

Wild seed collection and modified-extensive farming of *Mystus gulio* in inland water bodies of South 24 Parganas, West Bengal



Subrato Ghosh

122/1V, Monohar Pukur Road, P.O. Kalighat, Kolkata – 700026, West Bengal, India
Email: subratoffa@gmail.com

70 g *Mystus gulio*.

Mystus gulio in pisciculture

The cultivable small- to medium-sized bagrid catfish *Mystus gulio* is a mangrove fish species, inhabiting estuarine brackishwater wetlands, tidal rivers and streams, creeks and confined freshwaters, and sold as a high-priced food fish in retail markets in cities and towns in southern West Bengal. It is distributed in the lower-most saline zone of the Hooghly estuary, and also encountered in the Sundarbans estuarine complex where it is commonly found at 10-20 cm length¹, although it spawns in freshwater. Among the farmers of fourteen and six brackishwater Blocks in South and North 24 Parganas districts respectively, where both fresh- and brackish-water habitats exist, *M. gulio* ('nona tengra' or 'bherir tengra' in Bengali vernacular) is being extensively adopted important new species in both freshwater and brackishwater fish culture in village ponds (old backyard semi-managed and well-maintained; also in those having quite high iron content and turbidity) in modified-extensive mixed culture system.

With other brackishwater fishes, *M. gulio* is a good component in culture-based fisheries in canals in the Indian Sundarbans region. It adapts and grows well in freshwater ponds and is recommended for freshwater fish culture in areas of the Sundarbans vulnerable to 5-10+ ppt saline water inundation². A production of 1,200-1,400kg/ha is achievable during April to July and it acts as bottom cleaner, consuming

detritus in polyculture ponds (Dr D. De; excerpt of talk on 'Brackishwater aquaculture opportunities and challenges for meeting livelihood demand in the Indian Sundarbans', 11/1/2020, Kolkata).

In inundated freshwater ponds turned brackish due to natural calamities in the Sundarbans, *Tilapia nilotica* and *M. gulio* can survive. A cluster of villages namely Amjhara, Taldaha, Khorimachan, Phulmalancha, and Sambhunagar-Chunakhali located on the eastern side of the Matla River in Basanti Block in South 24 Parganas are a 'nucleus' of naturally-occurring *M. gulio* seedlings and seeds, exploited every year in good quantity and sold to fish farmers by local seed traders. The Kakdwip Research Centre of ICAR-CIBA in West Bengal developed a comprehensive package for controlled breeding, larval rearing and farming of *M. gulio*. Sri Rabiul Islam Sekh at Namkhana Block in this district developed cost-effective and farmer-friendly modular homestead hatchery technology in 2018³ and is continuing with support of the institute. Now *M. gulio* farmers in southern West Bengal can avail for its seed, both wild-collected and induced-bred, for stocking in freshwater and brackishwater ponds and larger fish farming areas, viz., rice fields turned freshwater body, ricefield-pond complex, 'mithen gheri' or freshwater ponds of 10,560-26,400 m² or even more in area.



A stretch of the Matla River during ebb tide.

Scientists at Ramkrishna Ashram Krishi Vigyan Kendra, Nimpith, South 24 Parganas conducted on-farm trials on increasing profitability from carp polyculture ponds (650 m²) by introducing *M. gulo*. Village farmers practice polyculture of major carps in freshwater ponds with proper pond management and application of supplementary feed @ 3% of body weight daily; carp fingerlings stocked @ 10,000/ha and additionally *M. gulo* fry stage stocked @ 5,000/ha and 7,500/ha as two technology options. On farm trials have also been conducted on enhancing profitability by culturing *M. gulo* in small monoculture freshwater ponds of 325 m² in the Sundarbans region⁴. Bacterial ulcers, tail/fin rot, and fungal infections are sometimes observed in air-breathing catfishes but not in *M. gulo*. Other merits include its good market demand and rate (even 7.5 cm stage sold @ INR 300/kg in district wholesale markets); it may be cultured with monosex tilapia, *Pangasianodon hypophthalmus*, major carps and other fishes; accepts boiled broken rice, broken maize grains, byproduct of wheat flour 'gomer bhushi', poultry litter mixed with powdered floating feed or wheat flour as feed. The 40-70 g farmed *M. gulo* are sold at much higher price in areas of Basanti and Gosaba near to the Sundarbans when tourists arrive during the year-end.

