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Small indigenous fish & nutritional security

Giant featherback seed production

Asian seabass

Integrating ducks & poultry

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Aquaculture Asia

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NACA

An intergovernmental organisation that promotes rural development through sustainable aquaculture. NACA seeks to improve rural income, increase food production and foreign exchange earnings and to diversify farm production. The ultimate beneficiaries of NACA activities are farmers and rural communities.

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Development and climate adaptation

Bill Gates' recent climate statement arrives at a critical moment for agriculture. Whilst his message has sparked controversy in climate circles, his central thesis deserves serious attention from those working in rural development: for poor rural communities, the most effective climate adaptation strategy is development itself.

Gates challenged the prevailing narrative that positions climate change as an existential threat requiring all other concerns to take second place. For poor communities across Asia engaged in small-scale aquaculture and agriculture, this reframing matters. Climate action that ignores immediate existential welfare needs, or worse, actively hinders them is a serious moral failure, and counter-productive.

The evidence Gates presents is striking. Research shows that economic growth in poor countries could reduce climate-related deaths by over 50 per cent. Meanwhile, poverty-related diseases claim approximately 8 million lives annually, dwarfing climate-specific mortality. Excessive cold kills ten times more people than excessive heat. These are not arguments against climate action, but rather a call to maintain perspective and allocate resources rationally, where they have the most impact.

Agriculture is a practical cornerstone of this approach as poor nations and communities also tend to be agrarian. Gates highlights Kenyan farmers who adopted climate-resilient maize varieties, achieving 66 per cent yield increases that generated $880 in additional annual income, equivalent to five months' wages. This exemplifies development that simultaneously addresses climate resilience, food security, and poverty reduction. Similar opportunities exist across aquaculture, where improved genetics, feed management, and disease resistance can deliver transformative gains for smallholder farmers.

The warning against well-intentioned but harmful climate policies deserves particular attention. When one nation banned synthetic fertilisers on environmental grounds, yields collapsed and food prices soared. When multilateral lenders pressured low-income countries to reject fossil fuel financing, communities lost access to reliable electricity for homes, schools, and clinics. Climate advocacy disconnected from local realities can inflict serious harm on vulnerable populations. People cannot adapt to climate change, let alone mitigate it, while every day is a struggle for survival. It is usually the case that those who set such policies are personally insulated from the impacts of them.

The message for rural development is clear: we must maintain focus on improving farmer livelihoods through better seeds, improved practices, enhanced market access, and strengthened health systems. These investments deliver immediate welfare gains whilst building real, measurable resilience to climate impacts. They represent the most ethical, impactful and effective use of limited resources.

Climate change demands serious attention. But the path forward must prioritise human welfare, measure success through lives improved rather than emissions targets alone, and recognise that lifting communities out of poverty represents our most powerful climate adaptation strategy. For Asia, this means continuing to focus on fundamentals: giving farmers the tools, knowledge, and support they need to improve their practices and enhance their welfare and livelihoods.

Simon Wilkinson

AQUACULTURE ASIA

Integrating fish farming with ducks and poultry in Meghalaya: A case study in a farmer's field

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Integrated fish-duck-poultry culture, the combined duck/poultry shed in the background.

The term 'integrated farming' refers to a method of cultivation that combines two or more enterprises at the same time. It may include various combinations, such as crops, horticulture, dairy, livestock, ducks, poultry, fish and vermicompost. In principle, integrated farming means two or more enterprises cultivated together to benefit each other through nutrient cycling and shared resources. It is a farming system that increases productivity, profitability and employment opportunities, and is therefore considered a sustainable practice. It aims to use minimal external inputs, compensated by recycling nutrients and sharing resources within the farm. Ideally, nutrients from one source flow to another, and vice versa.

Integration of fish culture with ducks and poultry has long been practised. Cultivating a single enterprise may not be as beneficial as their integration, in which each enterprise is treated as a sub-system. The sub-systems are interconnected so that wastes or by-products generated from one act as inputs to another. In this way, land and water resources are used efficiently and farming can be sustained with lower cash and labour inputs, while providing substantial output. In practice, integrated fish farming uses wastes generated from ducks or poultry, or both, for fish culture. Such waste is treated as manure, recycled and utilised as nutrients in the pond ecosystem through the trophic food web. Adding organic manures increases the phytoplankton population, which acts as the primary producer and enhances water productivity. Phytoplankton are used as food by a variety of zooplankton. The ideal balance between phytoplankton and zooplankton in the pond ecosystem provides live food for fish.

An increase in phytoplankton due to manuring also has concurrent effects on water quality. During daylight, photosynthesis raises dissolved oxygen and gross primary productivity, and helps to maintain a balanced pH. Levels of free carbon dioxide and un-ionised ammonia may decline. Together, these factors lead to higher fish yields.

In addition, integrated farming offers the following benefits: (i) simultaneous use of land and water for two or more enterprises; (ii) minimal use of external inputs; (iii) recycling of by-products or wastes as manure; (iv) maintenance of enterprise diversity within the same period; (v) a more eco-friendly environment, as negative effects of intensive farming are moderated; and (vi) greater profitability, as diversified outputs reduce the chance of losses across all enterprises at the same time.

Aquaculture development in Meghalaya - the contribution of ICAR-CIFA

For a long time, the Indian Council of Agricultural Research - Central Institute of Freshwater Aquaculture (ICAR-CIFA), Ministry of Agriculture and Farmers' Welfare, Government of India, has been actively engaged in improving and extending aquaculture, as well as developing fishers' livelihoods in Meghalaya, as part of the NEH (North Eastern Hill) region development programme. ICAR-CIFA carries out these activities in collaboration with the Meghalaya State Aquaculture Mission (MSAM). MSAM selects beneficiaries for training, arranges aquaculture inputs, and monitors progress. It also coordinates among farmers and liaises between farmers and scientists to solve problems.

Integrated aquaculture farming: A common practice in Ri Bhoi District, Meghalaya

Meghalaya is one of the eight 'sister' states of north-east India. Its topography is mountainous, with valleys and highland plateaus, as well as plains. It is among the wettest places, with average annual rainfall reaching 12,000 mm in some areas. The population was 2,964,000 at the 2011 Census. In Ri Bhoi district, which adjoins Assam, the terrain is mostly plain and semi-intensive pond aquaculture is common. Many farmers practise integrated aquaculture with ducks and poultry, each as a sub-system. Combining the three components needs proper coordination and monitoring. If one sub-system is mismanaged, the whole integration can be disturbed. An effective integration, run with a sound combination, should maintain the following: (i) the density of each component, appropriate to the overall system; (ii) suitable size and age of the components; (iii) conditioning before release; (iv) health and immunity checks before release; (v) timely feeding; and (vi) close monitoring and surveillance for the first one to two months to ensure the components are compatible and function properly.

Mr Elbert Roni Ramde, of Liarkhla village in Ri Bhoi district, is a progressive fish farmer. He practises integrated farming with fish as the principal component, and ducks and poultry as sub-systems. He is a beneficiary of ICAR-CIFA and has received training in scientific aquaculture. He was provided with aquaculture inputs, including fish seed and feed. Horticultural crops, including bananas and turmeric, are planted on the pond dykes in an integrated manner. Mr Elbert has been technically guided by Krishi Vigyan Kendra (KVK), Ri Bhoi,

Training program conducted by ICAR-CIFA.

Above,below: Elbert receiving fish seeds from CIFA scientists.

under the ICAR Research Complex for the NEH Region, Umiam, Meghalaya. The KVK implements technologies in farmers' fields and gathers feedback to communicate to the concerned scientists.

Mr Elbert manages four ponds for integrated farming. The ponds are constructed almost in a straight line; each pond adjoins the next by a dyke. The first pond is about 0.5 m higher than the second, and the alignment continues to the third and fourth. A narrow channel (150.0 m × 0.5 m depth × 0.5 m width) runs parallel to the four ponds and connects

Turmeric plantation.

to each pond through an inlet. The ponds lie at the foot of a small hill. Run-off from the hill flows into the channel and is the main water source for the ponds. A single iron pipe (4.0 cm diameter) is set in the dyke between ponds so that excess water drains by gravity from the upper pond to the lower one.

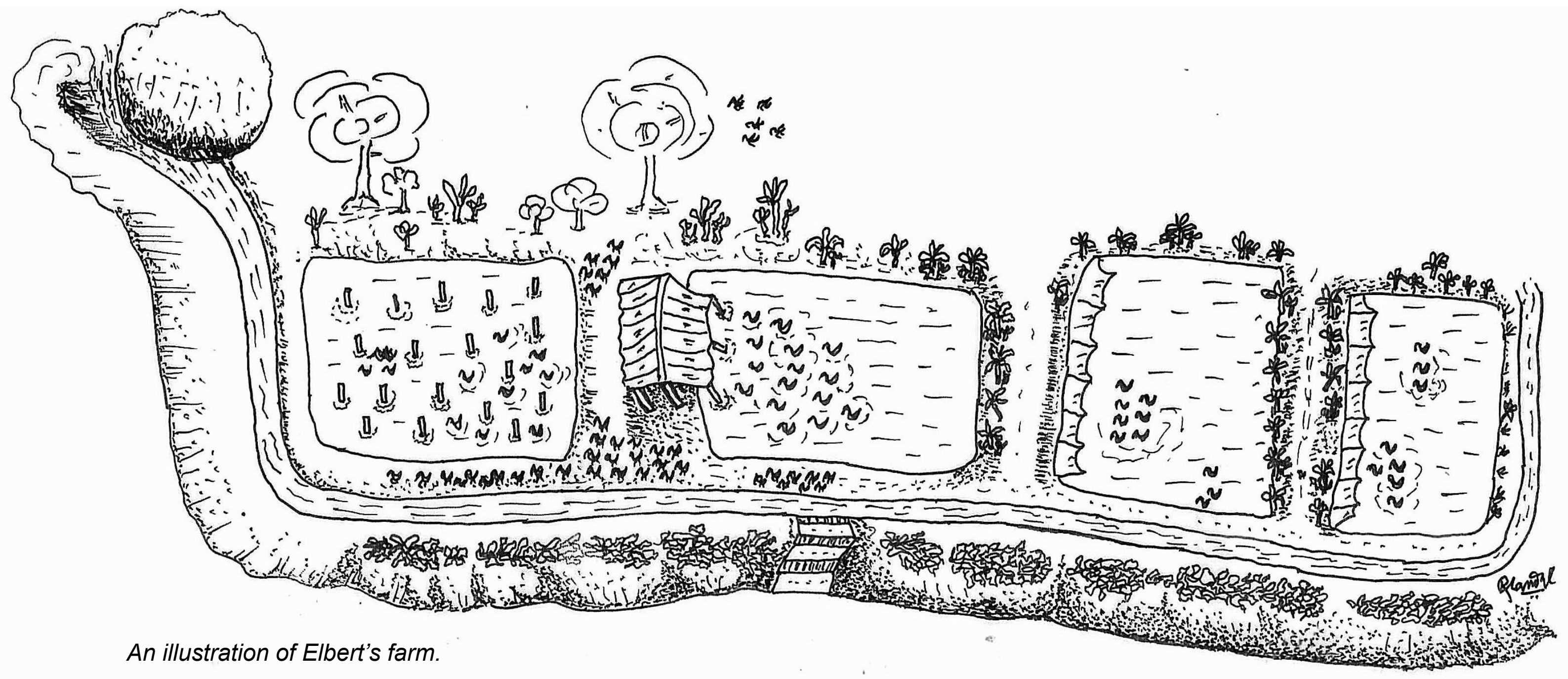
Pond sizes vary. The first, second, third and fourth ponds have areas of 70.0 m^2 (9.2 m × 7.6 m), 93.0 m^2 (12.2 m × 7.6 m), 93.0 m^2 (12.2 m × 7.6 m) and 62.0 m^2 (8.2 m × 7.6 m), respectively. Pond depth ranges from 0.9-1.2 m. Water temperatures range from 10-25°C, and dissolved oxygen from 5-9 ppm (≈ 5-9 mg/L). Lime is applied to maintain pH between 6 and 7.

