Seed production of giant freshwater prawn in brackish-water ponds in Purba Medinipur, West Bengal

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A healthy adult harvested from a grow-out pond.

Macrobrachium rosenbergii farming in West Bengal (with respect to Purba Medinipur)

Freshwater prawn farming is an important and valuable aquaculture sector in Asian countries including China, Bangladesh, Thailand, India, Vietnam and Myanmar[1].
The giant freshwater prawn *Macrobrachium rosenbergii* is becoming one of the most important cultured species in inland aquaculture in India due to its fast growth, strong demand in domestic and export markets, good price and compatibility with major carps[2]. Recently, its culture has expanded rapidly in India with improved seed availability from the wild and hatcheries, and wider adoption of semi-intensive practices. It began with traditional methods with low stocking densities and minimal management, but has developed into a major economic activity[3 4].

In West Bengal, *M. rosenbergii* is cultured in waterlogged paddy plots under rice-prawn integration; in pen enclosures installed in freshwater floodplain wetlands (“beels”); in freshwater farm ponds as monoculture; in tide-fed canals of the Indian Sundarbans; in brackish-water ponds as mono- or polyculture; in modified-extensive brackish-water polyculture with mullets and *Penaeus monodon* in large brackish-water bodies (“bheri/gheri”); in composite fish culture with major carps (avoiding *Cyprinus carpio*, *Cirrhinus mrigala* and *Labeo bata*); and in rectangular cement cisterns (6.1 m × 5.5 m × 1.06 m, or similar) constructed at home premises. *M. rosenbergii* can also be incorporated as a component of carp polyculture in ponds.

Of the twenty-three districts in West Bengal, Purba Medinipur stands out as a leader in commercial grow-out culture and production of Indian major carps, brackish-water shrimps *P. vannamei* and *P. monodon*, and *M. rosenbergii*. This district is resource-rich and a pioneer, dominating freshwater and brackish-water aquaculture and marine capture fisheries (and their annual production). In Purba Medinipur, *M. rosenbergii* monoculture is undertaken in grow-out freshwater ponds by small- and medium-scale farmers; main producing areas include villages under Bhagabanpur-1, Bhagabanpur-2, Moyna, Sabang, Pingla, Contai-1 and Contai-3 CD Blocks[5]. Notably, another established and successful sector in Purba Medinipur is the production of stockable-sized seed (post-larvae; PL) of *M. rosenbergii* in rural brackish-water ponds, sold to grow-out prawn farmers.

Healthy seeds for successful grow-out culture

Demand for *M. rosenbergii* seed has risen sharply in recent years with increased emphasis on farming this high-value species[6]. Success in grow-out farming and wider adoption, extension and higher production depends on the availability of good-quality post-larvae (PL) and juveniles in sufficient numbers. In West Bengal, about 0.20-0.25 million hectares of freshwater ponds may be suitable for *M. rosenbergii* grow-out. To produce a single crop in one-tenth of this area under monoculture, a total of about 500-600 million juveniles would be required (at ~25,000 juveniles/ha), which in turn would need roughly 1,500 million healthy PL[7].

In Purba Medinipur, *M. rosenbergii* seed (7-10 mm; “paddy grain” size) is collected from the Rupnarayan River from early April to late August each year, mainly by women in Gujarkharui village, Sahid Matangini CD Block, about 5 km from Kolaghat on the Kolaghat-Tamluk Road[8]. In the district, PL (10-20 mm) are available in the Shilabati River in the Ghatal area, peaking from March to May; juveniles (40-70 mm) occur in the Keleghai River in Narayangarh, Potashpur and Egra areas (July-October); and collections are also made from the Subarnarekha River near Dantan, the Rasulpur River in Khejuri, and from Kalinagar Canal and Pousi Khal in Bhagabanpur (July-September)[9]. Collections are typically made just after the onset of high tide and supplied to grow-out farmers.

During periodic segregation of *M. rosenbergii* seed from the total catch, collectors discard non-target organisms such as early fry of some riverine brackish-water finfishes and PL of other, less valuable prawn and shrimp species which do not survive. In this context, cost-efficient production of *M. rosenbergii* PL in confined, controlled systems in Purba Medinipur is preferred and increasingly relied upon as a source of stockable-sized seed, rather than river capture.

Giant prawn seed production in ponds: The beginning

In 1993, consultancy and financial support led to construction of a small-scale demonstration shrimp/giant prawn hatchery at Digha, Purba Medinipur, based on a plan presented by an officer of the Department of Fisheries, West Bengal. It had

Kalinagar river in Purba Medinipur.