Canals in the Sundarbans region

Canals, inundated paddy fields, backyard ponds, large natural water bodies and excavated ponds form five distinct types of freshwater niches in the Sundarbans⁵. The tidal brackishwater Matla River runs in a north-south direction and is a major riverine system in the Sundarbans region. Its tributaries include the Karati, Rampura Khal, Atharobanki and



A canal in Amjhara-Taldaha village.

Bidyadhari rivers. A large number of canals ('gang') in the Sundarbans, 500-2,500 m long are fed by tidal waters from their parent rivers and through connecting channels. Adult *M. gulio* enter canals forming natural populations. During the monsoon, water enters canals when the river water level is high⁶; such inundation canals are fed both by tidal flush and freshwater influx.

Open fields – repository of *M. gulio* seed

The occurrence of *M. gulio* seedlings observed over the last 20-30 years has occurred exclusively in vast stretches of agricultural land on low-lying extended floodplain ('gher' or 'gheri') in the afore-mentioned villages. With onset of the first pre-monsoon and monsoon rain in March-April and April-May and during the first full moon and new moon periods, large (75-150 g; 12-15 cm) mature *M. gulio* of both sexes leave the Matla River and canals near the river bank as the water rises, and migrate into extended paddy fields and gher (individually 66,000 – 528,000 m²) with shallow (7.5-20 cm) stagnant water for spawning. Other fishes such as *Channa* sp, *Anabas testudineus* and *Mystus* sp. also enter the paddy fields to lay eggs in monsoon during paddy sowing season as waters flow in from adjacent beels⁷.

Female *M. gulio* become gravid in early summer with occurrence of mild rainfall. Brooders move into paddy plots from estuarine wetlands, unexploited brackishwater canals (unfished and water never drained) that have connections to the Matla River through sluices, semi-derelict ponds and common village ponds lying near to the fields in the afore-mentioned villages. The sluice gates of canals are often manually opened in that time of year. Smaller-sized brooders (50-75 g) move into the same plots in the next 30-45 days and spawn.

In the Sundarbans, breaching in river bundhs facilitates the inflow of water into canals and entry of *M. gulio* brooders into adjoining fields. After spawning, adhesive fertilised eggs are laid over the submerged portion of young grasses; parents provide oxygenation to developing eggs with their tail. The fecundity of 50-70 g brooder females (6-8 months old) is 5,000-8,000⁸; that of females one year old or more (100-200 g) is higher.

Often, mature *M. gulio* migrate and enter into fields from canals as water flows out from paddy fields. Fish farmers prefer seedlings resulting from the first spawning of the larger brooders, as they have better survival and fast growth when stocked in ponds. According to seed traders, the seedlings of March-April attain 100-150 g by next April or April-May in culture ponds; whereas seed of the next 1-2 months takes 14-18 months to reach this size.



A rice field-pond complex.

***M. gulio* seed collection and supply**

From March-April and April-May onwards every year around seven days after the the first rain, 7-10 mm *M. gulio* seedlings or spawn (5-10 days old; cumin seed in size) are exploited by many women belonging to economically-poor local households and traditional fish seed collectors over the next 3-4 months using fine-meshed nylon nets 1.5-2.0 m long and 45-50 cm high, dragged forward along the bottom of fields by two people bowing down. Every pair of women can collect around 50-250 g seedlings working from 7.00 am-1.00 pm and 500-800 g by more impecunious women (fewer in number) who work till 6.00-6.30 pm, eliminating early frog larvae (if any) from their collection. Seedlings of *M. vittaus* ('sona tengra') comprise only 10-15% of it. Seedlings from every *M. gulio* female congregate or remain in a small grassy area, almost sticking onto the grass surface with their head end. Naturally collected early season seedlings are bought by farmers from seed traders of these villages @ INR 2,200-2,500/kg, size: 45,000-55,000/kg (35,000-40,000/kg according to another trader).