Stocking of fish seed and rearing

Four species are selected for culture, considering their suitability to the agro-climatic conditions of Ri Bhoi district: rohu, *Labeo rohita*; Amur carp, *Cyprinus carpio haematopterus*; common carp, *Cyprinus carpio*; and grass carp, *Ctenopharyngodon idella*. Fish seed with an average individual weight of 3.5 g are stocked into the four ponds with selective release. The first pond is stocked with 1,000 rohu seed as a monoculture, equivalent to 142,000/ha. The second and third ponds are each stocked with 1,500 seed (500 Amur carp, 500 grass carp and 500 common carp) as mixed culture, equivalent to 160,000/ha. The fourth pond is stocked with 900 seed (300 Amur carp, 300 grass carp and 300 common carp) as mixed culture, equivalent to 150,000/ha.

Selection of ducks and their rearing

Mr Elbert prefers the Indian Runner breed for integration. A total of 100 ducklings, averaging three weeks old, were supplied by Krishi Vigyan Kendra (KVK), Ri Bhoi, under the ICAR Research Complex for the NEH Region, Umiam, Meghalaya. About 5.0 kg of faecal matter is collected daily from the duck shed and applied to the ponds as manure. In addition, 5.0 kg/day of a feed-starter and rice bran mixture is used for feeding; leftovers are added directly to the fish ponds. Ducks swim in the ponds during the day and their droppings fertilise the water. At night they shelter in a roofed shed (75.0 m^2) with five compartments (each 2.0 m × 1.5 m). Three compartments are used for ducks and two for poultry. The shed is built partly on the pond dykes and partly extended over the pond surface.



An illustration of Elbert's farm.

Selection of poultry and their rearing

A total of 50 poultry, averaging three weeks old, mostly Banaraja with a few Rainbow Star, were supplied by KVK, Ri Bhoi, under the ICAR Research Complex for the NEH Region, Umiam, Meghalaya. About 5.0 kg of faecal matter is collected from the poultry shed daily and applied to the ponds as manure. A further 5.0 kg/day of a feed-starter and rice bran mixture is used for feeding; leftovers are added to the ponds.

Benefits of integration: Three crops grown simultaneously in the same unit area

Mr Elbert benefits by harvesting three crops-fish, ducks and poultry-from the same area, which covers 318 m^2 across four ponds, in addition to vegetables and spices grown on the pond dykes. In this system, fish culture is treated as the major sub-system, while ducks and poultry are two minor sub-systems. Fish is considered the major crop because it uses the water area. Ducks and poultry are the minor crops because they mainly fertilise the water body. Their stocking and husbandry are determined by the cultivable water area.

Integrated fish-duck farming: the benefits

Ducks act as “manuring machines”, fertilising the pond with their droppings. Their swimming and light raking of the pond bottom help to aerate the water. The largely self-operating system is efficient, saves labour and is cost-effective. Estimates suggest that duck droppings can reduce the cost of supplementary fish feed by about 60% in traditional pond aquaculture. Duck waste and leftover, partly digested feed are eaten directly by fish. The droppings add essential nutrients, which stimulate the growth of natural foods.

Duck movement also helps break up and distribute droppings and other food particles more evenly across the pond. Ducks keep macrophytes in check and loosen the pond bottom through dabbling, releasing nutrients from the soil and increasing pond productivity. They meet much of their own diet from the pond by eating aquatic weeds, frogs, tadpoles, dragonflies, insects, larvae, earthworms, snails and other aquatic biota, which helps maintain a safe environment for fish. Ducks can obtain around 50-75% of their feed requirement from the pond, while poultry drink from the ponds and take insects, helping to keep water plants in check.

A long channel passing alongside the ponds.

Elbert applying lime in his pond.

Elbert stocking fish seed in his pond.

Live food organisms and a suitable pond environment supported by added manures

Phytoplankton density is high due to organic manure from duck and poultry faeces and duck droppings entering the pond. High phytoplankton supports zooplankton and other benthic communities. The supply of duck droppings, poultry and duck faeces, and leftover feed promotes the growth of live food organisms to an optimal level. Phytoplankton production that supports zooplankton growth helps maintain a balanced proportion of phytoplankton and zooplankton across trophic levels. In addition, duck movements aid oxygenation through surface aeration, increasing dissolved oxygen and helping to reduce ammonia, thus maintaining a healthy environment for fish farming.

Nutrients management and fish rearing

Of the four ponds, the first is used for monoculture with rohu only. Numerous bamboo poles are placed across the water surface to promote periphyton growth. Faecal matter and leftover feed are added to the first and second ponds, as the duck and poultry shed is located on their shared dyke. Ducks and poultry move frequently in and around these ponds. Rohu are column feeders and browse periphyton growing on the bamboo poles. Duck activity acts as natural aeration and helps distribute added manures evenly through the water, which in turn supports periphyton proliferation.

Excess water, carrying suspended nutrients, flows by gravity through an iron pipe from one pond to the next. This helps spread nutrients uniformly and reduces losses. Continuous flow through the inter-pond pipe also promotes surface oxygenation, improving conditions for fish survival.

The other ponds are used for mixed culture, combining grass carp, common carp and Amur carp. Ponds at the lower tier receive the most nutrient deposition, which stimulates dense plankton blooms and the growth of benthic organisms and macrophytes. Grass carp consume macrophytes and help keep the ponds free of aquatic weeds. Common carp and Amur carp feed mainly near the bottom, exploiting benthic foods and helping to control bottom-dwelling organisms. In this integrated system, manures from ducks and poultry, together with leftover feed, promote the growth of plankton, benthos, periphyton and other organisms, including aquatic macrophytes. These biotic resources are then used as food by the respective fish species. It is estimated that approximately 40-50 kg of organic waste can be converted into 1 kg of fish.

Maintenance of a healthy environment

Nutrient-rich pond water is used to irrigate banana and turmeric, taking advantage of the water resource flowing from the hilltop. Poultry and duck droppings serve as manure and no external manuring is applied. Crops planted on the pond dykes and around the pond margins also provide ground cover, which reduces direct sunlight on the soil. This helps maintain soil moisture and protects soil health. Even in hot weather, the pond environment remains at a favourable temperature, which appears eco-friendly under the integrated farming approach.

Marketable products and earnings from integration

Culture was undertaken for an average of eight months, with multiple harvests. Harvesting begins when fish reach an average weight of about 400 g. Multiple partial harvests gradually reduce stocking density, allowing the remaining fish to grow to larger sizes as space becomes available. The farm-gate price for harvested fish across species is around INR 270.00/kg (about USD 3.10/kg). An adult duck weighing about 2.0 kg fetches around INR 700.00 (about USD 8.04) per bird, and an adult poultry bird weighing about 1.0 kg fetches around INR 300.00 (about USD 3.45) per bird. It is estimated that Mr Elbert's profit from the integrated system is around INR 450,000 from sales of fish, ducks, poultry and eggs, in addition to income from bananas and turmeric, which are also sold. These farm products are also used for household consumption.

Feeding time for ducks and poultry.

Conclusion

Integration of fish, ducks and poultry is a promising farming system, particularly for resource-poor farmers in rural areas. It has proved sustainable and income-generating, including for unemployed youth. The integrated approach offers a practical route to economic success and helps address issues at the grassroots level, including livelihoods, nutritional security and poverty alleviation. It also encourages ongoing innovation: components can be adjusted or replaced with other subsystems to improve compatibility and profit under changing climatic conditions.

Mr Elbert's farm demonstrates a replicable model that highlights resource efficiency, productivity and income generation. Such integrated farming can help rural communities meet pressing challenges. It enables multiple crops to be harvested from the same area in a cost-effective way, with modest labour and input needs, to achieve greater overall benefit. The system produces a range of marketable products-fish, meat, eggs, bananas and turmeric-giving farmers several options to reach customers. By combining diverse outputs, integration supports climate-resilient farming and strengthens local food supply.

Acknowledgement

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Small indigenous fish species: A source of nutritional security through rural aquaculture development

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Locally available SIS in market of North Eastern states of India

Small indigenous fish species (SIS) are a diverse group of native, small-sized freshwater fish that inhabit various natural and man-made aquatic ecosystems such as rivers, beels, canals, ditches, rice paddies, ponds and floodplains. These fish have historically been a staple in the diets of rural populations due to their widespread availability and nutritional richness. SIS are unique in that they are often consumed whole, including bones, head and internal organs, which significantly enhance their nutritional value. This whole-fish consumption provides an exceptional source of essential micronutrients like calcium, iron, zinc, iodine and vitamin A, as well as high-quality protein and beneficial fatty acids. These species play a vital role in ensuring food and nutrition security for underprivileged communities, particularly in regions where diets are heavily carbohydrate based and lack diversity. Importantly, SIS contribute not just to daily nutrition but also to long-term health by addressing public health concerns like vitamin A deficiency, anaemia (iron deficiency) and poor bone health (calcium deficiency).

Additionally, SIS are abundant during specific seasons, especially the monsoon, and thrive with minimal human intervention. These species are often self-recruiting, meaning they naturally replenish in various aquatic systems without the need for hatcheries or intensive aquaculture management. From an ecological and economic standpoint, SIS are crucial to sustainable livelihoods. They are naturally resilient, breed prolifically and adapt well to both stagnant (lentic) and flowing (lotic) water bodies. Early aquaculture practices mistakenly viewed these species as pests or “trash fish”, removing them to prioritise large commercial species. However, modern research and aquaculture practices have highlighted the benefits of integrating SIS into polyculture systems, as they not only boost overall productivity but also maintain ecological balance. Moreover, their low market demand and ease of access, often harvested as bycatch, make them especially important for food-insecure households that cannot afford other protein-rich foods.

Recently, WorldFish is implementing a GIZ-supported project called “Taking Nutrition-Sensitive Carp-SIS Polyculture Technology to Scale” in the states of Odisha and Assam, India. Techniques have been successfully developed for farming SIS in polyculture with carps, and in rice fields, but a lack of readily available SIS seed produced by hatcheries is the key technical bottleneck inhibiting the scaling up of nutrition-sensitive aquaculture (Rajts et al., 2022).

Wild collection of small indigenous fish species.

Despite their significance, SIS remain under-researched, particularly regarding their captive seed production, farming and conservation. Due to their high nutritional value and social relevance, SIS hold immense potential for tackling malnutrition and strengthening rural economies through the development of SIS aquaculture.

Small indigenous fish species

Small indigenous fish species are defined as fish that reach a maximum size of about 25-30 cm at the mature or adult stage of their life cycle. They inhabit natural water bodies such as rivers and tributaries, floodplains, ponds, lakes, beels, streams, lowland areas, wetlands and paddy fields.

In India, 2,319 species of finfish have been recorded, comprising 838 freshwater species, 113 brackish-water species and 1,368 marine species. Of the 765 native freshwater species documented, about 450 may be categorised as SIS, and among these, 104 species (23%) are considered highly important. Of these 104 species, approximately 62 are recognised as food fish and 42 as ornamental fish.

