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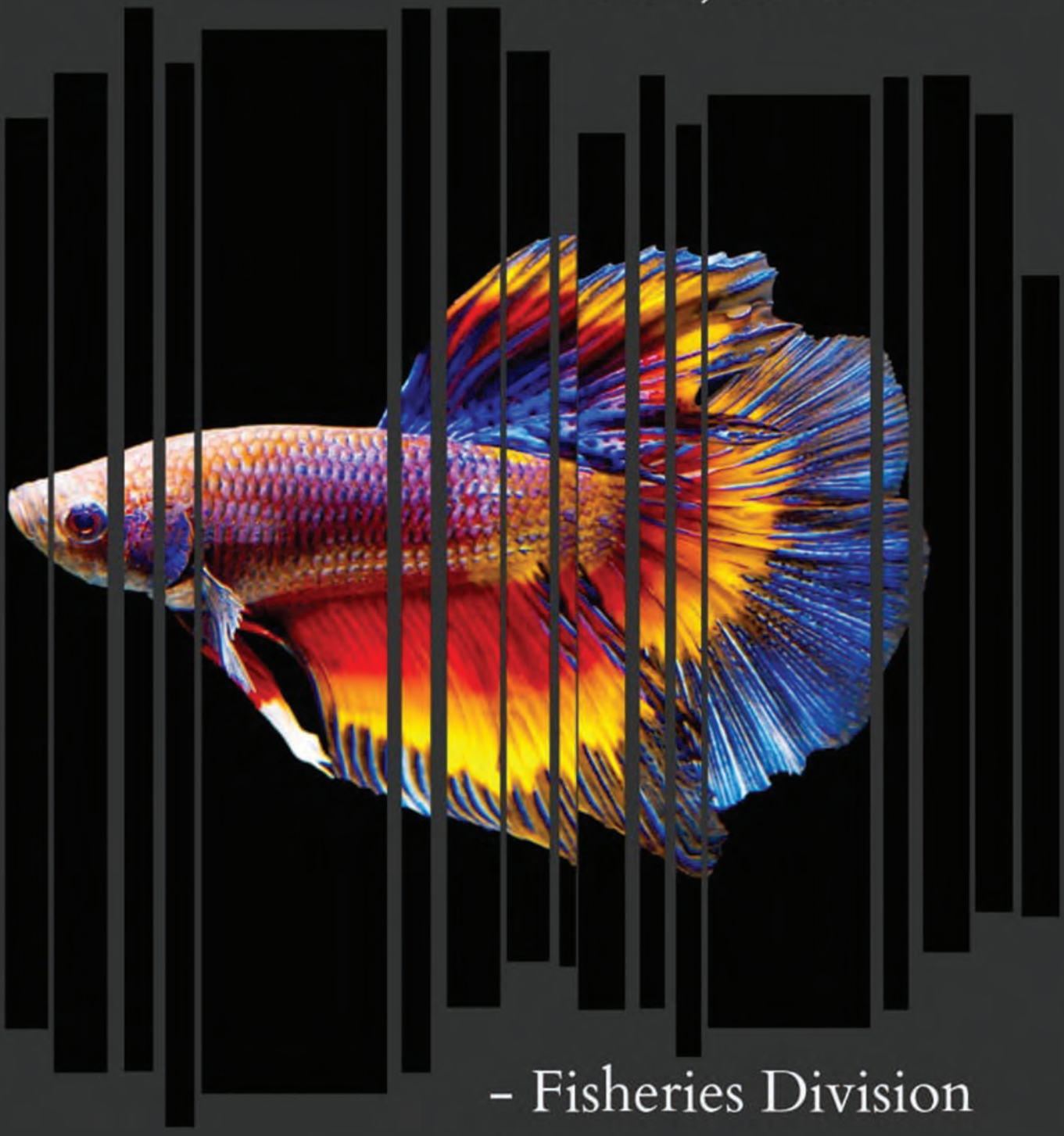
MATSYA JAGAT

Vol. 1, Issue 1



- Fisheries Division
The Neotia University
Sarisha, Diamond Harbour

Content

Forewords

This magazine entitled Matsya Jagat has been written for university students and other fisheries professionals who are keen to learn about Fisheries and Aquaculture.

I found that it was difficult for the students, professionals, to gather text material for study, current knowledge from a available literature.

This magazine will certainly fulfill the required needs of the readers specially those who are interested in recent development in aquaculture and fisheries development. It is a valuable compilation of topics, ranging from the basic to the most advance theories, current affairs and principles of the aquaculture and fisheries. Here, some of the popular techniques like Nutrient requirements, Aquaponics, Biofloc technology, and micro algae culture as well as few news, subjects of B.F.Sc. Curriculum, students section and activity with advanced techniques have been discussed for betters understanding of the readers.

It provides comprehensive insights into this field. Coherent flow of recent news, readers friendly language and extensive use of examples make this magazine an invaluable source of knowledge.

Dr. Biswajit Ghosh
Hon'ble Vice Chancellor
The Neotia University

Chair Professor's Message

I am extremely happy to know that an E-Magazine is being brought out by the Division of Fisheries Science. All the faculty and students are actively involved and contributing articles, information and news items etc.

This magazine will be a flatform to showcase the activities of students and faculty. I understand it is a quarterly magazine and every three months there will be a new issue of the magazine. I expect that our students and faculty will utilize this forum more effectively and it will become a vibrant magazine I'm the future months for dissemination of information and knowledge.

The Division of Fisheries Science is growing steadily. Technically qualified faculty has been recruited in the recent months. Infrastructure and facilities including a carp hatchery, wet lab, fish ponds, laboratories of different Departments have been created. Our first batch of students have had very useful internship and inplant training in best institutions and presently they are undergoing All India Study Tour covering most of the important fisheries institutions in the country.

I wish all the best for the success of the magazine.

Prof H Shivananda Murthy
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Prof.(Dr.) H S Murthy has served as Dean of College of Fisheries, Mangalore, the first Fisheries College in South East Asia and extensively worked in Education, Research & Development/Extension in different capacities namely, as Registrar, Director, Professor& Head and other positions. He has guided 42 research scholars in Aquaculture and Fisheries as Research Guide. He has published over280 publications including research papers, books and other publications and handled 17major externally funded research projects as Principal Investigator funded by different international and national funding agencies. Has visited UK,USA, Spain, Denmark, Netherlands, Norway, Singapore, Malaysia, Hongkong, SriLanka, Dubai and other countries.

He is the Recipient of several prestigious national/international awards for outstanding contributions in 'aquaculture & fisheries'. Served as Member of the Planning Commission Technical Committee, Karnataka Biodiversity Board, Pollution Control Board, Agricultural Scientists Recruitment Board, New Delhi, Boards and Academic Council of various Universities and other organizations.

Editorial

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Dear Readers,

The February 2023 issue of Matsya Jagat is in-front of you. In the Article section you may find articles about …

The Impact of Aquaculture on Mangroves Authored by Diksha Arya, Avdhesh Kumar, Anurag Semwal and Ujjwala Upreti, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand discussed about Ecological and economic functions of mangroves, Threats to mangroves and Actions that are needed to be taken for mangrove conservation.

Another article titled **Culture of Brine shrimp (Sea monkey)** Authored by Anurag Semwal, Avdhesh Kumar, Ujjwala Upreti, Neelesh Kumar and Ranjeet Singh, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand discussed The role of phytoplankton in Artemia production., Optimum range of certain parameters to be maintained for Artemia culture.and Decapsulation of Artemia Cysts.

Article titled **Fish Motif in traditional Patachitra of Bengal Authored** Aliya Halim, The Neotia University, West Bengal discussed about Bengali tradition and culture, folklore, literature, sculpture and paintings of Bengal abound with the stories of fishes, Unique story of Patachitra with visual communication accompanied with song and music and A new format of story telling to meet the demands of the modern society

Article titled Need and Scope of Integrated Horticulture-cum-Fish Farming in India authored Vivek Thapliyal and Ujjwala Upreti, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand discussed Needs and major advantages of Fish cum horticulture integrated farming and Scope of integrated horticulture-cum-fish farming to enhance rural economy with low investment and high profit returns.

Article titled **Women's Triple Role – A boon for the society** Authored Camelia Chattopadhyay, The Neotia University, West Bengal highlighted Role of women in society,

Women in fisheries sector and sensitive issues like early marriage, girl child abortion and women abuse.

Article entitled **Pearl Oyster: Cultural Techniques and their Management** Authored Neelesh Kumar, Amarjeet Singh, Anurag Semwal, Ranjeet Singh, Avanish Kumar Shrivastav, Ashish Sahu Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand highlited Pearl oysters and their importance, Culture techinques, management and maintenance.

