Indian J Anim Health (2022), 61(2): 414- 418
DOI: https://doi.org/10.36062/ijah.2022.14322

News & Views

Unlocking the technology for mola (*Amblypharyngodon mola*) mass production hastens nutrition-sensitive aquaculture in India

S. K. Dubey[1*], F. Rajts[2], B. Belton[2], K. Gogoi[1], R. R. Das[1], A. Padiyar[1], S. Rajendran[1], V. M. Chadag[2] and S. Thilsted[2]

[1]WorldFish, Cuttack– 753 001, Odisha, India; [2]WorldFish, Penang, Malaysia

Aquatic foods to conquer malnutrition

Despite advances in health services, undernutrition remains one of the major public health issues in India. The recent National Family Health Survey (NFHS-5) highlighted pervasive malnutrition among children and women in India (NFHS, 2022). The situation is especially acute in eastern states like Assam, Odisha, and West Bengal, where more than 30% of children are malnourished and anaemia is highly prevalent, affecting more than 60% of children and women (Fig. 1).

Aquatic foods such as fish are increasingly recognized as crucial components in the fight against malnutrition because they are rich sources of protein, minerals, vitamins, and essential fatty acids that are essential to human health and cognitive development and are particularly important from conception to a child's second birthday (Ahern *et al*., 2021). Therefore, aquatic foods have a critical role in battling undernourishment in states like Odisha, Assam, and West Bengal, where fish and fish-based products are central to local cuisine.

Small fish are too big to ignore

Small indigenous fish species, collectively referred to SIS, are regarded as natural "superfoods" because they are much richer in vital micronutrients than popularly farmed Indian major carps like rohu and catla (Bogard *et al*., 2015). SIS are characterized by their diminutive size, growing to a maximum length of about 25 cm and largely inhabit freshwater habitats like floodplains, rivers, streams, canals, ponds, rice fields, and wetlands. Despite the ability of many species to reproduce quickly and endure unfavourable environmental conditions, these SIS are increasingly at risk in the

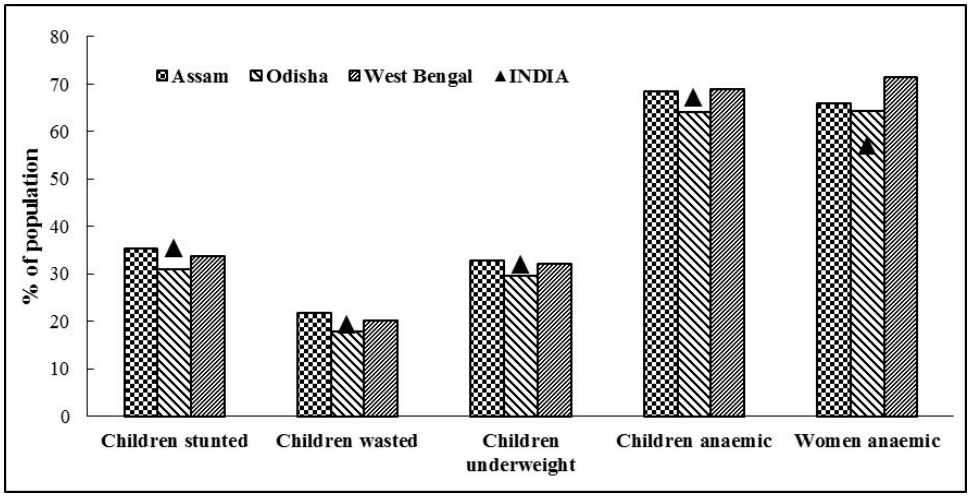

Fig. 1. Malnutrition in children under 5 years and women aged 15-49 in India (Source: NFHS-5)

*Corresponding Author, E-mail: s.dubey@cgiar.org

current Anthropocene due to resource degradation, overexploitation, pollution, and climate change (Rajts *et al*., 2022a). Although once ubiquitous and affordable, some SIS are now increasingly scarce and expensive, making them less accessible to lower-income fish consuming populations (Belton *et al*., 2014).