Many SIS are cultivable and can be introduced as candidate species in freshwater aquaculture systems. Examples include *Amblypharyngodon mola*, *Notopterus notopterus*, *Puntius sarana*, *Labeo bata*, *Cirrhinus reba*, *Salmostoma bacaila*, *Nandus nandu*s, *Anabas testudineus*, *Esomus danricus*, *Glossogobius giuris*, *Devario devario* and *Chanda nama*. Other potential species for aquaculture diversification include small carps (*Labeo* spp.), small murrels (*Channa spp*.), air-breathing catfish (*Heteropneustes fossilis*) and non-air-breathing catfish (*Mystus* spp., *Horabagrus brachysoma*, *Notopterus notopterus*, *Ompok pabda*), for which seed production and farming need to be popularised and expanded.

The greatest diversity of SIS has been recorded from the North-Eastern region, followed by the Western Ghats and Central India. Rural populations in many parts of India depend heavily on indigenous fish species for nutritional and livelihood security. Small indigenous fish species are an important source of essential macro- and micronutrients, and can play a significant role in eliminating malnutrition and micronutrient deficiencies in rural communities (FAO, 2003).

Nutritional value of small indigenous species of fish

SIS are widely recognised not just for their abundance in freshwater ecosystems, but more importantly for their superior nutritional profile, especially in contexts where malnutrition and hidden hunger (micronutrient deficiency) are prevalent. These small fish are typically consumed whole, a practice that significantly enhances their nutritional benefit compared with filleted or larger fish, where nutrient-dense parts such as the head, bones and organs are often discarded.

One of the most striking features of SIS is their concentration of essential micronutrients. Species such as *Amblypharyngodon mola*, *Esomus danricus*, *Osteobrama cotio* and *Corica soborna* are especially rich in vitamin A, which is crucial for maintaining vision, immunity and cellular growth. Studies indicate that the vitamin A content in some SIS is so high that a small portion can fulfil a substantial part of the recommended nutrient intake (RNI) for children and adults. In fact, 1 kg of SIS may contain as much vitamin A and minerals as 50 kg of larger fish, such as Indian major carps (IMCs) (Roos et al., 2007).

In addition to vitamin A, SIS are excellent sources of iron, zinc, iodine, calcium and vitamin B12, all commonly deficient in cereal-based diets prevalent in low-income households. Iron from SIS, particularly from their blood-rich organs, contributes to reducing anaemia; zinc supports growth and immune function; calcium from the bones aids bone development and maintenance; and vitamin B12, found in the flesh and organs, is essential for neurological health.

These nutrients are especially important in vulnerable groups such as pregnant women, children and the elderly (Suo et al., 2021). SIS also provide high-quality animal protein and essential fatty acids such as omega-3 (EPA and DHA), which are key to brain development and cardiovascular health. Unlike plant-based sources, the protein in fish is more bioavailable - easily digested and absorbed by the human body. The fat content in SIS, though lower than in marine fish, includes important polyunsaturated fats that help reduce inflammation and support heart health (Thilsted et al., 1997).

Their nutrient profile is particularly beneficial in addressing the “double burden of malnutrition”, where communities face both undernutrition and micronutrient deficiency. For food-insecure households that may struggle to afford meat, dairy or diverse vegetables, SIS are an essential, low-cost dietary component to meet daily nutrient needs (Banna et al., 2022). Furthermore, SIS are seasonally abundant, especially during the monsoon and floodplain expansion, making them a natural solution for seasonal dietary gaps. Integrating them into regular diets can markedly improve nutrient intake without major lifestyle or culinary changes, especially in regions where they are already part of traditional food systems.

However, the nutritional richness of SIS is not yet fully utilised due to limited data, underdeveloped processing methods and low commercial value. There is an urgent need for more nutrient-composition studies, standardised processing and strategies for better year-round availability. Enhancing awareness and accessibility of SIS through nutrition-sensitive policies could play a transformative role in public health nutrition.

Captive breeding potential of SIS

Captive breeding refers to the controlled reproduction of animals, including fish, within specially managed environments rather than in their natural habitats. This practice has become an essential tool for conserving vulnerable or underutilised species, promoting sustainable aquaculture and ensuring long-term food and nutrition security. In the context of freshwater fish, especially small indigenous species, captive breeding holds significant promise. These small-sized, nutrient-dense fish are crucial in the diets of low-income communities. However, many SIS face threats from habitat loss, overfishing, pollution and being mistakenly treated as “trash fish” in intensive aquaculture systems.

Captive breeding presents an opportunity to protect and propagate these native species, while also supporting year-round availability and easing pressure on wild populations. The goal is not just to conserve these species, but also to culture and promote them actively, much like larger commercial fish (e.g. catla, rohu, pangas). This involves developing dedicated breeding programmes, maintaining genetic diversity to avoid inbreeding and mimicking natural environmental conditions such as appropriate water quality, space, temperature and feeding patterns.

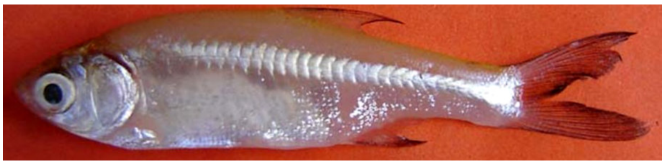
Harvest of farmed small Indigenous fish species.

By creating a controlled breeding environment, SIS populations can be stabilised and farming practices promoted. This approach also allows researchers and fishery experts to study growth rates, reproductive behaviours and micronutrient retention under captive conditions, data that can further improve farming and processing techniques. Moreover, captive breeding of SIS can play a critical role in sustainable aquaculture, as these species are often prolific breeders, require minimal inputs and coexist well with other fish in polyculture systems. This means farmers can rear SIS alongside larger fish to increase overall pond productivity while also diversifying the nutritional offerings from aquaculture.

From a conservation standpoint, such programmes can also safeguard endangered or declining SIS by maintaining broodstock in hatcheries and potentially reintroducing them into the wild when needed. Furthermore, increasing the captive-bred supply of SIS could reduce reliance on wild harvests and help curb destructive fishing practices, while opening doors to value-added products for domestic and export markets.

Mola (*Amblypharyngodon mola*)

A. mola, commonly referred to as moa, mourala, mowka, moya or mola carplet, is a small freshwater fish valued for its high nutritional content, particularly essential fatty acids (EFAs), minerals and vitamin A. This species reaches sexual maturity as early as three months of age and exhibits fractional spawning behaviour. The eggs of *A. mola* are slightly adhesive, meaning that the presence of a suitable substrate can significantly enhance both spawning success and hatching rates. Length at first maturity ranges from 3.57-9.94 cm in females and 3.69-8.88 cm in males. Under

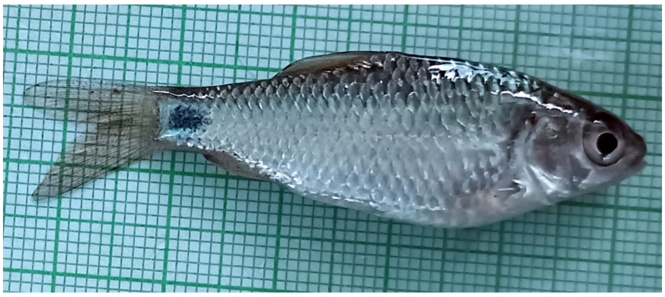


Mola (Amblypharyngodon mola).

optimal conditions, such as a temperature of 27 °C, larval development typically takes about 72 h (Rajts, Belton & Thilsted, 2022).

Puti (*Puntius sophore*)

P. sophore, commonly known as katcha-karawa, phabounga, bhadi punti, jat punti, jatputi, puti or sarputi, is mainly herbivorous. It reaches sexual maturity at a length of about 5 cm, with males showing reddish colouration during the breeding season. It is naturally a pre-monsoon to monsoon spawner, breeding from March to July, though this may vary by region due to environmental conditions. Fecundity ranges from 1,560 to 6,942 eggs, with mature egg diameter around 0.7 mm (Das, 2013).



Puti (*Puntius sophore*).

Climbing perch (*Anabas testudineus*)

A. testudineus, commonly known as koi, kai or kawai. Fecundity ranges from 300-400 eggs per g body weight of the female. The fertilised eggs are incubated in stagnant water in plastic tubs or fibre-reinforced plastic (FRP) tanks. Incubation time is 12-15 h at 26-28 °C water temperature. The newly hatched larvae measure 1.6-1.8 mm in length and rest in an upside-down position. A 2:1 male-to-female ratio was maintained during breeding. Spawning occurred in nylon hapas equipped with *Hydrilla verticillata* as a substrate for egg collection. For induced breeding, females received intramuscular injections of synthetic gonadotropin-releasing hormone (sGnRH). This hormone effectively reduced the latency period, increased egg output and improved fertilisation and hatching success (Sarkar et al., 2005).

Climbing perch (Anabas testudiens).

Peacock eel (*Macrognathus aral*)

Also known as the spiny eel, *M. aral* belongs to the family Mastacembelidae and is distributed across Asia and Africa. In Asia, the genus *Macrognathus* comprises 25 species, while *Mastacembelus* includes 17 species.

Fecundity and ova characteristics

M. aral is considered a low-fecundity species, with total fecundity ranging from 1,000 to 5,000 eggs. A recent study (2023) reported an average fecundity of 1,250 eggs. The ripe ova are dark green in colour, with an average diameter of 0.74 mm.

Hormone-induced breeding

Attempts to breed wild *M. aral* using commercial hormone injections showed that the fish responded after a 20-25 h latency period. The spawned eggs were green in colour and required a suitable substrate for attachment. This method shows potential for controlled breeding in aquaculture settings (Aquaculture Spectrum, Peacock eel, 2024).

Climbing perch (*Anabas testudiens*).

Dhela (*Osteobrama cotio*)

Osteobrama cotio (Hamilton, 1822), also called dhela hafo (Assamese), gila khani or keti (Froese & Pauly, 2021), is a small indigenous species found across Pakistan, India, Nepal and Bangladesh. Adults typically reach a maximum length of about 15 cm. Nutritionally, dhela is rich in calcium, selenium and vitamin A, making it beneficial for human health.

The breeding season begins with the onset of the monsoon in May, peaks in June and July, and concludes before September. Fecundity ranges from 512 to 6,849 eggs, depending on the size of the fish. The gonadosomatic index (GSI) reaches a maximum of 15.31 in June, indicating peak gonadal development, and declines to 3.79 by September, signalling the end of the breeding season.

In aquaculture trials, dhela demonstrated an 83.56% survival rate and nearly tripled its initial weight over four months. Despite this growth, the fish did not reproduce in ponds, likely due to late stocking and unsuitable pond conditions. Consequently, dhela's biomass at harvest represented a

Dhela (Osteobrama cotio).

modest 4.87% of the total, suggesting limited competition with other species such as carps in polyculture systems (Kunda et al., 2014).

Pabda (*Ompok bimaculatus*)

This fish, commonly known as the Indian butter catfish or pabda, is a non-air-breathing freshwater catfish native to South and Southeast Asia. The species faces challenges in captivity, as it does not typically spawn under controlled conditions, complicating conservation and aquaculture development. Fish attain first maturity at one year; males and females become mature from April to July. The breeding season extends from early June to late July.