Seed collectors exploit advanced fry (6.35-8.90 cm; 300-450/ kg) from canals during August and August-September in same year, which are sold to farmers @ INR 700-800/kg. In October, 5.0-6.35 cm seeds also available in canals (600/kg) in addition to larger sizes, captured and sold @ INR 400-600/ kg to farmers. In the beginning of the season, *M. gulio* seed traders buy seedlings from collectors @ INR 1,600-2,000/kg; its price falls towards the middle and end of season. A few weeks later, from April-May, the 25-30 days old *M. gulio* seeds (8,000-12,000/kg) are also captured from fields by village women and seed collectors singly using circular nets of 60 cm diameter and sold to traders @ INR 700-900/kg. Traders transport and supply oxygen-packed *M. gulio* seedlings to farmers mainly in Patharpratima, Namkhana, Bishnupur-I, Diamond Harbour-I and II Blocks in South 24 Parganas 30-80 km from home and North 24 Parganas (Sandeshkhali-I and II, Basirhat, Hasnabad Blocks).

Presently 12-14 professional *M. gulio* seed traders in afore-mentioned villages (i.e., in entire West Bengal) and 6-8 persons exclusively in Amjhara, Taldaha, and Khorimachan villages supply the wild-collected *M. gulio* seedlings and seeds to pisciculturists from the entire area, representing



Author right with *M. gulio* farmers at Jharkhali.



Author with *M. gulio* farmers beside the Hatamari River.



Advanced fry of *M. gulio* captured from canal.



Author with three *M. gulio* farmers.



A few pond-grown *M. gulis* of 70-80 g.

some 200 square kilometres. Sri Balai Naskar, age 69 at Taldaha-Shikaripara Village in Basanti has been collecting and trading *M. gulis* seed since 1995 and was the first person to initiate collection and trading of naturally occurring *M. gulis* seedlings/seeds in West Bengal. Younger son Tapas Naskar works with him, while elder son Khokan Naskar is also an established and successful *M. gulis* seed trader. *M. gulis* seedlings and seeds are also available around the same time of year in fields in Canning-II and other places in both districts on river banks and associated canals but no *M. gulis* seed traders exist there and local people aren't interested in collection, so the resource is left unexploited.

Traders collect *M. gulis* seedlings from women and other persons at home in evening and transport them overnight, selling them within 8-30 hours, maintaining the seed on wheat flour in cotton cloth hapa enclosures fitted in homestead ponds for brief period. Prior to beginning of the season, they survey the possibility of sufficient occurrence of *M. gulis* seedlings over the next 3-5 months in specific zones of open fields in afore-mentioned villages and areas of the neighbouring Canning-II, Hasnabad Blocks. Women and *M. gulis* seed collectors are informed accordingly. During August-early October, larger *M. gulis* seeds are collected from deeper areas on the sides of paddy fields; the very small ponds without embankments. For seed traders in these villages, the profit margin from sale of every kilogramme of *M. gulis* seed is INR 200-450 in the beginning of the season and INR 50-80 towards the end. As recruitment of wild *M. gulis* seed is observed in nature by collectors, 10-25% of it (which

is a considerable quantity) could be captured from open fields and nurtured in well-managed ponds; while the remainder survives in the wild to replenish natural stocks.

Sri Naskar opined that in every 640 m² polyculture pond, 250 g *M. gulis* seedlings (30,000-35,000/kg) may be stocked in addition to carp fry. In monoculture ponds, 8-10 kg seedlings may be stocked exclusively and propagated, attaining marketable size of around 8.9-10.2 cm (20-50 g) in 90-100 days. Dry wheat flour can be fed daily up to 2.5 cm and subsequently commercial floating fish feed (INR 90-100/kg). Growing *M. gulis* also accepts soaked mustard oil cake and by-product obtained from the Ghatakpukur leather complex near Kolkata where animal skin and cartilage processed and converted into leather ('sukno jhilli'); but this is controversial and so is not used at present. He maintains a stock of *M. gulis* seed (around 7 kg @35,000/kg) stocked in a 96 m² pond which reaches 2,000-2,500/kg (22-25 mm) in 35-50 days. These are sold to farmers @ INR 700-900/kg as demand arrives. Wheat flour and/or fine particles of boiled eggs are fed to growing seedlings every day.

At Chunakhali-Mirsahebpara and Gongorpara villages near the Hatamari River, 12-24 mm *M. gulis* seed (2,000-2,500/kg) captured from fields during June-July are sold to freshwater fish farmers in Deuli, Jibontala and other distant villages @ INR 500-1,200/kg, stocked in large freshwater bodies of low depth. Seeds of 10-15 g are caught in traps placed near sluice gates when water is let out from *M. gulis* farming plots into canals during October-November and preparations are



Net for catching 15-25 mm *M. gulio* seed.



