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AQUACULTURE ASIA

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Fish dressing

Medicinal leech farming

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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AQUACULTURE ASIA

What does Artificial Intelligence mean for aquaculture?

Firstly, I'm sure you're already sick of hearing about AI, so my apologies, but we do need to talk about the impacts on the aquaculture sector. To summarise, it does depend on who you are, but most likely the impact will be beneficial.

I've spent much of the last six months wrestling with AI, largely in a software development capacity, but also with documentation and other projects. Frankly, this technology is as close to a miracle as we are ever likely to see. For example, I recently downloaded the FAO aquaculture statistics, which are provided as a series of spreadsheets with about 100,000 rows. After providing the files and some background information, I asked the AI if it would be possible to convert the data into a relational database? It didn't just say 'yes'. It designed a database schema, created the database, imported the data, and wrote a 'how to' guide with a preliminary analysis, interesting trends worth exploring and sample queries to run. It can also read the newly created database and use it as a reference to answer my questions directly.

That probably would have taken me a week to do by myself, if I did not get frustrated and give up altogether. The AI did it in 10 minutes. It took me another 20 minutes to understand what it had actually done and to verify that it worked, since I was not expecting this result and did not initially believe that it was possible.

So what about aquaculture? There has been a lot of talk of impending job losses due to AI across the whole of society. Clearly this is going to be the case, but not for everyone, and not at all production scales. I think the impacts and opportunities are likely to be as follows:

- For people and businesses that are producing or dealing with material goods, such as aquaculture, AI will have minimal impact on labour (until AI robots show up). However, for medium and large-scale aquaculture it may offer substantial benefits on 'back end' logistics and administration, where AI can assist with automation of information-based processes, planning, ordering, scheduling, analysis of farm performance and so on. IoT automation of the farm environment does not require AI, and most such devices and systems actually use conventional software models, although they are often marketed as "AI".

- For people and businesses whose primary activities deal with information, such as research, policy, or advisory services, the impact can go two ways. The key issue is that an AI-literate information worker can *easily* be five to ten times more productive, or more. For small businesses and organisations this translates into massive leverage and efficiency gains. But larger organisations are more likely to view it as an opportunity to heavily reduce head count, and my guess is that it will be workers that are not AI-literate that get cut first.

So the takeaways are: AI will probably have little impact on labour in the aquaculture sector per se. It will probably have negligible impact and is perhaps irrelevant to small-scale aquaculture altogether, but offers substantial efficiencies to larger businesses that have administrative and logistical overheads to manage. For scientists and information workers the situation is different: My advice is to harness these tools or be left behind, and this is particularly important if you are at the early career stage.

If you haven't tried AI tools yet, give them a go. You're in for a real shock.

AQUACULTURE ASIA

Improved larval rearing of *Heteropneustes fossilis* with live fish food organism - a method practised in the farmer's field

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Segregated larvae collected from chamber.

Stinging catfish or singhi, *Heteropneustes fossilis*, belongs to the family Heteropneustidae. It has red-brown or brownish-blackish skin with a slender, flattened body. One healthy adult has an average length of 18.0 cm. Male and female brooders weigh 70-80 g and 100-120 g respectively. The head is flattened. Bony plates cover the top and sides. The snout is flat and rounded. The mouth is small, terminal, and transverse, with the upper jaw slightly longer. The eyes are small, lateral, and sit in the anterior part of the head. The nostrils are placed apart. The fish has four pairs of barbels. Maxillary barbels extend to the pectoral fin or pelvic base. Mandibular barbels extend beyond the pectoral fin ends. Nasal barbels reach the middle of the pectoral. The species has accessory air-breathing organs, which enable it to survive in water with low oxygen levels or in shallow water bodies. It also lives in freshwater habitats such as ponds, canals, swamps, marshes, and muddy rivers. It can survive on land for a considerable period because of its accessory air-breathing organ. *H. fossilis* is commonly found in Asian countries, including India, Bangladesh, Pakistan, Nepal, Sri Lanka, Myanmar, Vietnam, and Thailand. In 2017, the IUCN categorised the species as 'least concern' in the IUCN Red List of Threatened Species.

A pair of male and female singhi, Heteropneustes fossilis.

Nutrients profile and medicinal importance

H. fossilis has a rich nutrient profile (amounts per 100 g): calories, 119.50 kcal (27.97 kcal and 91.53 kcal from fat and protein respectively); protein, 16.12 g; total fat, 2.96 g (monounsaturated fat 1.08 g, polyunsaturated fat 0.41 g, omega-3 fatty acid 184.4 mg, omega-6 fatty acid 225 mg, and EPA+DHA 153.90 mg); vitamins (per 100 g): A 49.68 IU, D 197.20 IU, E 0.19 IU, K 1.63 mcg; minerals (per 100 g): Ca 221.37 mg, P 185.68 mg, Na 200.04 mg, K 113.53 mg, Fe 2.32 mg, Mn 0.29 mg, Zinc 1.30 mg, Se 0.31 mg, ash 2.72 g; and moisture, 74.61 g (Paul et al. 2015).

Because of its beneficial nutrient profile, people use it as a medicinal diet to treat different health ailments. Communities also know it through indigenous traditional knowledge for treating many ailments. People consume boiled singhi as a tonic to treat anaemia. They eat singhi cooked with black pepper to relieve pain and promote wound healing. Lactating mothers consume boiled singhi to regain strength after delivery and remove physical weakness.

Larval rearing - a critical stage for survival

Catfish, murrels, and their juveniles, as well as all ornamental fish, prefer to eat live food organisms. Recent progress in developing manufactured diets for fish larvae has yet to provide an alternative for feeding juveniles. Fish larvae are naturally adapted to capture moving prey and are generally visual feeders. In their early stage, they chase organisms that move in the water. Such movement of live food stimulates larval appetite to capture prey.

Live foods are categorised into various groups, including phytoplankton, zooplankton, benthos, nekton, periphyton, and others. Diverse groups of live foods with different sizes are important sources of nutrition, supporting larval survival and growth through easy digestibility and nourishment. In most fish and prawn species, the larval phase is the most critical phase of the life cycle. Live foods contribute immensely to the growth and survival of larvae during their rearing and are considered ‘living capsules of nutrition’.

Why live foods?

Live foods offer the following advantages:

- Early stages of most species feed on live foods.
- Live foods provide suitable diets for various developmental stages of fish species. Farmers can cultivate more finfish and shellfish species as rearing techniques and mass production of live foods advance.
- Live foods include species of microalgae. Farmers use them as food through the ‘green water’ technique for larval rearing, with zooplankton as part of co-feeding.
- Microalgal biomass culture helps maintain water quality in aquaculture. It also supports feeding, digestion, nutrition, nourishment, and overall growth of the larvae. Farmers use zooplankton as live foods either as single items or by way of co-feeding.

Advantages of live foods feeding to larvae

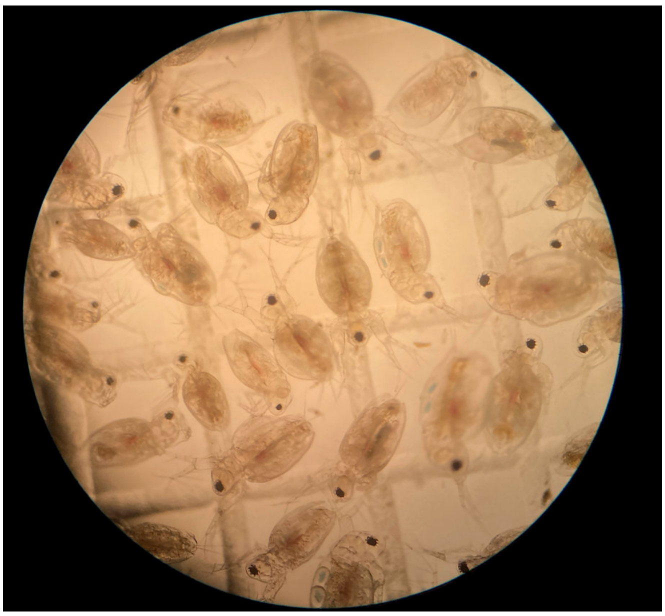
In an ecosystem, organisms at different trophic levels are linked through food webs and feeding patterns. Organisms that feed on others are again fed upon by other organisms at higher trophic levels. Fish larvae prefer to feed on live foods because of advantages from an evolutionary perspective, as follows.