In many fish species, males and females exhibit distinct external characteristics, aiding identification. Males often possess prominent pectoral-fin serrations, which are absent in females. Generally, males are smaller, more slender and more translucent with less pigmentation than females. The genital papilla in males is typically elongated and pointed or conical. In contrast, females tend to be larger, with a soft, rounded, bulging abdomen. Their genital papilla is fleshy, round and large, with a reddish vent.

Fecundity ranges from 2,000 to 30,000 eggs per female, with the number of mature ova per g of ovary varying between 950 and 1,090. Ripe brooders weighing approximately 40 g or more are optimal for induced breeding. Induced breeding can be achieved by administering synthetic hormones such as Ovatide, Gonadoprim, Ovasis or Wova-FH at doses of 1.5-2.0 mL/kg body weight for females and 0.5-1.0 mL/kg for males. The hormone is injected intramuscularly at the base of the pectoral fin, or between the base of the dorsal fin and the lateral line. After hormone administration, brooders are transferred to a breeding hapa or pool. Females are stripped for spawning by gently applying pressure to the abdomen 8-12 h post-injection, and eggs are collected in a dry enamel or plastic tray. Males are sacrificed to remove testes, which are then macerated in normal saline to prepare a sperm suspension. The sperm suspension is spread over the collected eggs and mixed gently using a bird feather to facilitate fertilisation. A small amount of distilled water can be added to activate the sperm.

The fertilised eggs are thoroughly washed with freshwater, cleaned and transferred to a specially designed hatchery or a simple flow-through system for incubation. Egg incubation is typically carried out using a flow-through system comprising plastic tubs or circular FRP tanks equipped with individual water inlets and outlets. The fertilised eggs are evenly distributed across the containers, and a gentle water current is maintained to facilitate hatching. Optimal hatching occurs at a water temperature of 27-30°C, with hatching completed within 22-24 h post-fertilisation.

The newly hatched larvae are transparent, cylindrical and lack a mouth, pectoral fins and body pigments. The yolk sac is pale greenish in colour and is fully absorbed within three days. For improved embryonic development and hatching success, soft water with low alkalinity is recommended. The mouth of the larvae begins to open by the second day, and a small amount of live feed is provided from that day onwards. During the rearing period, cannibalism is observed from the second day onwards, wherein healthy larvae prey upon weaker ones. Therefore, thinning the density of stocked spawn and subsequent segregation based on size is essential; this is done using nets of different mesh sizes. Fish larvae are fed ad libitum with a heterogeneous mixture of live zooplankton alone up to the 7th day (NFDB, 2018).

Brackish-water catfish, *Mystus gulio*

Mystus gulio, commonly known as whisker catfish, is a high-valued brackish-water catfish. In this species, males and females can be readily distinguished: males have a distinct muscular papilla with a pinkish tip, whereas females have a round genital vent. *M. gulio* typically spawns during the monsoon season, with peak breeding varying by region, often in July or between September and October. Fecundity ranges from about 5,950 to 141,210 eggs in individuals measuring 14.5-23.0 cm. The highest reproductive activity occurs in July,

Pabda (*Ompok bimaculatus*).

marked by peak gonadosomatic index (GSI) values and fully mature ovaries. GSI rises from March, peaks in July and then gradually declines through December.

For induced breeding of *M. gulio*, several hormones have been used successfully. Ovaprim is commonly administered at a dose of 2.5 mL/kg body weight for females and 1.0 mL/kg for males, though some studies report effective spawning with a single dose of 1.0 mL/kg for both sexes. Carp pituitary extract has also been used, with females receiving two doses of 15 mg/kg body weight at a 6 h interval, and males receiving the same dose at the time of the second female injection (Kumar et al., 2019).

Brackishwater catfish, Mystus gulio.

Gangetic mystus, *Mystus cavasius*

Mystus cavasius, commonly known as the Gangetic mystus, is a freshwater catfish belonging to the family Bagridae. It has an elongated, laterally compressed body and a distinctly conical head, with a narrow occipital process. A distinguishing feature is a dark spot located just before the origin of the first dorsal spine, typically highlighted by a contrasting white or pale patch along the ventral edge of the mark. The dorsal, adipose and caudal fins are usually pigmented with melanophores, giving them a shaded appearance.

Despite its ecological significance, the population of *M. cavasius* has been declining in recent years. Contributing factors include excessive capture for food and the ornamental fish trade, as well as degradation and loss of freshwater habitats. Conservation measures and habitat protection are crucial to prevent further reductions and to ensure the long-term survival of this species within its native range (Chakrabarty & Ng, 2005).

The captive breeding of SIS is a forward-thinking approach to conservation and aquaculture production that will support the food security of rural communities. It reflects a shift towards recognising the potential of small fish not only as food but as a sustainable, regenerative resource that merits protection, propagation and promotion, alongside commercially dominant species.

Gangetic Mystus, Mystus cavasius.

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A short note on two new instances of aquaculture species and system diversification in Purba Medinipur, West Bengal, India

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Young murrel *Channa striatus*.

Purba Medinipur District leads West Bengal state every year in all fisheries segments, including aquaculture and production of Indian major carps, economically important brackishwater shrimps, giant freshwater prawn, and marine capture fisheries. Quite a few elderly, progressive and innovative fish farmers in this district possess a rich wealth of indigenous technical knowledge and skill. They have developed new ideas which are unique of their kind. One such farmer is Sri Buddhadeb Maity, at Village Ghagra, Gram Panchayat Kismat-Naikundi, Mahishadal Community Development Block. He has brought aquaculture species diversification and initiated scientific farming of the economically important murrel *Channa striatus* in two freshwater ponds. Another is Sri Uttam Manna, at Village Raghusardarbarh-Jalpai, Gram Panchayat Majilapur, Contai-1 Community Development Block. He is conducting large-scale farming of high-valued freshwater aquarium fishes in brackishwater ponds 2.2 km from the sea (Bay of Bengal). *C. striatus* (‘shol machh’ in Bengali vernacular) is a new candidate species in freshwater aquaculture. It has shown increasing consumer preference and market price in recent times in eastern India.

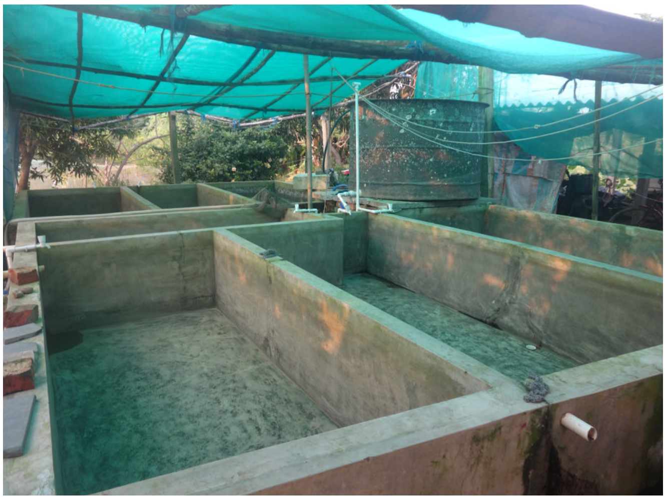
Sri Maity has been involved in commercial farming of air-breathing fishes *Clarias batrachus* and *Heteropneustes fossilis* since 2010. At the end of April 2025, he started *C. striatus* farming in his own concrete-sided ponds after procuring 5,500 seeds from Andhra Pradesh. Initially, the seed (36-48 mm in size) were reared in a concrete tank (3.65 × 2.4 × 1.4 m^3, with an outlet in the middle) for 20-25 days. In his two grow-out ponds of 240 m^2 and 480 m^2 effective water area (0.9 m deep), he distributed 2,000 and 3,500 fish respectively. Remarkably, the fish are exhibiting fast growth rates of 250-300 g in the first 2 months. Adults will be sold at INR 350-400 per kg in the wholesale market in Mahishadal. As observed in September 2025, the fish weighed 500-800 g and are expected to attain 1.2-1.5 kg by March-April 2026.

Sri Maity provides commercially available pelleted feeds formulated for murrel: 0.8 mm diameter (INR 120 per kg; kept soaked in water before application for better results), 1.2 mm, and 1.8 mm. In 2024, he also farmed *C. striatus* using only 500 seeds. He now provides 15 kg of pelleted feed (1.8 mm) daily for his 5,500 growing *C. striatus*. Raw turmeric dust and Becosuls (vitamin) tablets are added to the feed. Yearlings of *Catla catla* (200 g size, total 20 kg) have been stocked with *C. striatus*. They have exhibited good growth (400-500 g by September 2025).

Sri Manna has brought aquaculture system diversification, farming five varieties of goldfish, Koi carp, milky carp, black molly, colour widow tetra, tiger barb, and rosy barb successfully since 2015. He uses open ponds that are slightly brackishwater in nature, unlike conventional medium- to large-sized rectangular cement cisterns or nylon net enclosures fitted in homestead ponds. He has leased 16 ponds, each 2,000-3,000 m² in effective water area and owns 6 smaller ponds. Overhead netting covers every pond. Water exchange is not conducted.

A striking feature is that no infectious diseases have been observed in his growing fishes. This is most probably due to the salt content in water, which is higher than in freshwater. The salinity in Sri Manna's ponds restricts the growth and presence of bacterial and fungal microorganisms and ectoparasites that are generally pathogenic to aquarium fishes. Longevity of the fish is also high, with bright body colour. He also conducts controlled breeding and seed production of these fishes in rectangular cement cisterns, maintains brood fishes, and supplies aquarium fish seeds to villagers who have started this venture on a small scale. Marketable-sized fishes are supplied in oxygenated packets from his site 10-25 times every month to popular wholesale aquarium fish shops at CTI Dasnagar, Ankurhati, and Belepole in Howrah district, approximately 150-165 km away. He and four workers provide a total of 60 kg of feed daily to the aquarium fishes.

Both Sri Maity and Sri Manna have shown a new way forward. They have encouraged and guided several other farmers by profession in the same and adjacent Community Development Blocks in such new aquaculture practices, which are profitable and show promise. As an extension worker in fisheries, I had conversations with Sri Maity and Sri Manna at their pond sites on 13 September 2025 and 12 October 2025 respectively. These visits enriched and educated me about such newer aspects of aquaculture and the methods involved and allowed me to document farmers' knowledge.



Aquarium fish seed production facilities of Sri Manna.

A large specimen of *C. straitus*.

Black molly at one side of Sri Manna's pond.

An aquarium fish pond with overhead netting.

Sri B. Maity feeding *C. striatus*.

Adding knowledge to the seed production process of giant featherback (*Notopterus chitala*) in captivity

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Mature giant featherback broodstock.

Aquaculture in Asian countries is well recognised globally. It contributes to food security, rural livelihoods, employment and foreign exchange. Production has accelerated rapidly over the past two decades across Asia, using both native and exotic species. Yet many preferred native species remain neglected and have not reached commercial scale, despite strong market demand. A major reason is the lack of complete knowledge of their production processes.

Notopterus chitala, also known as chitala, clown knifefish or giant featherback, is one such species in South-East Asia. It is valued as a nutritious food fish and also as a sport fish. In carp ponds, it helps control weed fish, minnows and insects, so its inclusion in composite culture can add a useful secondary crop. The species prefers well-oxygenated water but can survive extended periods in low oxygen because it has an air-breathing organ. These traits make it a promising candidate for aquaculture diversification.

However, *N. chitala* is listed as Near Threatened/Endangered by the IUCN in parts of its range, likely due to overfishing, habitat degradation, pollution and other human pressures. It is therefore timely to compile and share practical knowledge from different groups on captive production. Improving access to seed will ease scarcity for farmers, and seed can also be ranched to reinforce wild populations.

