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Haryana Minister invites the already established entrepreneurs from southern and western region to establish processing plants in Haryana

The process of repealing *the 133-year-old Private Fisheries Protection Act was started in the West Bengal Assembly. Fisheries Minister Biplab Roy Chowdhury tabled a new Bill, which he said, would safeguard the owner's rights against fish theft. With the passage of time, the Private Fisheries Protection Act, 1889 has become obsolete. There has been a long-felt need to bring about changes in the legislation. The government has finally been able to formulate the much-needed changes and give them shape.*

Dear Readers,

The December 2022 issue of *Aqua International* is in your hands. In the news section you may find news about ...

The Government of India celebrated World Fisheries Day at Daman. The Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying is the nodal agency behind this initiative. The Ministry organised various awards at different levels to recognise the best practices involved in the fisheries sector. The awards are categorised into Inland, Marine, Hilly and North-eastern region. Moreover, awards to the best fish farmer, best hatchery, best fisheries enterprises, best fisheries co-operative societies/ FPOs/SHGs, best individual entrepreneurs and best innovation idea/technology infusion was presented. The schemes are focused on transforming the fisheries sector and having a sustainable approach towards fisheries and aquaculture. In what can be termed as the "Blue Revolution" in the country.

Aqua International has organized the first aquaculture expo in north India on 20 and 21 November 2022 in Hisar, Haryana. Mr Jai Parkash Dalal, Minister for Agriculture, Govt. of Haryana. Inaugurating Aquaculture Expo 2022 announced a target of promoting and developing 10,000 Shrimp farmers in Haryana and North India who will become crorepatis. The government is aware of problems of shrimp farmers in Northern region and the government will support farmers through setting up cold storage facilities and processing units. The Minister invited the already established entrepreneurs with shrimp processing plants from southern and western region to come to Haryana state and establish processing units and the state government will extend support to such companies.

Dr A. K. Das, Principal Scientist and Head (Acting), Reservoir & Wetlands Fisheries Division and In-charge, Extension and Training Cell, ICAR-CIFRI, Barrackpore, spoke about Indian Council of Agricultural Research, the largest national agricultural research and education system in the world. Ministry of Fisheries, Animal Husbandry and Dairying, Govt of India allotted Rs 11000 crores in PMMSY in marine and inland fisheries and aquaculture and Rs 9000 crores for infrastructure development. He spoke about state-wise distribution of number of cages in operation; simple cage design; evolution of cage culture technology at ICAR-CIFRI and milestones achieved; that IMC fingerling production started in GI cages in Maithon reservoir in 2011. He informed participants online about proposed sites in India for cage installation; techniques of cage fabrication and installation in reservoirs with clear photos; materials required, frame construction, positions of attachment of floats below main frame, fish fingerling stocking, etc.

The process of repealing the 133-year-old Private Fisheries Protection Act was started in the West Bengal Assembly. Fisheries Minister Biplab Roy Chowdhury tabled a new Bill, which he said, would safeguard the owner's rights against fish theft. With the passage of time, the Private Fisheries Protection Act, 1889 has become obsolete. There has been a long-felt need to bring about changes in the legislation. Our government has finally been able to formulate the much-needed changes and give them shape, he said. The word private water means waters which are the exclusive property of any person or in which any person has an exclusive right of a fishery, as mentioned in the draft of the Bill.

Contd on next page

NRS GROUP

Aqua International

Our Mission

Aqua International will strive to be the reliable source of information to aquaculture industry in India.

AI will give its opinion and suggest the industry what is needed in the interest of the stakeholders of the industry.

AI will strive to be The Forum to the Stakeholders of the industry for development and self-regulation.

AI will recognize the efforts and contribution of individuals, institutions and organizations for the development of aquaculture industry in the country through annual Awards presentation.

AI will strive to maintain quality and standards at all times.

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Mr Prabir Roychowdhury, Proprietor of National Aqua Farm and Kolkata-based business person has obtained success in soft-shell mud crab production in medium- to large-scale for export in frozen form, following the 'box farming' technology in a tide-fed one acre brackishwater pond. Wild-caught *Scylla olivacea* 50-75gm in size are stocked in LDPE boxes, reared individually for small period of time till moulting, inspected frequently and harvested just after undergoing moulting, *i.e.*, ecdysis.

The soil salinization is a global challenge, which has affected the agricultural productivity of more than 100 countries worldwide. Since, such lands are degraded and no more suitable for any profitable agricultural activity, it has snatched livelihood of many farmers, leaving them debt ridden despite having large landholdings. Human activities have further aggravated soil salinization leading to secondary salinization of lands, where the underground water is saline. The lack of proper drainage facilities and intensive irrigation (with canal water) practices has led to severe water logging (water table rise) problems in these areas. The previous studies conducted by different agencies have revealed that salt composition and salinity of inland saline water varies with site, sometimes even within few kilometres. Thus, development of region specific and viable aquaculture technologies is the need of the hour to overcome the dual problems of salinity and water logging.

Vaccine manufacturer Indian Immunologicals plans to launch fish vaccine. First to introduce several innovative veterinary vaccines, IIL is poised to be the first in India to get to fish vaccines too, managing director K. Anand Kumar said. We are committed to introducing more products for the aquaculture market and help shrimp and fish growers increase productivity.

In the Articles section – *Plastic Eating Bacteria - A solution to Plastic Pollution ???,* *authored by* Mr Abarna Krishna Moorthy, Department of Aquatic Environment Management, Fisheries College and Research Institute, CIFE, discussed that Plastic has become the most common form of marine debris since it entered the consumer arena less than 60 years ago, and presents a major and growing global pollution problem. Plastic pollution is the most widespread problem affecting the marine environment. It also threatens ocean health, food safety and quality, human health, coastal tourism and contributes to climate change. The most visible and disturbing impacts of marine plastics are the ingestion, suffocation and entanglement of hundreds of marine species. Marine wildlife such as seabirds, whales, fishes and turtles, mistake plastic waste for prey, and most die of starvation as their stomachs are filled with plastic debris.

Another article titled ***Sustainable Shrimp Farming Through Aquamimicry Technique,*** *authored by* Mr K.S.Vijay Amirtharaj, Assistant Professor and Head i/c Mariculture Research Farm Facility Department of Aquaculture, Fisheries College and Research Institute, Tharuvaikulam, Thoothukudi, Tamil Nadu, said that Aquamimicry is a concept to stimulate the natural estuarine conditions by enhancing the growth of copepods along with the development of beneficial bacteria (Copefloc) in the system which is used as supplemental feed to the cultured shrimp and maintains the water quality. Copepods are tiny crustacean arthropods found in fresh, brackish and seawater all around the world. These creatures have a promising nutritional profile. Such an eco-friendly, greener alternative and sustainable concept for shrimp production is the new age aquamimicry technology. This is done by fermenting a carbon source such as rice or wheat bran along with probiotics like *Bacillus sp*. to function in the release of their nutrients. Though this method is similar to biofloc technology, there are certain differences such as the amount of carbon added and the sediments reduced to be used by other animals. Thus, the water mimics the appearance and composition of natural estuarine water that includes microalgae and zooplankton. The presence of bacteria provides nutrition and serves as probiotics. This system mimics the natural estuarine system with a balanced composition of microalgae and zooplankton.

Article titled ***Bronze Featherback, Notopterus – Manifold benefit for Freshwater Aquaculture,*** *authored by* Mr P. Yuvarajan, Dr M. G. R. Fisheries College and Research Institute, TNJFU, Ponneri, informed that Fish is an easily digestible protein diet for human health. In India, about 1030 freshwater fish species have been reported, in which carps and tilapia are mostly consumed by the inland people. In addition to those species, many other fish varieties have to be commercialized through aquaculture to enhance the food supply for growing human population. In this connection, feather backs have been recognized as commercially important food fish due to its taste and healthy nutrients. Apart from this, it could be used as ornamental fish and pharmaceutical purposes. It belongs to family Notopteridae under Osteoglossiformes order. In past few years, wild stock of *N. notopterus* has been declined due to environmental pollution and over exploitation consequently which is listed as threatened species in India.

Another article titled ***Ecological Engineering in Pond Aquaculture System,*** *authored by* Mr Suvendu Saha, Faculty of Fishery Sciences, West Bengal University of Animal and Fishery Sciences, Kolkata, West Bengal, said that Aquaculture is one of the fast-growing food producing sectors of the world and aims to increase productivity per unit space and play a significant role in food and nutrition security. In India, the fisheries sector provides livelihood to approximately 14.49 million people and also plays a significant role in the national economy as well as earning foreign exchange. In the last few years, aquaculture production has increased significantly. As being the major source of animal protein, the native people are accustomed to fish along with rice. It also recognized as a powerful income source and employment generator as it stimulates the growth of a number of subsidiary industries. Moreover, it is the source of livelihood for a large section of economically backward population in the rural sector, particularly among the landless labours, small and marginal farmers and women of the country. No wonder that it can be regarded as "poor man's protein".

Results in Shrimp, Fish and Crab farming can be achieved as per specifications when the pond management guidelines are followed. Farmers and Integrators have to give sufficient time and attention to farm management and check the developments there to ensure results. When you invest your hard earned money into it, a little more care and attention can prevent losses and help in profitable farming all the time.

Readers are invited to send their views and comments on the news, special feature and articles published in the magazine which would be published under "Readers Column". Time to time, we shall try to update you on various aspects of Aquaculture sector. Keep reading the magazine Aqua International regularly and update yourself. Wish you all fruitful results in your efforts.

M.A.Nazeer
Editor & Publisher
Aqua International

World Fisheries Day Celebrated; Entrepreneurship, Innovation & Technology Infusion

Recognising the contributions made by fish farmers and the fisheries sector, the Government of India is celebrated World Fisheries Day at Daman. The Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying is the nodal agency behind this initiative.

Union Minister for Fisheries, Animal Husbandry and Dairying, Parshottam Rupala, MoS Dr Sanjeev Kumar Balyan, MoS Dr L. Murugan, along with other administrative personnel participated in the occasion.

To begin with, the Ministry of Fisheries, Animal Husbandry & Dairying has organised various awards at different levels to recognise the best practices involved in the fisheries sector. The awards are categorised into Inland, Marine, Hilly & North-eastern region, and they will be distributed to the best state, district, and quasi-government organisations/federations/ corporations respectively.

Moreover, awards to the best fish farmer, best hatchery, best fisheries enterprises, best fisheries co-operative societies/ FPOs/SHGs, best individual entrepreneurs, and best innovation idea/technology infusion were presented.

Transfer of technologies

Keeping up with the pace of technological advancements happening in the sector, an exhibition pertaining to various technologies developed by institutes/government organizations/ private sector is being organised. The event will also witness the launch of the Video Song on Sagar Parikrama – Gujrati Version, SSS: India @75 – "100 Super Success Stories from Indian Fisheries", as well as posters and other publications.

The scenario of Fisheries sector in India

In India, the fish farming sector has always been a very prominent source of livelihood, especially in the coastal regions of our country. The sector is responsible for providing livelihood to more than 25 million fishers and fish farmers. In addition, the sector provides various livelihood opportunities indirectly linked with fish farmers or fishers.

The schemes are focused on transforming the fisheries sector and having a sustainable approach toward fisheries and aquaculture. In what can be termed as the "Blue Revolution" in the country.

Realising the huge potential and dependency of a major portion of the population on the sector, the Government has launched various schemes and initiatives. Prime Minister Modi in May 2020 launched the "Pradhan Mantri Matsya Sampada Yojna (PMMSY)" with an estimated budget of Rs 20,050 crores, over five years.

Pradhan Mantri Matsya Sampada Yojna (PMMSY)

Earlier in November 2022, Under the PMMSY scheme, Prime Minister Modi laid the foundation stone for the modernisation and upgradation of the Visakhapatnam Fishing Harbour. The project is built with an estimated cost of 150 crores, after completion the project aims to double the handling capacity from 150 tons per day to about 300 tons per day.