M. gulio 15-20 g in a sample netting.

made for summer paddy farming. Reputed fish breeder and farmer Mir Amirul Islam stocks 5 kg of *M. gulio* seed (10,000) / 1,320 m² in monoculture ponds and 10 kg in his 13,200 m² gheri at a low density in the presence of major carps. He uses 1 mm pelleted feed during the initial few days of farming (INR 65/kg) and 3 mm pellets (INR 52/kg) later on. The fish attain 80-100 g when harvested in April-May of the following year. A uniform size is obtained in 8-9 months of culture with very low mortality during winter months if fishes are fed properly, otherwise size variability and slow growth is evident (maximum 40 g). The 80-100 g *M. gulio* are sold @ INR 500/kg in the local fish market but reach INR 650-700/kg in Topsia wholesale market, much nearer to Kolkata city. He often maintains the early stages in large hapa enclosures in ponds for a month up to 36-48 mm and subsequently stocks them in large water bodies; higher survivability is observed.

Farming of *M. gulio* in freshwater bodies

In a few places in Basanti Block, *M. gulio* (600/kg at stocking) is cultured in large water bodies of 5.28-6.6 ha in association with other finfishes and giant prawn. Almost every household in the Sundarbans region has a freshwater pond, typically around 200-320 m². Some farmers in Nafarganj village, Basanti and other Blocks in South 24 Parganas do *M. gulio* culture in 320-1,320 m² ponds with *Heteropneustes fossilis* or *Puntius sarana*. A fish farmer in Jyotishpur Village mentioned that in monoculture in well-managed brackishwater ponds of maximum 105 cm depth, *M. gulio* can attain 100 g in 120-130 days, stocked @ 10,000/bigha (size: 500-1,000/kg) with 70% survivability, fed on commercially pelleted feed with 28-30% protein content. Harvested *M. gulio* are sold @ INR 450-500/kg. In these villages, 2.5 cm seeds captured in fishing traps and nets from naturally-occurring canals and water-logged fields in June-July. Later stages of 10-20 g are captured and sold locally to farmers during September-early November (while post-monsoon rainfall persists) in Notunhat market @ INR 120-140/kg.

Sri Prabhas Jana's pond ('fishery') in Dholar-Kachharipara village is 200 m from the eastern bank of the Bidyadhari River in Basanti but of zero salinity; *M. gulio* is cultured with Indian major carps and 100-150 g (15-20 cm) of specimens



M. gulio 15 g at Canning fish market.



Female *M. gulio* 125 g.



M. gulio 20 g grown in freshwater pond.

of the latter are harvested when ponds are dewatered during February-March to April-May. *M. gulio* of 15-20 g in September-October attain maturity in next April-May. The 20-40 g stages are sold in local markets @ INR 350-400/kg (more in Kolkata city and sub-urban fish markets) in live condition without water. Dead and ice-preserved *M. gulio* fetches only INR 100-150/kg as the body colour turns whitish and is unappealing to buyers. Some farmers harvest at the end of November as it only feeds a little and the body turns thin in winter with low water temperature. Mature *M. gulio* enter partially-inundated fields in pre-monsoon and monsoon, and move into canals and creeks during post-monsoon flood-like situations. They may remain in deeper areas of paddy fields.

In deeper areas (90-105 cm water depth) on the sides of paddy fields, monsoon paddy saplings are sown and grown in field and *M. gulio* achieves good growth in the former. In early December, large *M. gulio* fry are captured quite easily from canals as the water table recedes. Sri Dipankar Bera at Patharpratima Block has success in polyculture of milkfish *Chanos chanos* and *M. gulio* (bottom feeder) in freshwater ponds; the latter attained 40-60 g from 36 mm stage in eight months. In 1,320 m² of such ponds, 20,000 *M. gulio* fry (induced-bred; 24-36 mm) may be stocked and fed a mixture of fish meal 300 g, mustard oil cake 300 g and rice bran 400 g as dough balls in small earthen containers ('maateer maalsa')