This article provides information on breeding and seed-rearing management for chitala. The aim is to support expansion of chitala aquaculture to meet market demand while contributing to conservation of the species.

Biology of the species

N. chitala is a large, air-breathing freshwater fish found in rivers, reservoirs, ponds and tanks in South-East Asia. It prefers still waters with good oxygen levels, yet can tolerate low oxygen because of its accessory air-breathing organ. The body is silvery, with a slightly darker, banded dorsal side. The dorsal profile is arched, giving a humped appearance. The head is flattened with a terminal mouth bearing villiform teeth in both jaws, directed backwards. The dorsal fin is short, and the anal fin extends for about two-thirds of the body length.

The species is planktophagous in early life, then becomes predatory, feeding on crustaceans, insects, fish larvae and small fishes, which together form about 80% of gut contents. A U-shaped stomach allows ingestion of relatively large quantities of prey or feed.

Males mature in their second year, and females in the third. Fish of 2.0-2.5 kg (both sexes) are considered mature. Spawning in nature begins with the early monsoon. Both ovary and testes are single-lobed. The gonado-somatic index is about 2.0-2.5% in males and 5.0-6.0% in females. Fecundity is low, at roughly 8,000-18,000 eggs in females of 1.5-2.5 kg. Two egg size classes are present in the ovary during the pre-mature stage; as spawning approaches, the smaller oocytes decline and larger ones dominate. Water-hardened eggs are spongy and large, up to 5 mm.

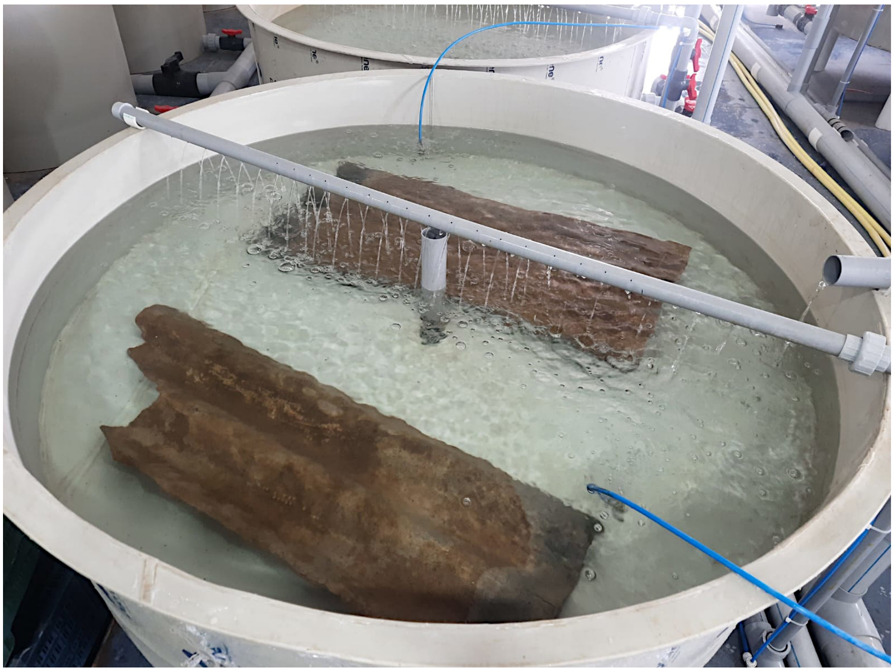
Wild populations show an isometric growth pattern. Growth is slow in the first year, with faster growth from the second year onwards. In captivity the species can add about 1 kg per year, and individuals of 8-10 kg are recorded in the wild.

Brood stock development

Brood fish of about three years of age or above 2 kg are expected to breed and are considered good brood stock. Juveniles can be reared in ponds to produce brood fish. Farmers also often collect large fish from the wild and rear them in ponds for seed production to shorten the time needed for brood development. Because chitala are predators, they rarely accept artificial feeds. Researchers recommend including more than 50% good-quality fishmeal in formulated feeds to improve acceptance.

A pond size of about 0.1 ha is suitable for rearing, providing ample space for activity. Some farmers suggest stocking 40-50 fish for breeding in 0.1 ha of water; others prefer lower numbers to reduce grazing/predation pressure on natural food in the pond. Farmers and researchers also rear mature chitala with carps in production ponds, as their feeding habits differ and competition for feed is limited.

Attached egg collected from pond.



Incubation of egg in flow-through system.

It is useful to release “weed fish” or species with frequent breeding in the pond. Naturally recruited fish can serve as live feed for chitala throughout the year. Tilapia may be added for this reason, as they breed often and their early fry can be eaten by chitala. However, uneaten tilapia may grow to early fingerling/fingerling stages, when their dorsal spines become strong and sharp, making them difficult for chitala to consume. Increasing tilapia populations can then become problematic due to higher grazing pressure on natural food resources. Using local species with frequent breeding as live feed is therefore often the best option to provide a regular food supply and maintain healthy brood stock.

Breeding the fish

Chitala is an air-breathing, monsoon-breeding fish that lays eggs in its habitat when conditions are suitable. After the first pre-monsoon showers, fish show signs of imminent spawning: twisting body movements at the surface become more frequent as egg release approaches. Males and females can be distinguished by the genital papilla: the male has a thin, conical papilla, whereas the female's is stout and broad. The testis is unilaterally placed, and the ovary is single-lobed.

There is little literature on induced breeding, apart from a few reports of eggs adhering to mosquito netting. In nature, however, the species lays eggs profusely on hard substrata within preferred habitats. Farmers exploit this behaviour by providing hard materials, such as broken asbestos sheets, car tyres, bricks or stones, and wooden planks, in brood ponds. Before laying, fish clean the pond bottom around the chosen substratum; this can indicate imminent spawning. In our observations, eggs were attached to asbestos sheets within a few days.

Regular checking (once or twice weekly) is needed to detect egg laying; more frequent disturbance can disrupt spawning or reduce egg numbers. The species is low-fecund. Egg counts on asbestos sheets in several instances ranged from 300 to 1,100 per provided substratum. Because spawning occurred in a pond, it was difficult to confirm how many females participated. We observed egg deposition until mid-August, with fertilisation above 80% during this period. Spawning later than mid-August yielded more unfertilised eggs, probably due to poorer spermiation by males.

Egg-laden substrata can be transported to the hatchery for incubation. A flow-through water supply is essential to ensure adequate oxygen and gentle current during embryonic development. Freshly laid eggs are off-white to slightly yellowish/brownish; viable eggs retain this colour. Eggs that turn fully white or gradually shrink are unfertilised. Water-hardened eggs are spongy and large, measuring 4-6 mm in diameter and weighing 65-70 mg. Incubation usually exceeds 6-7 days. Hatching is asynchronous: complete hatch-out may take 3-4 days as embryos drop from the chorion. Hatching is likely within 1-2 days once surface venation is visible on the eggs, reflecting blood vessels of the developed embryo; feeble embryonic movements can also be seen under a microscope at this stage.

Hatchlings are collected daily by siphoning until hatching is complete and are then transferred to rearing tanks for further nursing.

Haul of yolk sac larvae.

5 day yolk bearing larvae.

Nursing the larvae

Newly hatched larvae show limited movement because of the large yolk sac. Hatchlings are 12-15 mm in length, 40-45 mg in weight, and the yolk sac measures about 5-7 mm. Yolk absorption takes more than one week. The larvae are negatively phototactic even during the yolk-sac stage, so shelter should be provided. Without cover they tend to congregate in one or two spots in the rearing tank.

Good water quality is essential. Debris and uneaten feed should be removed with regular water replenishment. The larvae are very sensitive to low dissolved oxygen and to ammonia accumulation; prolonged exposure leads to sluggish movement and poor feed acceptance. Daily aeration and partial water exchange greatly reduce these problems. They are also sensitive to handling stress. Stress can be caused inadvertently during tank cleaning or by strong inflow currents when refilling; both should be avoided.

Low rearing density improves performance: 3-4 larvae/L typically yields survival ≥ 70%. Over 25-30 days of larval rearing, they usually reach 0.2-0.4 g. Live feeds such as Tubifex larvae, Artemia nauplii and mixed live zooplankton are well suited at the start. Mixed zooplankton collected from ponds should be sieved before feeding. Live items persist in the tank water and provide food throughout the day. Growth

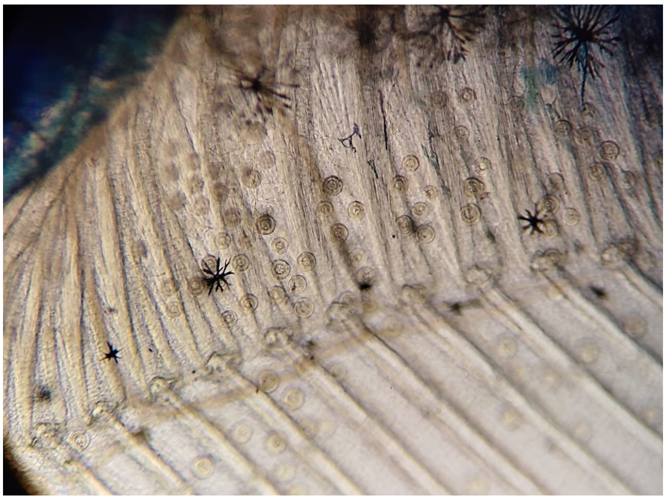

Group of fry after indoor rearing.


Haul of N. chitala fingerlings.

and survival are often better with *Tubifex* and *Artemia* than with zooplankton alone. *Tubifex* should be finely chopped, as longer worms are difficult to ingest; larvae will also nip at bunches of *Tubifex*.

A compound feed containing 40-50% high-quality fishmeal, offered as a soft dough, is accepted by 14-15-day-old larvae. Gradual weaning from live feeds to the compound feed is


Juveniles of chital from tank culture.


View of trichodina infection in larvae.

recommended as best practice. Some farmers also feed larvae/fry with live carp larvae or low-cost seed of other fish species.

Fingerling production

Fry of 20-25 days are well suited for rearing in fingerling tanks or small earthen ponds. Prepare rearing units as for carp nurseries, manuring to promote plankton production before stocking. Plankton and other live organisms generated by manuring provide natural food alongside a regular compound feed. As with larval diets, the compound feed should include high-quality fishmeal as a major ingredient. The fishy odour increases acceptance in this predatory species. Feed should be crumbled during the first 3-4 weeks of rearing. Provide shelters in the tanks, which the fish use as hiding places. Filamentous algae often develop in shallow water; remove them to allow free movement.

Good growth is obtained by stocking about 100-150 fry in a 16 m² tank. Over 6-8 weeks, fish typically reach 12-13 cm in length and 6-7 g in weight. Seed of this size is suitable for grow-out. With further rearing in tanks, fingerlings can reach 18-24 g and 16-19 cm over an additional 4-5 months.

Health management

During larval rearing we encountered and confirmed *Trichodina* infection. Fish appeared healthy at first, but at 13-15 days old showed unusual swimming behaviour and then died after 2-3 days. Mortality was never mass, but occurred in phases. We concluded that pond-collected plankton was the source. When we stopped feeding plankton to other batches of newly hatched larvae, mortality did not occur during nursing. Care is therefore needed when offering pond-collected plankton to larvae.

Local knowledge and practices in Asian seabass (*Lates calcarifer*) nursery to grow-out culture in Andhra Pradesh, India

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Harvested adult Asian seabass measuring approximately 67 cm in total length.