It is a flagship scheme focused on the development of the fisheries sector and doubling the incomes of fishers and fish farmers. Announced as a part of the Aatmanirbhar Bharat Abhiyan in May 2020, the scheme is an Umbrella scheme for various other government initiatives and projects by the Government in the fisheries sector.

The scheme aims for the adoption of 'Cluster or Area-based Approaches' and ultimately creating fisheries clusters through backward and forward linkages. The scheme targets enhancement in fish production by an additional 70 lakh tonne and increase fisheries export earnings to 1,00,000 crore by 2024-25.

Further, the scheme also envisioned generating employment opportunities through seaweed and ornamental fish cultivation and to bring new interventions such as fishing vessel insurance, support for upgradation of fishing vessels/boats, integrated aqua parks, e-trading/marketing, etc.

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Probiotics for water treatment

1. WATER QUALITY CONDITIONING

Best choice of *Bacillus* spp. that rapidly decompose uneaten feed, feces and other organic substances in pond water, keeps water quality optimal

2. HIGH ACTIVITY OF SPORES

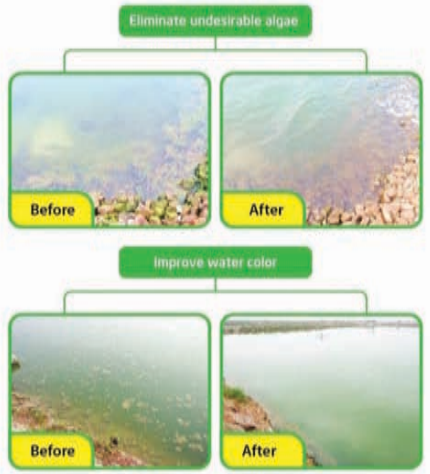
No cultivation is needed. Easily adapt to the changes of surroundings and grow fast in freshwater or seawater culture farming, even under low oxygen environment

3. DECREASE AMMONIA CONTENT

Prevent the accumulation of toxic substances such as NH_3, NO_2, etc.

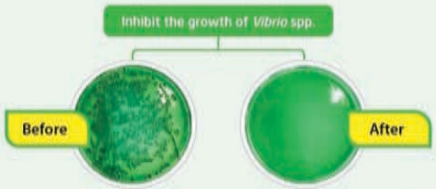
4. IMPROVE WATER COLOR

Improve water color regulate the algae and bacteria balance in water, turning your pond from green to clear



5. ESTABLISH BALANCED POND BACTERIA SYSTEM

Compete nutrition with vibrio and inhibit them to grow. Provide nutrition for probiotics in the pond, to establish a well-balanced farming system.



6. INCREASE AQUACULTURE PRODUCTION

Good quality of water prevents fish/prawn infections, making high profit of production

* COMPOSITION:

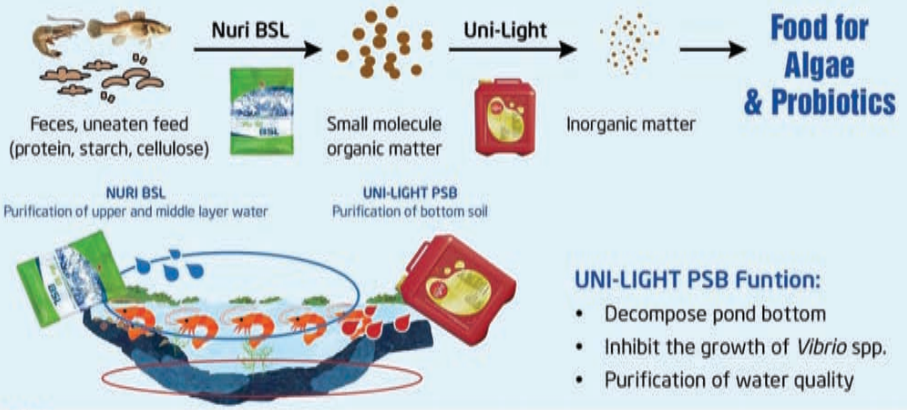
Bacillus spp. > 1x 10^{11} cfu/kg	15%
(Bacillus subtilis, Bacillus amyloliquefaciens, Bacillus licheniformis)	
Carrier (rice bran, corn gluten)	75%
Moisture	10%

* STORAGE:

Keep at dry, well-ventilated condition. Avoid direct sunlight exposure and use as soon as possible once opened for best quality.

* DIRECTION OF USE:

No cultivation is needed. Apply Nuri BSL with water-soluble bag near to the working water wheel or pour into the pond evenly. Recommend apply Uni-Light PSB together with Nuri-BSL on sunny day to achieve a clear pond more efficiently.



UNI-LIGHT PSB Funtion:

- Decompose pond bottom
- Inhibit the growth of *Vibrio* spp.
- Purification of water quality

BSL Dosage:

/10,000 m³ Quantity	10 - 30 pl/m² tiger prawn or < 80 pl/m² Vannamei	For >30 pl/m² tiger prawn or > 80 pl/m² Vannamei	For > 150 pl/m² Vannamei
7 days before stocking	800 g - 1,000 g	1,200 - 1,500 g	1,200 - 1,500 g
Day of stocking	300 g - 500 g	800 g - 1,000 g	800 g - 1,000 g
Every 7 - 10 days after stocking	300 g - 500 g	800 g - 1,000 g	3 - 5 days / use 1,000g - 2,000g

****Dosages can be adjusted according to the water conditions and practices.*

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Enclosure Culture in Inland Open Waters towards Production Enhancement

The 'Sage Talk' on 'Enclosure culture in inland open waters towards production enhancement' was organized in Zoom platform by SAGE University, Bhopal on 1/11/2022. Dr (Mrs) S. Saxena, Head of Department of Aquaculture, SAGE University was Co-Advisor and Dr R. Das, Asst. Professor of the same Department was Moderator of this programme. Invited Speaker was Dr A. K. Das, Principal Scientist and Head (Acting), Reservoir & Wetlands Fisheries Division and In-charge, Extension and Training Cell, ICAR-CIFRI, Barrackpore, who made a very informative and illuminating audio-visual presentation in detail on this subject topic.

Dr Das begun his talk with a short account of the Indian Council of Agricultural Research (largest National Agricultural Research and Education System in the world); Ministry of Fisheries, Animal Husbandry and Dairying, Govt of India; Rs 11000 crores allotted in PMMSY in marine and inland fisheries and aquaculture and Rs 9000 crores for infrastructure development (fishing harbours, cold chains, etc). Participants were informed about pattern of fish eating in different Indian states, number of fishermen, that 8.2 and 35.17 lakh ha comprise wetlands and reservoir respectively as a part of inland open water fishery resources in India, with 77 large, 257 medium and 25000 small reservoirs. In 2021, inland and marine fish productions in India were 11.25 and 3.48 million tonnes respectively. As in 2019-2020, av per capita fish consumption is 9.8kg/year, with 29.29kg/capita/year in Tripura. Dr Das spoke on concept and technology of enclosure culture, where stocking materials in reservoirs and wetlands be produced for fisheries enhancement (20-100cub.mt recommended area for cage unit). With photographs, he lucidly described about circular, square and rectangular-shaped cages; fixed, floating, submersible and submerged rectangular cages; low-cost, Pontoon and Galvanized Iron based cages. Cage culture is a call for Blue Revolution - an opportunity to utilize existing reservoirs with huge production potential to enhance production from inland open waters, which will be an answer to meeting increased demand of fish.

He spoke about state-wise distribution of number of cages in operation; simple cage design; evolution of cage culture technology at ICAR-CIFRI and milestones achieved; that IMC fingerling production started in GI cages in Maithon reservoir in 2011. We found Padmashree Dr S. Ayyappan inspecting cage culture activities at Kabini and Dahod reservoirs. He informed participants online about proposed sites in India for cage installation; techniques of cage fabrication and installation in reservoirs with clear photos; materials required, frame construction, positions of attachment of floats below main frame, fish fingerling stocking, etc. Species experimented and reared in cage culture include Giant freshwater prawn, monosex Tilapia, *Ompak bimaculatus*, Koi carp, Pangas catfish, *Gibelion catla, Labeo bata, Barbonymus gonionotus*, air-breathing fishes – fingerling to table fish production with different stocking densities (SD). Growth performance of fishes, survival rate, optimum SD, technology packages for different species combinations for table fish production in cages, stages of commercial-scale Pangas catfish production in cages (from 3.0-3.5gm→50-55gm→400-420gm→2200gm) were informed by Dr Das.

Cage farming can be done with integration of duckery component, can be installed in brick-kiln ponds. We were shown on-field demonstration of cage culture in different states in north-east India; trout cage farming at Koldam, Himachal Pradesh; at Coochbehar in West Bengal (WB) and other different places in India in beels and reservoirs. Empowerment of women was possible with CIFRI-made cage at Asansol, WB. He further spoke about problems of green sponge infestation in cages; impact of stocked herbivore fishes in periphyton development; *Tilapia nilotica, Labeo calbasu* as cage net cleaners; health management and disease control of fishes in cages during winter months; control of Ich disease; recommended dosages for drugs and chemicals against specific infections/indications in cage culture; that bags containing lime, Potassium permanganate, common salt can be hung down inside water to prevent disease occurrence. The CIFRI-HDPE circular cage has 20mt diameter and 1000cub.mt volume. Area for cage culture is about 20 lakh ha in medium and large reservoirs in India, each cage can be of 25sq. mt area. Dr Das spoke about guidelines (carrying capacity, SD, etc) for cage culture; same implemented at poverty-driven Palna village in Palna reservoir, Jharkhand; concept, technology, area suitable and importance of pen culture. Each pen unit can be 0.1-0.2ha in area.

With photographs, Dr Das spoke about materials for pen construction, site

selection, making bamboo mat, bamboo-based pen, lining mats with nylon net, mats at the stage ready for erecting, erection of pens in wetland, pen made of HDPE net, fish harvesting from pens, pen erection in inundating land beside reservoir. Carp fingerling production, table-sized carp production, giant prawn culture can be done in pens. A rectangular pen erected in reservoir can be (20 x 10)sq.mt in area. He described available technology packages in pen culture; discussed about cost of construction of 0.1ha pen; economics for carp seed production and table fish production in pens; climate-resilient pen without bamboo mat; CIFRI HDPE model pen. Shallow marginal areas of wetlands can be utilized by means of pen culture. Installation of floating pen is a new concept, which has been done in Indirasagar reservoir. In the end, Dr Das spoke about PMMSY cage installation at Dudhawa reservoir and emphasized on Fish – for Food, Income, Savings and Health. News communicator Subrato Ghosh participated in this online Talk organized by SAGE University.

Bengal begins process of repealing 133-year-old Fisheries Act

The process of repealing the 133-year-old Private Fisheries Protection Act was started in the West Bengal Assembly on Monday. Fisheries Minister Biplab Roy Chowdhury tabled a new Bill, which he said, would safeguard the owner's rights against fish theft.

"With the passage of time, the Private Fisheries Protection Act, 1889 has become obsolete. There has been a long-felt need to bring about changes in the legislation. Our government has finally been able to formulate the much-needed changes and give them shape," he said.

The old Act will be revoked after the new Bill, the Private Fisheries Protection (Repealing) Bill 2022, is discussed and passed in the Assembly during the ongoing winter session and receives the Governor's nod.

As per the provisions of the new Bill, those found stealing fish from a private fishery will have to pay a sum of Rs 50 for the first offence, while a repeat offence will invite one-month imprisonment or Rs 200 as a fine or both if convicted.

The word 'private water' means "waters which are the exclusive property of any person or in which any person has an exclusive right of a fishery", as mentioned in the draft of the Bill.

"The Act shall come into force on such date as the state government may, by notification, in the official gazette appoint," it said.