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Dr. Ujjwala Upreti is working as Assistant Professor and Head in The Neotia University from July 2022. She has research experience in the areas of nano-toxicity in aquaculture, plankton diversity and supplementary feed in aquaculture. She completed her Post-graduation (M.F.Sc.) from Doon P.G. College, Sri Dev Suma University, Tehri Garhwal (Uttarakhand) and Doctorate Degree (Ph.D.) from Govind Ballabh Pant University of Agriculture and Technology, College of Fisheries, Pantnagar, Uttarakhand in the department of Aquaculture. She has published several Research papers, Book Chapters, and Popular Articles. Also she has presented several oral / poster presentations in national and international conferences / seminars. She has attended several offline / online training / Webinar / Seminar / conference etc.

Dr. Takar has more than one year of teaching experience . She has research experience in the areas of Fish Biology, Biodiversity & Conservation, Fish Population Dynamics and plankton diversity. She completed her Post-graduation (M.F.Sc.) from ICAR-Central Institute of Fisheries Education, Mumbai (Maharashtra) and Doctorate Degree (Ph.D.) from Tamil Nadu Dr. J. Jayalalithaa Fisheries University-Fisheries College and Research Institute, Thoothukudi (Tamil Nadu) in the department of Fisheries Resource Management (FRM). She has published several Research papers, Review papers, Book Chapters, and Popular Articles. Also she has presented several oral / poster presentations in national and international conference / seminar. She has attended several offline / online training / Webinar / Seminar / Workshop / conference etc.

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Ms. Camelia Chattopadhyay is associated with The Neotia University in the last 7 months. She holds a master degree (M.F.Sc) in Fisheries Extension from ICAR-Central Institute of Fisheries Education, Mumbai. She has different training experiences regarding fish culture and value-added fish products from several reputed fisheries institutes. She has participated as Event Manager/Media Crew in ICAR NAHEP sponsored Skill Development Programme on Communicating Science at ICAR-CIFE, Mumbai in 2019. She has completed one month internship in 'Video Editing' from 'Bangla Time', Kolkata. She has participated in All India Agri Uni Fest in the event group dance at Shree Venkateshwara Veterinary University (SVVU), Tirupati in January 2017. Her directed and edited tribal short film 'Dream Never Lies' has been awarded in International Micro Film Festival, Kolkata in January, 2022. She has published article and research paper in popular journals.

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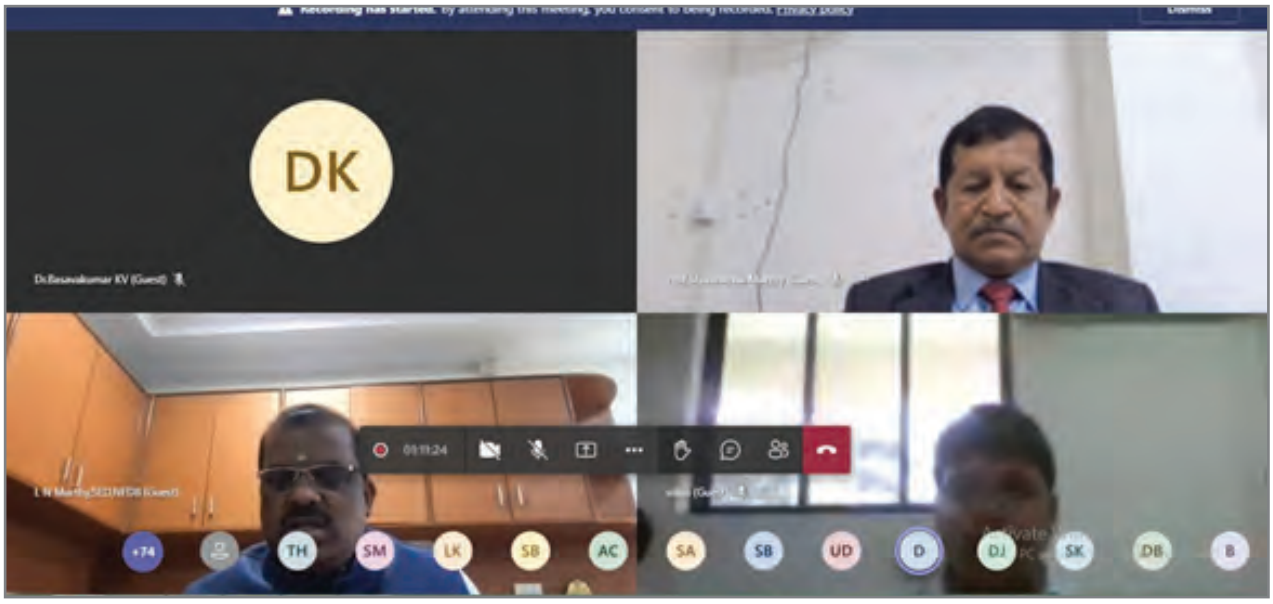
Mr. Dhande Kranthi Kumar, is an Assist. Professor and head, in the department of Fisheries Economics and Statistics, Division of Fishery Science, The Neotia University, West Bengal, India. He has done PG and Ph.D. in Fisheries Economics from ICAR- Central Institute of Fisheries Education, Mumbai. He worked as faculty for more than two years in the department of Fisheries Economics, Extension and Statistics, College of Fishery Science, Pebbair, Telangana. He has worked on research topic entitled *"An Analysis of Socio-economic Parity of Fishers vis-à-vis Primary Producers in Coastal India"* during PG. During doctoral degree, he opted to work on the research topic entitled *"Economic Assessment of Freshwater Fish Culture Systems vis-à-vis Paddy Cultivation in Andhra Pradesh"*. He has published a few research articles in peer reviewed journals. He is passionate for teaching therefore consistently update self to impart sufficient knowledge and to bring a positive change in the behavior of the students.

National Seminar Report

Division of Fisheries Science,The Neotia University

National Seminar (Virtual) On "Recent Advances in Post-Harvest Technology of Fish"

A National Virtual Seminar on "Recent Advances in Post-Harvest Technology of Fish" was organized by Division of Fisheries, The Neotia University on 12th October 2022 (Wednesday). The programme started with a brief inaugural note and welcome address by Prof. H Shivananda Murthy, Chair Professor, Division of Fisheries, The Neotia University. While welcoming the chief guests, lead speakers, participants, faculty and students, Prof. Murthy highlighted the purpose of the seminar, fisheries development at global and national level in the recent years and introduced The Neotia University. Prof. Biswajit Ghosh, Hon'ble Vice Chancellor, The Neotia University delivered the inaugural address and the Chief Guest Mr. Suhas Mukherjee, Assistant Vice President, The Neotia University addressed the participants. Key note address was given by Dr. L Narshimha Murthy, Senior Executive Director, National Fisheries Development Board, Hyderabad. Prof. G Jeyasekeran, Present NAAS fellow and former Director of Research, TNJFU, Tamil Nadu, presented on "Emerging Aquatic Food Quality and Safety Management Systems". Dr. J. Bindu, Principal Scientist & Head of Fisheries Engineering Division, ICAR-CIFT, Kochi, has delivered her lecture on "Advances in Packaging of Fish and Fishery Products". Dr. George Ninon, Principal Scientist & Head of Fisheries Engineering Division, ICAR-CIFT, Kochi, has delivered his talk on "Entrepreneurship Opportunities in Fisheries in Post-Harvest Sector". Presentation on "Status and Potential of Value-Added Fish Products in Domestic and International Markets" was made by Dr. Supratim Chowdhury, Professor & Head, Dept of FPT, WBAFSU, Kolkata. More than 300 participants participated from all over the country and few from abroad. The programme ended with a vote of thanks delivered by Dr. Neeraj Pathak, Asst. Prof. & Head, Department of Fish Processing Technology and Fisheries Engineering, Division of Fisheries Sciences, The Neotia University. There was an overwhelming response and very good participation. More than 300 participated from all over the country and few from abroad. All the expert speakers had very well presented and there was no interruption of internet either for speakers or for us, the organizers, which was commonly observed in other such seminars. There was a very good feedback and appreciation from the participants for the efficient organization and the subjects and issues covered in an advanced manner by the speakers. The organizing committee take this opportunity to thank the University Management, other officers, in particular, PJ sir for his support and encouragement for the effective organization of the seminar.