Bleaching powder applied over a sundried post-larvae production pond.

Close view of M. rosenbergii post larva 10-15mm.

A brooder male of M. rosenbergii.

A healthy berried female of M. rosenbergii.

A healthy juvenile stage of M. rosenbergii.

six 4,500 L rearing tanks, algae-culture tanks, a 25,000 L brine-storage tank and a pump house[10]. The Meenakshi Giant Prawn Hatchery at Digha was intended to produce and supply good-quality *M. rosenbergii* PL and higher stages to farmers from March to October each year. However, grow-out farmers in Purba Medinipur showed greater interest in wild-collected PL and PL produced in brackish-water earthen ponds by inland fishers in coastal villages near Contai town. The then Fisheries Minister of West Bengal, Sri Kiranmoy Nanda, prioritised the popular indigenous practice of producing *M. rosenbergii* PL in brackish-water ponds in Contai-1 and Contai-2 CD Blocks, on a large scale, with guidance and technical support from the Digha Experimental Giant Prawn Hatchery. *M. rosenbergii* PL began to be produced in increasing numbers, meeting seed demand for grow-out farmers. A giant prawn seed market with improved facilities was set up at Radhamoni on the Mecheda-Nandakumar High Road (Courtesy: Dr S. N. Biswas, Retd. Joint Director of Fisheries, West Bengal).

The technology flourished. Professional seed producer Sri Tuhin Rana (aged 40), of Vill. and P.O. Basudebberia, Aurai Gram Panchayat (GP), Deshapran (Contai-2) CD Block, Purba Medinipur, told the first author on 1 May 2025 that this activity has been in vogue for 25-28 years in the coastal Blocks of Purba Medinipur. He noted that PL produced in government and non-government hatcheries is not sufficient to meet farmers' needs, and exploitation from rivers is discouraged because it reduces riverine finfish and shellfish biodiversity. Production in well-maintained brackish-water ponds is an innovative, profitable, low-investment option.

Since 2009, Sri Rana has produced *M. rosenbergii* PL (with fewer juveniles) during March-May in three brackish-water ponds, each with 2,080 m² effective water area (EWA). He purchases healthy, ripe berried females carrying fertilised eggs at various stages (orange, yellow and slate-grey) in the brood chamber on the ventral abdomen, typically 50-150 g from their natural habitat in the Kalinagar River at Suniaghat (4-5 km from Basudebberia). These are bought at INR 700-3,200/kg for stocking in early March. Female brooders collected from other waterbodies 22-25 km away are also transported with care in open containers, such as 20-25 kg plastic "Fevicol" buckets and 15-16 L vanaspati jars half-filled with water, and stocked at about 200-350 brooders per 2,080 m² pond.

Sri Rana's management practices

As pre-stocking practice, Sri Rana dewaters and empties his ponds in mid-March, allowing the bottom soil to dry and crack under strong sunlight. Any thick layer of soft, black, foul-smelling topsoil is removed or sun-dried. He applies agricultural lime (limestone powder) at 10 kg per pond. On the next day, high-tide water from a nearby canal connected to the Rasulpur River is let in through a fine-mesh microfilament screen and maintained at 1.06-1.20 m depth with 10-12 ppt salinity. After 36-48 hours, bleaching powder is applied at 35-50 kg per pond. On day four, paddle-wheel aerators positioned at opposite corners of each pond are run vigorously to increase dissolved oxygen and drive off residual chlorine. The water is circulated strongly and deliberately kept turbid with suspended soil particles. Short, cut branches of date-palm are placed in bunches in the pond.

First author, Sri Tuhin Rana and fishery technician Sri Gokul Rana.

The next day, commercially available powdered zeolite (3-4 kg per pond) and an aqua-product (e.g. yucca powder) that adsorbs toxic gases in water and soil (300 g per pond) are mixed with sand and applied. After 2-3 days, in the mornings, the water is again made turbid manually for two consecutive days. He then applies a dolomite-based aqua-product (3 kg per pond) and a mineral mix (2 kg per pond) in the morning during aeration. Female *M. rosenbergii* brooders are stocked 12-18 hours after this application.

The following evening, he adds a fermented mixture to each pond containing bakery yeast (250-300 g), rice dust (2-3 kg), groundnut oil-cake (1-3 kg) and sugarcane jaggery (2-3 kg) mixed into 20 L of lukewarm water and pre-fermented for 36-60 hours. This promotes high zooplankton production. On subsequent days after brooder stocking, the water is made turbid daily by manual churning for one hour. Adult *M. rosenbergii* prefer turbid to clear water[12]. On the fourth day after applying the indigenous organic formulation

A close view of circular hand net used for collecting post larvae.