Success in soft-shell mud crab production at Purba Medinipur, West Bengal

Shed-off exoskeleton of recently-moulted crab

Sri Prabir Roychowdhury, Proprietor of National Aqua Farm and Kolkata-based business person has obtained success in soft-shell mud crab production in medium- to large-scale for export in frozen form, following the 'box farming' technology in a tide-fed 1acre brackishwater pond. Wild-caught *Scylla olivacea* 50-75gm in size are stocked in LDPE boxes, reared individually for small period of time till moulting, inspected frequently and harvested just after undergoing moulting, *i.e.*, ecdysis. Since March 2020, this activity is followed seriously at this soft-shell *S. olivacea* production unit at Vill. and P.O. Narandia, Balisai Gram Panchayat, Ramnagar-II Development Block, PS Ramnagar, Dist. Purba Medinipur, WB. On 16/10/2022, News communicators Subrato Ghosh and Himadri Chandra had a detailed view of the proper set-up of soft-shell *S. olivacea* production unit of Sri Roychowdhury. Modified-extensive type mullet polyculture is practiced in this open pond and in adjacent pond. Boxes kept positioned within floating frames or rafts, with 1 crab/box. Soft whole body of good quality harvested crabs at 80-100gm size, after death, are wrapped individually in plastic sheets and kept at -20°C in deep freezer in this crab farm until export. Sri Roychowdhury is keen to provide hands-on training to interested persons and aqua-entrepreneurs and promote this prospectful technology in coastal villages.

Prabir Roychowdhury (in middle)

Shrimp farming in Punjab and the future


Dr Prabjeet Singh & Dr. Meera D.Ansal

The states of Haryana, Punjab, Rajasthan and Uttar Pradesh are the worst affected with underground water salinity. Development of viable, sustainable and suitable technologies for utilization of inland saline areas has not only made these lands usable for aquaculture but also increased the income of the farmers.

Introduction

The soil salinization is a global challenge, which has affected the agricultural productivity of more than 100 countries worldwide. Since, such lands are degraded and no more suitable for any profitable agricultural activity, it has snatched livelihood of many farmers, leaving them debt ridden despite having large landholdings. Human activities have further aggravated soil salinization leading to secondary salinization of lands, where the underground water is saline. The lack of proper drainage facilities and intensive irrigation (with canal water) practices has led to severe water logging (water table rise) problems in these areas.

Globally more than 1,300 million ha of land has been documented as salt affected, severely impacting the agricultural productivity and rural economies of many developing countries, including India. Out of total 6.74 million ha salt affected (including coastal saline soil) areas in India, around12lakh ha is located in the non-coastal Indo-

Gangetic plains of Northern India, including seven states viz, Punjab (1.51 lakh ha), Haryana (2.32 lakh ha), Rajasthan (3.75 lakh ha), Bihar (1.53 lakh ha), Uttar Pradesh (1.37 lakh ha), Madhya Pradesh (1.39 lakh ha) and Jammu and Kashmir (0.17 lakh ha)

Development of viable, sustainable and suitable technologies for utilization of inland saline areas has been marked as a national priority by

the Government of India. The states of Haryana, Punjab, Rajasthan and Uttar Pradesh are the worst affected with underground water salinity. Non-utilization of saline waters in these areas is leading to the problem of water logging and secondary salinization.

In order to make these areas agriculturally suitable, it is necessary to reduce the water table to safer levels (below root zone) by pumping out of ground water. Unfortunately, this task of pumping out the ground water is a challenging job; and it is only possible through evapotranspiration, which itself is a very costly process; beyond the investment capacity of the resource deficient farming community. However, these unproductive zero-earning lands can be converted into economically viable lands through aquaculture. The aquaculture can help in evapotranspiration of a large proportion of water from these areas,besides generating livelihood for the affected farmers.

The previous studies conducted by different agencies have revealed that salt composition and salinity of inland saline water varies with site, sometimes even within few kilometres. Thus, development of region specific and viable aquaculture technologies is need of the hour to overcome the dual problems of salinity and waterlogging.

Chronological account of shrimp farming in Punjab

About 1.5 lakh ha of salt affected lands are available in South West districts of Punjab covering six districts – SriMuktsar Sahib, Bathinda, Fazilka, Mansa, Faridkot and Ferozepur, which has become unfit for profitable agricultural activities.

It has affected crop cycles, crop output and has also converted many areas into zero earning waste lands. In this view, these lands offer a gigantic resource for economic development through horizontal expansion of the aquaculture sector; without exerting pressure on multiple use of agricultural land and water resources.

With the initiatives and consistent efforts of Guru Angad Dev Veterinary and Animal Sciences University (GADVASU) for more than a decade (2007- 2020), aquaculture in salt affected area of South-West district of Punjab has developed swiftly under embryonic and developmental funding support from the State and Central Governments. Success of first pilot project on aquaculture in inland saline area by the university, under pioneering funding by the Punjab State Farmers Commission (2007- 2010), was

First Vannamei Shrimp Farming Commercial Trial in Punjab

recognized and financially supported by the Indian Council of Agricultural Research (ICAR) under "Niche Area of Excellence Project" from 2010-2015 for subsequent development.

GADVASU initiated carp culture in low saline areas(≤5 ppt) in village Shajrana of district Fazilka. First fish harvest from the waste lands attracted the attention of the farmers and subsequent adoption in the village increased the area under aquaculture from 1 ha in 2010 to about 30 ha in 2015; with an average annual earnings of Rs. 1,50,000/ha. Encouraged by successful culture of freshwater carps in low saline area, universityfurther took the challenge of utilizing medium to high saline area for aquaculture and conducted the preliminary vannamei

(Litopene ausvannamei) shrimp culture trial in village Shajrana (2013), followed by first commercial farming trial in village Painchanwali (District Fazilka) in 2014, which also reaped rich harvests beyond expectations of the villagers.

Impressed by the outcomes of the said aquaculture trials (fish and shrimp), Government of Punjab sponsored another Vannameiculturedemonstration projectinvillageRattakhera(DistrictSri Muktsar Sahib)in 2016;through State Fisheries Department under technical guidance of GADVASUand Regional Centre of ICAR- Central Institute of Fisheries Education (CIFE), Rohtak, Haryana. After overwhelming success of the said demonstration project, the State Government initiated start-up promotional scheme (financial assistance/subsidy) for aquaculture in inland saline areas; which motivated the farmers to adopt shrimp farming in state; with consequent increase in culture area from 37.5 acres (in 2017)

to 230 acres (in 2018) and approximately 350 acres in 2019. As we know, shrimp is the major aquaculture commodity contributing more than 60% to the India's total export earnings (over Rs. 46,000 crores) from fisheries; hence, shrimp farming in inland saline areas is expected make significant contributions to state and national economies.

Shrimp farming practices in Punjab and GADVASU's role

With constant technological and extension support from GADVASU and State government promotional schemes, shrimp farming is slowly moving towards a commercial industry; presently located in four districts (Fazilka, Shri Muktsar Sahib, Mansa and Bathinda), involving about70-80 farmers. These farmers are actively associated with the university, for technical guidance, disease surveillance support and many other utility services like training, water testing, seed testing, disease diagnosis/management, consultancy and literature.

The shrimp farming in Punjab is dependent upon seed supply from the coastal states of the country like Andhra Pradesh, Gujrat, Tamil Nadu and Puducherry. Specific Pathogen Free (SPF) or Specific Pathogen Resistant (SPR) certified seed is airlifted from Coastal Aquaculture Authority (CAA) approved hatcheries. Regular awareness camps are organised by the university to sensitise the farmers about procurement ofSPF/SPR seed from CAA registered hatcheries, strict implementation of best management practices (BMPs) and stringent bio-security protocols. Under National Fisheries Development Board (NFDB) &ICAR-National Bureau of Fish Genetic Resources (NBFGR) funded project "Surveillance of freshwater and saline water fish and shellfish diseases in Punjab", GADVASU is sensitising the farmers about shrimp diseases besides screening the shrimp seed

for pathogens and providing disease diagnostic services throughout the culture period. Training programmes are also organised for the stakeholders on "BMPs for Shrimp Farming" besides publishing literature in print and social media.

Farmers of Punjab have evolved novel and intelligent strategies for marketing of their produce by developing strong network with the shrimp processing industries of Gujrat, Orissa, Andhra Pradesh etc. and many have also become facilitators for fellow farmers to coordinate with the buyers for direct marketing of their harvest. The buyers travel with their insulated vehicles to lift the shrimp produce from the farm site with instant payment. Besides this, some of the farmers take their produce to the neighbouring Ghazipur fish market of Delhi for direct marketing; which fetches them more prices. Some of the produce is also being sold in the local fish markets of the State and a major portion of it is sold in Ludhiana fish market.

Gassen Plus

Bon Ammonia and obnoxious Gasses

Shrimp / Fish performs all their body functions and growth in water. Good quality water and proper D.O. levels determines the success or failure. Good quality water, optimum D.O. level is of prime importance for health and growth of Shrimp / Fish.

Irregular water exchange, excess and leftout feed, dead algae, fecal matter, increases the organic load at the pond bottom. Accumulation of such waste absorbs available oxygen, creating anaerobic condition which leads to pollution of pond bottom. Polluted pond bottom and unhealthy environmental conditions triggers the release of toxic gasses like Ammonia, H_2S, Methane, etc, The toxicity of Ammonia, Hydrogen Sulphide, Methane attributed mainly due to unionized form. As the concentration in water increases, ammonia excretion by aquatic organism diminishes and the level of ammonia in blood and in other tissues increases. Ammonia increases oxygen consumption by tissues, damage gills and reduces the ability of blood to transport oxygen, and increases the disease susceptibility. To eliminate / overcome the above problems 'GASSEN PLUS' Yucca Schidigera, it contains Steroidal"Saponin" which help to reduce ammonia and other noxious gasses such as H_2S, Methane, etc., Microbial enzyme "Urease' Production inhibited by Saponin which leads to an increases D.O. and reduction of BODand COD levels.

Bacterial strains such as Bacillus Subtilis, Nitrobactor, Nitrasomonas, rapidly converts ammonia into Nitrates, Nitrites and finally non-toxic Nitrogen. Hydrogen Sulphide converts into Sulphates, Sulphites and finally non-toxic Sulphur, Methane into Non-toxic carbon. This conversion reduces the obnoxious gasses in the pond bottom. Reduction of this gasses improve the D.O. level in the water and bottom.

COMPOSITION:
YUCCA SCHIDIGERA
ALOEVERA
BACILLUS SUBTILIS
BACILLUS POLYMIXA
BACILLUS LICHENIFORMIS
NITRASOMONAS
NITROBACTOR
STABILIZERS

DOSAGE : 1 Kg per Acre or consult your Aqua Technician For Specific Usage & Dosage

PRESENTATION: 500 gms &1 kg

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Covid-19 pandemic and Punjab shrimp farmers

With the outbreak of novel Corona Virus pandemic and imposition of strict lockdown across the country last year, the shrimp farmers of Punjab were in great despair, since Punjab is mostly dependent on Coastal states for seed supply. With suspension of air cargo services across the country, Punjab farmers were feeling hopeless about seed supply. To foster resurgence among bemused shrimp farmers of Punjab; an online webinar was organised by the university on "Covid-19 Crisis: Mitigation Strategies"in the month of May, 2020. During the webinar, the farmers were educated about certain mitigation strategies with a message that "Food is a Necessityandnotan Option" and like other food items demand for shrimp will certainly be there at national/ international levels; and hence, they shall go ahead with shrimp farming with some strategic measures. Among the proposed mitigation actions; the farmers were advised to postpone stocking, reduce stocking density to maximum 25-30Post larvae (PL)/m2, stock in phased manner, follow strict bio-security and look for domestic marketing avenues.

Later with resumption of air cargo services in the country, shrimp farming activity kicked off in Punjab. The farmers started stocking their ponds in the month of May and continued up to the month of July/August, with an average stocking density of 25-30 PL/ m2, covering approximately

395 acres of area. However, total area under shrimp farming in Punjab was expected to increase to 500 acres in 2020, if Covid-19 pandemic crisis would have not happened. Under university recommended resilient strategies, farmers were able to achieve productivity range of 3.0-3.5 tonnes/ acre and majority of the farmers raised 30-40 count shrimp (25-35 gram size), up to 40gm in some cases, enabling them to fetch good market price (300-450 Rs/ kg) with higher profit margins as compared to previous years...