Behavioural adaptation

Naturally, the juvenile phase of fish and prawn species prefer live foods. The larval stages requires compatible nourishment, which promotes early-stage growth. Diverse groups of live foods with the right nutrients support their early growth. The

Adult Moina.

larvae usually have an an undeveloped intestine which may lack the required amount of enzymes to digest artificial feed, at least in the early stages. Instead, they prefer suitable natural food available in the aquatic system. Moreover, at such a stage, larvae may not be used to accepting manufactured feed, which requires training for weaning. Ingredients in manufactured feed may not be suitable for larval nourishment, whereas adults might accept and prefer them.



Moina on Sedgwick Rafter Plankton counting cell.

Life form importance

Live foods have appropriate cell sizes that meet the demands of fish larvae, along with short life cycles. Fish larvae can easily access them through water currents. They can tolerate environmental variation. They have a thin skeleton that is easily digestible.

Nutritional importance

Live foods have adequate nutritional value with high digestibility, which boosts larval growth. They have high water content (>80%) and lower nutrient concentration, which seems suitably palatable.

ICAR-CIFA reaching out to farmers for larval rearing with live fish food organisms

Scientists practise mass culture of live fish food organisms in the outdoor system at ICAR-CIFA. They produce live foods to feed larvae and increase their survival. Larvae of catfish and murrels prefer live foods, and their survival increases after feeding. Farmers who rear catfish larvae, particularly *H. fossilis*, necessarily require the techniques of live food production. The progress of Mr Imran Molla, among others, is remarkable for the production of *Moina* sp., a zooplankton belonging to Cladocera, a suborder of crustaceans.

Senior author and Mr. Imran Mollah with live foods banner.

Hands-on training on culture of *Moina* sp.

Mr Imran Molla is a resident of Uluberia subdivision of Howrah district, West Bengal, India. He was not able to raise the desired number of larvae of *H. fossilis*. He believed that feeding live food to H. fossilis might be the way forward for obtaining desirable larval survival. He came to RRC, ICAR-CIFA, Rahara to learn the techniques of live food rearing, particularly *Moina* sp., which, among other live foods, seems a preferable food for larvae of H. fossilis. He received training in *Moina* rearing with the following steps: (i) identification of *Moina*, (ii) segregation of *Moina* through sieving with plankton nets from pond-collected mixed plankton, (iii) collection of individual *Moina* with the help of a simple microscope, (iv) conditioning of isolated *Moina* in a beaker with underground bore-well water, (v) culture of *Moina* in a small aquarium (length 15 cm × width 12 cm × height 12 cm), (vi) shifting of *Moina* culture into FRP tanks of 1,000 L capacity. Mr Molla then produced *Moina* with different resources and manures: waste bread, mustard oil cake, and meat juice. The combination of carbohydrate, fat, and protein boosts the growth of *Moina*.

Mr Molla's larval rearing of singhi - a success story

Mr Molla has several cemented tanks partitioned into several compartments, each with a respective length, width, and height of 1.2 m × 1.0 m × 1.0 m. He uses each compartment for conditioning five different age groups of singhi larvae: 4-6 days, 7-10 days, 11-18 days, 19-25 days, and 26-35 days. Mr Molla maintains the specified age groups as far as possible and segregates such age groups for better management of larval rearing to reduce cannibalism. Mr Molla observed that cannibalism seems more aggressive in the early age groups of larvae than in older ones. For this reason, he segregates those larvae that are close in age groups, having uniform size.

Population of Moina as segregated in beakers.

Cemented tanks used for Moina rearing.

Mr Molla's effort to culture *Moina* in an outdoor system to feed singhi larvae

Mr Molla has been enthusiastic and confident about the culture of *Moina* in his farm after receiving training. He established 25 tanks, each with 12,000 L capacity, in an open ground near his residential area. Each circular tank is made of a thick polythene sheet supported with a steel-made thick ring so that it will not be squeezed by outer air pressure and will not get ruptured by water pressure within the tank. He covers each tank on the upper side with a green shade nylon net to prevent direct sunlight inside the tank. He unfolds the cover to allow the entry of air when the intensity of the sun is favourable. Mr Molla cultures *Moina* with substances such as waste bread, meat juice, and mustard oil cake in these tanks. A huge number of *Moina* grow in each tank. He maintains two ways of feeding larvae. Firstly, he collects *Moina* from his polythene tanks with plankton nets and segregates them with different mesh sizes of plankton nets. He gives smaller *Moina* to early age groups of larvae, whilst he gives the adult ones to aged larvae, which he segregates and keeps in cemented tanks earmarked for each age group. Secondly, he collects different age groups of larvae and puts them separately into different polyethylene tanks for rearing. The operation of all these activities, as mentioned, is not static but changes as per the situation that arises. Sometimes, he uses 25 tanks exclusively for *Moina* production during the off-season. In peak season, he uses a few tanks for *Moina* production whilst he uses other tanks for raising larvae in huge numbers for farmers as demand increases.

Moina feeding to boost survival of singhi larvae

The mouth aperture of *H. fossilis* larvae is small and terminal. It has a transverse opening and develops within a few hours after hatching. By 72 hours post-hatching, the size of the mouth aperture increases with time. The mouth opens around 12 hours post-hatching. After four days, the larvae are steadily ready for feeding live foods after the disappearance of the yolk sac. On the fourth day, the mouth aperture measures an average of 650 µm, with a wide range of variation observed. The fourth-day mouth aperture of H. fossilis is suitable for feeding juvenile *Moina*, as observed on Mr Molla's farm.

Production of *H. fossilis* larvae through a unique method of feeding

Mr Molla rears singhi larvae for one month and then sells his larvae. He produces an average of 42,000 fry from each circular polyethylene tank. When the weight of an average of 3,000 fry becomes 1.0 kg, it is known as the '3,000 line'

Segregated larvae are placed different containers.

Table 1. Calculation of singhi fry production and earning

Criteria	'3,000 line' (average)	'2,500 line' (average)
Understanding	3,000/kg	2,500/kg
Production	14 kg × 3,000 = 42,000 numbers/tank	12kg× 2,500=30,000/tank
Cost	INR 2.50/individual fry	INR 4.00/individual fry
Earning	INR 2.50 × 42,000 = 105,000	INR 4.00 × 30,000 =120,000
Duration	30 days	40 days
Gross earning from 25 tanks	INR 105,000 × 25 = 2,625,000	INR 120,000 × 25 = 3,000,000
Remark	Most preferable	Less preferable due to risk involvement

as per business procedure for understanding between buyer and seller. Mr Molla produces an average of 14 kg of '3,000 line' (42,000 individuals/14 kg = 3,000/kg) fry from each circular tank. In a '3,000 line' fry, one fry costs around Rs 2.50 (US$0.03), and the cost of 14 kg fry becomes Rs 105,000 (US$1,396), which is earned per tank. He produces one million singhi fry monthly from 25 circular polythene tanks by feeding only *Moina* and earns Rs 2,500,000 (US$33,245) from one breeding season. However, the '3,000 line' may be changed to the '2,500 line' when buyers demand larger-sized fry. In such cases, the cost of a single fry becomes higher, around Rs 4.0 (US$0.05). Then he obtains an average of 12 kg of fry of the '2,500 line' from the single circular tank, and the cost of 12 kg of fry becomes Rs 120,000 (US$1,596), which is earned per tank. However, growing larger fry is always risky because of space constraints, cannibalism, disease, and feeding due to a shortage of live foods. Mr Molla always prefers producing '3,000 line' fry.

Management of larval rearing in tanks

Rearing singhi larvae requires the utmost care. Any negligence in managing larval rearing leads to catastrophe. Mr Molla provides care 24 hours a day, 7 days a week, for rearing singhi larvae. He performs exchange of water, feeding, production of *Moina*, and its application to larval rearing tanks. He also checks cannibalism, growth, and survival in the tanks. Together, all these activities require sincere effort. Mr Molla prefers larval feeding with *Moina*

Mr. Imran Mollah with Scientists and students of ICAR-CIFA.

for the following reasons: (i) water exchange is not always required as compared to manufactured feed, (ii) the application of manufactured feed is not suitable for feeding small larvae, which prefer live foods as an instinctive behaviour, (iii) the application of manufactured feed requires weaning, for which extra effort is needed, (iv) application of manufactured feeds leads to water quality deterioration, which may cause severe larval mortality, (v) application of live foods requires less management care, and maximal survival is achieved. Mr Molla prefers 30 days of rearing to 40 days because when the days increase, the risk of fry mortality may be higher. In larval rearing, increasing days, by and large, invites more risks. However, 30 days of rearing is optimal for larval sale for which buyers are available, except for a few who prefer 40 days of rearing larvae. When the availability of *Moina* is less than required, Mr Molla uses manufactured feed after grinding, followed by sieving. He uses the powder of manufactured feed along with *Moina* for larval rearing as co-feeding.