Nutrition-sensitive aquaculture is a food-based approach to aquaculture development that prioritizes the production of nutrient-dense SIS alongside conventional carp polyculture to support beneficial nutritional outcomes (Thilsted *et al*., 2016). Among the important SIS, Mola (*Amblypharyngodon mola*) popularly known as *mahurali*, *moa*, and *mourola* in Odisha, Assam and West Bengal, respectively, is a champion species for nutrition-sensitive aquaculture (Fig. 2). Mola is particularly rich in vitamin A, which can be beneficial for preventing eye and skin diseases associated with vitamin A deficiency. Mola is also rich in essential minerals like iron, zinc, and calcium, and a good source of essential fatty acids and amino acids (Table 1). These are advantageous for bone development and can protect against anaemia, stunted growth, and other outcomes of micronutrient deficiencies in children and expectant mothers.

SIS such as mola are frequently cooked and eaten whole, enablingthe ingestion of vitamins and minerals found in the head, bones, and liver (Roos *et al*., 2002). Therefore, mola has potential to play a significant role in food-based strategies to address malnutrition where the majority of women and children are malnourished.

The technological barrier to scaling up carp-mola polyculture

WorldFish is an international research institute with its main office in Penang, Malaysia. It carries out research and innovation toward eradicating hunger, malnutrition, and poverty throughout Africa, Asia, and the Pacific. Over the past decade, WorldFish has promoted inclusion of mola in homestead pond-based carp polyculture in Odisha, Assam and Bangladesh to popularize SIS production for household consumption and income generation. WorldFish's research indicates that SIS, including mola, can be co-cultured in farm ponds alongside larger fish such as carp, and that the inclusion of these fish in polyculture systems does not decrease carp production (Roos *et al*., 2007). Including SIS like mola in carp polyculture increases intakes of micronutrient-rich small fish by women and children and is a cost-effective way to reduce malnutrition (Fiedler *et al*., 2016; Castine *et al*., 2017).

However, unlike most conventional aquaculture which uses juvenile carp seed produced in hatcheries, these initiatives have relied on collecting SIS parent fish (brood stock) from natural sources to stock in farmers' ponds, where they reproduce naturally. A lack of standardized hatchery-based mass production techniques for SIS seed has proven a key technical barrier to scaling up nutrition-sensitive aquaculture to reach much larger numbers of people (Ali *et al*., 2016). To address this bottleneck, WorldFish in collaboration with Department of Fisheries and private hatcheries is implementing a project in Odisha and Assam named "Taking nutrition-sensitive carp-SIS polyculture technology to scale", with funding from GIZ Germany. A key goal of the project is to develop easily scalable

Table 1. Nutrient content (per 100 g raw edible fish) of mola, rohu and catla (Extracted from Bogard *et al*., 2015)

Fish species	Protein (g)	Fat (g)	Iron (mg)	Zinc (mg)	Calcium (mg)	Iodine (μg)	Vitamin A (μg)	Vitamin B12 (μg)
Mola	17.3	4.5	5.7	3.2	853	17	2503	7.98
Rohu	18.2	3	0.98	1	51	20	13	5.05
Catla	14.9	0.7	0.83	1.1	210	18	22	1.3

techniques for the mass production of mola seed, by standardizing methods of hatchery-based breeding.

The ground-breaking: Induced mola breeding for mass seed production

SIS are small and delicate to handle, making it difficult to produce seed in large quantities using conventional hatchery methods. Induced breeding, therefore, needs innovation and specially modified technology (Ratjs *et al*., 2022b).

In June 2022, WorldFish successfully carried out induced breeding of mola for the first time in India at its partner hatchery, Biswal Aquatech, in Jagatsinghpur district, Odisha. From June to September 2022 the project's fish breeding field team, led by veteran fish breeding expert Mr. Francois Rajts, produced more than 7 million mola hatchlings in a series of carefully designed and monitored breeding experiments. A combination of hormone (Synthetic GnRH analogue) administration and environmental manipulation was used to stimulate seed production (Fig. 3). Breeding was performed in tanks specially constructed by the project, fed with steady shower of oxygen-rich water from an aeration tower to improve breeding performance and larval survival (Fig. 4-5). Mola hatchlings produced in this way are ready for sale within 3-4 days of hatching (Fig. 6-8). The field team also developed guidelines for nursing mola seed to fry sizes prior to stocking or sale, and the hatchery is currently selling mola hatchlings and fry to local farmers and Women's Self-Help Groups (WSHGs).