Major concerns and road map ahead

The emerging industry of shrimp farming in Punjab is facing certain concerns, which need to be addressed for further development of the sector. Seed quality and disease outbreak are the two major concerns affecting output, quality and marketing/ export of shrimp. Further, lack of feed and processing industry in the region is also adding to the production cost and procurement hassles. Presently, the shrimp farmers of the State are completely dependent on the coastal states for seed, feed and marketing support (processing and export). The future road map of the industry needs following considerations:









Awareness Camps, Training Programmes and Technical Guidance to Farmers

- Unlike typical seawater, the salinity and ionic composition of inland saline waters vary with location, even within the same districts. So ecological mapping of salt affected areas is the need of the hour for developing region specific aquaculture practices to achieve optimised production levels.
- Ensured supply of certified shrimp seed from registered hatcheries through an agency in government or private sector is required.
- National Aquaculture Network is also desired for optimised utilization of available aquaculture resources across the nation; through ensured input supply (seed, feed, pharmaceuticals etc.) and marketing support including processing and exports.
- Development of shrimp farming clusters, promoting fish farmers producer organisations (FFPOs), cooperatives and contractual farming models for inland saline regions to overcome exiting limitations through collective efforts.
- In view of high cost and risk involved in shrimp farming, there is a need to introduce low-cost and low-risk species for sustainable development of inland saline aquaculture, keeping in view the small and marginal farmers.
- Farmer utility services like training/ capacity building, water quality testing, seed testing, consultancy, disease diagnosis and management etc., are required within approachable distances.
- Inland saline water aquaculture in the northern states like Punjab, Haryana, Rajasthan and Uttar Pradesh need to be developed in a mission mode with
- subsequent development of a processing hub in the region to cater these states.
- Possibility of developing shrimp hatchery in the inland saline area also needs to be explored to cater the seed requirement of the northern region.
- Like CAA, a regulatory authority is also required to regulate aquaculture activities in the inland saline areas of northern states in respect to following aspects; for its sustainable development:
  - Utilization of only salt affected waste lands (unfit for agricultural practice) for shrimp farming or other aquaculture activities
  - Registration of shrimp farms with Department of Fisheries of the State and/ or CAA, India
  - Procurement of SPF/SPR seed from CAA approved/ registered hatcheries
  - Disease surveillance and management to curtail disease spread
  - Abidance toBMPs and bio-security protocols
  - Environmental impact assessment

Disclaimer: Dr Prabjeet Singh is working as Asst. Professor while Dr. Meera D. Ansal is the Dean of College of Fisheries, Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana- Punjab- . Views expressed are personal. They can be reached at prabjeet29255@yahoo. co.in & ansalmd@gmail.com respectively.)

Indian Immunologicals set to launch fish vaccine

Indian Immunologicals Managing Director K Anand Kumar and CIFE Director CN. Ravishankar with senior officials

Vaccine manufacturer Indian Immunologicals (IIL) plans to launch fish vaccine. First to introduce several in novative veterinary vaccines, IIL is poised to be the first in India to get to fish vaccines too, managing director K. Anand Kumar said.

"We are committed to introducing more products for the aquaculture market and help shrimp and fish growers increase productivity," he said.

In October, Hyderabad-based subsidiary of National Dairy Development Board had forayed into aqua business with products for aquaculture health market dealing with pond management and fish/ shrimp gut management.

On Monday, IIL announced a partnership with Central Institute of Fisheries losses. Education (CIFE) for commercial development of vaccine against common bacterial diseases in freshwater fish. CIFE, an Indian Council of Agricultural Research (ICAR) institute, will be providing technology for two in activated bacterial vaccines, one for Columnaris Disease, a serious condition affecting numerous freshwater fish species and the other for Edwardsiellosis that causes high degree of mortality, leading to severe economic

Both diseases are common in freshwater fishes and considered ubiquitous, IIL said in a release.

"CIFE and IIL have come together to partner in developing India's fist bacterial fish vaccine", said CN Ravishankar, director and vice chancellor of ICAR-CIFE.

IIL deputy managing director Priyabrata Pattnaik said the company plans to introduce vaccines and immunostimulants with technology transfer from various fisheries institutes under ICAR. Several fish vaccine candidates were being evaluated by IIL for commercialisation.

Minister Dalal targets to promote 10,000 shrimp farmers in North India; make them crorepatis

Aqua International organizes 37th Aquaculture Expo at Hisar, Haryana

M. A. Nazeer, Editor, Aqua International, welcoming Shri Jai Parkash Dalal, Hon'ble Minister for Agriculture, Govt. of Haryana with a flower bouquet for the inauguration of Aquaculture Expo 2022 at Hisar, Haryana on 20 November 2022 at Flamingo Convention Center, Hisar. Ravinder Singh and other officials are also seen on the occasion.

Hisar: Our goal is to promote and develop 10,000 Shrimp Farmers in Haryana and North India who will be crorepatis, said *Mr Jai Parkash Dalal, Minister for Agriculture, Govt. of Haryana*. Inaugurating *Aquaculture Expo* 2022, a 2-day Exhibition and Conference held in Flamingo Convention Centre, Hisar, Haryana on 20 November 2022, the Minister said that while India is producing 900,000 tonnes of shrimps annually Northern region is producing over 9000 tonnes of shrimps. The government is aware of problems of shrimp farmers in Northern region and the government will support farmers through setting up cold storage facilities and processing units.

The Minister invited the already established entrepreneurs with shrimp processing plants from south and western regions to come to Haryana state to establish processing units and the state government will extend support to such companies. The Minister asked Aqua International Editor to organize the expo next year also and the government will involve in it and support the event to promote Aquaculture in Haryana state.

Mr Dharmender Singh, Director of Fisheries, Govt of Haryana, outlined the importance of setting up cold storage and processing facilities for shrimps in northern region of the country.

In his welcome address Mr M.A. Nazeer, Chief Executive of the Expo and Editor, Aqua International said that the main objective of the Expo is to bring awareness among aquaculture farmers on shrimp, fish and crab culture and various products, technology and services available to get better yield and results in aquaculture farming. The Expo had a wonderful opportunity to aquaculture farmers to update their knowledge on various aspects in aquaculture. The event was an opportunity for buyers and sellers as well in the sector. Companies dealing with manufacture and supply of products and services related to aquaculture sector displayed their products in the Expo.

According to available data, Haryana stands second in the average annual fish production per unit area in the country. The average annual fish production in the state is 7000 kgs per hectare against a national average of 2,900 kgs.

Everybody is concentrating on production and expansion of production, but no one is putting any efforts on marketing of shrimps. Shrimp production is growing all over the globe

Jai Parkash Dalal
Minister for Agriculture, Govt. of Haryana.

M.A. Nazeer
Chief Executive, Aquaculture Expo and Editor, Aqua International.

Ravinder Singh
Promoter, Haryana Aqua Food, Haryana.

Karan Kalra
Proprietor, Royal Health Food, Punjab

and it would be difficult for India in future if you depend only on exports. We need to give focus on developing domestic consumption of shrimps and other species in India itself. Like China, India has huge potential for the consumption of shrimps, he stated.

Dealers are playing very important role in Aquaculture in Northern region and they are the ambassadors of farmers and the industry. He requested the Dealers to help farmers in getting better yield and profitable price to their shrimps. If farmers get profits, the industry will grow well in northern region, the Editor added.

As Aquaculture is at Nascent Stage in North India, there is a need of creating awareness among farmers – in preparing shrimp and fish ponds, water quality, pond management, biosecurity, proper nutrition and healthcare of the species, getting better yield at the end of the crop – harvesting and post harvesting measures, and export of quality produce to overseas. Farmers should not compromise in the quality aspect in culture anytime, he stated.

Mr K. Ravikumar, Managing Partner, Golden Marine Harvest, speaking on the occasion said that shrimp farming will grow in a big way in northern region of the country and he will try to contribute for the development of the industry in the region through quality inputs.

Mr Ravinder Singh, Jagdeep Singh, Sripal Rathee, Karan Kalra and Karan Singh spoke on the occasion. They said that Aquaculture industry in North India which is 10,500 tonnes of feed market has huge potential to grow and all of us should work together for sustainable development of this industry in the region. Farmers are struggling to sell their shrimp production and we have to protect their interests.

Conference

On this occasion a technical conference was held with presentations by Mr Brij Bihari Rai,
Dr Deepak Sharma, Mr Ravikumar Bangarusamy, Dr Rachna Gulati, Prof Ashutosh Lowanshi,
Dr Prabjeet Singh.

Dharmender Singh
Director of Fisheries, Govt of Haryana.

Sripal Rathee

K Ravikumar Bangarusamy
Managing Partner, Golden Marine Harvest.

Mr Brij Bihari Rai
Zonal Manager - North and East, Himalaya Wellness Company, Varanasi, Uttar Pradesh.




From left: ***Jagdeep Singh, Ravinder Singh, Sripal Rathee, Dharmender Singh (Director of Fisheries, Govt of Haryana), Karan Kalra, Karan Singh and Narendra during the inaugural session of Aquaculture Expo at Hisar on 20 November 2022.***


A view of participants in the inaugural session of Aquaculture Expo.

A view of Aquaculcutre Expo 2022 held at Hisar on November 20 & 21


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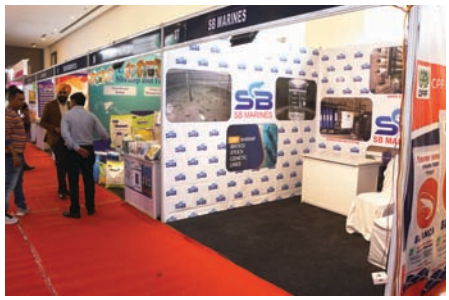
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Expo Chief Executive and Editor, Aqua International, M. A. Nazeer presenting Mementos to Exhibitors at AE 2022 in Hisar on 20 & 21 November.


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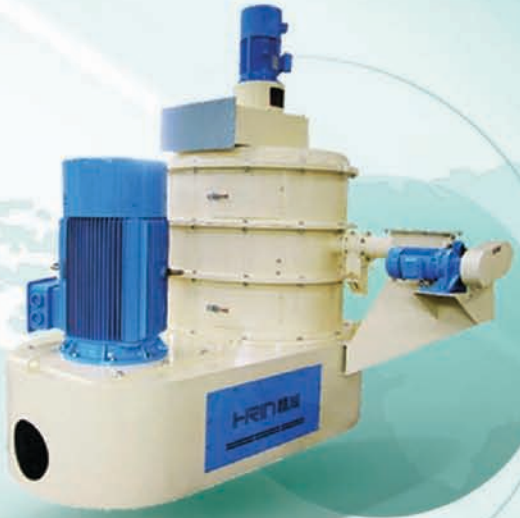

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Plastic Eating Bacteria- A solution to Plastic Pollution ???

Email: abarnalatha111@gmail.com

Abarna Krishna Moorthy[1], Dr V. Rani1 and Dr Rathi Bhuvaneswari Govindarajan[2]

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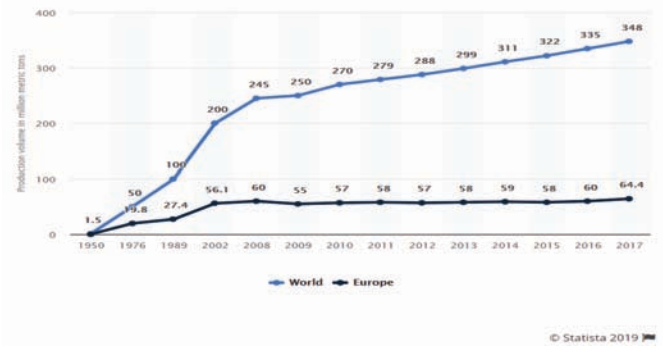
[2]Division of Aquatic Environment and Health Management, Central Institute of Fisheries Education.