Conclusion

Larval rearing of singhi with *Moina* feeding is unique and replicable. Mr Molla developed the method for rearing singhi exclusively with *Moina* feeding, which may encourage other farmers to follow. This is cost-effective, environment-friendly, and easy to learn. Moreover, larval rearing with live foods is a natural phenomenon for which management is minimal.

Collected larvae of larger size.

Polythene tanks for rearing H. fossilis seed.

On the contrary, the method of feeding manufactured diet to singhi larvae is costly, time-consuming, and has a poor chance of larval survival. The way by which singhi farming extends requires versatile methods of larval rearing. The advantage of diverse methods of larval feeding is essential because if any method fails, others may compensate to support larval survival; otherwise, farming may suffer.

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From scarcity to supply: The Nalbari magur (*Clarias batrachus*) seed hub in north-eastern India

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ICAR-CIFA provides training to farmers for magur breeding and seed production.

Why magur seed matters in North-eastern India

Access to quality seed remains one of the biggest constraints limiting the expansion of freshwater aquaculture across Asia. For indigenous species such as magur (*Clarias batrachus*), farmers' dependence on declining wild stocks has long limited adoption of culture despite strong consumer demand. The experience from Nalbari district of Assam, India, shows how a farmer-led seed production system can transform this. With targeted institutional support, local scarcity has become a sustainable supply base for an entire region.

C. batrachus is a high-value indigenous catfish. Consumers in eastern and north-eastern India prefer it for its taste, high nutritive value, and low intramuscular spines. Traditionally, markets have depended largely on capture fisheries from natural water bodies. However, overexploitation, habitat degradation, and contamination of aquatic ecosystems with agricultural chemicals have led to a steady decline in wild catches. As a result, demand for magur has consistently outpaced supply.

Despite strong consumer preference, the unavailability of quality seed has primarily constrained expansion of magur aquaculture. Assam, a leading state in freshwater aquaculture and carp seed production, has a strong farmer knowledge base and infrastructure. Farmers can use this to diversify into indigenous catfish culture. Recognising this potential, scientists from ICAR-Central Institute of Freshwater Aquaculture (ICAR-CIFA) started systematic efforts to promote captive breeding and seed production of magur. They provided farmer training, on-farm demonstrations, and sustained technical support.

The Nalbari context

Assam occupies a central position in the north-eastern region of India and has extensive inland water resources. Nalbari district, located on the north bank of the river Brahmaputra, is surrounded by aquaculture-intensive districts such as Baksa, Kamrup, and Barpeta. Fish farming is a major livelihood activity in the area. Farmers have long-standing experience in carp seed production and grow-out culture.

Consumers in the region strongly prefer indigenous catfishes such as *C. batrachus*, *Heteropneustes fossilis*, *Ompok bimaculatus*, and *O. pabda*. These species command premium prices due to limited availability and high demand. Although the region is well suited for catfish culture, farmers have been reluctant to adopt these species because of breeding difficulties, high seed mortality, and lack of locally available seed. These constraints, coupled with farmer interest, prompted ICAR-CIFA to start focused interventions in Nalbari district.

Putting farmers at the centre

ICAR-CIFA conducted a baseline survey in Nalbari and adjoining areas in collaboration with Krishi Vigyan Kendra (KVK), Nalbari, and the Department of Fisheries, Assam. Because of the regular engagement of these agencies with local farmers, mobilisation was smooth and effective. Initially, they selected a group of 30-40 motivated farmers for capacity building in magur seed production over a two-year period.

Demonstration of breeding at farmer's hatchery.

ICAR-CIFA, in partnership with KVK Nalbari and the Department of Fisheries, Assam, helped establish magur hatcheries through hands-on training, demonstrations, and cluster-based technical support. A key technological intervention was the development of a fibreglass-reinforced plastic (FRP) magur hatchery by the ICAR-CIFA team. Farmers in Nalbari and surrounding areas have since commercialised and adopted this design. The lightweight, durable, and modular FRP design is easy to install and move. It also offers greater resilience under flood-prone conditions. This makes it particularly suitable for smallholder hatchery operations in the Brahmaputra valley. These sustained efforts led to the emergence of Nalbari as a major magur seed production hub in north-eastern India. At present, more than 25 functional magur hatcheries operate in the district, in addition to several units in neighbouring Barpeta district.

Making captive magur seed production work

Magur is an omnivorous catfish that typically reaches a marketable size of 150-200 g and breeds naturally during the monsoon season. Scientists have successfully standardised captive breeding using healthy broodstock. Farmers rear broodstock in cement cisterns or ponds at a density of 2-3 fish per m² with intermittent water exchange. They feed broodfish compound diets containing 32-35% crude protein.

Farmers can identify sexually mature brooders weighing 100-150 g during the breeding season by the pointed genital papilla in males and rounded papilla in females. Hatchery operators inject only females with synthetic hormones such as Ovaprim, Ovatide, Wova-FH, or Gonopro at a dose of 1.0-1.5 ml per kg body weight to induce ovulation.

Operators strip eggs 16-17 hours after injection. They achieve fertilisation using sperm suspension prepared from dissected testes of males in normal saline. They incubate fertilised eggs in flow-through hatcheries. Magur is a low-fecund species, producing approximately 4,000-5,000 eggs per 100 g female.

Hatching occurs within 24-26 hours. Operators collect larvae weighing 2-3 mg for indoor rearing at a density of 1,000-1,500 larvae per m² for at least two weeks. Given their delicate nature, careful tank bottom cleaning and partial water exchange are essential. Farmers initially feed larvae live feed, followed by gradual introduction of formulated diets, including the ICAR-CIFA-developed and commercialised magur larval feed 'Starter-M'. This results in survival rates of ≥80%.

The larvae develop into advanced fry (25-30 mg). Farmers stock these in cement tanks at 150-200 individuals per m² for fingerling production. After 1-2 months, periodic grading and thinning are required. Further rearing for 4-6 months at lower densities produces stockable fingerlings (>4-5 g) suitable for grow-out systems.

Farmers can stock well-prepared ponds with fingerlings (>5 g) at 50,000 per hectare and feed them compound feed at 3% of body weight. These ponds can produce 2-3 tonnes per hectare per year. Occasional disease problems such as fin rot, aeromoniasis, or epizootic ulcerative syndrome may occur, particularly under high organic load. Farmers can reduce these through timely water exchange and pond management.

Haul of magur fingerlings.

Farmers' voices from the ground

Mr Amal Medhi (Nalbari)

Mr Medhi, a graduate from Sondha village, actively produces seed and grows out indigenous fishes including *C. batrachus*, *Anabas testudineus*, *H. fossilis*, and carps. With a total water area of six hectares, he produces and sells catfish seed at Rs 3-5 per piece (US$0.04-0.06), earning Rs 300,000-500,000 (US$3,600-6,000) per season. He has also diversified into fish feed distribution. The National Fish Development Board recognised him as a progressive farmer in 2020.

Mr Hemanta Das (Nalbari)

An Industrial Training Institute graduate, Mr Das operates a magur hatchery spread over 0.13 ha and produces 300,000-500,000 fry and fingerlings per season. His integrated approach of combining carp and catfish culture allows efficient use of broodstock and pond resources.

Mr Bapan Talukdar (Nalbari)

Mr Talukdar, a graduate in Arts, adopted magur seed production alongside carp farming following training and technical support from ICAR-CIFA. He has consistently produced 200,000-300,000 magur seed annually since 2016-17.

Mr Makibuddin Ahmed (Barkura village)

Initially dependent solely on carp seed production, Mr Ahmed diversified into magur hatchery operations after being trained. With continuous technical guidance, he now produces more than 300,000 magur fry and fingerlings per season.

Mr Ratul Das (Barazara village)

Mr Das expanded his seed production capacity after installing a commercialised FRP magur hatchery developed by ICAR-CIFA. With regular technical guidance, he scaled up production despite limited resources. He innovatively established fingerling rearing units using bamboo pens and hapas. Regional media have featured his success, and he received the Best Fish Farmer Award from the Department of Fisheries, Assam, in 2015.

> *"Floods used to cause heavy losses. The FRP magur hatchery and proper larval feed made seed production safer and easier. Today, magur is no longer a risk for me."*

> ***"Magur seed production gave me steady income beyond carp farming. Buyers come directly to my farm, and the demand never drops. Now I am confident to expand and guide other farmers."***

Marketing and demand dynamics

Farmers in Nalbari sell magur seed at Rs 2-5 per fry (US$0.02-0.06) and Rs 5-10 per fingerling (US$0.06-0.12). Farmers market seed directly from their farms, often receiving advance orders by telephone. They use oxygen-packed transport for long-distance supply, while traditional silver hundi containers work for short-distance distribution. Farmers supply seed across Nalbari and neighbouring districts, contributing to improved local availability.