To celebrate this momentous breakthrough and share the project's experiences, WorldFish and partners organized a "mola seed release programme" with Biswal Aquatech on 28th September 2022, in collaboration with the Fisheries and Animal Resources Development Department, Government of Odisha, where Dr. Shakuntala Thilsted (2021 World Food Prize laureate) was the chief guest. More than 100 fish farmers and WSHG members attended, and many received oxygen-packed bags of mola seed.

Stocking hatchery produced mola seed: A leapfrogging opportunity

Stocking hatchery produced mola seed offers several advantages over the previous practice of stocking broodfish harvested from natural water bodies (Rajts *et al*., 2022b). It can be difficult to stock wild breeders in seasonal ponds where water is only present for a short time because ponds might dry up before their offspring reach market size. Moreover, ponds stocked with wild breeders contain SIS populations comprised of a mix of age groups, resulting in the production of SIS of variable sizes that are less preferred in the market. Stocking wild fish runs the risk of contaminating the farmer's pond with pathogens. Seed produced by spontaneous natural spawning in the pond also faces multiple hardships such as competition for food, cannibalism, and predation.

In contrast, hatchery produced SIS seeds are of uniform size and age and can be stocked at the optimum time and density to maximize survival and growth. Because of hatchery management procedures like isolating brooders, upholding biosecurity, and disinfecting fish, pathogen infections are less likely when stocking SIS seed produced in a hatchery. Moreover, hatchery produced seed can be conditioned and packed in clean well-oxygenated before being transported, lowering mortalities during transport and stocking. Stocking hatchery-produced fry can also guarantee a consistent size at harvest, improving their marketability and bringing in higher prices. As a final advantage, hatchery-based seed production enables farmers to benefit from early breeding in hatcheries to ensure a steady supply of SIS seed by encouraging spawning much earlier than in the wild.

Mola hatchlings can be reared in a nursery pond with a stocking density of 200/m^2 (20 lakh/ha) using plankton-based pond management practices. After three weeks, mola fry can be harvested and stocked into grow-out ponds at the rate of 5-10/m^2 (50,000-100,000 fry/ha). Stocking density in grow-out

Fig. 2. A mature female mola from Assam

Fig. 3. Hormone administration through the peritoneal cavity of mola brood to stimulate breeding

Fig. 4. An aeration tower has improved breeding performance and larval survival by supplying oxygen-rich water

Fig. 5. Mola brood were exposed to constant showers of oxygen-rich water in the breeding tanks after hormone administration

Fig. 6. Mola eggs attached to outer hapa (left), and one day old hatchlings (right)

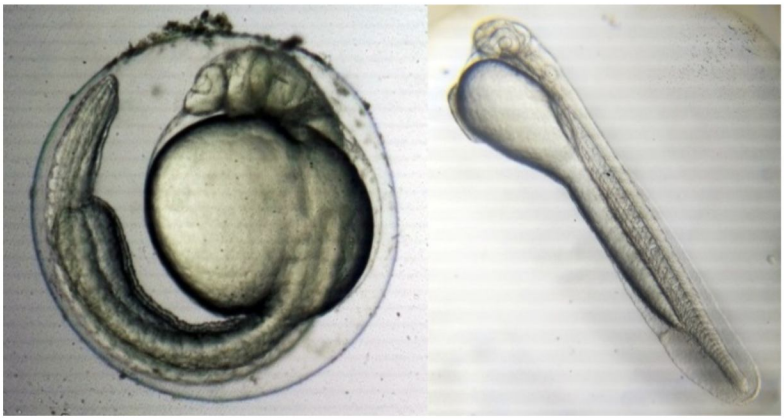

Fig. 7. Microscopic view of developed mola embryo (left) and a freshly born mola hatchling (right)

Fig. 8. Mola hatchlings ready for sale after 3-4 days

Fig. 9. Two-and-a-half-month-old mola fry

ponds depends on the biomass and species proportion of carps in polyculture with mola. The planned biomass of phytoplankton feeders should be around 40% of the total stock in the grow-out pond. Mola can be harvested for home consumption and sale after just three months. Mola that escape during harvest will continue to reproduce in the pond, ensuring ongoing mola production. Therefore, the integration of mola with carp in pond polyculture may increase total fish production, providing a source of income for households and as contributing to meeting nutritional requirements.