Fish Seed Stocking Ceremony
at the Neotia University Campus

The Division of the Fisheries Science of the Neotia University had organised a program and stocked Jayanthi rohu, catla and mrigal fish fingerlings to all the 7 fish ponds available in the campus on 10th of September, 2022 at 9.45 AM. Genetically improved Jayanti rohu developed through selective breeding program will grow 27% faster than the normal rohu. Ten thousand fingerlings of Jayanti rohu were stocked for the first time in the campus ponds and another 15000 fingerlings of catla and mrigal were also stocked..

The Vice Chancellor Dr Biswajith Ghosh, Asst. Vice President, Mr Suhas Mukherjee and others Deans were partipated in the ceremony. Few photos are attached.

Article

The Impact of Aquaculture on Mangroves

1. Diksha Arya, 1. Avdhesh Kumar, 1. Anurag Semwal, 2. Ujjwala Upreti

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Introduction

Mangroves are plants which are salt tolerant and occur along the intertidal areas of the coastal zones. They occur in low-oxygen soil, Mangrove areas are typically distinguished by the uniformity of their trees and shrubs. They are mainly present in tropical or subtropical areas. Mangroves have a very important role in terms of fisheries and aquaculture i.e. it creates shelters for the spawning of fishes, provide hatching grounds and have a vast source of food and resources that can be easily utilized by aquatic organisms. The shoreline of the coastal zone is guarded by mangroves, maintaining the balance of the coast and protecting it from incoming waves. With the help of the submerged roots of mangroves, the water can be filtered. Due to coastal development, aquaculture expansion, salt pan, sea level change, overharvesting and other factors, mangrove dense areas are disappearing. In India, Mangroves were exploited during the 1960s. India has mangroves on its east and west coasts as well as the islands of Andaman and Nicobar. Mangroves currently cover 4921 square kilometers of India **(Tian et al., 2021).**

Significance of Mangroves

- Mangroves have several ecological and economic functions.
- They have important role in the sulphur, nitrogen and carbon cycles.
- They serve as a sink for sediments and detritus that drain from coastal catchments and aid in tertiary waste assimilation.
- Mangroves are high in nutrients and they help to regulate and support marine food chains as well as maintain their productivity **(Páez-Osuna et al., 2003).**

Threats to Mangroves

Today mangroves are under pressure and under high threat due to various anthropogenic activities which have a negative impact. There are some of the main threats to mangroves as described below:

- The flow of freshwater has decreased into the area of mangroves; this has resulted in increasing the soil salinity of the area which affects the habitat diversity of the mangroves.
- The major threat to mangroves has been caused due to human interference, aquaculture and agricultural activities; this has been seen especially in the state of Orissa and Maharashtra.
- In Maharashtra, due to several human activities like - pollution, the building of kharland, aquaculture activities and mangroves utilized for commercial purposes has affected the mangrove forests and cleared thousands of hectare of mangrove area. The only cause of all of these issues is a lack of understanding among locals about the importance of mangroves to the ecosystem. Certain conservation strategies were proposed and implemented in this regard, such as germplasm preservation, protection and preservation of value-added species, sustainable land use, and so on **(Ahmed and Glaser, 2016).**
- The introduction of alien species.
- The threat of disease spread into the environment.

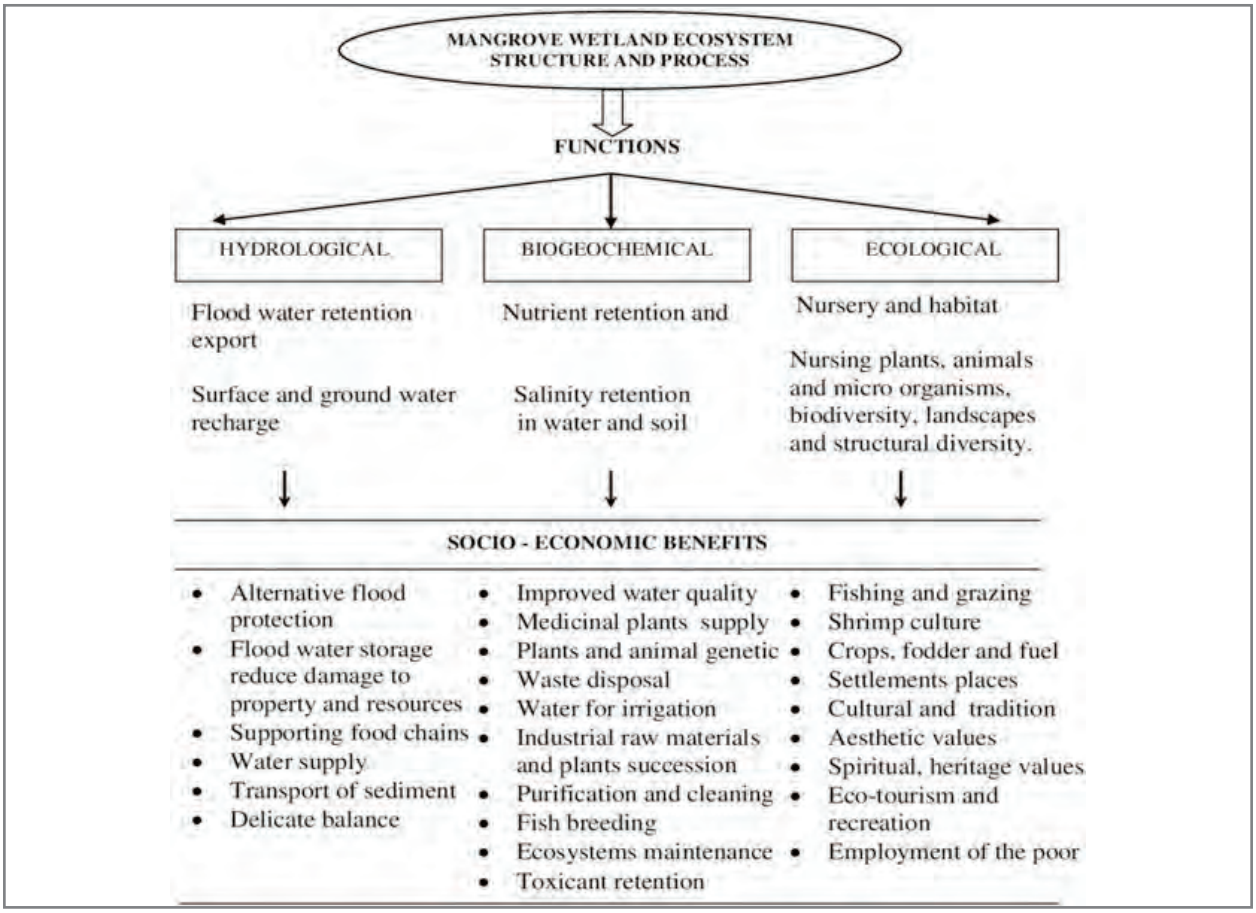

Fig1: Mangroves several ecological and economic functions (Islam, 2014)

Impact of aquaculture on mangroves

The major impact of aquaculture on the mangroves is converting the mangrove areas into fish and shrimp ponds for farming practices. The aquaculture practice in the mangrove areas has destructed a huge and vast area of world mangrove forests such as, in the countries like India, Thailand, Costa Rica and Ecuador (Peng et al., 2009).

The aquaculture practices in the mangrove forests have created many problems even in the surrounding environment as:

- Water pollution.

Shrimp and fish hatcheries located near shore areas.There are many types of aquaculture farming practices performed within or close to the mangrove areas in which many of these practices are performed for hundreds of years and are seen providing economic support and livelihood to the rural families which were thousands in number. The primary cause of mangrove destruction was the farming of shrimp and fish, as well as the construction of aquaculture farms in these areas, which require the clearing of the existing mangroves. However, many issues arise and problems were faced by the mangrove ecosystem due to water pollution and eutrophication caused by the intensive cage culture of fish **(Hong et al., 2019)**

What is being done?