What did not work as expected

Excessive rainfall and seasonal flooding during the breeding period remain major challenges for farmers in Nalbari. Flood events frequently damage hatchery infrastructure and result in loss of broodstock and seed. In addition, farmers report constraints related to timely availability of quality feed ingredients and hatchery inputs.

Lessons for replication

Trained farmers in Nalbari no longer see magur seed production as a complex activity. Exposure visits to functional hatcheries, peer learning, and recognition through awards and public acknowledgement have encouraged wider adoption. The willingness of experienced farmers to support newcomers has further strengthened horizontal technology transfer. This makes the model suitable for replication in similar agro-climatic regions.

Conclusion

With sustained technical support from ICAR-CIFA and logistical help from KVK Nalbari and the Department of Fisheries, Assam, farmers have established more than 25 magur hatcheries in Nalbari district. Approximately 70 farmers now actively produce magur seed, supplying quality seed to multiple districts within Assam and adjoining states. The Nalbari magur seed hub shows how targeted capacity building and farmer-centred interventions can address seed scarcity and promote diversification in inland aquaculture. The experience shows that combining farmer capacity with appropriate hatchery hardware and species-specific feeds can convert indigenous fish seed production from a constraint into a scalable enterprise.

Fish dressing facilities in inland areas of India: Challenges and opportunities

A look at how youth in Tripura are creating livelihoods through informal fish dressing and what it tells us about the future

Biswajit Debnath, Anup Das, Ujjwal Kumar, Anirban Mukharjee, and Tarkeshwar Kumar

Entrepreneurs providing dressing services for small fish at the Durga Chowmuhani fish market in Agartala.

When you think about fisheries in India, you probably imagine vast coastal waters. But here's something most people don't realise: 70% of India's fish actually comes from inland sources such as rivers, lakes, reservoirs, and ponds scattered across the country. States like Andhra Pradesh, West Bengal, and Bihar have turned their inland waters into goldmines of food production.

But there's a critical problem that often gets overlooked. While we've become quite good at producing fish from inland waters, we're not particularly efficient at handling the catch after it comes out of the water. In fact, between 15 and 20% of the fish we produce in inland areas simply spoils and goes to waste before it even reaches your plate. That's roughly one fish out of every six that doesn't make it to market in decent condition.

This wastage happens because fish dressing - the critical process of cleaning, scaling, gutting, and packaging fish - remains stuck in the past in most inland areas of India. And this isn't just an economic loss. When fish isn't properly handled, people's health suffers too. The quality drops, food safety risks increase, and fisherfolk and vendors don't get fair prices for their hard work.

In this article, we want to focus on what's actually happening on the ground in one particular place: Tripura. What I've discovered there is something quite surprising and encouraging. While the challenges are real, a new story is emerging - one about young people finding entrepreneurial opportunities in the simple act of dressing fish.

Tripura's fish culture: High demand, local supply problem

Let us start by explaining why fish dressing matters so much in Tripura specifically. Tripura is a small northeastern state with rich inland water resources. Rivers, reservoirs, and wetlands are everywhere. The state has a vibrant fishery sector, with farmers cultivating Indian major carps, catfish, tilapia, and other species.

But what really sets Tripura apart is the cultural significance of fish. It's not just food here; it's part of daily life, woven into celebrations and everyday meals. Fish consumption in Tripura is around 27.6 kilograms per person per year. That is roughly four times the national average of about 6-7 kilograms. Fish appears in virtually every household, in multiple forms including smoked, fried, curried, and steamed.

Here's the challenge: Tripura can't produce enough fish to feed its own population. Despite ongoing efforts to boost aquaculture and fish farming, the state faces a supply-demand gap. So Tripura imports fish from neighbouring states like Andhra Pradesh and West Bengal, and even from Bangladesh. The state government has been pushing hard to increase local production and reduce this dependency on imports, but it's an uphill battle.

All this imported fish, plus the locally caught fish, needs proper dressing and preservation. That's where things get interesting.

The current reality: Informal processing with surprising demand

Walk into most inland fish markets in India, and you'll see workers processing fish the traditional way - by hand, with simple tools, at market stalls. But in Tripura's retail markets, something different is happening.

A visit to Tripura and conversations with different stakeholders of fish marketing in 2024 revealed a striking pattern. When we collected information from fish retailers across several retail fish markets in West and South Tripura, covering many retailers, we found something unexpected. More than 95% of retailers offer fish dressing services. Most of them do this without any formal infrastructure, just market space and traditional tools. They primarily dress large-sized carps, which consumers prefer to buy fresh-dressed rather than pre-packaged.

But here's where it gets interesting. For small indigenous fishes - the ones Tripura's consumers actually prefer most - fewer than 10% of retailers offer dressing services. Why? Because dressing small fish is time-consuming and intricate. It takes patience and skill. Most retailers simply refuse to do it, even if customers offer to pay.

This created a gap. Consumers wanted their preferred small fish cleaned and ready to cook, but nobody was providing that service. That gap turned into an opportunity.

Youth fish dressers: A new entrepreneurship story

At the Durga Chowmuhani fish market in Agartala, something remarkable has emerged. Around 22 young people, mostly unemployed urban and semi-urban youth, have turned fish dressing into a viable business. They set up by the market entrance each morning, tools in hand, ready to dress fish for customers who need it.

Let us paint the picture: these young people work roughly from 7 in the morning to 11 in the morning - about 4 hours a day. During those hours, they're completely occupied. There's demand. People want their small fish cleaned, gutted, and scaled, and they're willing to pay for it. Consumers prefer not to do the work at home, because they find it tedious and time-consuming.

What did we observe? Each dresser earns between 530 and 680 rupees per day. That translates to a monthly income of between Rs. 15,900 and Rs. 20,400, or an annual income of roughly Rs. 190,800 to Rs. 244,800 (~US$2,100-2,700). To put this in perspective, Tripura reported a per capita income of Rs. 159,419 (~US$1,740) during 2022-23. This means these young fish dressers are earning incomes that significantly exceed their state's average per capita income.

The remarkable part? Their startup cost was minimal. The primary capital investment was a fish dressing sickle - a specialised curved knife - costing a maximum of 500 rupees per person. Their daily running cost was Rs. 50 per dresser, which they paid as rent to the fish marketing cooperative for using market space.

The average age of these dressers is 27.4 years. Most of them had been unemployed before taking up this work. Now they're not just earning, they're earning above average. And interestingly, about 77% of them have additional income sources for times when fish dressing isn't happening - mainly after 11 am in the morning when the morning market rush ends.

Why this matters

What we're seeing at Durga Chowmuhani is not just a business - it's a livelihood solution that emerged organically from market demand. These young people identified a gap (the need for small fish dressing services), had minimal barriers to entry (a simple tool and a bit of market space), and found willing customers. They're not waiting for government schemes. They're not sitting idle. They're making it work.

This tells us something important about fish dressing in Tripura. There's a real, profitable market for these services. It's not formalised, it doesn't require expensive infrastructure, and it's generating decent incomes for young people who would otherwise be unemployed.

The challenges remain real

Of course, this success story at one market doesn't mean everything is perfect. The informal nature of fish dressing in Tripura still presents problems.

Most fish processing happens manually at markets or by vendors, often without access to proper hygiene and sanitation facilities. The lack of modern fish dressing infrastructure - cold storage, mechanical processing units, proper water supply - has led to high post-harvest losses. The quality of processed fish varies. And consumers, particularly those buying imported fish, deserve better assurance about food safety.

Additionally, traditional fish dressing methods often don't meet hygiene standards. Fish gets contaminated. It spoils faster. When workers don't handle fish properly, consumers get food-borne illnesses. The quality of the product suffers. It's a concern that shouldn't be ignored.

Many inland areas also lack basic infrastructure that would support better fish dressing. There's no reliable electricity supply in remote fishing villages. There's no clean water on demand. There's no cold storage. These aren't luxuries - they're essential if you want to dress fish properly and keep it fresh for longer.

Moving forward: Building on what works

The encouraging part is that solutions exist, and we know what works. Here's what we think matters most:

First, we should recognise and support what's already working - like the fish dressing at Durga Chowmuhani. These informal businesses are responsive to market demand, they're generating employment, and they're profitable. Rather than trying to replace them overnight with formal facilities, we could work with them. Provide them with basic training on food safety. Help them access better tools and cleaner work spaces. Connect them with resources to improve gradually.