Asian seabass is quietly making waves along India's coast, especially in Andhra Pradesh. Internationally known as giant seaperch or barramundi, this sleek predator is called *pandugappa* in Andhra Pradesh. It is not just another fish: it is a culinary favourite, thanks to its firm white flesh, excellent taste and nutritional richness. Belonging to the family Latidae, this species has gained considerable attention in both domestic and international markets, and it is easy to see why. Seabass has everything an aquaculture farmer could hope for: fast growth, tolerance of a wide range of salinities and water conditions, and the capacity to thrive at high stocking densities. It is therefore no surprise that it is cultured worldwide in systems such as cages, ponds and recirculating aquaculture systems (RAS).

In India, the ponds and cages of coastal states have become the primary zones for seabass farming. Post-COVID, there has been a spike in pond-based culture, especially across Krishna, Eluru and West Godavari districts in Andhra Pradesh. With the uncertainties plaguing shrimp aquaculture, many farmers have shifted gears, attracted by the prospect of better returns from seabass. Naturally, this growing interest has also boosted the development of seabass seed and nursery systems near the farming hubs.

This article walks through the seabass farming journey in brackish-water environments - from sourcing eggs to nursery rearing and through to grow-out. It outlines culture duration, feeding, growth milestones and market prices.

Nursery phase I: where it all begins

The seabass production cycle begins with the transformation from egg to fry during the first nursery phase. These eggs are commonly compared to cumin seeds by local fishers due to their similar size and colour. They are primarily collected from brackish and marine waters between May and October. Coastal communities, particularly those residing near Mogalturu, Kruthivenu, Machilipatnam and other fishing villages in the Krishna and West Godavari districts, play an active role in this egg-collection process.

Following collection, the eggs are incubated and reared in nursery tanks for 20–30 days, during which they develop into 2.54-cm fry that visibly resemble adult seabass. During this period, the fry feed on naturally available food such as microflora, mosquito larvae, small aquatic insects and organic detritus present within the tank environment. Maintaining optimal tank hygiene and ecological balance is essential to ensure continuous availability of this natural diet.

In addition to wild-sourced fry, hatchery-based supply also contributes to nursery stocking. Notably, institutions such as the Rajiv Gandhi Centre for Aquaculture (RGCA) in Chennai provide hatchery-reared 2.54-cm fry to support farming operations. Market rates typically range from ₹1–1.5 per egg and ₹2–3 per fry, depending on quality and source.

Seabass fry.

Nursery phase II: growing into fingerlings

Once the fry reach a length of approximately 2.54 cm, they enter the second nursery phase, where they are further reared to fingerling size, typically around 7.5-10 cm in length. This stage generally spans 1-3 months, with growth rate largely influenced by the quality and frequency of feeding. Rearing continues in tanks situated near the backwater regions of the same coastal fishing villages mentioned for nursery phase I.

The primary feed used during this stage is locally known as royya pottu, referring to small shrimp (*Acetes* spp.), which provide a protein-rich diet essential for healthy development. Under optimal conditions, including proper tank management and consistent feeding, fingerlings may reach the desired size within a month, though in most cases the duration extends up to three months. These fingerlings are typically sold at market rates ranging from ₹25–30 per piece, based on their size and overall quality.

Seabass fingerlings.

Pre-grow-out phase: getting them pond-ready

Before being introduced to the main grow-out phase, the fingerlings undergo an intermediate rearing stage in pre-grow-out ponds. During this phase, they are grown to juvenile size, typically weighing 100-200 g and measuring around 15-20 cm in length. This process usually takes 2-4 months and is carried out in smaller ponds located near established grow-out farms across the districts of Krishna, Eluru and West Godavari.

Some farmers choose to rear the fingerlings themselves during this stage, while others prefer to purchase juveniles already grown to the required size. The diet during this period consists primarily of *Acetes* shrimp and small fish of about 13 mm in length. The market price for juveniles at this stage typically ranges from ₹100–150 per piece, depending on their size and condition.

Grow-out phase: the main event

The grow-out phase forms the core of seabass aquaculture. While individual farmers may introduce minor variations to suit specific needs, overall practices across farms remain largely uniform. Grow-out ponds generally range in size from 0.4-1.2 ha, aligning with the recommended 0.5-1.0 ha suggested by the Central Institute of Brackishwater Aquaculture (CIBA). Rectangular ponds are commonly preferred due to practical advantages such as ease of management and enhanced water circulation, which support uniform fish growth and efficient harvesting.

Stocking densities typically range between 1,000-1,500 juveniles per 0.4 ha, with some farmers going up to 2,000 per 0.4 ha based on management capacity. Feeding is generally carried out once daily, predominantly before 2 pm. Live feed is used throughout the culture period. Initially, *Acetes* shrimp and juvenile tilapia (2.54-7.62 cm) are provided. As the seabass grow, the feed gradually shifts to larger tilapia (7.62-10.16 cm). The entire culture cycle spans approximately 14-16 months.

A typical month-wise feeding and growth pattern followed for every 1,000 juveniles stocked in grow-out ponds is as follows:

- Month 1: Approximately 1 tonne of live feed, comprising small tilapia and shrimp, is administered.
- Month 2: Feed quantity increases to around 1.5 tonnes.
- Month 3: Feeding volume rises to 2 tonnes.

Harvested adult Asian seabass weighing approximately 4 kg.


Seabass juvenile.

- Month 4: An additional 2 tonnes of tilapia (2.54-7.62 cm) is provided. Cumulatively, around 6 tonnes of live feed will be used by the end of this month, with the estimated fish biomass reaching 1 tonne. This stage corresponds to a feed conversion ratio (FCR) of 6.
- Months 5-6: A further 2-3 tonnes of tilapia are fed during this period. By the end of the sixth month, individual fish typically weigh around 1 kg.
- Months 7-8: Daily feeding increases to approximately 70 kg of live tilapia (2.54-7.62 cm).
- Months 9-10: Daily feed input reaches 100 kg.
- Months 11-12: Feeding rates further rise to 120-140 kg per day. By the end of this period, the average fish weight reaches approximately 2.5 kg.
- Months 13-14: Daily feeding continues at 120-140 kg. By this stage, it is estimated that each fish consumes around 25 kg of live tilapia throughout the culture cycle. Final weights typically range between 3-4 kg per fish, reflecting healthy growth and efficient culture practices.

Use of chemicals and treatments in the grow-out phase

Maintaining optimal water quality in grow-out ponds is a fundamental aspect of successful seabass aquaculture. Farmers routinely implement a series of measures to ensure that the aquatic environment remains conducive to fish health and growth. A combination of zeolite and Gasonex is typically applied every one to two months to regulate pH and adsorb harmful substances such as ammonia (NH_4) and hydrogen sulphide (H_2S), which can otherwise compromise fish health. Additionally, agricultural lime and dissolved oxygen-enhancing powders are applied monthly, commonly mixed with sand, to stabilise water quality and improve oxygen availability within the ponds.

Disinfection protocols are followed diligently throughout the production cycle. Iodine-based disinfectants are primarily used: iodine 20% is applied during the first three months to ensure effective sanitisation during the early, more vulnerable stages of fish development. From the fourth month onwards, a less concentrated iodine 2% solution is employed to maintain hygiene without causing undue stress to the maturing fish.

Preventive measures against parasitic infections are also routinely practised. To address common ectoparasites such as *Dactylogyrus* and *Gyrodactylus*, farmers administer treatments of potassium permanganate (potash) and common salt at scheduled intervals. These applications help control parasite loads and ensure the overall health of the fish stock.

Live tilapia for seabass feed transported in aerated containers.

Key challenges

Seabass aquaculture faces several pressing challenges that hinder its sustainability and profitability. One major concern is fluctuating market prices, often driven by unpredictable export disruptions and external factors such as regional instability. These fluctuations make it difficult for farmers to plan harvests effectively.

At the same time, the rising cost of feed, particularly live tilapia, has significantly increased production expenses. As growing numbers of farmers culture seabass, demand for tilapia has pushed up prices substantially. Compounding these issues are disease outbreaks such as gill infections like columnaris and fluke infestations, largely resulting from intensified farming and poor management practices.

What exacerbates the situation is the lack of species-specific therapeutics for seabass, leaving farmers dependent on generic or off-label treatments originally developed for other fish species or even livestock.

Harvest output from a seabass grow-out pond.

Conclusion

Asian seabass aquaculture in Andhra Pradesh has evolved into a structured, multi-phase practice driven by local knowledge, adaptive feeding strategies and region-specific management inputs. Each stage from egg collection to grow-out reflects a blend of traditional methods and science-based recommendations that together ensure steady growth and productivity.

Currently, harvested seabass is primarily routed to the Kolkata export market, with some volume channelled through Chennai, mainly exported in raw, whole form. However, there is a growing global demand for value-added seabass products. Strengthening efforts in processing and marketing such products could significantly enhance profitability and provide greater income stability for farmers.

Moreover, seabass remains a highly regarded culinary favourite, especially in tourist destinations across India, signalling potential for domestic market expansion. By boosting both domestic consumption and export-oriented value addition, the industry can cushion itself against market volatility while ensuring long-term sustainability and improved livelihoods for those involved.

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AquaInnovate showcases regional aquaculture innovation and nature-based solutions

AquaInnovate participants.

The first AquaInnovate event, held in Bangkok from 12-16 May, brought together aquaculture startups, entrepreneurs, researchers, and investors from across the Asia-Pacific region for an intensive week of learning, pitching, and collaboration. Convened by NACA and FutureFish, with funding support from Canada's International Development Research Centre (IDRC), the programme focused on accelerating nature-based aquaculture innovation and building a stronger regional startup ecosystem.

A platform for innovation

AquaInnovate was designed to provide entrepreneurs with the knowledge, networks, and tools to transform promising ideas into viable businesses. Over 25 participants from across Asia-Pacific joined the event, representing a diverse mix of early-stage companies, researchers, and innovators. Across five days, they engaged in interactive sessions, personalised coaching, field visits, and practical workshops, all aimed at sharpening business models and fostering partnerships.

Startup pitches and feedback

A key feature of the event was the startup pitch sessions, where 14 aquapreneurs presented solutions ranging from sustainable aquafeeds and probiotics to shrimp health innovations, aquaculture automation, and circular economy approaches. Each pitch was followed by questions and feedback from peers, industry experts, and investors.

Entrepreneurs received practical advice on investment readiness, market positioning, and scaling strategies, helping to refine their value propositions

Industry representatives from HydroNeo and UniFAHS shared lessons on scaling aqua-tech and biotech innovations, stressing the importance of affordability, trust-building, and local validation. Their insights reinforced the challenges and opportunities for startups navigating fragmented markets in Asia.

Expert sessions and coaching circles

The programme featured a series of expert-led sessions on core themes, including:

- Business fundamentals - practical steps to strengthen operations, build scalable ventures, and prepare for investment.
- Investing for impact - strategies to attract mission-aligned capital and engage with investors in developing Asia.
- Nature-based aquaculture solutions - aligning innovation with ecosystems, community resilience, and sustainability.
- Gender equality and social inclusion (GESI) ensuring aquaculture innovation is accessible, equitable, and empowering.

Small-group coaching circles gave participants the opportunity to workshop challenges directly with experts, covering issues such as IP ownership, commercialisation strategies, financing, and inclusive business design. These sessions provided targeted feedback and encouraged peer learning.