For preventing the mangrove ecosystem from the impact of aquaculture practices many countries have realized that the mangroves in their country are valuable when unharmed. In 1971, the Ramsar Convention on Wetlands was held in Ramsar, Iran, where mangroves were included in protection actions agreed upon by several countries. Several NGOs have made agreements which provoked the government to take certain steps for the conservation of mangroves by improving the practices. Some aquaculture companies also realized problems the industry creates for mangroves, even the mangroves are Several types of culture activities are practised in mangroves including:

- The introduction of alien species.
- Groupers, red snapper, milkfish and sea bass are some examples of the fish that are raised in floating cages or pens (typically in estuaries and creeks)
- Rafts, poles, lines and clutches are tools for cultivating oysters, mussels and seaweeds

- Pond culture practice for shrimp and milkfish (in the intertidal or supratidal zone.

not suitable for shrimp farming, due to the high sulfur content of the soils

Need for action

- The establishment of an institutional framework and a mechanism for strategic planning in the impacted areas to offer direction on land-use options within a framework for the integrated management of coastal areas
- The involvement and interest of people in the management and conservation of mangroves on public lands and knowing about the benefits
- Different programmes should be set up, to spread awareness about the importance of mangroves through banners, newspapers, exhibitions, posters, camps, seminars etc.
- Practicing sustainable mangrove management on private and communal lands in villages
- Enforcement of environmental protection legislation
- Various investigations and studies should be conducted on issues relating to pathogens and pests, as well as on the proper management of the mangrove ecosystem
- Reclaiming mangrove habitats that have been damaged

Conclusion

Mangroves must be studied from a wider perspective with the active participation of communities. It is also necessary to establish their sustainable use and enhance their management. The present mangrove conservation practices also support “early detection and protective rehabilitation”, for successful management and to achieve this successful management of the mangroves location-specific and species-specific information on the mangrove is essential to study.

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Highlighted points

- Ecological and economic functions of mangroves.
- Threats to mangroves.
- Actions that are needed to be taken for mangrove conservation.

Culture of Brine shrimp (Sea monkey)

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Introduction

The brine shrimp (Artemia) or sea monkey belongs to the Crustacea subclass of the phylum Arthropoda. Similar to copepods and Daphnia, Artemia is zooplankton that is used as live food for marine finfish and crustacean species as well as in the aquarium trade. Of the several species of Artemia, Artemia salina is the most common and Sixty different strains of brine shrimps have been identified. Around 90% of the brine shrimp cysts (the dormant stage) used for commercial purposes worldwide are harvested from Utah's Great Salt Lake. Artemia is a genus of brine shrimp that feeds nonselectively on small food particles such as algal cells, bacteria and detritus ranging in size from 1 to 50 µm. Artemia is regarded as a high-nutritional-value aquaculture live food. Artemia is a highly euryhaline organism (withstand salinities ranging from 3 to 300 ppt). They can even survive in freshwater for short periods of time. Artemia can tolerate temperatures ranging from 15 to 55 °C. For newly hatched fish and shrimp larvae, Artemia was found an excellent food source. Two types o is advised to promote the growth of green algae (such as Tetraselmis sp., Dunaliella sp.) and diatoms (e.g. Chaetoceros sp., Nitzschia sp.). Traditional method of Artemia culture involves little water exchange and using locally available supplementary food by-products from agriculture (e.g. corn meal, micronized rice bran, cassava powder) and also direct use of chicken manure in the Artemia culture ponds, in addition to the use of 'green water'. Abiotic factors (water temperature and salinity) and the availability of food have a significant impact on Artemia density, which is a major factor in the production of Artemia cysts in salt ponds i.e., quality and quantity of microalgae, suspended organic particles, bacteria etc. (Sui et al., 2013).

Reproduction

Artemia are used in aquaculture: (1) resting eggs that can be kept dormant for a long time (years) before hatching within a day to produce live food in the form of nauplii and (2) adult biomass, which is given to cultured fish and shrimp broodstock and juveniles as a live, frozen or dried product (Zmora et al., 2002).

The role of phytoplankton in Artemia production

Chicken manure (organic fertilizer) with inorganic fertilizers (urea, diammonium phosphate DAP) is used as Nitrogen (N) and phosphorus (P) source to stimulate the growth of microalgae in the fertilization ponds . "Green water" from these ponds is then daily drained into the Artemia culture ponds. The two most crucial nutrients for the growth of the algal population are N and P. Additionally, it is believed that the N:P ratios play a significant role in the structure of the algal community. According to Smith et al., (2006), a fertilization pond N:P ratio of 10:1 Under normal circumstances, Artemia is an ovoviviparous condition in which the mother releases the nauplii into the water after the fertilized eggs have developed inside her uterus. However, when the embryo is in the gastrula stage, shell glands found in the uterus secrete a shell around the embryo in extremely adverse conditions like high salinity (above 150 ppt) and low oxygen. The embryo goes into diapause or a state of dormancy. The females release these, which are known as cysts (oviparous reproduction). One adult Artemia can live for several days (up to 50/60 days) and it can reproduce at a rate of 300 cysts/nauplii every four days (Wache and Laufer, 1997).

Artemia Cysts

The cyst has a diameter of 200 to 300 µ, depending on the strain. A hard, dark-brown shell covers its outer layer. The encysted embryo enters a dormant state under dry conditions, which enables it to withstand complete drying, temperatures above 100 °C temperatures close to absolute zero, high energy radiation and a variety of organic solvents. (Treece, 2000).

Table 1: To achieve the optimum level of hatching the following are to be strictly observed.

Salinity	15-35 ppt
Aeration	Vigorous aeration @ 10-20 litre air per minute
Temperature	25 °C to 32 °C
pH	8 to 8.5
Illumination	More than 1000 lux (2000 lux at water surface preferred)

Hatching of Cysts

Multinational corporations produce Artemia cysts on a commercial scale in various locations, and these cysts are available in sealed cans for use in hatcheries. A nauplius larva hatches out within 24-36 hours after being soaked in seawater to restart embryonic development in these stored cysts The cyst swells and develops a spherical shape within one to two hours under the above conditions. The nauplii larva emerges as free swimming soon after the hatching membrane ruptures. The freshly hatched nauplius measures 400–500 µ and is coloured brownish-orange. The nauplii go for about 12 hours without eating. It begins feeding on bacteria, algal cells and debris with a size range of 1 to 40 µm after 12 hours. It matures after 15 moults.

Fig 1

Fig 2

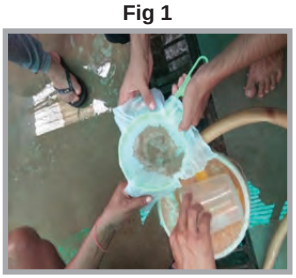

Fig 3

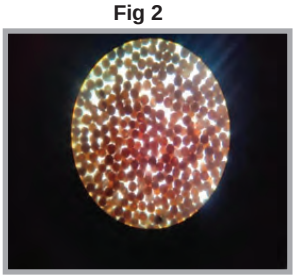

Fig 4

Fig 1,2,3,4: Resting eggs of Artemia salina

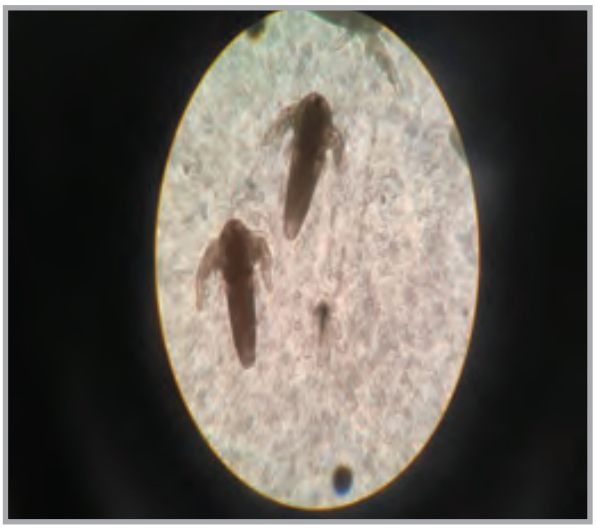

Fig 5: Nauplii stage of Artemia salina

Decapsulation of Cysts

Bacteria, fungi and other microorganisms have been found in the shells of Artemia cysts. If empty shells, unhatched cysts or leftovers from the hatching medium are added to the larval tank along with the Artemia nauplii being fed to fish larvae, the fish larvae will become infected, suffer from diseases and cause significant mortality. Therefore, decapsulating the cyst before incubation was advised by (Khoi et al., 2006).

Scientists recommend the following procedure for Artemia cyst decapsulation

(a) Hydration of cysts for 1 hour in freshwater or salt water (100 g cysts in 1litre water)

(b) Collect the cyst using a 125µ mesh sieve and place it in the hypochlorite solution made as follows

Bleaching power CaOCl2	71%
Na2CO3	64%
pH	1400ml

Before adding the cyst the solution is cooled to 15 °C to 20 °C by placing it in ice water. Add the hydrated cysts and stir for 5-15 minutes. Never allow the temperature to rise above 40 °C by cooling it with ice.

(c) When the outer parts of the cyst shell have been completely dissolved, remove the cysts and rinse with water on a screen with a mesh size of 120 µm until the chlorine odour has gone away.

(d) To completely remove the hypochlorite, immerse the cysts in 0.1 N HCl or 0.1% NaS2O3 solution for less than one minute and after that, rinse with water.