Towards a secure nutrition landscape

Fish are highly beneficial to nutrition and health and will play an essential role in sustaining healthy diets in the future. This ground-breaking commercial mass seed production trial with mola will facilitate the large-scale adoption of carp-SIS polyculture to increase farm incomes and consumption of micronutrient-dense fish in regions of India where undernutrition is prevalent. The government's role is very critical here to advance and propagate innovation. This will be especially helpful in the case of Odisha and Assam, where the state governments have recognized and prioritized nutrition-sensitive approaches and included carp-SIS polyculture in their institutional policies by launching new programmes under the auspices of the Department of Fisheries.

ACKNOWLEDGMENTS

This project is funded by the German Federal Ministry for Economic Cooperation and Development (BMZ) and commissioned by the Deutsche Gesellschaftfür Internationale Zusammenarbeit (GIZ) through the Fund International Agricultural Research (FIA). We are thankful to the Fisheries and Animal Resources Development Department, Government of Odisha for their active support and collaboration.

REFERENCES

Ahern M, Thilsted SH and Oenema S, 2021. The role of aquatic foods in sustainable healthy diets. Discussion Paper. UN Nutrition Secretariat, Rome, Italy, pp 64

Ali H, Murshed-e-Jahan K, Belton B, Dhar GC and Rashid HO, 2016. Factors determining the productivity of molacarplet (*Amblypharyngodon mola*, Hamilton, 1822) in carp polyculture systems in Barisal district of Bangladesh. Aquaculture, 465: 198-208, doi: 10.1016/j.aquaculture.2016.09.017

Belton B, van Asseldonk IJM and Thilsted SH, 2014. Faltering fisheries and ascendant aquaculture: implications for food and nutrition security in Bangladesh. Food Policy, 44: 77-87, doi: 10.1016/j.foodpol.2013.11.003

Bogard JR, Hother AL, Saha M, Bose S, Kabir H *et al*., 2015. Inclusion of small indigenous fish improves nutritional quality during the first 1000 days. Food Nutr Bull, 36(3): 276-289, doi: 10.1177/0379572115598885

Castine SA, Bogard JR, Barman BK, Karim M, Hossain M *et al*., 2017. Homestead pond polyculture can improve access to nutritious small fish. Food Secur, 9(4): 785-801, doi: 10.1007/s12571-017-0699-6

Fiedler JL, Lividini K, Drummond E and Thilsted SH, 2016. Strengthening the contribution of aquaculture to food and nutrition security: The potential of a vitamin A-rich, small fish in Bangladesh. Aquaculture, 452: 291-303, doi: 10.1016/j.aquaculture.2015.11.004

National Family Health Survey (NFHS-5), 2022. NFHS-5 (2019-2021). India and States Factsheet: International Institute for Population Sciences (IIPS) and Ministry of Health and Family Welfare Government of India

Rajts F, Belton B and Thilsted SH, 2022a. Guidelines for setting up breeding experiments for small indigenous species (SIS). Penang, Malaysia: World Fish, Program Report, 2022-03

Rajts F, Belton B and Thilsted SH, 2022b. Selection of small indigenous fish for breeding trials in the states of Assam and Odisha in India. Penang, Malaysia: World Fish, Program Report, 2022-04

Roos N, Leth T, Jakobsen J and Thilsted SH, 2002. High vitamin A content in some small indigenous

fish species in Bangladesh: perspectives for food-based strategies to reduce vitamin A deficiency. Int J Food Sci Nutr, 53: 425-437, doi: 10.1080/09637480210000044778

Roos N, Wahab MA, Hossain MSAR and Thilsted SH, 2007. Linking human nutrition and fisheries: incorporating micronutrient dense, small indigenous fish species in carp polyculture production in Bangladesh. Food Nutr Bull, 28(2): 280-293, doi: 10.1177/15648265070282S207

Thilsted SH, Thorne-Lyman A, Webb P, Bogard JR, Subasinghe R *et al*., 2016. Sustaining healthy diets: The role of capture fisheries and aquaculture for improving nutrition in the post-2015 era. Food Policy, 61: 126-131, doi: 10.1016/j.foodpol.2016.02.005

Received- 29.10.2022, Accepted- 19.11.2022, Published- 01.12.2022 (Print)
Section Editor: Prof. S. K. Das, Member, Editorial Board