Highlight Points

- Plastic accumulates not only on beaches worldwide, but also in "remote" open ocean ecosystems.
- Globally, we generate around 57 million tonnes of plastic waste per year, with between 5 and 13 million tonnes of this ending up in our surrounding environment, particularly in the oceans.
- In March 2016, a Japanese research team found a bacteria *Ideonellasakaiensis* that could completely degrade Polyethylene terephthalate, or PET, within 6 weeks.
- Genetic engineering could be used to increase the production of PETase and MHETase, making each bacterium more efficient at decomposing the plastic.

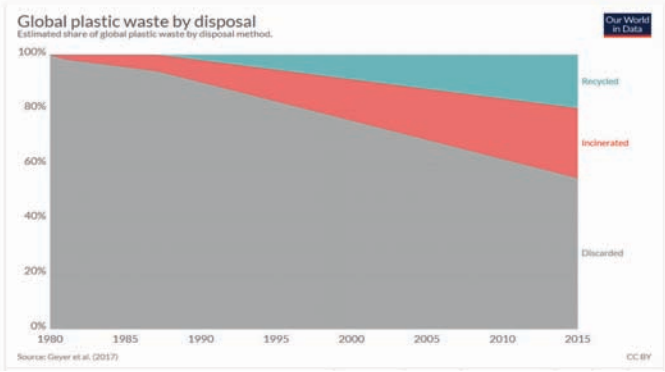
Introduction

Plastic has become the most common form of marine debris since it entered the consumer arena less than 60 years ago, and presents a major and growing global pollution problem. According to the UN estimates, every year the world uses 500 billion plastic bags. The global plastic production in 2017 was around 348 million metric tonnes. In India, 70% of total plastic consumption is discarded as waste. Around 5.6 million tonnes per annum (TPA) of plastic waste is generated in country, which is about 15,342 tonnes per day (TPD). The current global annual production, estimated represents 35 kg of plastic produced annually for each of the 7 billion humans on the planet, approximating the total human biomass.Plastic accumulates not only on beaches worldwide, but also in "remote" open ocean ecosystems. Plastic pollution is the most widespread problem affecting the marine environment. It also threatens ocean health, food safety and quality, human health, coastal tourism, and contributes to climate change. The most visible and disturbing impacts of marine plastics are the ingestion, suffocation and entanglement of hundreds of marine species. Marine wildlife such as seabirds, whales, fishes and turtles, mistake plastic waste for prey, and most die of starvation as their stomachs are filled with plastic debris. They also suffer from lacerations, infections, reduced ability to swim, and internal injuries. Floating plastics also contribute to the spread of invasive marine organisms and bacteria, which disrupt ecosystems. Plastic, which is a petroleum product, also contributes to global warming. If plastic waste is incinerated, it releases carbon dioxide into the atmosphere, thereby increasing carbon emissions. Hence serious measures or actions has to be taken in controlling the plastic pollution inorder to protect our environment.



Plastic entering ocean:

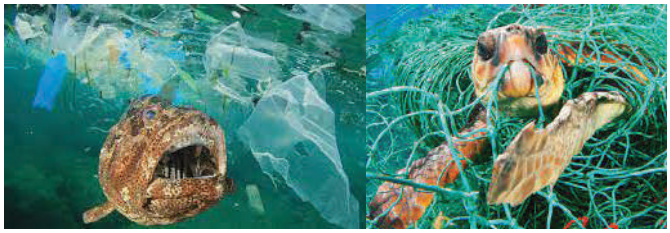
It is estimated that about 348 million tonnes of plastic are produced each year across the globe, which includes 56 million tonnes of PET. Of all this plastic produced, only 10%



is recycled. Globally, we generate around 57 million tonnes of plastic waste per year, with between 5 and 13 million tonnes of this ending up in our surrounding environment, particularly in the oceans. In 2015, it was estimated that more than 5 trillion plastic pieces weighing over 268,940 tons were afloat at sea, not including the larger plastic debris.In a trawling mission across the Pacific, Hayden K. Webb et. al. of Swinburne University of Technology found plastic debris in every ten-degree latitudinal belt.

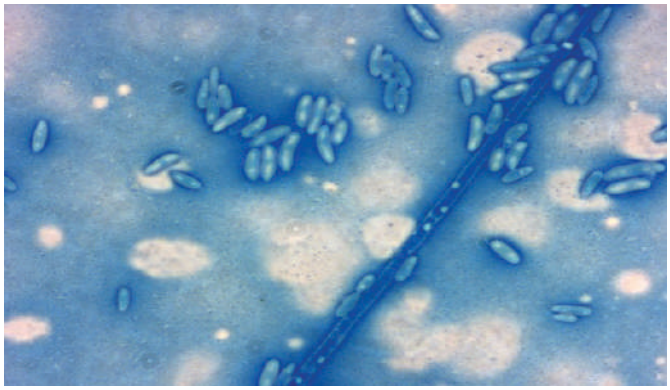
Aquatic organisms at risk:

Most critically, the plastic in the ocean endangers marine life because it is a choking hazard and toxic. The plastics are not just thinly spread, either. The mass of microplastics -plastic chunks smaller than five millimeters long is six times greater than that of the world's zooplankton , a vital food source for thousands of marine species. Many of those marine species eat small objects indiscriminately, the plastic sticks around in the larger animal's digestive systems. Small as well as large marine life are affected, suffering from starvation or malnutrition along with hormonal problems



Plastic eating fungi

A plastic comprised of harmful compounds, PET, has been degraded by different types of fungi in the past. *Fusarium oxysporum* and *F. solani*, two filamentous fungal species, have been grown on media enriched with minerals and PET yarn. The fungi use enzymes to break down the plastics into safe monomers and carbon dioxide to be used for their own growth. Depending on the efficacy of the enzymes, the leftover PET could be collected and recycled like it is now. The degraded humus digested by the fungus or other organism could also be repurposed in ornamental gardens or other organic purposes. Solutions like *Fusarium* fungi are not poisonous, so they could be used near people. Both types of fungi, though not toxic to humans, can be harmful to plants, making them unideal candidates for PET degradation. Also, *Fusarium oxysporum* can penetrate soils and attack plants, so the generated humus from the PET would be pathogenic and unusable until sterilized.

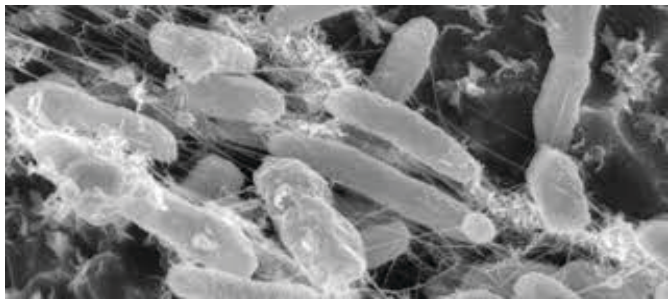


Plastic eating caterpillar

In 2017 researchers in the UK and Spain reported that a particular species of caterpillar was able to degrade PE at a comparably faster rate than any observed previously. Caterpillars of the wax moth *Galleria mellonella* were found to be able to degrade PE at a rate of 0.23 mg cm–2 h–1, a greater rate than the one found for the PETase degradation of PET.The researchers provided a probable explanation as to why these caterpillars were able to digest an artificial substrate such as PE. Honeycomb contains a complex mixture of components, with one of the main ones being beeswax, which itself is composed of over 248 different compounds, many of which contain long alkyl chains. It therefore seems likely that the ability of these caterpillars to digest the C–C bonds in the alkyl chains of the beeswax translates into being able to digest the C–C bonds within PE. Introducing the wax worms and wax moths for plastic degradation into environments outside where they naturally occur cannot be done, as it would endanger other species in those ecosystems such as bees. However, the bacteria and their proteins responsible for the breaking down of the plastic can be cultured within a laboratory and have the potential to be used on a large scale for plastic recycling. Further research into optimising and understanding these enzymes could result in a solution to the problem of recycling and disposing of plastic.

Plastic eating bacteria

In March 2016, a Japanese research team found a bacteria that could completely degrade Polyethylene terephthalate, or PET, within 6 weeks. This plastic is found in water bottles, clothing, and packaging, and has known to be very non-biodegradable. Out of a variety of microbes, one was responsible for PET degradation: *Ideonella sakaiensis.* The most efficient *Ideonella sakaiensis* was responsible for breaking down three times more material than all the other microbes combined. *Ideonella sakaiensis* is a negative-gram bar-shaped bacterium. They are aerobic bacteria and have flagellum whichhelps it move quickly. The optimum temperature and pH for the better growth of this bacteria is30-37°C and 7-7.5 respectively. But it can survive in temperatures of 15°C and 42°C and in pH 5-5.9. This strain is positive to catalyse and cytochrome oxidation test.



Bacterial Enzymes for PET degradation

Ideonella sakaiensis damaged PET film extensively and almost completely degraded it after 6 weeks at 30°C. When sequencing the genome of this bacterium to find the main contributors to the PET hydrolytic activity, they found an enzyme this bacterium secretes: a PETase. This enzyme

generates and intermediate MHET, which is taken back up by the cell and hydrolyzed by a second enzyme.This second MHET hydrolase converts MHET into two environmentally benign monomers: terephthalic acid and ethylene gylcol. Both safe chemicals can be further reduced into carbon dioxide and water by more common enzymes and are then used as a carbon source by the bacterium.

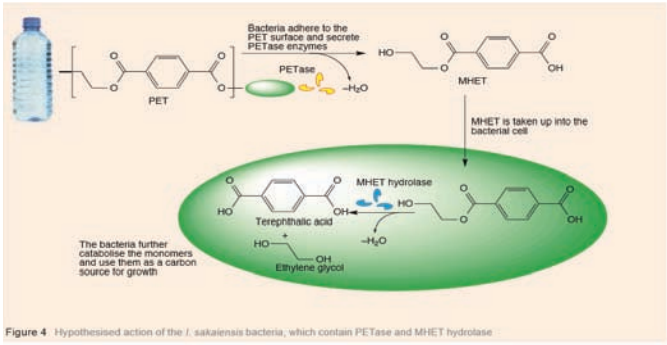


Figure 4 Hypothesised action of the I. sakaiensis bacteria, which contain PETase and MHET hydrolase

Hypothesised action of the I. sakaiensis which contain PETase and MHET hydrolase

Genetical engineering

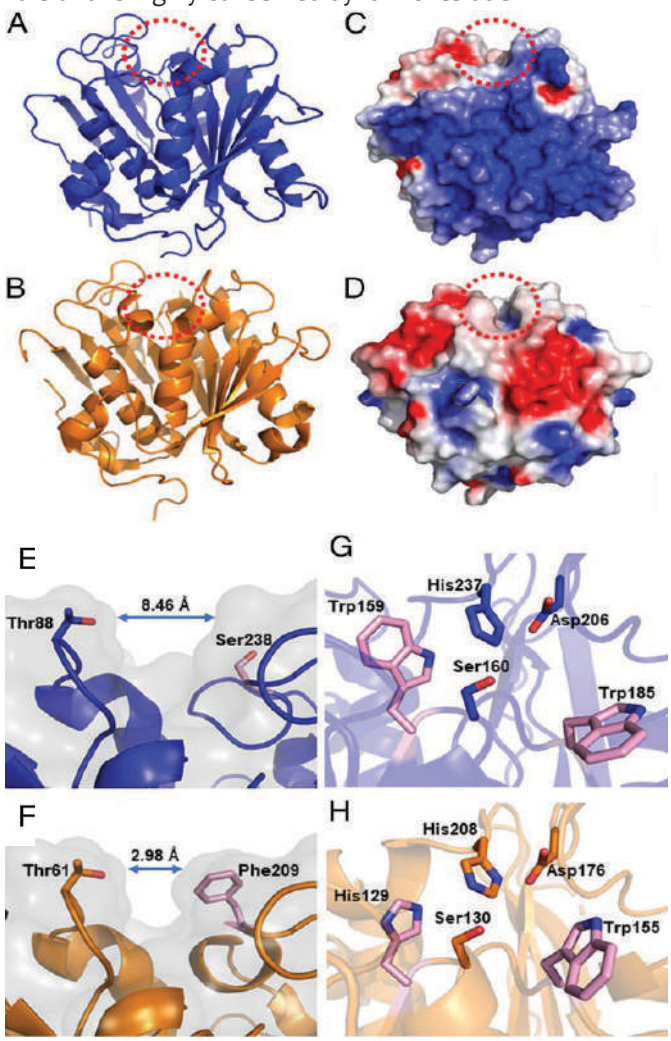
Genetic engineering could be used to increase the production of PETase and MHETase, making each bacterium more efficient at decomposing the plastic.Gene splicing involving CRISPR-Cas9 -- a biotechnology that can alter the genome of a living organism -- could also be used to place the PETase and MHETase production traits into sea-dwelling bacteria.If many bacteria in the ocean carry these enzymes, the South Pacific Garbage Patch could be reduced over time without a major clean-up operation. Waterborne plastic-degrading bacteria could also contribute to the reduction of microplastics suspended in the ocean, stemming tide of PET in the ocean.