@ 8-10% of body weight daily. Market-sized *M. gulio* of 40-50 g are sold locally @ INR 350/kg; the cost of production for 1,000 g fish is estimated to be INR 180 (Sri D. Bera; personal communication). It consumes quite a high amount of pelleted feed quickly in monoculture ponds; the 2,000-3,000/kg stage may be stocked. In monoculture ponds with greenish water, farmers may stock *M. gulio* @ 600-700/40 m², 1,200-2,000/kg size; 7.6 cm *M. gulio* are sold at Rs 350/-/kg in Bangladesh. If 10,000 seed are stocked weighing 10 kg, then 2 kg commercial pelleted feed (0.8-2 mm) should be applied daily in two halves. Broken maize, mustard and soyabean oil cakes can also be used. *M. gulio* seed of 2,800/kg size grow up to 200/kg in size in 16 days. Stocking of grass carp in the same pond and its faecal matter proved useful for *M. gulio* growth. Every 10,000 fish (20-22 g at stocking) require 5-6 kg feed everyday (Courtesy: Bala Fisheries, Jessore, Bangladesh). From 5 g (200/kg) size onwards, pelleted feed applied @ 5-6% of body weight two times daily (Courtesy: Desi fish farming you tube channel)

During high tide in canals in full moon and new moon days beginning in May till July-August ('snarasarir kotal') in different areas in the Sundarbans region, villagers report the occurrence of *M. gulio* seeds (2,200-25,00/kg) in good numbers along with seeds of other brackishwater fishes, which are captured and locally supplied to fish farmers @ INR 200-300/kg who in turn randomly stock about 5-7 kg seeds in every

130-400 m² homestead pond where fry/fingerlings of major carps already exist. Little pond management or feeding is practised. Table-size *M. gulio* of 35-210 g, pond-grown using a modified-extensive method, are observed in small rural retail fish markets. In rural ponds of 7,100 m² at Joynagar-II Block, *M. gulio* is cultured traditionally in association with major carps (stocking 2,000/10,000 m² out of total 15,000/10,000 m²) using rice bran and mustard oil cake as feed @ 3% of body weight daily. At stocking, fry/fingerlings of major carps must be larger in size than *M. gulio*.

Sri Debdas Das at Paschim Dighirpar village in Canning-I Block procured and stocked 2 kg of *M. gulio* seedlings (90,000-100,000) from Sri Naskar in a 320-400 m² pond with zero salinity, which reached 45-48 mm size (1.0-1.5 g) in 30-35 days of nursery with 80% survival and 8-10 g in 75 days. He stocked *M. gulio* fry in larger freshwater ponds and reared them with major carps (72 mm at stocking; 250-300/kg) and pangas catfish. *M. gulio* attained 50-70 g in 6-7 months and Indian major carps 250-400 g in 5-6 months using home-made wet formulated feed @ 5-8% of body weight daily. If naturally occurring seeds resulting from first spawning of large brooders are first nurtured in small earthen nurseries, and next in grow-out ponds, they exhibit good growth and reach 100 g in 11-12 months, Sri Das opined. He prepares dust-type feed using de-oiled soyabean dust, pulverised groundnut and mustard oil cakes, wheat flour, pulverised and sieved fish meal and semai noodle (rice vermicelli) dust; its cost comes to INR 60/kg whereas commercially-available non-air-breathing catfish feed costs INR 90-120/kg. Feed is applied to *M. gulio* seedlings @ 100% of body weight for the first 7-8 days and reduced to 15-20% on each day of the fourth week. Seedlings are stocked in small earthen ponds of 200-320 m² in early May. They prefer to take feed during late evening and night hours and cannot tolerate too much light.

According to giant prawn farmer Sri Ashok Giri at Parbatipur-Birinchibari in Basanti, *M. gulio* grows up to 100-150 g in 8-9 months and is sold @ INR 500-600/kg in Canning town fish wholesale market. He stocked 12 mm *M. gulio* seedlings in mid-June in a 92 m² pond, 15,000/kg, total 30,000 after buying @ INR 1,500/kg and 10,000 giant prawn juveniles (4.8 cm). *M. gulio* feeds upon faecal matter of major carps but must be fed properly otherwise considerable difference in body weight occurs at harvest. In polyculture systems, growing *M. gulio* of 7.5-10 cm can hurt carp fingerlings with their sharp dorsal and pectoral spines while feeding, particularly if feed is applied in insufficient amount. It reached 40-50 g in 3.5 months with 80% survival. His *M. gulio* are acclimatised to accept trash shrimp meal (sieved) and/or pulverised fish meal. Both *M. gulio* and prawn accept boiled mussel meat. Prawn juveniles should be of a large size at stocking; otherwise growing *M. gulio* will be aggressive towards them after moulting.