Second, there's enormous potential for cooperative-based processing centres. A group of young fish dressers pooling resources to establish a modest facility with basic equipment - cleaning units with running water, proper drainage, basic packaging - could scale up their current success. It's more affordable than individual investments in large facilities, and it builds on an existing community of people who already understand the business.

Third, the Tripura government has initiated programmes under the Pradhan Mantri Matsya Sampada Yojana (PMMSY) to promote the establishment of modern fish dressing units and cold chains. If these government initiatives support informal businesses to upgrade gradually, they could be transformative.

Fourth, research institutions and NGOs are introducing low-cost, eco-friendly technologies. Solar-powered ice plants and portable fish dressing kits exist. Cooperatives could adapt these for Tripura's context and scale them up through cooperative models.

Finally, targeted training programmes can help. Not theoretical training, but practical workshops where young fish dressers learn about food safety, better hygiene practices, and perhaps the operation of simple mechanical tools. Institutions like the Central Institute of Fisheries Technology can play a key role in spreading knowledge and skills tailored to Tripura's actual market conditions.

Conclusion

Fish dressing facilities in Tripura tell a story that's different from the usual narratives about agricultural development. Yes, there are challenges - infrastructure gaps, hygiene concerns, post-harvest losses. But there's also emerging evidence that the market itself is creating solutions.

Young people in Tripura have discovered that fish dressing can be a viable livelihood. They're filling a gap that retailers weren't filling. They're earning decent incomes with minimal startup investment. That's entrepreneurship in action, and it deserves recognition and support.

The path forward isn't necessarily about importing expensive technologies or waiting for large-scale government facilities. It's about strengthening what's already working, upgrading gradually, and creating the conditions for these informal businesses to formalise and scale up when it makes sense.

Fish dressing in Tripura isn't just about post-harvest processing. It's becoming a source of employment, livelihoods, and dignity for young people. That's the story worth telling and supporting.

Entrepreneurship development through brackish water ornamental fish farming in Indian Sundarbans

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Crescent perch, Terapon jarbua.

The Indian Sundarbans are crucial in supporting fisheries and providing livelihoods for local communities in West Bengal, India. These mangrove forests are surrounded by a network of rivers and estuaries and are home to many euryhaline fish. Situated in the transition region between the riverine zone and the Bay of Bengal, brackish water fish species are dominant and found in different saline zones. The Sundarbans also provide excellent breeding and nursery areas for many fish species. Fishing and aquaculture are major sources of income and food security for the people living in and around the region.

Many fish seed collectors capture juvenile stages of various euryhaline ornamental fish - including spotted scat (*Scatophagus argus*), green puffer fish (*Dichotomyctere fluviatilis*), four-banded tiger fish (*Datnioides polota*), crescent perch (*Terapon jarbua*), brackish water eels (*Anguilla* spp.), and knight goby (*Stigmatogobius sadanundio*) - for livelihood generation. These juveniles are either reared in nursery ponds for a short duration or directly sold to ornamental fish traders in Kolkata. As the ornamental fish trade expands year by year, the number of people involved in ornamental fish rearing increases simultaneously.

Globally, ornamental fish culture is a multi-million-dollar industry with many enthusiasts. Due to this emerging hobby, many fish farmers have adapted to ornamental fish culture for livelihood. The earning potential of this sector has been poorly understood until now. This activity has the potential to create substantial employment opportunities in rural areas, due to simple technological interventions. Farmers can generate additional income with minimal risk within a short time. Due to their euryhaline nature, brackish water fishes can thrive in marine as well as freshwater environments.

A local seed collector in Sundarbans.

In West Bengal, seed of these brackish water fish naturally enter traditional bheries situated at coastal regions and grow with other cultured food fish species. Bheries are harvested annually during the winter season and food fish are sold in the market. Many traders associated with the ornamental fish trade collect live ornamental fish from bhery owners and transport them to pet markets at Kolkata and Howrah in West Bengal. After realising the demand and opportunity, a few small-scale farmers recently started raising and selling brackish water aquarium fish on a commercial scale in South 24 Parganas, West Bengal. The culture of these fishes has upgraded their economic profile, as the ornamental fishes have wide domestic and export markets.

Interventions at Kakdwip Block, Indian Sundarbans by ICAR-Central Institute of Brackishwater Aquaculture

Kakdwip is a small block in the South 24 Parganas district in West Bengal, India, located in the south-eastern part of the Indian Sundarbans. It is prone to cyclones and coastal flooding due to its proximity to the Hooghly River and the Bay of Bengal. Traditional capture fisheries and brackish water aquaculture are the main livelihoods for people at Kakdwip block.

ICAR-Central Institute of Brackishwater Aquaculture has a regional centre that is strategically located in the Indian Sundarbans. Kakdwip Research Centre (KRC) of ICAR-CIBA at Kakdwip is known as a harbinger of scientific brackish water aquaculture in eastern India. Farmers have been trained for scientific brackish water aquaculture since 1987. Brackish water ornamental fish species such as pearlspot (*Etroplus suratensis*) and orange chromide (*Etroplus maculatus*) were introduced and disseminated to many fish farmers by the centre for livelihood generation of small-scale farmers.

Three experienced brackish water ornamental fish farmers from Kakdwip Block - Mr Tapan Maity, Mr Arabinda Haldar, and Mr Mahendra Dului - are among many farmers who have successfully run this venture for the past 5-10 years after being trained by the centre. These farmers produce larval stages of ornamental fishes in hatcheries and scientifically culture them in their earthen ponds. These entrepreneurs from rural Indian Sundarbans are gaining employment as well as setting trends for the younger generation to take up ornamental fish production and culture for sustainable livelihood generation.

Success story of Mr Tapan Maity

JoyKrishna Hatchery, which is located in South 24 Parganas in West Bengal, has been operated by Mr Tapan Maity (father) and Mr Himadri Maity (son) since 2010. Mr Tapan Maity was trained by KRC of ICAR-CIBA, Kakdwip and since then he has been managing his farm and hatchery with scientific guidance from the institute.

Brackish water ornamental fishes having commercial value - such as spotted scat, green puffer, pearlspot, orange chromide, eels, and crescent perch - are produced at his farm. His farm sprawls over 5.7 hectares and is divided into eight ponds for fish culture and seven ponds for nursery rearing of hatchery-produced larvae and fry stages. He collects juveniles of brackish water ornamental fishes from nearby tidal water sources and grows them for selling to the ornamental fish trade. He has also constructed a backyard hatchery for seed production and larval rearing.

His farm receives tidal water from the Muri Ganga River around the year. The water depth in the pond is between 1.0 and 1.5 metres and water salinity ranges between 3 and 15 ppt. Mr Tapan Maity produces the fry and fingerlings of pearlspot and orange chromide using broodstock maintained on his farm. These broodstocks were provided by KRC of ICAR-CIBA, Kakdwip along with training on broodstock management, pairing of fishes, incubation of eggs in hatchery, and larval and fry rearing in tank systems. Now each month, he usually sells 1,000-3,000 pearlspot and orange chromide fingerlings to traders.

First author with Mr. Tapan Maity's family (centre) at his farm.

Orange chromide (Etroplus maculatus).

He purchases juveniles of ornamental fishes such as spotted scat, green puffer, eel, and crescent perch from seed collectors in Sundarbans. These juveniles are further reared in nursery ponds for 2-3 months until they attain marketable size (5-9.5 cm). He rears each fish species in separate ponds due to their different feeding habits and growth rate. He prepares the nursery pond a month before stocking using mustard oil cake, yeast, wheat flour, cow dung, and other materials. He ensures that a good amount of zooplankton is available throughout the nursery-rearing period. Feeding with farm-made feed is also practised, a technique he learnt during his training at KRC of ICAR-CIBA, Kakdwip.

Pond fencing and bird net fencing are strictly followed to avoid the loss of fish due to flooding during cyclones and bird predation. The bird net fencing is made from a high-quality monofilament net with a mesh size of 1 cm. Fingerlings are harvested from the pond and acclimatised for 2-3 days in the concrete tank before transportation.

Father and son usually sell fish to traders at the Kolkata and Howrah pet markets. Occasionally, his son sells some fish in other states like Chennai, Kerala, and Ahmedabad upon demand through social media marketing. Acclimatised ornamental fish are carefully packed in polythene bags filled with water and oxygen to ensure safe transportation. The fish are then transported via road or rail to markets in Howrah, which serves as a major commercial and transportation hub.