Characterisation of PETase

Sequence analysis and recent structural studies of PETase highlight similarities to α/β-hydrolase enzymes including the cutinase and lipase families, which catalyze hydrolysis of cutin and fatty acids, respectively. This observation provides clues to the origin of PETase, but further insights into its structural and functional evolution are needed.A multiple high-resolution X-ray crystal structures of PETase, enable the comparison with known cutinase structures based on differences in the PETase and a homologous cutinase active-site cleft.As predicted from the sequence homology to the lipase and cutinase families, PETase adopts a classical α/β-hydrolase fold, with a core consisting of eight β-strands and six α-helices with an Open Active-Site Cleft. PETase has close sequence identity to bacterial cutinases, with Thermobifida fusca cutinase being the closest known structural representative (with 52% sequence identity) which is an enzyme that also degrades PET.Despite a conserved fold, the surface profile is quite different between the two enzymes. PETase has a highly polarized surface charge creating a dipole across the molecule and resulting in an overall isoelectric point (pI) of 9.6. In contrast, T. fusca cutinase, in common with other cutinases, has a number of small patches of both acidic and basic residues distributed over the surface, conferring a more neutral pI of 6.3 .

Improved Crystalline PET Degradation

Converting PETase to a Cutinase-Like Active-Site Cleft Enables Improved Crystalline PET Degradation, changes in the active site relative to the T. fusca cutinase resulted from the evolution of *I. sakaiensis* in a PET-containing environment, thus enabling more efficient PET depolymerization. Hence mutation done in PETase-active site to make it more cutinase-like. A double mutant was produced, S238F/W159H, based on homology modeling to narrow the PETase active site similar to the *T. fusca* cutinase. Additionally, W185A mutant was produced to examine the role of this highly conserved dynamic residue.



Source: Austina et al.,2018

A) Cartoon representation of the PETase structure at 0.92 A⁰ resolution (Protein Data Bank (PDB) ID code 6EQE). The active-site cleft is oriented at the top and highlighted with a dashed red circle

B) Comparative structure of the *T. fusca* cutinase (PBD ID code 4CG1)

C) Electrostatic potential distribution mapped to the solvent accessible surface of PETase compared with the *T. fusca* cutinase as a colored gradient from red (acidic) at -7kT/e to blue (basic) at 7kT/e(where *k* is Boltzmann's constant, *T* is temperature and *e* is the charge on an electron).

D) *T. fusca* cutinase in the same orientation.

E) View along the active-site cleft of PETase corresponding to the area highlighted with a red dashed circle in *A* and *C*. The width of the cleft is shown between Thr88 and Ser238.

F) Narrower cleft of the *T. fusca* cutinase active site is shown with the width between Thr61 and Phe209 in equivalent positions.

G) Close-up view of the PETase active site with the catalytic triad residues His237, Ser160, and Asp206 colored blue. Residues Trp159 and Trp185 are colored pink.

H) Comparative view of the *T. fusca* cutinase active site with equivalent catalytic triad residues colored orange. Residues His129 and Trp155 are colored pink. The residues in PETase colored pink correspond to the site-directed mutagenesis targets S238F, W159H, and W185A.

In the original report describing the discovery of PETase, Yoshida et al.,2016 examined PETase digestions of amorphous PET films with a crystallinity of 1.9%, which is lower than that of most PET samples that would be encountered either in the environment or in an industrial recycling context. To examine the performance in the wild-type PETase relative to the two mutants, PET digestion was conducted with coupons of higher crystallinity. Specifically, PET coupons with an initial crystallinity of 14.8 ± 0.2% (for reference, a commercial soft drink bottle exhibits a crystallinity of 15.7% as measured by DSC) were synthesized and characterized by NMR spectroscopy to confirm their structure and by DSC to determine their crystallinity.Results of PET degradation,has wildtype PETase induces surface erosion and pitting of a PET film with a crystallinity of 13.3 ± 0.2%, resulting in a 10.1% relative crystallinity reduction (absolute reduction of 1.5%). Surprisingly, the PETase double mutant outperforms the wildtype PETase by both crystallinity reduction and product release. The absolute crystallinity loss is 4.13% higher, and the corresponding SEM images appear to show that slightly more surface ablation occurs.

Uses

- Bacteria are indiscriminate; they will degrade PET regardless of contamination.
- In this way, *I. sakeiensis* is superior to recycling, which can only reuse plastics that are sufficiently clean and sorted.
- Since bacteria can be grown easily, this technology is perfectly scalable, reducing the need to decrease plastic usage.
- The bacteria could also be added to landfills to accelerate the decay of disposed plastics. Also, *I. sakeiensis* is not malicious to plants; its byproducts can, therefore, be used horticulturally.

References:

- Koelmans, A. A., Bakir, A., Burton, G. A., & Janssen, C. R. (2016). Microplastic as a vector for chemicals in the aquatic environment: Critical review and model-supported reinterpretation of empirical studies. Environmental Science & Technology, 50(7), 3315-3326.
- Sahana Ghosh,2018. India to galvanise greater action against plastic waste on World Environment Day.
- www.hoddereducation.co.uk/chemistryreview
- Eriksen M, Lebreton LCM, Carson HS, Thiel M, Moore CJ, et al. (2014). Plastic Pollution in the World's Oceans PLoS ONE 9(12): e111913.
- H. K. Webb, J. Arnott, E. Ivanova. "Plastic Degradation and Its Environmental Implications with Special Reference to Poly(ethylene terephthalate)". Swinburne University of Technology. Date of publication 01.06.2016. Accessed 10.28.2016.
- http://www.mdpi.com/2073-4360/5/1/1/htm.
- R. Cho. "What Happens to All That Plastic?". Columbia University Earth Institute. Date of publication 01.21.2012. Accessed 10.28.2016.
- C. M. Rochman, E. Hoh, B.T. Hentschel, S. Kaye. "Long-Term Field Measurement of Sorption of Organic Contaminants." The American Chemical Society. Date of publication 12.27.2012. Accessed 10.28.2016.
- Shosuke Yoshida, KaKa zumi Hiraga, Toshihiko Takehana, Ikuo Taniguchi, Hironao Yamaji, Yasuhito Maeda, Kiyotsuna Toyohara, Kenji Miyamoto, Yoshiharu Kimura, Kohei Oda (2016). A bacterium that degrades and assimilates poly(ethylene terephthalate) Science 1196-1199.
- C. Morawski. "Single-stream Uncovered." Resource Recycling Magazine. Date of publication 02.2012. Accessed 10.28.2016. http://www.containerrecycling.org/assets/pdfs/media/2010-2SingleStreamUncovered.pdf.
- A. Reis. "CRISPR/Cas9 and Targeted Genome Editing: A New Era in Molecular Biology." New England Biolabs Expressions. Date of publication 01.2014. Accessed 10.28.2016.
- Han X, et al. (2017) Structural insight into catalytic mechanism of PET hydrolase. Nat Commun 8:2106.
- Joo S, et al. (2018) Structural insight into molecular mechanism of poly(ethylene terephthalate) degradation. Nat Commun 9:382.
- Roth C, et al. (2014) Structural and functional studies on a thermostable polyethylene terephthalatedegrading hydrolase from Thermobifida fusca. Appl Microbiol Biotechnol 98:7815–7823.
- Wagner A, Duman R, Henderson K, Mykhaylyk V (2016) In-vacuum long-wavelength macromolecular crystallography. Acta Crystallogr D Struct Biol 72:430–439.
- Harry P. Austina,2018 .Characterization and engineering of a plastic-degrading aromatic polyesterase.
- Roth C, et al. (2014) Structural and functional studies on a thermostable polyethylene terephthalatedegrading hydrolase from Thermobifida fusca. Appl Microbiol Biotechnol 98:7815–7823.

More References can be provided on request.

SUSTAINABLE SHRIMP FARMING THROUGH AQUAMIMICRY TECHNIQUE

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Aquamimicry is a concept to stimulate the natural estuarine conditions by enhancing the growth of copepods along with the development of beneficial bacteria (Copefloc) in the systemwhich is used as supplemental feed to the cultured shrimp and maintains the water quality.Copepods are tiny crustacean arthropods found in fresh, brackish and seawater all around the world. These creatures have a promising nutritional profile. Such an eco-friendly, greener alternative & sustainable concept for shrimp production is the new age aquamimicry technology.This is done by fermenting a carbon source such as rice or wheat bran along with probiotics like *Bacillus sp*. to function in the release of their nutrients. Though this method is similar to biofloc technology, there are certain differences such as the amount of carbon added and the sediments reduced to be used by otheranimals.Thus, the water mimics the appearance and composition of natural estuarine water that includes microalgae and zooplankton. The presence of bacteria provides nutrition and serves as probiotics. This system mimics the natural estuarine system with a balanced composition of microalgae and zooplankton. Under this condition, the pH and dissolved oxygen fluctuation are minimized thus providing a conducive culture condition with minimum stress to the shrimps.

Aquamimicry –Sustainable approaches in shrimp farming.

Aquamimicry's development can be traced back to the 1990s in Thailand. At the time, it was realized that shrimp raised on a rice bran diet avoided disease despite being close to infected ponds.Aquamimicry is highly economical compared to a biofloc systemas it provides a better production rate due to natural food production at less power consumption compared to a biofloc system and the FCR is better and the nutritional requirements of the shrimp are satisfied.

Highlight Points

- Natural estuarine condition is simulated for healthy shrimp culture
- Natural food (Copepods) provides better health condition in shrimp with better disease resistance
- Supplementary feed utilization is reduced in this aquamimicry based culture system with a better Food Conversion Ratio
- Water quality parameters like pH and Dissolved Oxygen are maintained with minimum fluctuation due to the appropriate composition of microalgae and zooplankton
- The culture pond bottom is maintained in good quality due to the growth of beneficial bacteria

Pond Preparation

Probiotics are appliedto the pond filled with filtered seawater to a depth of 80-100 cm and chain is dragged for a week. If HDPE lined ponds are used, probiotics are applied to the pond bottom and instead of chain heavy ropes should be used to prevent tearing of HDPE lined sheet. Dragging is done gently for proper mixing of probiotics in soil and to prevent the development of biofilms which is toxic to the shrimp.

Pre stocking management of Liquid Fermented Rice Bran (LFRB)

Carbon sourceslike rice or wheat bran (without husk), water (1.5-10 ratio) and probiotics are mixed under aerationfor 24 hours. The finely powdered bran along with entire mixture can be added to the pond, if it is crumbled,the "milk " or"juice" can be added to the pond and bran solids are fed to the fish on the bio-filter pond.Shrimps are stocked at a

density of 30-100 animals /squaremeters. The amount of fermented carbon source that can be added depends on the system and turbidity level. Generally, the recommended dose of fermented carbon source is1 ppm and 2-4ppm for extensive and intensive systems respectively. The ideal turbidity should be around 30-40cm. Rice bran should be adjusted based on the turbidity.