Sri Paritosh Mondal, Sri Haju Jana and a few others at Tridibnagar village in Jharkhali, Basanti are growing *Catla catla*, *Labeo rohita*, *M. gulio* and giant prawns in well-maintained 13,200-15,840 m² 'gheri' (perennial freshwater-logged paddy plots 76-120 cm deep, without paddy). Over the last two years, they bought *M. gulio* seedlings at a low price @ INR 700/kg (10,000-15,000/kg; 10-14 mm) in mid-June collected after first rain from fields on Herobhanga river bank at Tridibnagar-Adivasipara. 10 kg of seedlings were stocked in such areas.



M. gulio early fry harvested from nursery pond.



M. gulio 25-40 g at Sonakhali fish market.



M. gulio 30-80 g at Canning fish market.



Small freshwater *M. gulio* farming plots.

The Amjhara-Taldaha-Khorimachan villages are 50-55 km from this extreme end of Basanti. They used small particles of locally-available baked cake and biscuit crumbs (INR 12/kg), wheat flour, mustard oil cake, and non-edible portions of goat from local butcher shops (INR 40/kg) but found these ingredients to be insufficient; *M. gulio* will attain good growth and can be profitably cultured if floating/sinking pelleted feed (INR 1,800-1,900/40 kg; powdered ~2mm diameter) is combined with wheat flour or broken maize (2.5:1) and fed twice a day. *M. gulio* of 40-80 g is harvested at December-end along with paddy when ponds and gheri are dewatered but in conditions of insufficient and improper feeding, the fish attain 15-30 g (5-9 cm) during this period. Local marginal farmers with small land holdings (water-logged paddy fields with 20-25% deeper area as ponds with low embankments or fish refuges, paddy grown in upper region) stocked 2 kg seedlings in every 3,960-6,600 m² area but couldn't afford to buy protein-rich pelleted feed. Successful *M. gulio* farmers sold 35-70 g fish @ INR 500-540/kg in Sonakhali wholesale fish market; smaller ones as a second group (50-60/kg) were sold @ INR 350-360/kg.

***M. gulio* farming in brackishwaters**

In large brackishwater aquaculture areas in lower the Sundarbans where mullet, pearl spot and tiger shrimp are stocked and propagated, other fishes such as *M. gulio*, *Eleutheronema tetradactylum*, *Scatophagus argus*, *Rhinomugil corsula* and *Terapon jarbua* are observed as potential additional crops because of their natural entry during tidal water exchange⁹. In traditional brackishwater tide-fed impoundments ('bheri'), *M. gulio* attained a final body weight 82.5 g (20.5 cm) from an initial 1.78 g (5.6 cm) in 360 days of rearing, stocked @ 1 piece/m². In brackishwater earthen nurseries, it attained 460 mg (31.15 mm) from an initial 3.33 mg (4.53 mm) in 42 days with 89% survival stocked @ 200 individuals /m² ¹⁰. In addition to natural stocking of the 'bheris', shrimp and prawn seed are stocked together with fish seed including Asian seabass, mullet and *M. gulio*, which are wild collected and purchased from local seed traders¹¹. But brackishwater fish farmers and 'bheri' owners at Kotrakhali near Hana river in Basanti don't prefer the presence of *M. gulio* in brackishwater bodies and never stock its seed as it preys upon *Penaeus monodon* and *P. semisulcatus* seed. At times when tidal water is let in, larger *M. gulio* escape from bheri(s) through holes previously created in embankments underwater by eel-like fishes. In bheri(s), *M. gulio* feeds largely on algal growths and small crustaceans¹².



Structure for allowing entry of fish seed into large pond.