Sri Gokul Rana observing growth of M. rosenbergii post larvae.

A pond of Sri Tuhin Rana dewatered after one crop of post-larvae.

(zooplankton enhancer), he reapplies the mineral mix at 2-3 kg per pond. Four days later, in the morning, he "activates" the ponds ("probiotics charging") with a commercially available soil-plus-water probiotic at 400 g per pond to improve bottom health and overall water quality.

Feeding to growing larvae, production and sale

In *M. rosenbergii*, gonadal maturation, mating and fertilisation occur in freshwater. Egg ripeness is indicated by colour: newly spawned eggs are bright orange; the colour shifts to yellow and then slate grey just before hatching. As embryonic development proceeds in the brood pouch, eggs change from orange to yellow and finally to deep grey[11 12]. According to Sri Rana, larvae (which hatch at night) appear in the pond 9-12 days after stocking brooders carrying orange or yellow eggs. First larval stage (FLS) is observed within 2-3 days when brooders carry blackish to grey eggs. The larvae jump and cling to nearby substrates, such as the short, cut branches of date palm. Post-larvae (PL; 7-10 mm) are produced 11-12 days after the FLS appears in his well-maintained brackish-water ponds.

Ponds are aerated daily in the early morning, forenoon and evening, two hours each period, until metamorphosis from larvae to PL. Locally termed "Pin" stage in Bengali, these PL are the marketable *M. rosenbergii* seed. Sri Rana produces and harvests PL within 15-16 days of stocking females carrying grey to deep-grey eggs; more time is needed if eggs are orange or yellow. PL are held in buckets with well-oxygenated water. Healthy PL (7-10 mm) are transported and sold in oxygenated bags to progressive farmers at Fakirhat Upazila (Bangladesh); in Jharkhand and Mumbai; at Basirhat and Malancha in North 24 Parganas (West Bengal); and in Nagaland and Tripura, at INR 700-1,000 per 1,000 PL. Buyers acclimatise PL gradually to lower salinity and then to freshwater: freshwater is slowly added to the untied oxygenated packets, and PL are released into ponds after waiting 20-30 minutes.

After FLS formation, Sri Rana uses biscuit powder or good-quality gram flour (finely powdered roasted, water-swollen chickpea) in liquefied form as feed at one-day intervals. In addition, he applies the indigenous organic formulation the day after FLS formation, using one-third of the original ingredient amounts. Pond salinity and pH are maintained at 10-14 ppt and 7.5-7.8, respectively. Salinity is adjusted to the target level on the day before bleaching-powder application. He keeps nitrite and ammoniacal nitrogen below 0.1 ppm. A portion of the PL grow to 24-25 mm in a further 12-18 days, which he sells at about INR 1.50 per piece. Sri Rana noted that PL survival is poor during sudden, moderate to heavy rainfall.

At present, the main areas in Purba Medinipur where this activity is extensive include Dhobaberia, Bankipur, Sarda, Amtolia, Aurai and Basantia GPs in Deshapran CD Block. According to Sri Naba Kumar Acharya, Fishery Technician and subject expert at Vill. Pachuria, Khejuri-2 CD Block, some local fishers there also produce *M. rosenbergii* PL in earthen brackish-water impoundments using water from the Khejuri River.

Sri Amol Das's giant prawn seed production ponds

Another progressive *M. rosenbergii* seed producer, Sri Amol Das (48) and his father, Sri Sukumar Das, of Vill. and P.O. Namaldiha, Aurai GP, Deshapran CD Block, told the authors on 27/04/2025 that he began this activity in 2001. He owns ten *M. rosenbergii* seed-production ponds, each with 1,500 m² effective water area (EWA), sourced with brackish water from the Kalinagar Canal. Unlike Sri Rana, Sri Das relies on pond-reared brooders rather than wild-caught females. He purchases *M. rosenbergii* at INR 800-2,000/kg from two grow-out farms at Gorbhera village, Bhagabanpur-1 CD Block, Purba Medinipur, located 40-42 km from his site.