Field visits: Learning from Thai innovators

Participants travelled to two pioneering farms in Thailand for hands-on learning. At LST Farm, Somprasong Natetip demonstrated Thailand's only biosecure hatchery producing SPF all-male freshwater prawns, showcasing genetic RAS systems and low-energy water treatment innovations. At Boonsawang Farm, Gunn and Suthi Mahalao shared their approach to premium seabass farming, covering disease management, certification, and diversification into new species. These visits offered practical insights into the realities of farm operations, innovation adoption, and the commercial drivers shaping aquaculture businesses.

Watch the presentations

Videos of startup pitches and expert sessions from AquaInnovate 2025 are now available from the NACA website and YouTube channel, which you may access directly from the linked descriptions below:

https://enaca.org/?id=1403

An interim website for the AquaHub has also been established, and with the full website slated for launch in February 2026. For background on the participants and full programme details, please see the Aqua Hub website at:

https://aquahub.asia

Reimagine Fish Farming with RAS-P.I.N.A.S

Elisa Claire Sy of E-Primate presents RAS-P.I.N.A.S, a closed-loop, water-efficient system for land-based fish farming. The technology integrates biofiltration, aeration, and mechanical treatment to support high-density production while conserving water and land and reducing disease risk. RAS-P.I.N.A.S also offers flexibility in farm siting, with trade-offs in energy use and infrastructure costs. Recirculating aquaculture systems are gaining traction as a key innovation in Asia's sustainable aquaculture future.

Green Controller: Smart Farming for a Sustainable Future

Green Controller by ICM Electronics is a smart water quality monitoring system for aquaculture, powered by high-precision titanium sensors. It tracks dissolved oxygen, salinity, and pH in real time, with full control through a mobile app and instant anomaly alerts. The system enables automated aeration based on live data, reducing energy use, lowering aerator run time, and improving feed conversion efficiency for more sustainable aquaculture operations. This pitch was presented Sukmit Teekhasenee of ICM Electronics.

Cweed Aquasolutions: Empowering Communities Through Nature-based Solutions

Cweed Aquasolutions, a spin-off from Universiti Malaya, works with coastal communities to develop seaweed cultivation through integrated multi-trophic aquaculture. The initiative repurposes abandoned shrimp ponds in Peninsular Malaysia, providing training and technical support for farmers to start seaweed farming. Cweed Aquasolutions also buys back harvested product, creating a sustainable livelihood model that links community development with nature-based aquaculture solutions. This pitch was presented Adibi M. Nor, CTO of Cweed Aquaculture Solutions.

ShrimpGuard: Nature's shield for healthy shrimp

ShrimpGuard, developed by BIOTEC, NSTDA, and Kasetsart University in Thailand, is a phage-based innovation for managing shrimp health. It targets Vibrio infections using bacteriophages combined with immune-boosting agents, reducing antimicrobial use while improving farm productivity and sustainability across ASEAN. The project also engages farmers directly through training, outreach, and field trials to ensure practical application and lasting benefits for coastal communities and the wider aquaculture sector. This pitch was presented by Wanilada Rungrassamee of BIOTEC.

Circular Nutrition: Transforming Fish Byproducts into Sustainable Aquafeed

Circular nutrition in aquaculture focuses on reducing waste and closing nutrient loops by transforming fish byproducts into sustainable aquafeed. Simon Das from the Tropical Aquafeed Innovations Lab at James Cook University presents how this model can cut reliance on wild-caught forage fish while supporting cost-effective, nutritionally balanced diets. The lab's work includes developing weaning protocols for pellet-ready fingerlings, training farmers in advanced feeding practices and economics, and promoting gender and youth inclusion. Circular nutrition highlights how rethinking resource use can make aquaculture both more efficient and more sustainable.

TOMGOXY: Super Intensive Vannamei Shrimp Farming Towards Sustainability and Carbon Neutrality

TOMGOXY is an AI- and IoT-powered shrimp farming system developed by RYNAN Aquaculture in Vietnam. It transforms traditional ponds into super-intensive, high-efficiency systems that deliver higher yields with reduced water and energy use. The platform integrates smart sensors, cloud analytics, and advanced aeration to maintain optimal water quality, cut antibiotic reliance, and advance sustainable shrimp aquaculture. By combining digital technology with practical training and on-farm deployment, TOMGOXY helps farmers increase productivity, lower costs, and build long-term resilience in the shrimp industry. This pitch was presented by Dang Pham of RYNAN Aquaculture.

QS Aqua Technology: Nature-based Innovation for Sustainable Aquaculture

QS Aqua Technology, a startup from the InnoHub Program of Universiti Putra Malaysia, develops nature-based probiotic solutions for sustainable aquaculture. Their approach combines beneficial bacteria that support gut health and maintain balanced pond ecosystems with quorum sensing inhibition compounds from microalgae. These compounds block harmful bacteria from communicating, preventing disease outbreaks and reducing dependence on antibiotics. By improving pond health and resilience through microbial and algal innovations, QS Aqua Technology offers farmers safer, more sustainable tools to manage aquaculture production. This pitch was presented by Maya Liyana Hamzah.

PowBio: A nature-based microbial solution turning fish pond waste into protein

PowBio is a microbial inoculant developed by NileBioFish (NINEBIO GROUP Co., Ltd.) in Thailand to support sustainable biofloc aquaculture systems. Co-developed with Maejo University's Faculty of Fisheries and Aquatic Resources and supported by the Thailand National Innovation Agency, PowBio uses high-efficiency microorganisms to turn fish pond waste into natural protein. By reducing ammonia and nitrite levels, improving water quality, and recycling nutrients within ponds, PowBio helps farmers cut feed costs, lower water exchange needs, and reduce chemical inputs. The result is healthier harvests without muddy off-flavors—delivered through a practical, low-cost, and easy-to-use solution for more productive and resilient aquaculture. This pitch was presented by Nissara Kitcharoen of NileBiofish.

DeepBlue Aquaculture: Phytogenics Approach to Improve Mud Crab Growth Performance

DeepBlue Aquaculture, the world's largest soft-shell crab operation, is pioneering the use of phytogenics to improve mud crab growth performance. Soft-shell crab farming is traditionally labor-intensive and low-yield, making it difficult to scale. Their proprietary plant-based additive, PhytoEcR, boosts mud crab growth and moulting rate—delivering up to 20% higher weight gain after 45–60 days, with a 40% increase in moulting rate and 35% faster moulting compared to control groups. PhytoEcR is now moving into commercial-scale testing, aligning with global trends in phytogenic feed solutions to enhance productivity and sustainability. This pitch was presented by Andrew Ng of Deep Blue aquaculture.

Life Cycle Assessment for Eco-friendly and Sustainable Aquaculture by Nature-based Practice

This presentation introduces a life cycle assessment tool designed to evaluate the sustainability of nature-based aquaculture practices. The tool measures environmental impacts such as carbon footprint and supports farmers, researchers, and policymakers in identifying mitigation strategies for more eco-friendly production systems. This pitch was presented by Kobboon Kaewpila of the Life Cycle Sustainability Assessment Laboratory, King Mongkut's University of Technology.

LEAPS: Leveraging Climate-Smart Shrimp Aquaculture Solutions in Indonesia

LEAPS is a climate-smart aquaculture initiative in Java that combines shrimp farming with mangrove restoration to strengthen coastal community resilience. Implemented under the AQUADAPT program with funding from Global Affairs Canada and IDRC, the project promotes inclusive, nature-based approaches for small-scale shrimp aquaculture. By integrating real-time IoT water quality monitoring, wastewater treatment and gender-responsive practices, LEAPS reduces greenhouse gas emissions while restoring mangroves and supporting communities. The project also informs evidence-based policy, helping scale sustainable aquaculture solutions across the region. Aligning shrimp farming with ecosystem restoration, LEAPS supports livelihoods and adaptation. Pitch presented by Rocky Pairunan and Burhanuddin Zein.

Digital Solutions for Farmers in Myanmar

Farm Suite by Greenovator is a digital farm management tool tailored for aquaculture in Myanmar. The platform helps farms and agribusinesses streamline planning and daily operations by tracking activities, inputs, and yields through a real-time, business-grade dashboard. Recognised as a top-3 innovation in the Grow Asia Challenge, Farm Suite provides an affordable, professional alternative to manual record-keeping. With its mobile app interface, it delivers actionable insights that empower aquaculture managers to boost productivity and sustainability. This pitch was presented by Yin Yin Phyu.

UniFAHS: The Startup Journey of a Thai Phage Biotech Pioneer

Kitiya Vongkamjan, co-founder of UniFAHS, shares the journey of building a pioneering phage biotechnology company in Thailand. UniFAHS develops bacteriophage-based solutions to tackle antimicrobial resistance and improve food safety in agriculture, aquaculture, livestock, and food processing. From its origins in research at Chulalongkorn University to recognition as a Global Finalist in the Extreme Tech Challenge 2022, UniFAHS has grown into a venture-backed startup, raising USD 1.4 million in seed funding from A2D Ventures, ADB Ventures, and InnoSpace (Thailand). The story highlights how cutting-edge science can be transformed into scalable commercial solutions with real-world impact.

HydroNeo: Startup Journey of a Smart Aquaculture Innovator

In this presentation, Fabian Reusch, founder of HydroNeo, shares the story of how HydroNeo began and the lessons learned along the way of building a tech startup in Thailand. Aimed at fellow aquaculture entrepreneurs and startup founders, his talk is an open and honest reflection on the realities of the journey — not a polished, glamorous pitch that only highlights the wins, but a candid look at both successes and setbacks, the difficult decisions, and the ongoing challenges that shape the real path of building a company.

Nature-based Aquaculture for Entrepreneurs and Innovators

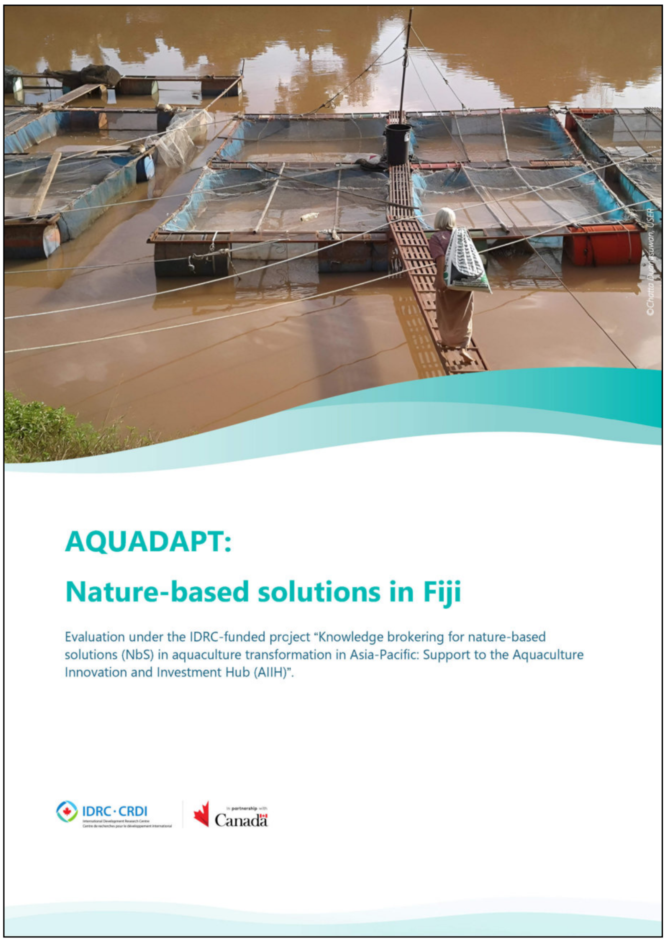
Mariska Bottema (WorldFish) and Rebecca McMillan (IDRC) discuss the concept of nature-based aquaculture, why it matters for innovation and entrepreneurship, and how it can support ecosystems, communities, and profitability. Topics include: Defining nature-based aquaculture and its connection to nature-based solutions; criteria such as climate resilience, ecosystem health, reduced antimicrobial use, and inclusivity; global examples: mangrove–shrimp integration, women-led seaweed farming, integrated multi-trophic systems, and rice–fish farming; supportive technologies including IoT, renewable energy, and life cycle assessment; and opportunities for entrepreneurs: resilient farms, reduced risks, lower costs, premium markets, funding, and partnerships.