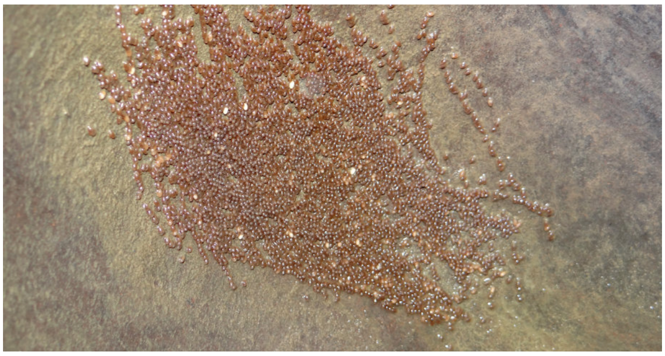
Success story of Mr Mahendra Dului

Mr Mahendra Dului, aged 62 years, and his son Mr Shyamal Dului reside in Lokkhi Narayanpur, South 24 Parganas, West Bengal. He was introduced to brackish water ornamental fish rearing during a training programme conducted at KRC of ICAR-CIBA, Kakdwip in 2010. He owns a hatchery and four backyard culture ponds. Mr Dului has constructed 32 cement tanks, each designed to accommodate a diverse range of fish species. These tanks have varying capacities, ranging from 1,500 to 2,500 litres, allowing for the optimal growth and health of the fish.

He produces juveniles of pearlspot and orange chromide in this hatchery using the brooders procured from the institute in the past. Apart from this, Mr Dului also cultivates several other species of ornamental fish that hold significant commercial value in the market. Among these are the spotted scat, known for its unique colour and adaptability; the green puffer, distinguished by its unusual body shape; crescent perch; and four-band tigerfish, which are in high demand in the ornamental fish market.

Mr Mahendra Dului and son, Shyamal.

Backyard hatchery at Mr Mahendra Dului's farm



Fertilised eggs of pearlspot.

Mr Mahendra Dului uses commercial floating feeds and farm-made feeds for nursery rearing for a profitable and sustainable business. For instance, he uses a combination of mustard oil cake, rice mill dust, and soybean dust fermented with yeast to optimise nutrition and reduce costs. He maintains the water quality parameters in the optimum range and tests his pond water monthly with the help of the KRC laboratory. The careful management of the farm illustrates Mr Dului's commitment to quality brackish water ornamental farming.

His son helps him run the hatchery and manage the farm. Mr Shyamal manages the transportation and sale of farmed ornamental fishes to ornamental traders at Kolkata and Howrah every week or fortnight. In the future, they aim to start seed production of many brackish water ornamental fish species at their hatchery facility for profitability and sustainability.

Four banded tiger fish (Datnoides polota).

Success story of Mr Aurobindo Haldar

Mr Aurobindo Haldar, a 62 year-old entrepreneur, used to run a small shop until 2008. However, he incurred losses and became debt-ridden. During this time, he attended a day workshop at KRC of ICAR-CIBA at Kakdwip where he learnt about brackish water fish farming and its profitability for small-scale farmers. Mr Aurobindo Haldar owned 1.4 hectares adjacent to a brackish water canal at Ganeshpur, South 24 Parganas. The farm is conveniently located just 3.5 kilometres from Kakdwip.

Indian mottled eel (Anguilla sps.)

Earlier he used to lease his three ponds to other farmers but after attending the workshop he decided to engage himself in fish farming and the ornamental fish trade. The pond has water depths from 1.0 to 1.5 metres throughout the year with the salinity profile fluctuating between 5 and 15 ppt, which is perfectly suited for brackish water fish species. He also procured brooders of pearlspot and orange chromide from the institute and released them on his farm. Within a year, he started harvesting juveniles which he transported himself to the Howrah pet market. He is primarily involved with the juvenile production of pearlspot, which he also sells to fish farmers for grow-out culture.

After three years of ornamental fish production, he could rid himself of debt and now he is fully occupied with fish farming and ornamental fish production. He also designed a small backyard hatchery at his home consisting of 16 cement tanks with capacities ranging from 1,000 to 2,000 litres. At this facility, Mr Haldar rears juveniles of brackish water ornamental fish species - including spotted scat, green puffer, knight goby, crescent perch, and brackish water eels - which he collects from creek water as well as from seed collectors. These fish become marketable size after 90-100 days of rearing. In the future, he wishes to expand his farm and hatchery facility for large-scale production.

Way forward

The brackish water ornamental fish sector in India is witnessing steady growth, particularly in coastal states like West Bengal, Tamil Nadu, Kerala, and Maharashtra. These states are also major export hubs in India for ornamental fishes. Traditional farmers in these states are now using scientific methods and community-driven practices to improve production and meet market demands.

Mr Aurobindo Haldar with pearlspot fingerlings.

Spotted scat (Scatophagus argus).

Knight goby (Stigmatogobius sadanundio).

In India, particularly in West Bengal, brackish water fish species such as spotted scat, green pufferfish, and pearlspot are already finding strong domestic market demand. However, challenges such as fluctuating salinity, limited access to high-quality seeds, and natural calamities remain. Addressing these issues through targeted interventions - including advanced hatchery techniques, improved market connectivity, farmer training programmes, and awareness - can significantly enhance productivity and profitability of farmers in this region. The sector also needs to focus on exploring export opportunities among neighbouring countries to promote indigenous species and to cater to the international ornamental trade.

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Farm brief: Medicinal leech farming, China

Simon Wilkinson

Network of Aquaculture Centres in Asia-Pacific

Recently the author had the opportunity to visit a leech hatchery and farm in Anhui Province, China, producing the medicinal leech *Whitmania pigra*.

The farm is producing 36 tonnes wet weight of leeches per year, which is dried to produce around 6 tonnes of final product. The dried product sells for around RMB 700 per kilo or just under US$100, which is used both in traditional Chinese medicine and in a variety of registered medicinal products such as blood thinning capsules.

The leeches are free swimming and grow up to 50 g in weight and can stretch to well over 15 cm in length, their ‘actual’ length being somewhat hard to guage. They are reared in long above ground tanks of 135 m^2 in area, each of which can hold up to about 10,000 individual leeches. The tanks are covered with shade cloth to maintain a dim environment.

The farm produces its own seed; adult leeches can produce around three cocoons each containing around 30 eggs, or a total of 90 eggs per individual, which are reared and then stocked into the tanks.

Noting the apparent lack of interns in the vicinity, the author ventured a question on how one might feed 10,000 leeches? Happily (at least for us) this particular leech is predatory and not blood feeding. It naturally feeds on a variety of aquatic snail species, even as a freshly hatched juvenile. The farm feeds the leeches with live aquatic snails sourced from ponds in the vicinity, which are an incidental byproduct and not cultured in themeselves.

Non-hematophagous medicinal leech, Whitmania pigra.

A bit of a handfull.

Leeches are fed on aquatic snails sourced from ponds.

Discarded (hatched) leech egg masses.

Waste shells from feeding.

Traditional, registered medicinal products containing dried leech, including blood thinners for treating heart disease.

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Thailand charts aquaculture transformation plan at Bangkok workshop

Bangkok, 21-22 October 2025 - Thailand convened a two-day workshop at the Department of Fisheries to shape a National Innovation and Investment Plan (NIIP) for aquaculture. The meeting formed part of FAO's Technical Cooperation Programme project TCP/RAS/4004, implemented with NACA, which is supporting India, the Philippines, Thailand and Viet Nam to prepare NIIPs and link them into a shared Aquaculture Transformation Monitoring, Evaluation and Learning System (ATMS) for Asia and the Pacific.

Blue Transformation: from vision to implementation

FAO's Blue Transformation sets a 2030 direction for aquatic food systems that is not simply about producing more, but producing better. For aquaculture, this means climate-smart and lower-carbon growth, greater resource efficiency, strengthened aquatic animal health, and broader social inclusion along the value chain. In Asia and the Pacific, FAO and NACA translated this direction into a regional White Paper (2022) and an action guide (2023) that show how countries can move from high-level goals to practical reforms, investment pipelines and measurable results.

Within this approach, the NIIP serves as the national vehicle for action. It defines a shared sector vision and the future state Thailand aims to reach; identifies bottlenecks that impede progress; prioritises areas for policy reform, innovation and investment; and assembles a shortlist of flagship programmes and projects. It also sets out enabling measures such as standards, permitting, extension and digital services; proposes financing pathways that blend public expenditure with private capital; and specifies the data, roles and timelines needed to manage delivery and adjust course as evidence accumulates.