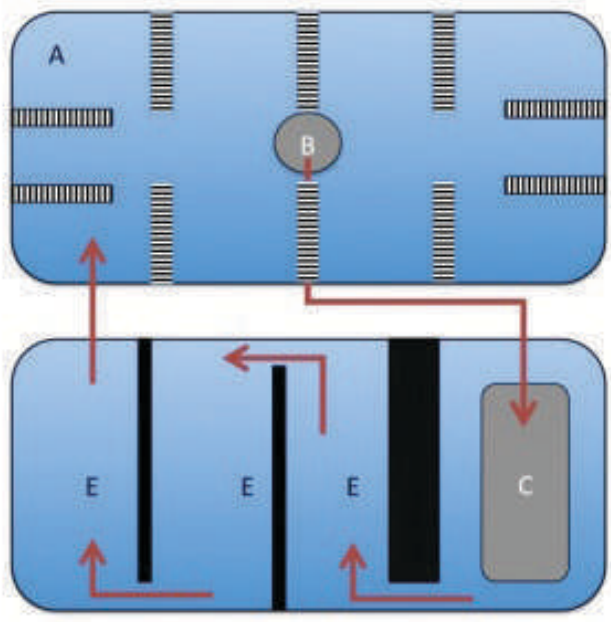
Post stocking management of Liquid Fermented Rice Bran (LFRB)

Maintains Liquid Fermented Rice Bran (LFRB) daily between 1-5 ppm (10-50 kg per hectare) depends on the pond turbidity preferably at 30 cm. If the turbidity is higher than 20-30 cm, reduce the amount of LFRB. If the turbidity is lower than 30-40 cm, increase the amount of LFRB. Turbidity (Biocolloids) should not be less than 30 cm throughout the cycle. Daily check for the early morning and late noon turbidity and LRFB application is done accordingly. Make sure the pH is not fluctuated more than 0.2 log with max of 0.3 log throughout day and night. Most preferably at 0.0-0.1 log.Dissolve oxygen (D.O) should be maintained at least 5 ppm during late night and should not exceed 10 ppm during the daytime between 5 – 8 ppm is most preferably. Divides the LFRB solution for 1-2 times per day (early morning and afternoon), dilute with pond water and slowly widespread the LFRB throughout the pond if possible. If observed any depletion in dissolved oxygen, immediately stop adding LFRB. Fully aerate the system and chain dragging around the feeding zone for the first 15 days after stocking is still preferably (20% of total area/ day). Avoid chain dragging around the center of the pond. Additional probiotics are added to the grow-out pond, to maintain water quality and increase the formation of bio-colloids(flocs consisting of detritus, zooplankton, bacteria etc). After 15 days of stocking, slowly dragging chains or ropes on the pond bottom is encouraged to decrease the formation of bio-films.Generally, an extensive system does not require further water quality management but there is a need to remove sediments two hours after feeding foran intensive system.

Liquid Fermented Rice Bran

Sedimentation Pond

In aquamimcry system, the sediment from the culture pond is pumped to the sedimentationpond and this pond should be deeper than the grow-out pond. For bio-mitigation of the sediment, detritus and algae feeding fishes likecatfish or milkfish arestocked to clean the pond sediment. The sediment contains fish food such as worms and benthic invertebrates, which is used as feed for stocked fishes.After the sedimentation, water is directedto another pond and increases the retention time and acts as bio-filter and tilapia can be added at low densities. From here, water is directed back to the grow-outpond but with little nitrogenous waste. The sedimentation pond is cleaned at an interval of every three years.After the harvest, the pond does not have a smell, black soil, or accumulated sediments and it is even ready for the next production cycle. It has been reported that the shrimp, which is culturedunder Aquamimicry systemhave deeper red color when cooked, resulting from the additional pigments released from the natural food in the pond. The omega 3 fatty acid content of the shrimp is increased by this technique and provides additional health benefits.



A.Culture Pond, B.Central Drainage, C. In Pond sedimentation tank, D. Retention System, E. Fish Culture System

Issues in Aquamimicry

Aquamimicry includes the difficulty in applying this concept to indoor conditions and in large treatment ponds. An indoor system in Korea with this concept gave better results but it produced excessive sediments which cannot be used again.In the case of large treatment ponds, recent efforts are being made to reduce the 1:1 ratio but on more extensive system no treatment ponds are needed. First of all, farmers should make a trial and confirm whether the concept is suitable for their present environmental conditions.

Advantages of Aquamimicry Farming

- Maintained water quality at optimum level and reduced fluctuations.Stress-free environment is created as there is no fluctuation in the water medium as result in minimized water exchange.
- Increased nutritional composition of cultured shrimp, as it uses the live microbial compound as feed and improved FCR.

- Automatically bottom soil problem is rectified by beneficial microbes.
- It decreased production cost, as supplementary feed usage is reduced.
- Pond conditions should mimic the natural estuarine conditions resulting in good growth of shrimp.

Future Prospects

As there is no use of chemicals or antibiotics shrimp grown will be rich in nutritious content and fetch a higher price in the market.Aquamimicry offers more sustainability than conventional farming. Itgivesbetter results than bio-floc technology. Good quality shrimp can be produced at a low production cost with health benefits. Aquamimicry will benefit future generations and can be a source of employment in coastal regions.

Conclusion

Aquamimicry is one of the eco-friendly shrimp farming techniques but still, it is not commercialized due to a lack of awareness of scientific approaches in farming and farm-level adoption of this technique. Therefore, awareness of aquamimicry has to be created among the farming community and farm-level studies have to be done for further validation of this technology for adoption by farmers.

References

Nicholas Romano (2017)Aquamimicry: A revolutionary concept for shrimp farming, Global Aquaculture Alliance. https://www.aquaculturealliance.org/advocate/aquamimicry-a-revolutionary-concept-for-shrimpfarming/#:~:text=Aquamimicry%20is%20a%20concept%20that,bacteria%20to%20maintain%20water%20quality.

Partha P. Biswas (2020) Aquamimicry: the road to sustainability in shrimp farming. https://www.agrinewsnetwork.in/ann-article.php?id=34

Vasava, Rajesh & Ap, Deepak. (2020). Aquamimicry: New an innovative apporoach for sustainable development of aquaculture. Journal Of Entomology And Zoology Studies. 2020; 8(2):. 1029-1031.

Bronze Featherback, Notopterus – Manifold benefit for Freshwater Aquaculture

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Highlight Points

- Bronze Featherback locally called as pholi, foli, seppili, serruppaachi, seppattai and seppaala and paravaala in various places of India.
- It is an additional food and ornamental fish for aquaculture.
- •It has remarkable health benefits such as high protein, fatty acids and its soup and oil has been used as medicine for measles.

Introduction:

Fish is an easily digestible protein diet for human health. In India, about 1030 freshwater fish species have been reported, in which carps and tilapia are mostly consumed by the inland people. In addition to those species, many other fish varieties have to be commercialized through aquaculture to enhance the food supply for growing human population (Raghavendra and Sudarshan, 2020). In this connection, feather backs ("Knife fish") have been recognized as commercially important food fish due to its taste and healthy nutrients (Mitra et al., 2018). Apart from this, it could be used as ornamental fish and pharmaceutical purposes. It belongs to family Notopteridae under Osteoglossiformes order. In past few years, wild stock of *N. notopterus* has been declined due to environmental pollution and over exploitation consequently which is listed as threatened species in India. In this concern, induced breeding was done using ovaprim hormone to ameliorate the fish seed production for conservation as well as diversification of this species (Srivastava et al., 2010). The present article encompassed the distribution, biology and importance of the culture potentialities of *N. notopterus.*

Distribution and feeding biology of bronze featherback

Bronze feather back is widely distributed in Pakistan, Nepal, Bangladesh, Indonesia, Thailand and India. It is locally called as pholi, fholi, seppili, serruppaachi, seppattai and seppaala in various places of India. Cast nets, drag nets and gill nets have been utilized to capture this fish in Indian rivers of Ganga, Brahmaputra, Mahanadi, Krishna, Indus, Gomti, Bheema, Kagina and Cauvery in addition to dams and lakes. This species are knife shaped, elongated and laterally compressed body, silvery and coppery brown in colour. They have well developed teeths in jaw and tongue, small appendage on each nostril, very small scales over the body, small dorsal fin and feather like anal fin which adjoins with caudal fin. It is a carnivorous and feeds on crustaceans, insects, small fish fry and organic matter.

Reproductive biology of bronze featherback:

Length at first maturity of *N. notopterus*is 15 – 16cm with 25g size in wild (https://www.fishbase.in/summary/Notopterus-notopterus.html). However, in captive condition, male and female matures in 27.5 and 23 cm, respectively, at the period of 30 months. Identification of sexual dimorphism is difficult, though some features are reported earlier as follows. Male is distinguished by appearance of conical shaped thin urogenital papilla with reddish colour, longer than pelvic fin and roughness of pectoral fin, whereas female is distinguished by fleshy broad without reddish colour papilla shorter than pelvic fin and smoothness of pectoral fin (Yanwirsal et al., 2017).

Breeding of Bronze Featherback:

N. notopterus naturally breeds during rainy season (June to September) in India. Above 40 g size fishes can be selected as brooders and enriched with diets such as earthworms, chironomids, liver and fresh chicken intestine (Yanwirsal et al., 2017). After conditioning, matured brooders are kept in tank with the sex ratio of 2: 1 (Male:Female) and induced with synthetic hormone (ovaprim) based intramuscular injection with rate of 0.5ml for male and 1 ml for female. Since eggs are adhesive in nature, substratum should be placed in the breeding tank. About 1200 – 1300 eggs are released female (21-25cm)on the substratum during night time and males fertilize the eggs externally. Fertilized eggs would be hatched after 5 to 6 days with the temperature of 24 to 28° C and expected survival would be 80 -85% (Srivastava et al., 2010).

Culture potentiality of *N. notopterus:*

N. notopterus is a hardy species can resist wide range of environmental condition. At the same time, fetching with good market value due to delicacy and its remarkable health benefits (Mitra et al., 2018) such as high protein, fatty acids, this soup and oil has been used as medicine for measles. Thus, it is considered as novel candidate species for freshwater aquaculture diversification.

At present, several research has been conducted on reproduction and growth of bronze feather back from Karnataka, Lucknow, West Bengal, Odisha, Tamil Nadu (Srivastava et al., 2010, Chakrabarti & Chowdhury, 2014; Samad et al., 2017; Mohanty & Samanta, 2018; Sukendi et al., 2020). Though, no clear evidence has been recorded towards the therapeutic compounds. Hence, to get better growth and survival, several research has to be conducted in the area of biology and nutrition of this species to make successful candidate species.

Conclusion:

Research on *N. notopterus* is still virgin stage. Hence, several research must be focused in terms of seed production, larval rearing, growth phase, nutrition and pharmaceutical compounds. Thus bronze feather back would be new candidate species in freshwater aquaculture to increase the fish production and profit. Consequently, over exploitation of this species can be reduced.

References:

Chakrabarti, P., & Chowdhury, S. H. (2014, December). Annual cyclical changes in the histological features and surface ultra structure in ovaries of the freshwater featherback Notopterus notopterus (Pallas, 1769). In Proceedings of the Zoological Society (Vol. 67, No. 2, pp. 158-166). Springer India.

Kulkarni Raghavendra S. and Sudarshan S.: Nutritional compositions in a locally available fresh water fish, Notopterus notopterus : A review. Intern. J. Zool. Invest. 6 (1): 94-106, 2020.

More References can be provided on request.