Nature-based Seafood Markets & Creative Partnerships

A discussion panel on how creative partnerships build markets for nature-based seafood from farm to fork with Special Guest Chef Black (Blackitch Artisan Kitchen)

Knowledge brokering for nature-based solutions in aquaculture

NACA's AQUADAPT knowledge-brokering project has released three new publications from Fiji, Thailand, and the Philippines, prepared to inform development of the Aquaculture Innovation and Investment Hub (AquaHub) and country innovation and investment plans. The work aligns with the FAO-NACA transformation agenda by documenting practical nature-based solutions (NbS) already in use, the conditions that enable them, and where further evidence is needed to scale. AQUADAPT is funded by Canada's International Development Research Institute (IDRC).



Climate change and social resilience

Across all three countries the focus is the same: Mitigate and adapt to climate change risks, improve efficiency and resilience, and capture social inclusion benefits where possible. The publications assemble farm-level cases and early metrics (productivity, energy use, costs, and-where available-emissions), providing a baseline for policy, technical assistance, and investment decisions.

Fiji

The Fiji report profiles four enterprises-Kerry Farms, SEAPAC PTE Ltd., Growa Fish Fiji Ltd., and the Muana-Ira community mangrove oyster project-covering tilapia, giant freshwater prawn, whiteleg shrimp and bivalves. Reported NbS include solar power (e.g., a planned 50-kW system at SEAPAC and solar pumping/aeration at Kerry Farms), hydropower and trompe aeration at Growa Fish, HDPE linings and biofloc, and an unfed, nature-positive oyster operation led by a women's group. The study also notes supply-chain realities for equipment (average landed-cost split ~71% purchase price, 14% shipping, 15% taxes/duties/inland freight), absence of major notifiable aquatic diseases at the time of reporting, and significant women's participation.

Thailand

Thailand's showcases present quantified outcomes from three energy-focused innovations. On a striped snakehead farm, adding on-grid solar for pumping and a daytime solar aerator increased productivity by ~21-25%, cut electricity per kilogram by ~42%, reduced energy costs per kilogram by ~42%, and lowered combined CO_2 emissions by ~28% (to ~0.79 kg CO_2-eq per kg of fish). At an intensive shrimp farm, a smart aerator control system reduced electricity per kilogram by 20% and lifted farm output by ~33%. A second shrimp site combining 50.4 kWp solar with smart aeration improved energy intensity by ~22% per kilogram and raised annual output by ~29%, while trimming costs and emissions.

Philippines

AQUADAPT: Nature-based solutions in the Philippines reports a preliminary scan of NbS in use-off-grid power, renewable materials and design improvements-plus an initial pipeline of 50 aquaculture innovations based on BFAR regional submissions, to be extended and screened with BFAR National Research Centers. Early field observations from CALABARZON and Region III document farms implementing NbS; forthcoming work will add GESI and transformation dimensions as detailed assessments proceed.

What this means for the AquaHub

Taken together, these findings begin to show where NbS are already delivering practical gains-lower energy intensity, steadier water quality, and, in some cases, measurable productivity improvements-while also exposing data gaps that matter to investors (e.g., consistent cost/benefit records, durability of performance across seasons). For the AquaHub, the near-term value lies in converting these documented practices into a structured pipeline: pairing innovators and farms with appropriate finance, technical partners and verification methods, and supporting governments with evidence for targeted incentives. As the datasets mature, the AquaHub can help standardise metrics (energy per kg, CO_2 per kg, survivals, payback) and convene partnerships that de-risk adoption at scale.

Publications & downloads

- AQUADAPT: Nature-based solutions in Fiji: https://enaca.org/enclosure/?id=1397
- AQUADAPT: Nature-based solutions in Thailand: https://enaca.org/enclosure/?id=1399
- AQUADAPT: Nature-based solutions in the Philippines: https://enaca.org/enclosure/?id=1398

"Innovation, Integration and Profitability in Tilapia Aquaculture: Modernisation for a New Era"

5th INFOFISH WORLD TILAPIA TRADE AND TECHNICAL CONFERENCE & EXHIBITION 2025

In collaboration with
13th International Symposium on Tilapia in Aquaculture (ISTA13)

TILAPIA 2025

3 - 5 NOVEMBER 2025
Bangkok, Thailand

INFOFISH has organised editions of the International Trade and Technical Conference and Exposition on Tilapia since 2001. The most recent was TILAPIA 2015, held in Kuala Lumpur in 2015 with the participation of more than 250 delegates from 25 countries. The Conference brought together more than thirty speakers comprising industry leaders, government representatives, researchers and experts who deliberated on the latest updates regarding production, markets and trade; innovations along the value and supply chains; industry initiatives on certification; and tilapia health management.

TILAPIA 2025, the 5th edition of the series, will be held in collaboration with the 13th International Symposium on Tilapia in Aquaculture (ISTA13); the University of Arizona; US Soybean Export Council (USSEC); and with the technical support from the Food and Agriculture Organization of the United Nations (FAO) and NACA. Themed "Innovation, Integration and Profitability in Tilapia Aquaculture: Modernisation for a New Era", TILAPIA 2025 will present updates on the production status of global, regional and major tilapia producing countries. It will also deliver consolidated information on emerging markets; innovative technological developments along the value and supply chains such as integration of farming practices, genetics and reproduction, nutrition and feed technology, biosecurity and health management; standards and certifications; wellbeing of small-scale holders and tilapia itself; policies related to investing in climate-smart, gender-focused and nutrition-sensitive aquaculture projects; valueadded products; diversification of markets; and consumer awareness as per local and international market demand; which might be useful for key industry stakeholders and relevant decision-makers from the competent authorities to move forward.

Alongside the Conference, there will be an international trade exhibition which is expected to be held with the presence of about 20 exhibitors represented by leading tilapia hatcheries, farms, feed millers, buyers, processors, traders and cage manufacturers etc.

For more information, the programme and registration please visit the Tilapia 2025 website.

https://tilapia.infofish.org/

12th Symposium on Diseases in Asian Aquaculture
23-27 September 2025, Chennai, India

The Fish Health Section of the Asian Fisheries Society (FHS-AFS) invites everyone to the 12th Symposium on Diseases in Asian Aquaculture (DAA12), to be held from 23-27 September 2025 in Chennai, India. DAA12 continues the legacy of the DAA series by providing an exceptional platform for researchers, industry professionals, and students to come together and share their expertise in the vital field of aquatic animal health.

Hosted by FHS-AFS in collaboration with the ICAR-Central Institute of Brackishwater Aquaculture in Chennai, India, DAA12 promises to be an enlightening experience. With the theme "Transformative Innovations Shaping the Future of Aquatic Animal Health Management", it reflects our commitment to addressing the pressing challenges faced by our industry today. Over the five-day event, participants can look forward to a dynamic program featuring seven technical sessions that showcase the latest advancements and research in aquatic animal health.

Key topics will include: Finfish and Shellfish Health, One Health and Aquatic Animal Biosecurity, Aquatic Animal Epidemiology, Disease Surveillance & Reporting and New Emerging Technologies in Aquatic Animal Health Management. Each session will feature esteemed experts delivering insights that will foster rich discussions and promote the sharing of cutting-edge research.

We warmly invite researchers, industry professionals, academia, and students to join this exciting symposium and collaborate on sustainable solutions for aquaculture's future. Mark your calendars for an unforgettable experience in DAA12 at Chennai, India!

For more information, please visit the Diseases in Asian Aquaculture 12 website.

https://daa12.in/

Reported Aquatic Animal Diseases in the Asia-Pacific Region during the Fourth Quarter of 2024

Listed below are the reported aquatic animal diseases submitted by countries in the Asia-Pacific region, which covers the fourth quarter of 2024. The original and updated reports can be accessed at the QAAD page:

https://enaca.org/?id=8

Finfish Diseases

- **Infection with Infectious haematopoietic necrosis virus:** Australia in wild juvenile redfin perch (*Perca fluviatilis*).
- **Infection with red seabream iridovirus (RSIV):** Chinese Taipei in seabass (*Lates calcarifer*) and hybrid grouper (*Epinephelus fuscoguttatus* x *E. lanceolatus*); India, reported as Infectious spleen and kidney necrosis virus (ISKNV) in oscar (*Astronotus oscellatus*), blue acara (*Adinoacara pulcher*) and midas cichlid (*Amphilophus*) hybrid; and, Indonesia in barramundi (*L. calcarifer*).
- **Infection with Koi herpesvirus (KHV):** Indonesia in common carp (*Cyprinus carpio*).
- **Infection with Tilapia lake virus (TiLV):** Indonesia in Nile tilapia (*Oreochromis niloticus*) and saline tilapia.
- **Viral encephalopathy and retinopathy (VER):** Australia in farmed Queensland grouper (*E. lanceolatus*); Chinese Taipei in hybrid grouper (*E. fuscoguttatus* x *E. lanceolatus*) and orange spotted grouper (*E. coioides*), India in mangrove red snapper (*Lutjanus argentimaculatus*); and, Indonesia in barramundi (*L. calcarifer*), hybrid grouper and pompano (*Trachinotus* spp.)
- **Enteric septicaemia of catfish:** India in pangas catfish (*Pangasius hypophthalmus*); and Indonesia in pangas catfish.

Molluscan Diseases

Infection with abalone herpesvirus: Australia in blacklip abalone (*Haliotis rubra*).

- **Infection with Perkinsus olseni:** India in wild green mussel (*Perna viridis*).

Crustacean Diseases

- **Infection with white spot syndrome virus (WSSV):** Chinese Taipei in whiteleg shrimp (*Penaeus vannamei*); India in *P. vannamei*; Indonesia in *P. vannamei* and black tiger shrimp (*P. monodon*); and, the Philippines in *P. monodon* and *P. vannamei* (PLs and grow-out) and wild crabs and shrimps.
- **Infection with Infectious myonecrosis virus (IMNV):** Indonesia in *P. vannmei* and *P. monodon*.
- **Infection with taura syndrome virus (TSV):** Indonesia in *P. vannamei*.
- **Acute hepatopancreatic necrosis disease (AHPND):** The Philippines in *P. vannamei*.
- **Hepatopancreatic Microsporidiosis caused by *Enterocytozoon hepatopenaei* (HPM-EHP):** India in *P. vannamei*; Indonesia in *P. vannamei* and *P. monodon*; and the Philippines in *P. vannamei*.

Amphibian Diseases

- **Infection with *Batrachochytrium dendrobatidis*:** Australia in an unknown species of amphibian.

Other Diseases

- India reported **Infection with Tilapia parvovirus** in Nile tilapia (*Oreochromis niloticus*).

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NACA is a network composed of 20 member governments in the Asia-Pacific Region.