(d) Incubate the cysts until they hatch.Decapsulation also lessens the difficulty of harvesting nauplii while separating the empty cyst shell. A newly hatched nauplius larva has a large reserve of nutrients that it uses for growth and feeding. Instar II larvae begin ingesting any particulate matter nonselectively after the first moulting, which occurs approximately 8 hours after hatching. Instar II larvae have 22 to 39% less energy content and 16 to 34% less organic dry weight than instar I larvae. Because they are bigger and swim faster than instar II, they are less digestible and less desirable to larvae. Instar II also contains lower amounts of nutrients like free amino acids. By keeping the larvae at a lower temperature, such as 10°C, it is possible to prevent them from moulting to instar II. For up to 24 hours, 5 million larvae/litre can be kept in storage. To avoid the accumulation and suffocation of larvae at the tank bottom, a small amount of aeration is provided (Le et al., 2019).

Bioencapsulation or Enrichment of Artemia Nauplii

The amount of essential fatty acid 20:5 n-3 eicosapentaenoic acid determines the nutritional value of Artemia nauplii (EPA). To take advantage of instar II primitive feeding behaviour, a technique known as bio-encapsulation, enrichment or boosting Artemia nauplii is used. In the rearing medium with vigorous aeration, emulsified concentrates enrichment emulsion is added at a concentration of 300 ppm. Because nauplii are non-selective feeders, they consume the HUFAs and then store them below 10 °C. The same method can also be used to bio-encapsulate growth promoters and antibiotics in Artemia nauplii and then deliver them to the larvae. Cylindro-conical tanks with capacities ranging from 400 to 5000 litres are used to hatch out Artemia cysts. It will be equipped with overhead fluorescent lights and a facility for continuous aeration. Except for the conical base, which is transparent to let light through, the tank is made of a black fibre gas sheet. It will have a central pipe that is connected to a drain pipe that has a ball valve that controls it. Unhatched cysts sink to the bottom, whereas hatched cysts float on the surface. The drain is then gradually opened, allowing the unhatched cysts to emerge first. The Artemia nauplii are then collected in Artemia harvesting buckets equipped with a 100 µ screen. After collecting all Artemia nauplii, discard the rest of the tank, which contains only hatched-out cysts. The Artemia nauplii are then thoroughly washed with sea water before being stored for feeding shrimp larvae (Treece, 2000).

Conclusion

A common issue in various Artemia pond production scenarios is the difficulty in maintaining a certain level of profitability. It has been demonstrated that maintaining the Artemia ponds during the winter (December–March) is not only feasible but also beneficial. Before the cold season, increasing salinity to 150 ppt was necessary to both enable stratification and maintain salinities above 90 ppt after the repeated dilution cycles. It can be difficult to maintain Artemia production above a certain point when promoting this type of extractive aquaculture in nations that require Artemia cysts and biomass to increase their domestic aquaculture production. For the production of species in captivity to be successful, numerous challenges must be overcome.

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Highlighted points:

- The role of phytoplankton in Artemia production.
- Optimum range of certain parameters to be maintained for Artemia culture.
- Decapsulation of Cysts

Matsya Jagat. Fish motif in traditional patachitr of Bengal. Vol 1 Issue 1, Jan-Mar 2023, pp 16-17

Fish Motif in traditional Patachitr of Bengal

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Fishes hold a special place in the lives of the Bengalis. It occupies a significant place in the Hindu religion as well as the culture and folklore of Bengal. For the Bengalis it is just not included in their diet but they consider fishes to be a bringer of good luck and prosperity in life. For this reason they use fish to begin something new in life.

Bengal is situated in the Gangetic Delta region with many rivers like the Ganges, Padma, Meghna, Damodar, Mayurakshi, Teesta and Rupnarayan flowing through it. These water bodies are a source of a wide variety of fishes like Rui, Katla, Pabda, Tangra, Koi, Hilsa, Pomfret, Bhetki, Prawns, Shrimps, Crabs and many others. Fishing therefore becomes one of the main occupational activities of the people living near the coastal regions in Bengal.

Bengali tradition and culture, folklore, literature, sculpture and paintings of Bengal abound with the stories of fishes. Fish is integrally related to the Bengalis so much that we Bengalis make use of it in almost all important occasions like Annaprashan or Mukhe Bhaat which is 'the first rice eating ceremony of a baby,' Aiburo-Bhaat which is 'the pre-wedding ceremony for the unmarried couple who is going to be married soon' and also in the different customs in a wedding ceremony. Even on the days of the Puja festivities the Bengali Hindus offer fish to the deity.

The Charyapadas which is the oldest of the Bengali texts mention fishing and hunting to be the main occupation of the people in Bengal during that time. The terracotta work found on the walls of the temples also depict stories of fishes being taken to the market in baskets, fishes being worshipped, fishes being dressed etc. This article looks into the use of popular fish motifs commonly used in Bengal Patachitra.

The cloth based scroll painting also known as Patachitra in Bengali is a common and well-known art form originating in the tribal villages of Bengal. The Patachitras are basically the visual accompaniments to the stories that were usually sung. The Patachitra painters are locally known as Patuas, Pattidar or Poto. The Patachitra artists paints on a variety of themes and subject-matter ranging from mythology, folklore, nature, social issues and many more. The stories and the paintings are delightful and appealing. These stories and paintings reflect the ancient tradition of story-telling in Bengal. One of the favorite and most loved themes of the Patachitra artists is the story of "Machher Biye" or the wedding of the fish. This folk tale originated in the Santhal community.

(Picture courtesy: From author's personal collection. Photograph by: Mr. Asif Chowdhury. The photo depicts the theme of 'Machher Biye' or the Wedding of the Fish.)

The Patachitra paintings narrate the wedding ceremony of two Dariya fishes ('Catfish'). The story is about the marriage of two fishes where all the other fishes have been invited. The scene depicts the fishes enjoying and merry-making. The flutes, trumpets, dhak and dhol ('drums') represent the festivity of a traditional wedding. The paintings are the artist's imagination of underwater life.

The Patachitra is a unique ensemble where several methods of communication have been used. The visual images are accompanied by song and music. There is a Bengali folk song narrating the story of the wedding of the fish. The full song along with a free translation of it is given in English.

Oi Dariya macher biye dite, cholo go Rangeela
Oi Dariya macher biye dite, cholo go Rangeela
Puti mach bole, ami
Puti mach bole, ami
Tor biyer shanai bajiye debo, lo Rangeela!
Oi Dariya macher biye dite, cholo go Rangeela
Oi Dariya macher biye dite, cholo go Rangeela
Chingra mach bole, ami
Chingra mach bole, ami
Harmoni bajiye debo, lo Rangeela!
Oi Dariya macher biye dite, cholo go Rangeela
Oi Dariya macher biye dite, cholo go Rangeela

Koi mach bole, ami
Koi mach bole, ami
Tor biyer dholok bajiye debo, lo Rangeela!
Oi Dariya macher biye dite, cholo go Rangeela
Oi Dariya macher biye dite, cholo go Rangeela

"Let's go for the marriage of Dariya fish. O Rangeela!" To this invitation the Pnuti fish (small fish) replies, "I will play the clarinet in your wedding!" The Prawn says, "I will play the harmonium in your wedding!" The Koi fish excitedly says, "I will play the drums at your wedding!"

So begins the marriage ceremony and the wedding feast of the fishes. While the merry-making and feasting is going on the fishes ignore the fact that there is danger lurking around. The threat of a monster fish looms large. The Boal fish attacks and swallows up all the fishes present because he is very angry on not being invited to the wedding.

(Picture courtesy: From author's personal collection. Photograph by: Mr. Asif Chowdhury. The photo depicts the Boal fish swallowing all the other fishes.)

Every folktale has an underlined symbolic meaning to it. The metaphor behind this story of the fishes upholds the hierarchy and the socio-economic distinction prevalent in society. It brings out the caste/class distinction which is one of the evils still present in modern society. The folktale of the marriage of the fishes is a critique of this differences existing in society. It also criticizes the exploitation, subjugation and suppression of the weak. It brings to light the domination of the then rich zamindar class over the common masses. Therefore the Patachitra paintings convey important messages that preserve valuable factual information of the past.

The fish motif is used as the Geographical Indication (GI) logo for Bengal Patachitra. The Patachitra paintings are very illustrative. They are traditionally made with organic vegetable paints. The paintings are bright and colorful that creates a dazzling effect. The Patachitra paintings are ethnic and aesthetically beautiful. The fish motif is used by the Patachitra artists and painters in various art works and different art products apart from paintings like pen-stands, lamps, trays, t-shirts, tea cups, coffee mugs and many other products because fishes are considered as auspicious and pure. These Patachitra paintings and art works will add glamour to one's home as well as can be gifted as souvenirs to family and friends.