Production of berried females at Gorbhera village

At Gorbhera, marketable *M. rosenbergii* are harvested from freshwater grow-out ponds during November-December after about seven months from PL, at 45-50 g body weight. About 70% of adults are removed; the remainder are maintained in the same pond for a further 3-4 months to reach brooder stage, mate and spawn. The farmer ensures the pond bottom remains free of toxic gases such as ammonia, sulphur dioxide, hydrogen sulphide and methane. A published article[13] notes that, after six months, adults should be maintained at a sex ratio of 1M:4F. The *M. rosenbergii* adults turning to brooders are fed commercial pellets (formulated for L. vannamei) and a home-made feed containing fishmeal, boiled lentil pulses, groundnut oil-cake, soybean meal and other ingredients.

In the grow-out ponds, a ripe female *M. rosenbergii* moults and then copulates with a hard-shelled male. Egg release follows within 2-3 weeks. Fertilisation is external; the eggs

Sri Amol Das collecting post larvae samples from a date palm tree branch in pond.

A branch of date palm tree used in post-larvae production pond.

are bright orange and are carried back to the brood chamber. Berried females of 50-60 g (some 60-80 g), aged 9-11 months, are collected during March-April and transported to Sri Das's brackish-water ponds for stocking at about 140 females per 1,500 m² pond (≈ 7.0-8.5 kg per pond) to produce one crop of PL. (Note: As in grow-out ponds, the peak breeding period of *M. rosenbergii* in the Hooghly estuary and in canals and creeks of coastal Purba Medinipur is March-May.) To produce three crops from each pond during March-May (with proper pre-stocking preparation and harvesting between cycles), Sri Das uses roughly 25 kg of female brooders per pond per season.

According to him, this is highly profitable because PL can be harvested and sold within a short period, typically from day 15-16 after stocking berried females carrying deep-grey to blackish eggs, or within 15-22 days. He also emphasised that the work is sensitive: pond-water salinity, transparency/turbidity, dissolved oxygen, hardness, ammonia and pH must be kept within specific target ranges throughout the production period.

Pond management practices of Sri Das

After dewatering, Sri Das first turns over the pond-bottom soil using a tractor plough. He then proceeds as follows: applies quicklime at 50 kg per pond; after one week, admits tidal water from the Kalinagar Canal to a depth of 1.36-1.52 m; applies a commercial product to kill early stages and sub-adults of unwanted fishes, insects, small molluscs and micro-organisms; applies bleaching powder the next day at 25 kg per pond; from day 3-4 after bleaching, aerates vigorously

A post-larvae production pond of Sri Amol Das.

about 4 hours per pond by day and by night for the next 4-5 days; deliberately makes the water turbid by manually churning the bottom so clay and silt remain suspended; applies a mineral mix at 25 kg per pond three days after starting aeration; applies the organic formulation “Juice” after 36 hours’ fermentation to promote zooplankton; applies a commercial dust-type probiotic in the early morning at 250 g per pond; and applies a good-quality “soil + water” probiotic at 5 kg per pond. He notes that benzalkonium chloride may be applied three days after bleaching at 1.5 kg per 1,500 m². Applying the mineral mix at 7-8 day intervals gives good results. Additional liming (calcium carbonate) is not required when bleaching powder has already been used.

The ponds are ready for stocking 10-11 days after filling. From the day chlorine is removed until the first larval stage (FLS) appears, the water is purposefully kept turbid by hand-churning the bottom and by operating a machine for two hours each in the early morning, daytime and night. According to Sri Das, 7-8 ppt salinity is favourable for PL production. Each pond has a 5 HP paddle-wheel aerator installed.

Healthy adult M. rosenbergii produced using post larvae of Sri Amol Das.

Sri Amol Das, his associate and both authors beside one of Sri Das's pond.

Bunches of short, cut date-palm branches are hung upside down and fully submerged in the water column, supported by long vertical wooden poles, at 15 points per pond. After lifting, the bunches are gently shaken to collect attached PL in a circular hand net held beneath. Larger branches are placed singly, upright, with the base inserted into the bottom and the tip emerging above the water surface.

Sri Das checks daily for larvae and PL from day 6 after stocking berried females, using a 0.75 m-diameter circular hand net of 10-micron mesh and a white enamel tray. Adequate zooplankton presence supports proper larval growth. From brooder stocking onwards, he runs the paddle-wheel aerator in each pond for two hours in the early morning, daytime and evening, continuing until PL harvest is complete.

Organic “juice” preparation and sale of post-larvae

To prepare the organic formulation “Juice” (an indigenous prebiotic), Sri Das mixes bakery yeast (450 g), three packets of Britannia biscuits (1,200 g), date-palm molasses (5 kg), wheat flour (4 kg), finely pulverised “Starter” grade shrimp pellets (2 kg), sun-dried and boiled paddy grains (1 kg) and “rice of the previous night soaked in water” (2-5 kg). The mixture is fermented for 36 hours, diluted and applied to each 1,500 m² pond during the daytime.