Ecological Engineering in Pond Aquaculture System

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Highlight Points

Pond aquaculture undeniably offers the potential for food production worldwide. However, with the continuous expansion of this practice, environmental problems such as a high level of water consumption, aquaculture water deterioration, and pollution from effluent and aquatic product quality decline seriously restrict the sustainable development of pond aquaculture. Thus pond aquaculture ecological engineering can be managed so as to improve animal welfare and the stability of water treatment systems, reducing the adverse effects on the environment and public health, and enabling the sustainable development of pond aquaculture.

1. Introduction

Aquaculture is one of the fast-growing food producing sectors of the world and aims to increase productivity per unit space and play a significant role in food and nutrition security. In India, the fisheries sector provides livelihood to approximately 14.49 million people and also plays a significant role in the national economy as well as earning foreign exchange. In the last few years, aquaculture production has increased significantly. As being the major source of animal protein, the native people are accustomed to fish along with rice. It also recognized as a powerful income source and employment generator as it stimulates the growth of a number of subsidiary industries. Moreover, it is the source of livelihood for a large section of economically backward population in the rural sector, particularly among the landless labours, small and marginal farmers and women of the country. No wonder that it can be regarded as "poor man's protein".

World fish production from capture fisheries has remained relatively stable over the past two decades while fish production through aquaculture has progressively increased. In India, freshwater aquaculture at presentaccounts for over 70% of total inland fish production. This sector alone is contributing to about one-third of the total fish production in the country. The production trend shows a consistent Annual Production Rate (APR) of 5% to 6% being significantly higher than in other sectors. India is now occupying the second position in production of fish and second largest aquaculture nation in the world after China. The total fish production during 2016-17 (provisional) is at 11.41 mmt with a contribution of 7.77 mmt from the inland sector and 3.64 mmt from marine sector. The inland fisheries sector presently has a share of 66.81% in the total fish production of the country. This sector contributed about 0.92% to the National Gross Value Added (GVA) and 5.23% to the agricultural GVP (2015-16) (Annual Report. DAHD, 2017-2018).The inland fishery resources of India consist of 0.19 million kilometres of rivers and canals, 3.15 million hectare of reservoirs, 2.36 million hectares of ponds and tanks, 1.24 million hectare of brackish water areas and 1.2 million hectares of floodplain lakes (Annual Report. DAHD, 2017-2018). Since India has a huge potential for pond aquaculture activity but still lack of supporting technology and management for intensive culturing, the water quality in pond aquaculture has rapidly deteriorated, diseases have become frequent, pollution emissions have increased, and the production quality has declined, causing serious challenges to aquaculture development (Liu et al., 2018).

Thus to overcome such challenges a review has been made to discuss the research progress in pond aquaculture ecological engineering, and its application prospects to achieve environmental and economic sustainability, and improve the quantity and quality of aquatic products.

1. Pond aquaculture ecological engineering

In 1962, Howard T. Odum proposed the concept of ecological engineering and defined it as 'environmental stimulation by man using small amounts of supplementary energy to control systems in which the main energy drives are coming from natural sources' (Jensen, 1999). Ecological engineering is defined as 'applying the principle

of species symbiosis and material recycling regeneration in ecosystems, the principle of structure and function coordination, combined with the optimized method of system analysis, to design a production process system to promote the hierarchical and multi-level use of materials' (Ma, 1985). Pond aquaculture ecological engineering mainly includes two elements: ecological engineering techniques and an ecological engineering system.

2. Ecological engineering techniques

2.1. Eco-slope and eco-ditch

Ecological slopes are generally those created by 'using plants or plants alone, combined with civil engineering measures and non-living plant materials, to reduce slope instability and collapse, and reduce water bank erosion' (Liu, 2002). Ecological slopes can effectively prevent soil erosion and intercept and purify agricultural non-point pollution (Chen and Li, 2006). Using ecological slopes may significantly improve the water quality in ditches, significantly reduce the total nitrogen and total phosphorus contents, and increase biodiversity (Zhu et al., 2008). The application of three-dimensional vegetation net slopes in river regulation produces benefits (Wang et al., 2005a), and this provides a reference for using them in aquaculture pond slope protection and water purification. Eco-slopes can protect pond banks, regulate water quality, and have the characteristics of 'economy, ecology, and emission reduction'. Eco-ditch is an ecological purification system formed by a ditch, which has the functions of ecological water purification and environmental beautification (Liang et al., 2019). Eco-ditch construction mainly involves sectioning, facility layout and bottom structure. Sectioning refers to separating the ecological ditch into several sections, each of which has different aquatic plants or animals such as omnivorous fish and shellfish. Facility layout involves arranging the ditch with, for instance, a biological floating bed, biochemical framework and wetland. The bottom structure is used in drainage channels with large areas and involves shaping the bottom to facilitate the growth of different plants and water flows. Ecological ditches usually divided into different functional areas, such as the compound ecological area, algal area and floating plant planting area. (Liu, 2011). The purification effect of the eco-ditch is mainly influenced by the plants and animals it contains. Management and maintenance are very important for the purification efficiency of eco-ditches.

2.2. Eco-pond and eco-floating bed

Ecological ponds, also called efficient biological treatment ponds, are generally used for sewage treatment. In ecological ponds, aquatic plants, fish, ducks and geese are added to form a complex ecosystem with a complete food chain to improve the purification effect. The integrated biological pond is a new type of ecological pond based on traditional biological pond technology, and it uses ecological principles to combine components in certain proportions, with the dual function of sewage purification and water resource protection (RGSBP, 1991). Eco-floating beds are also known as biological floating islands, aquatic plant floating beds and biological floating beds (Jing et al., 2003). The concept is based on soilless cultivation and ecological engineering technology using the aquatic plants and their root microorganisms to reduce pollutants in water (Ma et al., 2011).

In recent years, eco-floating beds have been commonly applied to pond aquaculture, mainly in the form of frame eco-floating beds, cage eco-floating beds, and composite eco-floating beds. Plants are the key component of floating beds. More than 80 types of plants are used in eco-floating beds (Liu et al., 2004), including food crops, vegetables, flowers and grasses, all annual or perennial herbs. Willows and other woody plants may also be used. However, in pond aquaculture, because of the short aquaculture period, woody plants are not suitable for eco-floating beds. Water spinach (*Ipomoea aquatica*) is frequently used in eco-floating beds, In compound eco-floating beds, digestion by aquatic animals improves the biodegradability of organic matter, and shellfish, such as mussels, snails and clams, are the most common aquatic organisms used (Liu et al., 2011). The plant roots in ecological floating beds are denser than those in wetlands, and the water treatment effect is more significant (Li et al., 2011). Because of root oxygen secretion, oxygen molecules diffuse to the biofilm, which easily forms a local oxygen-rich environment that is conducive to the formation of different dominant flora and the degradation of organic substances (Tang et al., 2011). At the same time, plant roots release secretions (such as biological enzymes) that can degrade organic substances, accelerating the degradation of organic pollutants (Liu et al., 1999). Environmental factors such as water temperature, pH and light conditions have a strong influence on eco-floating bed purification. The temperature has a pronounced effect on the removal of nitrogen and phosphorus, and the optimal water temperature for the floating beds is 25–29°C (Luo et al., 2010).

2.3. Composite constructed wetland

Constructed wetlands are based on the structure of natural wetlands. They are engineered systems similar to swamps but controlled by humans (Zhu et al., 1991). A constructed wetland can use the physical, chemical, and biological functions in the system to treat sewage. The composite wetland integrates the advantages of constructed wetlands and has a more efficient and flexible treatment effect. Using composite wetlands to treat aquaculture wastewater has many advantages. First, the composite wetlands can effectively remove TSS, nitrogen, and other eutrophic substances from aquaculture drainage (Costa-pierce, 1998). In addition, they can also support harvested plants for livestock feed (Lymbery et al., 2013). Constructed wetlands also efficiently remove heavy metals and antibiotics in water. The use of wetlands as land-intensive biological treatment systems has been applied to the purification of sewage by substrate filtration, plant adsorption, pollutant sedimentation, and exchange and microbiology oxidation.

3. Ecological engineering pond aquaculture system

Ecological engineering is the best way to achieve green development in pond aquaculture. In the past 30 years, many researchers have studied pond ecological

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engineering and made remarkable progress. ecologically engineered pond aquaculture could change traditional pond aquaculture and has the following advantages: (i) effectively improves yield and production efficiency; (ii) improves survival rate; (iii) improves the digestibility and absorption rate of feed; (iv) reduces production energy consumption; (v) recycles used water; (vi) improves labor efficiency; (vii) supports multilevel breeding, which can be well distributed to the market; (viii) reduces disease and drug use; (ix) is easy to manage and operate; (x) solves the problems of eutrophication and pollution of aquaculture, and (xi) is beneficial to the industrialized management of pond aquaculture.

4. Conclusion

Pond aquaculture not only provides a substantial amount of animal protein for people but also plays an important ecological role. Ecologically engineered pond aquaculture can continuously improve people's living standards. It enables the achievement of green development. Ecological engineering is an effective tool, but it needs to be based on knowledge of the ecology, physiology and behavior of aquaculture species. Therefore, it is necessary to focus on the study of the biological and ecological characteristics of aquaculture species such as crucian carp, special freshwater fish, shrimp, and crab and to fully understand the structure, capacity, environment, nutrition and disease control of aquaculture, in order to provide a solution for the precise ecological engineering of pond aquaculture. There are many problems in traditional pond aquaculture, such as heavy water consumption, high pollution rates, low utilisation of feed and abuse of fishery drugs. Therefore, it is necessary to focus on fry breeding, ecological culture, disease prevention, precise feeding, environmental management and production quality safety to establish ecological, clean, and accurate, healthy and efficient ecological engineering systems suitable for different aquaculture species. Regarding the 'green' goals of pond aquaculture, high quality and high efficiency, HACCP technical requirements, good agricultural practices (GAPs) and good manufacturing practices (GMPs) should be implemented throughout the process of pond aquaculture. This would promote the establishment of good environmental practices (BMPs) for ecologically engineered pond aquaculture systems, such as pond ecological aquaculture, comprehensive culturing, multi-nutrient level aquaculture, and graded sequential batch aquaculture. In addition, it would establish standardized systems for ecological, clean, and precise aquaculture.

5. References:

Annual Report. (2017-18). Department of Animal Husbandry, Dairying & Fisheries Ministry of Agriculture & Farmers Welfare Government of India (http://dahd.nic.in/sites/default/files/Annual%20Report%202017-18.pdf)

Chen XH, Li XP (2006) Ecological protection techniques of riverbank in agricultural catchment. Journal of Agro-Environment Science 25(z1): 140–145.

Costa-pierce BA (1998) Preliminary investigation of an integrated aquaculture-wetland ecosystem using tertiary treated municipal wastewater in Los angeles County, California. Ecology engineering 10: 341–354.

Jensen UHH (1999) The economic implications of using haccp as a food safety regulatory standard. Food Policy, 24(6), 625–635. https://doi.org/10.1016/S0306-9192(99)00074-3.

Jing YW, Hu XL, Xu ZL, Liu HC (2003) Study and demonstration on application of the Planted the in Floating Platform to restore water quality. Beijing Water Resources 6: 20–22.

Li H, Zhou Y, Zhang Q, Xu YT, Qin R (2011) Comparison of water purification on eco-floating bed and constructed wetland. Environmental Science & Technology 34(3): 58–61.

Liang S, Du JJ, Liu W, Lei ZX (2019) Review on the removal of nutrient pollutants in waters by ecological ditches. Journal of ZhongKai University of Agriculture and Technology 32(4): 60–65.

Liu HH, Wang XJ, Wu L, Li XN (2011) Effect of biological combination on pollutants purification performance of floating bed. Journal of Southeast University (Natural Science Edition) 41(4): 784–787.

Liu SY, Ren CJ, You WH (1999) A study on purification of the eutrophic water body with economical plants siollessly cultivated on artificial substratum. ActaScientiarumNaturaliumUniversitatisPekinensis 35(4): 518–522.

**** More References can be provided on request.***

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