Inside the Bangkok workshop

The programme was designed to move from context to action. Short technical briefings situated Thailand's work within the regional project and illustrated how other countries have approached NIIP design. Facilitated sessions then worked through the NIIP steps. Participants reviewed recent performance and development trends in Thai aquaculture and mapped system bottlenecks such as input costs, biosecurity, market access, environmental compliance and workforce skills. They framed a transformation vision for Thailand that reflected national priorities while aligning with regional targets, describing the future state in terms of resilience to climate shocks, lower emissions intensity, improved biosecurity and welfare, fair participation along the value chain and global competitiveness.

The discussion organised reforms and investments into practical pathways: technology adoption and innovation; aquatic animal health and biosecurity; environmental performance and water quality; data, traceability and market standards; finance, insurance and risk-sharing; and skills, extension and digital advisory services. Participants outlined an initial tranche of flagship programmes and projects suitable for development partners and private investors, with indicative scope and expected outcomes. Financing options were considered, including how to combine public budgets, concessional resources and private capital, and where guarantees or insurance could help crowd-in investment. The meeting agreed immediate next steps and responsibilities for completing the NIIP, along with the data and milestones required for implementation.

Connecting Thailand's NIIP to the regional monitoring system

A core deliverable of the Technical Cooperation Project is a regional Aquaculture Transformation Monitorying System that allows countries to track progress in a comparable way and to learn from one another. Thailand's NIIP will be linked to this system through harmonised indicators and regular reporting. The ATMS is designed to establish a common baseline foreseen for 2026; enable comparison across countries on productivity, environmental performance, climate resilience, aquatic animal health and welfare, social inclusion and investment mobilisation; and provide an evidence base for policy dialogue and for signalling bankable opportunities to public and private investors. Periodic regional syntheses, including an initial consolidated report targeted for 2028, will highlight trends, gaps and emerging good practice that can be replicated or adapted.

For Thailand, this linkage means national progress will be visible in a regional frame. The country will be able to benchmark outcomes, share lessons, and signal investment-ready programmes that align with both national objectives and the wider regional transformation.

Outcomes

By the close of the workshop Thailand had defined the components of a draft NIIP draft that sets a clear transformation vision, prioritises a manageable set of reforms and investments, identifies a first set of flagship programmes for detailed design, outlines feasible financing pathways, and assigns responsibilities, timelines and data requirements for implementation. Alignment with the ATMS will support transparent tracking of results over time, such as adoption of climate-smart practices, improved biosecurity, reduced environmental footprint, increased participation by women and smallholders, and mobilisation of private investment-while enabling timely adjustments as conditions evolve.

By situating national planning within a coherent regional effort, the outcomes of the Bangkok workshop will help Thailand progress from strategy to delivery, contributing to a more sustainable, competitive and inclusive aquaculture sector, and to shared monitoring and learning across Asia and the Pacific.

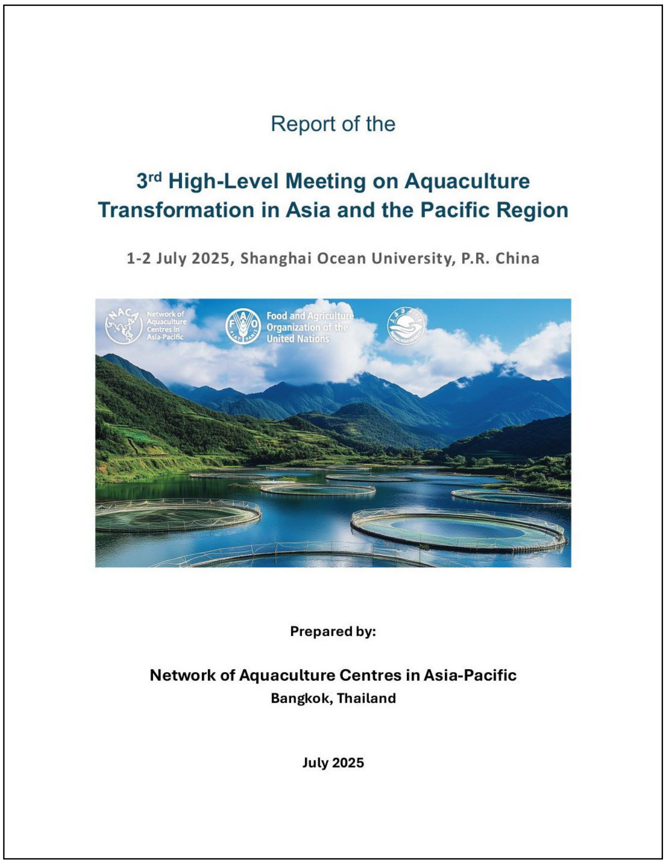
Report of the 3rd High-Level Meeting on Aquaculture Transformation in Asia and the Pacific Region

The third High-Level Meeting on Aquaculture Transformation in Asia and the Pacific assessed progress on the FAO/NACA White Paper 2030 transformation goals and identified priority actions for regional collaboration. Held 1-2 July 2025 at Shanghai Ocean University, the meeting brought together representatives from NACA member governments, the Pacific Community, FAO, WorldFish and research institutions.

Four panel discussions addressed regional innovation assessment, implementation progress, technology showcases and investment strategies. Participants identified multiple challenges requiring coordinated action: farmer scepticism about unfamiliar technologies, limited access to expertise, misaligned incentives that prioritise profit over sustainability, and failure to direct investment towards small-scale producers. Discussions emphasised the need for knowledge-based aquaculture, better storytelling to highlight social benefits, and collaborative approaches to leverage strengths.

NACA and FAO will continue supporting National Innovation and Investment Plans in India, the Philippines, Thailand and Vietnam. Future initiatives include assessing the regional innovation ecosystem through a Technical Cooperation Programme, developing an Aquaculture Transformation Monitoring and Assessment System to track implementation, and establishing an Aquaculture Innovation and Investment Hub connecting public and private partners. The report can be downloaded from:

https://enaca.org/enclosure/?id=1461


Report of the

3rd High-Level Meeting on Aquaculture Transformation in Asia and the Pacific Region

1-2 July 2025, Shanghai Ocean University, P.R. China

Prepared by:

Network of Aquaculture Centres in Asia-Pacific
Bangkok, Thailand

July 2025

AquaHub Vision Workshop: Setting a direction

Bangkok, 7 October - NACA convened a one-day, in-person working group to shape the vision, mission and strategy for the AquaHub, a startup incubator and support network for innovators in the aquaculture space. The workshop focused on establishing the AquaHub's vision, mission, values and partnership principles to define how it will operate, and the immediate steps required to mobilise partners and resources across the Asia–Pacific.

Participants began by clarifying the problems AquaHub should address and why a dedicated hub is the right vehicle. Small group exercises produced draft vision and mission statements looking to 2035, which were then refined through rapid peer feedback. This work was grounded in a brief review of AquaHub's current status and the wider innovation landscape to ensure complementarity with existing efforts.

The group reached initial consensus on a guiding architecture for the Hub: a draft vision and mission oriented to ecosystem health, community resilience and investable impact; a concise set of non-negotiable values and partnership principles to shape collaboration, due diligence and funding choices; and a simple strategy for how ideas progress through the system. Scenario work stress-tested these elements against common dilemmas to produce principles that are practical and actionable, not aspirational.

A staged support pathway was mapped from early concept to scale, using a progression from "prepare" to "grant" to "market access/accelerators" to "global." Clear entry points were identified for entrepreneurs, researchers, farmers and investors, with a view to matching support to the maturity of each innovation. The discussion also outlined core assets for the AquaHub to build: lightweight intake and screening tools aligned to the values; stage-specific mentoring and technical support; and mechanisms that connect ventures to market channels and appropriate forms of capital.

Target participant and customer profiles for future activities were defined to keep outreach focused and stage-appropriate. Relationship-building and transparency were emphasised, including clear selection criteria and expectations for all partners. The day closed with agreement on practical next steps and a shared intent to maintain momentum as the model is tested and refined.

Immediate actions include preparing a short summary pack that captures the draft vision and mission, values, strategy and pathways, along with an internal action list; standing up the "virtual AquaHub" web presence; formalising partnership agreements; and developing tools, resources and pilot activities to validate the approach ahead of a planned follow-on innovation event in March 2026.

NACA acknowledges the support of Canada's International Development Research Centre (IDRC) and its support under the AQUADAPT programme for the project "Knowledge brokering for nature-based solutions in aquaculture and transformation in Asia-Pacific: Support to the Aquaculture Innovation and Investment Hub".

Read more: Knowledge brokering for nature-based solutions in aquaculture and transformation in Asia-Pacific: Support to the Aquaculture Innovation and Investment Hub

AquaHub private-sector engagement discussion at Third AQUADAPT Peer Learning Event

Pathum Thani, 5-6 October - NACA participated in the 3rd AQUADAPT Peer-Learning Event at the Asian Institute of Technology Conference Center. Partners reviewed progress on nature-based solutions (NbS) in aquaculture, shared experience and set priorities for the year ahead. The two-day programme combined project presentations, a world-café on climate resilience, and working sessions designed to turn research insights into practice.