(Picture courtesy: From author's personal collection. Photograph by: Mr. Asif Chowdhury. The photo depicts the use of fish motif in various Patachitra handiworks.)

The Patachitra paintings highlight the oral tradition that has been passed down generation after generation. It preserves the historical past, traditional and cultural heritage of Bengal. With the emergence of the new media the scope of Patachitra has also expanded. The fish motif and the story of the wedding of the fish has gained a new form, a new voice and a new format of story-telling to meet the demands of the modern society and still remains the favorite of the masses.

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Highlighted points

- Bengali tradition and culture, folklore, literature, sculpture and paintings of Bengal abound with the stories of fishes.
- Unique story of Patachitra with visual communication accompanied with song and music
- A new format of story-telling to meet the demands of the modern society

Need and Scope of Integrated Horticulture-cum-Fish Farming in India

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Need of Integrated Farming System

80% of Indian farming community comprises of small and marginal farmers. These are the farmers who have very small land holdings are generally not financially strong and work in a risk prone environment. They don't have a sustainable source of income and have a constant pressure of feeding their families with limited resources. These farmers are highly dependent on the environment for their crops to grow and in case that doesn't go in their favour, they loose their crop and are left penny less which further pushes them to severe poverty. Keeping these factors under consideration, it is obvious that depending on only one source of income is risky for these farmers. To overcome this, the concept of Integrated Farming System was introduced.

Integrated Farming System

80% of Indian farming community comprises Integrated farming System may be defined as a system in which agriculture can be integrated with livestock, poultry and fish and they are maintained at same place to generate employment around the year and also get additional income. This system thus reduces the risk factor and dependency on a single source of income plus an opportunity to generate extra income.

Scope Of Integrated Horticulture-cum-Fish Farming

Integrated horticulture-cum-fish farming has a great scope in terms of improving rural economy given its low investment and high profit returns. It is a great way of diversification and producing food for the farmers' family. Moreover it is an ecofriendly form of farming system which doesn't require any additional infrastructure since the already available space of embankment can be utilized for this purpose. Investment in terms of labour cost can also be minimized in case family labour is deployed.

Advantages of Integrated Horticulture-cum-Fish Farming

The major advantages of this system are listed below

- The farmer can generate additional income by selling fruits and vegetables grown on the bank embankment.
- The nutrient-rich pond mud can be used as fertilizer for growing crops, and thus the cost of organic manure is reduced
- Irrigation of the plants can be done from pond water which is rich in nutrients.
- Residues from Fruit and vegetable can be used as feed for the fish.
- The roots of the plants on the embankment strengthen the dikes.

Suitable crops for Integrated Horticulture-cum-Fish Farming

The crops that are dwarf in stature, less shading and have high remuneration are perfect for this system. Fruit crops like Papaya and Banana are excellent to be grown on the embankment. Besides this, vegetables like brinjal, cabbage, cauliflower, tomato, cucumber, pumpkin, bottle gourd, radish, beans, cowpea and leafy vegetables are also suitable to be grown in this system.

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Highlighted points

- Needs and major advantages of Fish cum horticulture integrated farming.
- Scope of integrated horticulture-cum-fish farming to enhance rural economy with low investment and high profit returns.

Women's Triple Role – A boon for the society

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Introduction

From the ancient past both men and women are working hard for surviving and meeting up of the basic needs- food, cloth, and shelter though men are called breadwinners. Many western countries believe that women are more nurturing than men. Indian society has a social system that gives power and control to men rather than women called patriarchy society. The occurrence of gender stereotypes and non-occurrence of gender equity are predominantly found here. Though most of the parts of the country follow the traditional social norms some place like Meghalaya represents matriarchal society of 'Khasis.' 'Mosuo' culture in China near Tibet is frequently described as matriarchal. Women balance their triple roles- reproductive, productive and community managing roles together but do not receive recognition for that.

Gender roles

Gender role denotes how the people in the society is expected to act, speak, dress, groom and conduct themselves based upon their assigned sex. Now people often confuse between the terms 'SEX' and 'GENDER' however Gender is purely associated with socially constructed roles where Sex denotes biological attributes of a person. Gender role can be of different disciplines. This offers perspective on gender roles. Ecological gender role suggests that gender roles are created by the interactions between individuals, communities, and their environment. From sociological perspective masculine and feminine roles are learnt. They are not connected to biological traits. Sometimes gender roles are created based on gender stereotypes with the specific attributes, characteristics, or roles by an individual. It varies from group to group, community to community, nation to nation because of having different mindset. Girls with typically feminine costume and politeness and boys with aggressive attitude are not expected in so many countries or communities.

Women's triple role

Women are the backbone of a society. They are hard working and multi-tasking as they juggle with several works simultaneously. For examining the differences between the lives of women and men 'Gender Analysis' is very important. It is one type of socio-economic analysis that uncovers how gender relations affect a development problem.

Caroline Moser developed the Moser Framework for Gender Analysis in the 1980s while working at the Development Planning unit (DPU) in the university of London. Women's triple role is a vital concept derived from Moser Framework. In this framework Moser identifies a 'triple role' for low-income women in most of the societies. Her implementation of that idea in this framework made it distinct from other traditional ways of thinking. This framework involves the question "who does what?" The triple role for women consists of **Reproductive, Productive and Community managing** activities.

According to Moser **Reproductive role** of women involves the care and maintenance of the household and the members of the family. One of the most important reproductive roles is giving birth of a child. Men are less involved in child care as compared to women. Preparing food and housekeeping by women are two major reproductive roles. Women are not paid for this works. Rarely this work is considered as 'Real Work.'

Production of goods and services for consumption and trade by women in a society leads to women's Productive role. In fisheries sector, a huge number of fisherwomen are involved in making traditional fishing gears, fish culture practices and selling of fish and fish

Fig. 1 Women's triple role
Illustration: Ratna Sagar Shrestha/The Himalayan Times

products to the local market. It has been found that Gramin banks in India provide loans to women SHGs in rural areas for their upliftment. Women and men both are actively involved in productive activities but their functions and responsibilities often differ. However, women's contribution regarding the productive work is less visible and less valued.

Community managing roles include the participation of women in different social events, ceremony, celebration, activities to improve the community, political activities and so on. Any training or workshop for fish farmers by women fisheries experts can be a good example of community managing role.

During the explanation of women's triple role Moser also defines the Practical Gender Need and Strategic Gender Need. Practical gender needs deals with the development interventions which are intended to meet like water provision, health care provision, opportunities for earning and provision for housing etc. for women. Women's strategic gender needs are the outcome of their subordinate social status. Meeting the strategic gender needs women can be more self-dependent. The removal of institutionalized forms of discrimination such as laws and legal system biased in favor of men falls under the strategic gender need.

Conclusion

In the Indian society women are generally viewed as reproduction machine. There are ample examples of early marriages, abortion of girl child, abuse of women in several parts of India. Most often it is observed that men got the position of managers and executives but women as their secretaries. Moser gave an analysis of five different types of policy approach over the last few decades which she defined as welfare, equity, anti-poverty, efficiency, and empowerment approach. Women's triple role in the society is much important to understand which can be a key of healthy social environment and growth of the whole society.

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Highlighted points

- Role of women in society.
- Women in fisheries sector.
- Taking a note on sensitive issues like early marriage, girl child abortion and women abuse.

Pearl Oyster: Cultural Techniques and their Management

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Introduction

The Pearl oyster (Pinctada fucata Gould, 1850), is a kind of marine bivalve mollusk. It is employed in the production of pearls and is endemic to shallow seas in the Indo-Pacific area. The Red Sea, the Persian Gulf, the coasts of India, China, Korea, Japan, and the Western Pacific Ocean are all included in its range. Venezuelan coastal waters have now been exposed to it. The only biological jewels are pearls, and they don't need to be processed to show off their beauty. At first, humans depended on the accidental discovery of natural pearls in numerous types of freshwater mussels and sea bivalves. Natural pearls are created when the nacre, a bright, iridescent substance that coats the inside of the oyster shell, responds to an irritant. Natural pearls often have a crooked form, are petite, and come in a variety of hues. Due to the great value of natural pearls, there are now pearl fisheries almost everywhere where pearl-producing mollusks are found in the world. The majority of these pearl fisheries had brief lifespans due to the overfishing of the natural resources by the fishermen. In the production of pearl oysters, oysters from natural beds or those collected from naturally gathered or cultivated spat are both employed. A number of pearl banks are dispersed in the Gulf of Mannar, various banks are distributed off Tuticorin at a distance of 12-15 km with depths of 12-25 m. Skin and SCUBA-diving are used to obtain pearl oysters from these beds.

