indigenous open loader tricycle motor trolley and released into broodstock ponds (4,000-10,000 m^2) of hatchery owners located 2.5-3 km from the hatchery proper. These vehicles and hundi also carry selected healthy brood fishes of both sexes from these ponds for release in fish breeding units at the hatchery site 4-6 hours before preparations for pituitary extract injection. Only well-matured major carps weighing 1,800-4,000 g are used as brooders (100-300 g for *Labeo bata*).

Such large-sized carps are maintained as brooders with proper feeding and water quality management. Paddle wheel aerators used in many broodstock ponds. For them, a home-made supplementary feed comprising ground nut oil cake, soyabean meal, maize meal, de-oiled rice bran, fish meal, boiled rice, wheat flour, boiled lentil pulses, common salt and vitamin-mineral mixture is used to form dough balls in perforated bags kept suspended in the water column. It costs INR 30 per kg. During 9.00-10.00am every day, 100-150 kg of such feed is provided to every 10 tonnes of broodstock carps, i.e., @ 1,000-1,500 g per 100 kg fish. During 4.00-5.00pm of same day, commercially available floating pelleted broodstock feed (INR 50 per kg) is used, 50 kg for every 10 tonnes of fish. Newly excavated or re-excavated ponds (water bodies), done by fish breeders themselves or with the initiative of the Block Development Officer, Onda Development Block and 100% financial support from Government, serve as broodstock fish ponds in villages under Ramsagar Gram Panchayat. Sri Dey maintains large carp broodstock population of 55 to 60 tonnes. Like others, he replaces and exchanges the major portion of his own broodstock fishes of both sexes from a distant place almost every year. Only 2–3-year-old fishes used for injection, brooders are bought by Sri Dey @ INR 225 per kg. Major carps above 3 years in age are no more used for induced breeding and spawn production.

Part of egg incubation-cum-hatching pools of Sri B.Dey.

Sri P. Nayek's egg incubation-cum-hatching pools.

End note

Since 1950, the residents of Ramsagar Gram Panchayat have taken up fish seed production as one of their major means of livelihood generation, although at that time they used traditional methods for obtaining major carp seed from natural freshwater bodies like river tributaries, canals, and

Simple water sprinkler system in earthen fish holding chambers.

beels. The introduction of induced breeding methods helped them to produce spawn on a large-scale. Small ponds excavated in this Gram Panchayat under the MGNREGA programme are used by some fish breeders to hold brood fishes and/or use them for natural spawning and spawn production of major carps[4]. Two widely recognised and significant fish seed markets of the country viz, Naihati and Bankura, are functional in West Bengal within a distance of around 200 km, catering to the needs of the whole country. A large number of hatcheries are concentrated around Naihati and Bankura as seed producing clusters[5].

Presently about 6,000-8,000 people are involved directly or indirectly with this fish seed production business at Ramsagar Gram Panchayat, including trolley drivers, oxygen cylinder suppliers, hatchery labourers (who administer hormone injection of fishes, feed broodfishes, and conduct other kinds of work and monitoring), carp spawn packers, hatchery technicians, polythene packet and empty cement bag suppliers, cardboard carton suppliers, intermediary persons and customers in Bankura and adjacent districts; also those who do fish netting from ponds to get broodfishes, sieving and harvest of fertilised eggs from small squarish earthen or concrete carp breeding chambers and transfer to egg incubation-cum-hatching chambers. Many local village women make polythene packets of specific sizes from large polythene sheets required for carp spawn transportation, do

Overhead water sprinkler in fish holding pools.

cleaning of used cement bags for reuse, and pack oxygenated polythene spawn packets into cardboard cartons for long distance transport. Financially challenged youths take part in ancillary activities.

Sri Dey and others advise their customers to prepare their nursery ponds properly before spawn stocking by killing medium-sized predatory fishes and also aquatic insects,

Broodfish ready to be loaded and transported to hatchery site.

Harvesting spawn from egg incubation-cum-hatching pool.

Water-swollen fertilised eggs of major carp.

using soap-oil emulsion. Commercial products such as Butox and Cleaner may be used against insects but soap-oil emulsion is safer.

People form adjacent Gram Panchayats of Onda Block come to Ramsagar for work in fish hatcheries. Under each of large fish breeders like Sri Dey and others, 15-30 people work for income. Some of them are permanent labourers, and some are recruited as contractual and daily labourers mainly in the four-month long carp spawn production season. Sometimes customers cannot be present at hatchery site in proper time to receive carp spawn and they cancel previously-placed purchase orders due to sudden storms and natural calamities (and typically express unwillingness to buy and stock spawn in such weather conditions). In such circumstances, Sri Dey and others face monetary loss. Prediction of about-to-occur cyclonic storms or heavy rain in the next 2-7 days is declared in the news but customers have already placed orders much before that date. Carp spawn cannot be kept inside circulating water columns of egg incubation-cum-hatching pools for more than 75 hours from birth. In such unwanted conditions, those unsold spawn are transferred to local small-sized earthen ponds. The demand for carp spawn from customers is heavy during mid-March every year for people like Sri Dey and some others, 500-550 bati of spawn have to be produced per day per hatchery. Then 10-15 persons work, day and night, in one hatchery to produce and fulfil this demand. It is a fifty-year long tradition of induced fish breeding and carp spawn production at Ramsagar Gram Panchayat. In West Bengal, production of fish seed has been increasing as it has not only a good market within the state but also outside the state[6].

Sri Dey has 14 broodstock ponds each of 4,000-10,000 m^2 in area. He has been producing seed for the last 32 years. He received the 'Best fish seed producer' award from the Minister of Fisheries, Government of West Bengal in January 2019 and the State-level 'Krishak Samman' award from Hon'ble Chief Minister of West Bengal in March 2019. The Bankura District carp spawn producers' welfare society ('Bankura Zilla Machh Dimpona Utpadok Welfare Samity') was formed in 1985 with almost all the 130 carp hatchery owners as members. This co-operative aims to resolve the usual minor and major problems (poaching of brood fishes, putting up genuine problems or matter to local or State-level administration for consideration, etc) faced by member fish breeders. It fixes the standard price of sale of Ramsagar-produced carp spawn per bati, applicable to all carp hatchery owners in this Gram Panchayat. Sri Dey and Sri P. Nayek are its Governing Body members.

Sri Dey also owns a semi-indoor mini hatchery system with five small-sized circular and semi-squarish type egg incubation-cum-hatching units of 2.14 m outer diameter each (for circular structures), a overhead water reservoir and pond 140 m^2 in area. It is beside his home, 4,000 m from his main outdoor hatchery site. About 50-60 bati of spawn (60-75 hours old) of major carps is obtained from each of such new model of egg incubation unit in one operation.

Sri Dey and Sri Nayek expressed concern about the bad conditions of the 2-3 km reddish earthen link road between their hatchery proper and the carp broodstock ponds. Fish become stressed and even die sometimes during their transport to the hatchery site on tricycle motor van/trolley, which cannot ply smoothly. Perhaps these hard-working and honest carp hatchery owners will be able to gain more prosperity with prevention of loss in their income and will continue to sustain the livelihoods of hundreds of associated people if obstacles are removed from their way.

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Spawn packets ready for transportation by bus.

Below: Small concrete rectangular chambers for maintaining hatchlings.