The Peer Learning Event opened with a review of the cohort's progress against the wider Theory of Change for the AQUADAPT project. Presentations examined inclusive and equitable NbS for climate resilience and biodiversity; co-developing and testing inclusive nature-based solutions with communites; and monitoring and assessment frameworks for inclusive and gender-responsive approaches. This was followed by a report-back from working groups and consensus on programme-level priorities for knowledge sharing and synthesis into 2026.

The AquaHub project of NACA and FutureFish led a working session on "Knowledge brokering: Private sector engagement and nature-based and inclusive business models," convening researchers and practitioners to sharpen strategies for scaling NbS through market actors across the value chain, from small-scale farmers and associations to SMEs and larger enterprises. Discussion centred on pragmatic engagement models that can connect research outcomes to investable, inclusive business opportunities.

The session opened with findings and recommendations from 2024-25 private-sector scoping work under AQUADAPT. Participants shared their feedback, highlighting where there were opportunities to align NbS adoption with commercial realities, as well as roadblocks that could be overcome through incentives, risk-sharing and collaborative arrangements.

Project teams then conducted a "private sector engagement check-in" to take stock of current engagement with firms and producer groups, identify gaps, and outline next steps to move promising innovations toward uptake. Several teams prioritised partner mapping, light-touch investment readiness work, and clearer benefit sharing to encourage farmer participation.

AquaHub also invited feedback on the design of a virtual and in-person network to support learning, enterprise development and partnering around sustainable aquaculture. Inputs from the session will be used to refine service pathways, participation criteria and the interface between research partners, entrepreneurs and investors.

Immediate follow-ups from the working session include: circulating the scoping summary to participants for targeted feedback; consolidating a private-sector partner roster with clear entry points; and aligning AquaHub's tools and mentoring offers with project needs identified in the check-in exercises.

NACA acknowledges the support of Canada's International Development Research Centre (IDRC) and the AQUADAPT programme, under the project "Knowledge brokering for nature-based solutions in aquaculture and transformation in Asia-Pacific: Support to the Aquaculture Innovation and Investment Hub".

Veterinary training programme: Fundamentals of farm health management in aquaculture

The World Veterinary Education in Production Animal Health (WVEPAH), a non-profit organisation dedicated to advancing veterinary education and promoting sustainable practices in production animal health, announces registration for Module I: Fundamentals of Farm Health management in Aquaculture.

Programme goal

This advanced training and certification programme was developed at the request of the World Organisation for Animal Health (WOAH) to support sustainable aquaculture development for human consumption and improve global aquaculture competencies under the "One Health" perspective. The programme prepares experts to support farmers in disease prevention, biosecurity, surveillance, and product quality, from farm to national level.

Certification and recognition

The certification is granted by international institutions: Université de Montréal for quality control and academic diploma delivery, and WOAH for worldwide recognition. Certified professionals are recognised as international experts and will acquire the ability to become key auditors supporting farmers for biosecurity, disease management, prevention, surveillance, and product quality. They will also be internationally recognised in the aquaculture network as trainers for trainers, able to work at farm level, watershed level, and regional and national levels.

Course format and dates

Hybrid delivery: 40 hours online + 40 hours residential

Residential week: James Cook University, Singapore Campus, 2-6 March 2026

Course content

Module I adopts a holistic One Health approach to aquaculture health management. Experts will learn about:

- Pathogens
- Species specificity and physiology
- Farming structures and environmental conditions
- Feed (nutrition) and feeding
- Farm management
- Physiology and pathology
- Biosecurity and hygiene
- Diagnostic techniques and medication
- Epidemiology
- International regulations and WOAH standards
- Working with farmers at farm, watershed, national, and international levels

Through field visits and diagnostic laboratories, participants develop practical skills in necropsy, sampling, and case analysis to strengthen disease prevention and farm performance. The programme provides tools to identify limiting factors and deliver solutions in the field.

Programme objectives

Deliver comprehensive farm health management training applicable at farm, watershed, and national levels

Strengthen collaboration with farmers to improve disease prevention, biosecurity, and responsible antibiotic use

Enhance communication between veterinarians and producers for better health outcomes

Promote a One Health approach supporting food security and public health

Develop global capacity in reporting, surveillance, and holistic farm auditing

Who should attend

Veterinarians and aquaculture professionals seeking worldwide certification in Aquaculture Production and Health.

Registration and fees

The course fee (€2,600) includes access to course materials, examination administered by Université de Montréal, membership in a private Facebook group, dinners, and two coffee breaks per day during the residential week. Accommodation, transportation, health insurance, and travel visa expenses are not included.

Programme and Registration

Please download the programme below or visit the World Veterinary Education in Production Animal Health website for full details and registration download the programme below or visit the World Veterinary Education in Production Animal Health website for full details and registration.

- Programme: https://enaca.org/enclosure/?id=1463
- Website: https://www.wvepah.org/aquaculturemodulei-singapore2026

Reported Aquatic Animal Diseases in the Asia-Pacific Region during the First and Second Quarters of 2025

Reports received in 2025, as of the 2nd quarter, only came from few member governments including: Australia, Hong Kong SAR, India, Indonesia, Malaysia, Myanmar and Saudi Arabia. Listed below are the reported aquatic animal diseases covering the first and second quarters of 2025. The original and updated reports can be accessed at the Quarterly Aquatic Animal Disease report page.

Finfish Diseases

- **Infection with epizootic haematopoietic necrosis virus:** Australia in wild juvenile (6 months to 1 year of age) redfin perch (*Perca fluviatilis*).
- **Infection with *Aphanomyces invadans* (EUS):** India in great snakehead (*Channa marulius*).
- **Infection with Koi herpesvirus (KHV):** Indonesia and Malaysia in common carp (*Cyprinus carpio*).
- **Infection with Tilapia lake virus (TiLV):** India in tilapia (*Oreochromis niloticus*); Indonesia in tilapia (*O. niloticus*); and, Malaysia in tilapia (*Oreochromis* spp.).
- **Viral encephalopathy and retinopathy (VER):** Australia in farmed jungle perch (1-2 years of age (*Kuhlia rupestris*); and, Indonesia in pompano (*Trachionotus blochii*).
- **Enteric septicaemia of catfish:** Indonesia in common carp (*C. carpio*).

Crustacean Diseases

- **Infection with white spot syndrome virus (WSSV):** Indonesia in whiteleg shrimp (*Penaeus vannamei*).
- **Infection with yellowhead virus genotype 1 (YHV-1):** Malaysia in black tiger shrimp (*P. monodon*).
- **Infection with infectious myonecrosis virus:** Indonesia in P. vannamei; and, Malaysia in *P. monodon.*
- **Infection with infectious myonecrosis virus (IMNV):** Indonesia in *P. vannamei*; and, Malaysia in *P. monodon*.
- Hepatopancreatic Microsporidiosis caused by Enterocytozoon hepatopenaei (HPM-EHP): Indonesia in P. vannamei; and, Malaysia P. vannamei and P. monodon.

Amphibian Diseases

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

Other Diseases

- India reported Infection with Tilapia parvovirus in *O. niloticus*.

Prepared by: Eduardo Leaño, Director General and Senior Programme Officer (Health and Biosecurity)

PhD scholarships in marine sciences: Shanghai Ocean University PhD Programme 2026

Shanghai Ocean University (SHOU) is offering full scholarship PhD programmes in a wide range of marine sciences 2026. Disciplines include aquaculture, biology, fisheries resources, marine science, food science and engineering, fishery economics and management, and marine engineering and information.

Scholarships

The scholarships are open to non-Chinese citizens under 35 years old who have a master's degree with a good academic record and outstanding research potential. The scholarships cover tuition, accommodation, medical insurance and include a monthly stipend.

Applications

Applications are due 1 February 2026. For details of the programmes, eligibility criteria, required documentation and application procedures, please download the prospectus linked below. If you have any questions, please email admissions@shou.edu.cn or add the Admissions Officer Ms. Louise as a contact on Facebook or WeChat (louise2shou).

- Download the prospectus: https://enaca.org/enclosure/?id=1462

Postgraduate opportunities

Postdoc positions are available for excellent graduates and full-time faculty positions are available for excellent international postdocs.

Contacts

International Student Office, Shanghai Ocean University
Application portal
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Telephone: +86-21-6190-0763
SHOU Website
Facebook
Instagram: @shou_1912

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Website: www.enaca.org

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