Biology

A long, straight hinge joins the oyster's two valves together. The shell's breadth is around 85% of its length, which is somewhat longer than it is overall. In addition to having hinge teeth on both valves, the right valve is flatter than the left. In comparison to other species in the genus, the front ear is bigger, and the connection between the ear and the remainder of the shell has a slit-like gap through which the byssus threads can travel. Large in size is the back ear. The valves' exterior surface is scaly and reddish or golden brown with faint radiating lines. A dense coating of golden-yellow nacre with a metallic shine line the interior of the valve. Water enters the shell through a hole in the mantle, travels through the gills, where food particles are removed and gas exchange takes place, and exits through yet another hole. Infusorians, foraminifers, radiolarians, and other tiny planktonic creatures are the main food sources for these pearl oysters. Natural pearls are created when the nacre, a bright, iridescent substance that coats the inside of the oyster shell, responds to an irritant. Natural pearls often have a crooked form, are petite, and come in a

Classification

Kingdom:	Animalia
Phylum:	Mollusca
Class:	Bivalvia
Order:	Pteriida
Family:	Pteriidae
Genus:	Pinctada
Species:	fucata

variety of hues. Due to the great value of natural pearls, there are now pearl fisheries almost everywhere where pearl-producing mollusks are found in the world. The majority of these pearl fisheries had brief lifespans due to the overfishing of the natural resources by the fishermen.

Site Selection

The location needs to be both theft- and pollution-proof. The actual presence of a person at the location where the corals are found is one technique to ensure that it is theft-free. There should be no freshwater resources close to the company, and the water should be free of choppy water that stirs up sand and debris. Since the reef regions are home to many predators, the location should be set back 70 to 100 feet from them. Additionally, precise site depth is necessary for the organization to operate effectively. Oyster farming areas benefit from water currents because they give the necessary nutrients and oxygen. It is highly helpful for pearl farming to have a little current on both the top and bottom sides of the farm site.

Culture Parameters

Around 15 m is the ideal depth for pearl oyster aquaculture. Even though the rate of nacre deposition is slower at deeper depths, high-quality pearls with a pinkish color are produced there. Cultural places must be inherently protected from severe winds and seas. To refill oxygenated water, bring in new plankton, and remove waste, the tidal amplitude and currents must be sufficient. Although pearl layers often develop quickly in high water currents, the quality of the pearls produced is compromised. The state of a particular cultural ground is largely influenced by the type and quantity of plankton present, as well as by the chemical composition of the saltwater. High primary productivity is caused by rivers' nutrient-rich discharge into the ocean. The nitrogen content of the plankton is likely the oysters' primary source of conchiolin. The biological activities of pearl oysters in temperate locations are significantly influenced by the water temperature. The ideal temperature for oyster development in Japan has been discovered tide. For maintaining the main line's buoyancy and straightness, buoys and floats are utilized. By employing a variety of containers, such as

Fig. Pearl oyster; (a) Outer layer, (b)

technique to ensure that it is theft-free. There should be no freshwater resources close to the company, and the water should be free of choppy water that stirs up sand and debris. Since the reef regions are home to many predators, the location should be set back 70 to 100 feet from them. Additionally, precise site depth is necessary for the organization to operate effectively. Oyster farming areas benefit from water currents because to be between 20°C and 25°C. Hybernation is brought on by temperatures below 13°C. The oysters perish below 6°C. The oysters become fatigued at temperatures higher than 28°C. When the water is at 13°C, calcium deposition comes to an end. Oysters in the Gulf of Kutch develop rapidly in the winter when the water temperature is between 23 and 27°C. A 100% death rate among oysters may result from salinities between 14% and 55%. There hasn't been a thorough investigation of how salinity affects pearl oyster development. But it appears that pearl oyster favours high salinities.

Types of farming

Structures are needed in pearl cultivation to keep the shells submerged. There are idealistically three sorts of farming;

1. Tahitian Longline

It is common practice to anchor a rope line to rocks or other objects in the water. The anchor lines should be 12 mm in diameter, with the rope line being either polypropylene or nylon and 18 mm in size. On either side of the man rope line, anchor lines need to be placed at 20-meter intervals. The main line is kept fixed by the anchor lines, preventing it from swaying with the chaplets, net pocket panels, etc., the man rope line will store the oyster shells and be farmed.

2. Floating Rafts

In countries like Japan and Indonesia, this type of pearl cultivation is practiced. Rafts are placed in areas of water where the seas are calm, the currents are strong, and there are no thefts. The raft is floated using drums and Styrofoam floats. In order for this technology to endure the temperature and seas, careful material selection is necessary. In order for it to stay put, it has to be securely anchored. You may put pearl oysters in any kind of container, such as baskets, box cages, net pocket panels, and rope hanging.

3. Underwater Trestles

In the trestle method, the structure is constructed similarly to the floating raft approach using steel, PVC, or timber, all of which should be corrosion-resistant. Depending on the depth and profundity of the water, trestles may be constructed either low or high.

Management

Regular inspections are necessary for maintaining a pearl farm properly. You may then determine whether any lines are broken or missing. Additionally, look around the area for any lost shells. Because so many unneeded creatures thrive on the lines, shells, and other hanging things, the next step is to routinely clean the area. You must use extra caution when cleaning since pearl oysters often become anxious after being cleaned. Cleaning should only be done once a month and can be avoided.

Harvesting

In most cases, pearls are manually extracted during harvesting by either cutting or separating the two valves, then pushing the pearl out. Commercial growers carefully open the pearl sac to reuse the shells without damaging the organs or tissues. Pearls should first be thoroughly washed in distilled water, then cleaned with refined salt, and then rinsed once more in purified water. Then, pearls are organized according to size, surface, shape, shading, brightness, and other characteristics.

Commercial Business

Pearl oyster business is one of the high profit-making businesses and can make about 200% of the profit. But due to a lack of information and experience, the majority of individuals ignore this industry. A significant potential and chance exist to look into raw resources in beachfront locations with strong market demand. As young entrepreneurs and beachfront fishermen build the pearl clam farming industry as a lucrative financial pathway, it is becoming more and more accepted as an optional career. This perception has altered over the past fifty years. This is a culture of clams growing in incubators from seeds rather than dependent wild-find cultivation.

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Highlighted points:

- Pearl oysters and their importance.
- Culture techinques, management and maintenance.
- Commercial business and importance.

Seed Production of Clams

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Introduction

Clam meat is one of the major seafood items having consumer preference in several countries such as Japan, Thailand USA, Australia, Malaysia, Singapore, Kuwait, Belgium, France, Germany Italy, Netherlands, Spain and Switzerland. Apart from the clam meat, other products such as clam juice, clam strips, clam streaks, clam pickles etc. are also in good demand. Shells of clam are used in the manufacture of cement, lime, calcium carbide etc. Among the cultivable clams belonging to families such as Arcidae (blood clams) Veneridae (Meretrix, Paphia, Katylesia) Corbiculidae, and Tridacnidae, Anadara granosa, Paphia malabarica and Katelysia opima are the favoured species. A. granosa (blood clam) occurs in soft muddy substratum and attains 41 mm length in the first year and it is found all along the Indian coast, particularly in Kakinada bay P. malabarica grows to 49.1 mm in one year. K. opima attain 26-33.8 mm in one year and are found in estuaries. Clams of commercial importance found in other countries such as the Philippians, Solomon islands, Indonesia, Australia, Fiji etc. are Tridacna gigas, T. derasa, T crocea, T. maxima, T. squamosa and Hippopus hippopus. T. gigas is commonly known as giant clams as it is reported to grow to a giant size of 1 meter long and 250 to 300 kg weight. Hatcheries for giant clams are established in the above-mentioned countries. Other clams of importance are Venerupis japonica (Japanese little neck or Manila clam), Mercenaria mercenaria (hard clam)) and Meretrix meretrix (big clam).

Reproductive Biology

A. granosa

Males attain the first maturity at 20 mm length and females at 24 mm length. It is a "year-round spawner having 2-4 reproductive cycles a year. The fecundity is about 500000- eggs per spawner. Broodstock maybe 3-4 cm in length and 1-1.5 years old.

P. malabarica

Size at first sexual maturity is 11 to 20 mm. It spawns from September to January in Ashtamudi lake and from October-February in Mulky estuary.