When berried females with grey egg masses are stocked, saleable PL are produced by day 15, measuring about 7-8 mm (a little longer than a cumin seed). Harvest continues from this day until day 25. PL are sold at INR 300-350 per 1,000 in oxygenated plastic bags at the pond site. A larger 22-25 mm stage is sold at INR 400-500 per 1,000. Buyers include progressive prawn farmers in Purba Medinipur; farmers at Ghatakpukur, Basirhat and Malancha in North 24 Parganas; and some villages in Bangladesh. In West Bengal, most giant freshwater prawn culture is concentrated in North 24 Parganas[14], in both freshwater and brackish-water polyculture systems.

End note

Inland aquaculture plays an important role in poverty reduction: it provides reliable income, creates jobs and empowers low-income communities, small-scale and rural farmers[15]. In Purba Medinipur, both *M. rosenbergii* grow-out culture and PL production in ponds are carried out mostly by smallholder farmers, many of whom are resource-poor and marginal. Although smaller in scale than brackish-water shrimp farming,

Good quality M. rosenbergii being sold at a fish market.

these are established practices and clear avenues for income generation. Pond-based PL production creates employment while meeting the seed needs of grow-out farmers. In West Bengal, notable success has not yet been achieved in hatchery breeding and PL production of *M. rosenbergii*[16]. Rural pond PL production requires modest investment and is currently practised from March to June each year in Deshapran and Khejuri-2 CD Blocks of Purba Medinipur.

Among other systems, *M. rosenbergii* is a promising species for the cage-culture technology developed by ICAR-CIFRI for inland open waters of India (e.g., reservoirs), provided quality seed is available in adequate quantity[17]. The farmer-led seed-production method in brackish-water ponds in Contai-3 CD Block has been studied by researchers at the West Bengal University of Animal & Fishery Sciences and adds significant value to grow-out farming[18]. Pond oxygenation for 5-8 hours in every 24 hours (08:00-10:00, 15:00-17:00, 22:00-00:00 and 03:00-05:00) is essential; without sufficient aeration, egg incubation and hatching are impaired and larvae will not survive. Pond water should be iron-free and salinity should not exceed 15 ppt. After stocking *M. rosenbergii* mothers, bottom chaining/churning and aeration help maintain turbidity, which is important. Organic “juice” may be applied 2-3 days before stocking. Before stocking, apply a reputable Soil probiotics (mixed with sand), followed by a Water probiotics mixed with date-palm molasses in freshwater.

M. rosenbergii eggs hatch in freshwater ponds, but larvae do not survive; hence brackish-water ponds are used. Short, cut portions of date-palm branches and larger pieces should be treated with $KMnO_4$ before use. Both Sri Rana and Sri Das routinely check ammonia (NH_3) and maintain it below 0.1 ppm, with hardness at the lower end of the acceptable range. Suitability of pond water is the key to successful PL production. Although copper sulphate applied before stocking can kill unwanted molluscs, its use in aquaculture is no longer recommended. During transport of berried females from freshwater ponds and riverbanks to brackish-water ponds, stress should be kept to a minimum. For PL transport, 2,000-3,000 *M. rosenbergii* PL (7-10 mm) can be packed per polythene bag with roughly 1 part water to 2 parts oxygen for journeys of 5-6 hours. Buyers report that growth of these PL is comparable to riverine PL.

According to Sri Subhajit Mondal, a PL producer at Vill. Phulbari, Deshapran CD Block since 2019, PL (7-10 mm and 22-25 mm) in oxygenated packets are fit for journeys of 10-12 hours (or less) to destinations in Bangladesh and elsewhere. The larger PL can reach 35-40 g body weight in 100-120 days of grow-out when fed commercial pellets. He estimates that 2.0-2.5 million PL may be obtained from a 1,000 m² pond with effective water area. For one crop, he stocks 5-6 kg of berried females per 1,000 m² pond. The authors note that, because seed production in brackish-water earthen ponds occurs in summer, it is advisable to provide full or partial

Transportation of berried M. rosenbergii in containers on two-wheeler.

overhead shade to prevent excessive water-temperature rise. Higher temperatures may be unfavourable for the FLS and subsequent larval stages, and for PL. Direct, intense sunlight also raises salinity, which can exceed 15 ppt, is undesirable for PL production.

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