At Dakshin Gopalnagar and adjoining villages near the Chinai and Selemari rivers in Patharpratima Block, a brackishwater polyculture 'nona fishery' is practiced by farmers in 3,960-33,000 m² impoundments having 10-14 ppt salinity, comprising Asian seabass, mullet, *M. gulio* and *Scatophagus argus*. Fish seed enters plots naturally during rising tides. *M. gulio* grows to 50-70 g in 6-10 months feeding upon plankton and small wild shrimps, is harvested during April-May and sold @ INR 500-600/kg at Kakdwip and Nischindipur wholesale fish markets. If harvested during the previous November-December, it will have a low demand and fetch a low price as familiar marine finfishes dominate the local fish markets at that time of year. According to progressive and innovative brackishwater fish farmer and *M. gulio* seed producer (induced-bred) Rabiul Islam Sekh in South 24 Parganas, the 7-days old larvae (12-14 mm) grow up to 24-36 mm in 21 days in earthen nurseries of 45-60 cm depth when stocked @ 20,000-25,000/120 m² with 50-55% survivability. *M. gulio* fry attain 70-125 g in brackishwater grow-out monoculture ponds (7-10 ppt) in six months when stocked @ 20,000/1,320 m² with very low mortality. Each *M. gulio* individual consumes 3-4 feed particles (commercial pellets 1mm dia; INR 50-55/kg) per day in each of the first 60 days, 5-6 particles (2 mm diameter) per day from 31-60 days and 10 particles per day from 61-90 days. In Namkhana Block of South 24 Parganas, 5-6 farmers procure *M. gulio* seeds (fry) from Sri Sekh @ INR 2.00-2.50/ piece and are grown in clean brackishwater monoculture ponds of 600-800 m² with a hygienic bottom soil, for two

crops per year. Sri Sekh in turn procures and maintains brooder *M. gulio* 100-200 g from them as required. The author learnt from reputed fish farmers Sri Dibakar Majumdar and Sri Debakinandan Patra in Namkhana about their success in grow-out culture of *M. gulio* in polyculture in freshwater and brackishwater ponds.

End note

Farming of *M. gulio* as practiced by quite a few progressive fish farmers and rural fisherfolks in the Sundarbans region of South 24 Parganas has been brought into focus and discussed in this communication in addition to description of wild seed collection methods. Good-priced farmed *M. gulio* is tastier and nutritious than major carps; remains alive for considerable time outside water; the meat texture of 70-100 g oil-fried *M. gulio* remains stiff and unaltered for 5-6 days at room temperature at home whereas that of major carps starts becoming soft in 1-2 days.

While it is a food fish of the Sundarbans region, nurtured and grown here, demand is increasing in distant fish markets in cities and suburban areas in West Bengal but the quantity supplied presently cannot meet demand. Live *M. gulio* of 50-70 g and above is rarely found in Kolkata city markets.

Sri Sekh whole-heartedly disseminates the technology of seed production to 4-5 progressive fish farmers and gives advice in establishing and operating small-scale hatcheries, so that more seeds are produced and made available to fish farmers in North and South 24 Parganas, Nadia, and Murshidabad districts (as Sri Sekh receives phone calls from freshwater fish farmers on willingness to purchase *M. gulio* seeds). Ultimately *M. gulio* culture will flourish and gain wider acceptance. The income from sale of table-size major carps in wholesale markets in West Bengal, typically produced in a 1,320 m² pond is about INR 120,000 (considering stocking density of 1,000, selling price INR 120/kg, 1,000 kg production and 1 kg average body weight) but income from sale of *M. gulio* from the same area is estimated to be INR 425,000 (considering stocking density 20,000, selling price INR 425/kg, 50% survivability, 1,000 kg production and 100 g average body weight); thus income from the latter is about four fold in comparison to the former (Sri R. I. Sekh: personal communication).

According to a study¹³, farmers/fishers in the Indian Sundarbans preferred to culture *Ompak pabda*, *H. fossilis*, *Amblypharyngodon mola* and other small indigenous fishes over major carp species. Fish growers in some villages in the Sundarbans region in coastal West Bengal are doing culture of about eleven indigenous fish species in small backyard ponds, large ponds, drainage canals and low-lying paddy fields¹⁴. The Sundarbans region harbours both freshwater and brackishwater fish species; *Lates calcarifer*, *Liza tade*,

L. parsia and *M. gulio* are very common in grow-out fish culture in this region¹⁵. Major carps of 1,000-2,000 g fetch INR 90-120/kg in wholesale markets but farmed *M. gulio*, *M. vittatus* and *Heteropneustes fossilis* fetch a much higher price as their supply in markets is low in comparison to carps. As catfishes enjoy very good consumer preference and *M. gulio* is highly adaptable from freshwater to high saline conditions¹⁶, a high preference for *M. gulio* farming and production in water bodies with salinities ranging from 0-10 ppt salinities is observed among small- to medium scale farmers in different villages of Basanti and other blocks of South 24 Parganas in West Bengal.

References

1. Ghosh, A. (2008). Fishes of Hooghly Estuary. ICAR-CIFRI Bulletin No. 155: 1-42.
2. Trivedi, R. K. (2015). Climate-resilient aquaculture strategies for Indian Sundarbans delta. NICRA-WBUAFS, Kolkata publication: 1-4.
3. Sekh, R. I. (2019). Homestead modular hatchery of brackishwater catfish *Mystus gulio* for eastern India – an innovative model. In. M. Kumaran, D. Deboral Vimala, M. Muralidhar, C. V. Sairam, K. Sukumaran, P. R. Anand and K. K. Vijayan (Eds.) Innovative approaches and success stories of brackishwater farmers. ICAR-CIBA, Chennai publication: 1-84.
4. Annual Report January-December 2020 of Ramkrishna Ashram Krishi Vigyan Kendra, South 24 Parganas, WB: 1-193.



Pond side at a paddy plot.



Sluice gate constructed in a canal.

5. Chatterjee, P. (2010). Utilization of small freshwater bodies and domestic ponds of South 24 Parganas for growing indigenous fish for nutritional security of rural households. Book of Abstract for Golden Jubilee National Seminar on Diversification of Aquaculture using locally available fish species. ICAR-CIFE Kolkata Centre Publication: 140.
6. Gogoi, P., Parida, P. K., Sinha, A., Tayung, T., Suresh, V. R. and Das, B. K. (2020). Canals in Indian Sundarbans - Opportunities towards livelihood improvement through fisheries interventions. *Indian Farming*, 70(11): 10-13.
7. Mondal, B. K. (2013). Dependency on primary economic activity of the Sundarban populace. *The Observer*, 51.
8. Kumar, P. (2018). Low-cost *Mystus gulis* backyard hatchery construction, operation and maintenance. In. Prem Kumar et al (Ed). NFDB sponsored National Training on Seed production and farming technology of brackishwater catfish *Mystus gulis* at Kakdwip RS of ICAR-Central Institute of Brackishwater Aquaculture. CIBA-TM Series 2018, No.11: 25-28.
9. Sundaray, J. K., Biswas, G., Ghoshal, T. K., Panigrahi, A. and De, D. (2010). Species transition and enhanced aquaculture productivity in the lower Sunderbans of West Bengal, India. Book of Abstract for Golden Jubilee National Seminar on Diversification of Aquaculture using locally available fish species. ICAR-CIFE Kolkata Centre Publication: 16.
10. Mondal A. and Mitra A. (2016). Growth, food and feeding habits of *Mystus gulis* in brackishwater traditional impoundments of Sundarbans, India. *Int. Journal of Fisheries and Aq. Studies*, 4(6): 49-58.
11. Arthur, R. I., Bhaumik, U., Pandit, P. K., Saha, S., Garaway, C. J. and Ghosh, T. (2005). Results of management experiments implemented in rice-fish systems in West Bengal as a part of adaptive learning approach. FMSP Project of UK-DFID: 1-99.
12. Pillay, T. V. R. (1956). Land reclamation and fish culture in the deltaic areas of West Bengal. *The Progressive Fish Culturist*, 18 (1): 99-102.
13. Roy, A., Sinha, A., Manna, R. K., Aftabuddin, M. D. and Das, S. K. (2020). Traditional knowledge of the fishermen community of Indian Sundarbans. *Indian J. Fish.*, 67(2): 94-101.
14. Saha, D. (2010). Locally available fish species – a diversified livelihoods option for aquaculturists in coastal Bengal. In. Book of Abstracts, Golden Jubilee National Seminar on Diversification of aquaculture through locally available fish species, ICAR-CIFE Kolkata Centre publication: XV.
15. Sundaray, J. K., Chakrabarti, P. P., Mohapatra, B. C., Das, A., Hussain, A., Ghosh, A. and Hoque, F. (2019). Freshwater aquaculture in Sundarbans India. In. H. S. Sen (Ed.) *The Sundarbans: A Disaster-Prone Ecoregion: Increasing Livelihood Security*, Springer Nature publication: 297-322.
16. Rao, G. R. M. (2002). Catfish culture – time to take off. In *Souv. Sixth Indian Fisheries Forum*, ICAR-CIFE Mumbai publication: 143-147.