K. opima

Its size at first sexual maturity is 11-20 mm in length, main spawning season is October-November in Kalbadevi and a minor spawning period is during March- April.

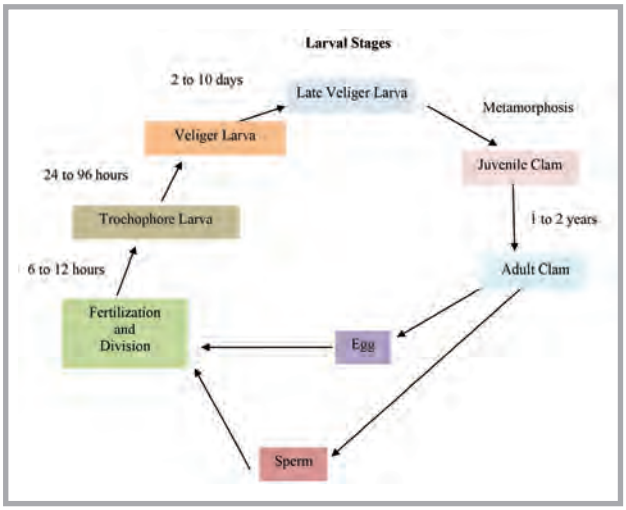

Fig1: Life cycle of Clam

The different stages in the development are mostly similar to that of mussels, the differences being that D-hinge veliger: starts consuming food 1- 3 days after fertilization in clam, umbo becomes visible 7-15 days after fertilization and the settlement stage is 21-35 days after the date of fertilization.

Hatchery Technology

Collection and Preparation of Brood Stock

Broodstock (3-4 cm in size and 1-15 years old) collected from muddy substratum is washed thoroughly in freshwater. This makes the animal keep the shell closed. The washed cockles are then disinfected by bathing

them in 10 ppm sodium hypochlorite solution for 15 minutes. This kills all harmful organism present on the outer surface of the shell.

Induced Spawning

Spawning Inducement by Temperature Shock

Sea water is taken into a tank and the same is heated to 34°C- 35°C or 45°C abuse ambient temperature. The clams were transferred to this tank and kept at this temperature for two hours. After this, the temperature is decreased gradually to ambient temperature or a lower temperature such as 20°C for two hours. This is the heat shock-cooling cycle. If the clam does not spawn with one cycle it may be repeated. This method was very effective for bivalves.

Spawning Inducement by Increasing pH and Addition of H2O2

pH of seawater was raised to 9.1 by the addition of 10% sodium hydroxide. Then hydrogen peroxide was added to form a 150 ppm solution. Clams were placed in his solution for 8 hours. After this keep the clam in a raceway with clean flowing seawater. After 1 to 4 hours, bivalves with ripe gonads spawned.

Inducing Spawning by the Injection of 0.1 N Ammonium Hydroxide into Body Cavity

1cc of 0.1 N ammonium hydroxide is injected into the body cavity of the clam. Then it was kept in the tank. After 30 minutes it spawned.

Development and Larval Rearing

The developmental stages are similar to that described for mussels. The larvae were stocked @10 numbers per ml in 50-litre fibreglass tanks at ambient salinity i.e. 32 ppt EDTA was added to the tank each day after water exchange so that its final concentration was 5 ppm. Larvae were fed on algae Isochrysis sp. from one day after fertilization @5000 cells cm-3. Feeding was done twice daily (morning and evening)-batch feeding or 4-5 times a day beginning with a small amount and continuing throughout the day when the water is cleared of foods-pulse feeding the quantity was increased to 30000 cells cm-3/day depending on the size of the larvae.

The spat stage is reached 21-35 days after fertilization. Cockles do not reed special setting substrate as they are set on the bottom of the rearing tank. After setting growth is very rapid and within a few days, it is easy to screen off cockle spat with 280 µm or a large screen to a nursery. They grow better when reared on a mud bottom.

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Highlighted points:

- Hatchery technology in clam culture.
- Importance of clam meat as major sea food.

Matsya Jagat. Dried Fish Day. Vol 1 Issue 1, Jan-Mar 2023, pp 26-28

Dried Fish Day

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Introduction

Drying is the most popular traditional fish preservation method that is commonly practiced throughout the world including India. Because of its simplicity and versatility and offering dry fish and fishery products with nutritional quality almost intact, drying as fish processing method is still continuing with the advances in modern technology i.e. freezing and canning. Dried fish relished as food all along the coastal states of India and there is a tradition to consume it during special functions, especially among the lower strata of the society. It is widely consumed in the interior parts of India, as low cost dietary protein some and used as a substitute of fish at the time of scarcity of fresh fish. It is the most effective method for production of traditional fish products. Dried fish product is an alternative to fresh fish across the country. Dried fish is a traditional part of the diet of a large section of the world's population (Reza et al., 2009; Chukwu and Shaba, 2009; Huda et al., 2010; Ahmed et al., 2013). Dried fish is nutritious food containing highly unsaturated fatty acids, fat soluble vitamins, essential minerals as well as proteins containing essential amino acids (Bilgin et al. 2008).

In India, dried fish are usually not properly packaged and sold within short period in local market. This has made dry fish business to remain restricted to small scale business with poor quality of product. Thus maintenance of quality of dried fish is a serious problem during transportation, storage and distribution in the distance and local market. It calls for improvement in packaging of dried fish to maintain the quality and consumer satisfaction.

Why celebration of dried fish day

1. People aware about dried fish.
2. Importance of dried fish with the high protein as compared to fresh seafood & other products.
3. Improvement in quality of dried fish products.
4. Development of dried seafood products in current market.
5. Boost in production and Marketing of dried fish products.

More research is required for dried fish

1. Preparation of good quality of dried seafoods.
2. Perfect packaging for dried fish products.
3. Development of ready to eat dried seafood products.
4. Good hygienic practice for drying of seafoods.
5. Good storage practice for dried fish products.

College of Fisheries Science is the only premier institute in the state for fisheries education (Solanki et al., 2017). College of fisheries Science (Veraval) works with education, research and extension of fisheries. Many extension activities related to dried fish products of fisheries college is in Table-1.

Table 1. College of Fisheries Science, Veraval celebration with dried fish products.

SR. NO.	YEAR	ACTIVITIES	PLACE	DATE & MONTH
1	2012	Sea Food Event -2012 (Exhibition of Different dried fish Products)	Veraval	02nd November
2	2013	Sea Food Event -2013 (Exhibition of Different dried fish Products)	Veraval	09th December
3	2014	Sea Food Event -2014 (Exhibition of Different dried fish Products)	Veraval	19th December
4	2015	Sea Food Event -2015 (Exhibition of Different dried fish Products)	Veraval	2nd December
5	2016	Sea Food Event -2016 (Exhibition of Different dried fish Products)	Veraval	16th December
6	2016	Fisherman awareness programme for dried fish quality and value addition organized by Reliance Foundation- Gir Somnath	Bhidiya	18th December
7	2017	Sea Food Event -2017 (Exhibition of Different dried fish Products)	Veraval	15th December
8	2017	Exhibitions of Dried fish products, Packaging and Marketing	Bhidiya	18th December
9	2018	Sea Food Event -2018 (Exhibition of Different dried fish Products)	Veraval	17th December
10	2019	Sea Food Event -2019 (Exhibition of Different dried fish Products)	Veraval	13th December
11	2019	Exhibitions of Dried fish products, packaging and marketing	Bhidiya	15th December
12	2021	Sea Food Event -2021 (Exhibition of Different dried fish Products)	Veraval	21th December
13	2022	Workshop on "Women's role in dried fish processing in Gujarat" organized by Gujarat Institute of Development Research, Ahmedabad	Veraval	8th August
14	2022	Sea Food Event - 2022 (Exhibition of Different dried fish Products)	Veraval	20th December

Dried fish is highly rich in protein, which is very important for human consumption (Madathil et al., 2017a). Modified drying technology of dried fish products is better than traditional method in terms of quality due to maintain quality of dried fish products (Solanki, 2020). It was observed that the active packaging using oxygen scavenger in the packaging of dried fish, may assure an effective packaging for dried fish, quality for long term storage. Quality losses due to fatty oxidation in fatty fish are important for a traditional salted dried fish product. (Solanki et al., 2019). Convert fishes to a value addition and to make more nutritionally rich product for consumers and to provide a new scope of money generation to the women self-help group (Madathil et al., 2017b).

Suggestion

No such a record of celebration of dried fish day in particular day or month. So, Celebration of dried fish day improve quality of dried seafood and more research in packaging for different dried fish products. December month or winter season is best for celebration of dried fish day. Because of winter season is the best for preparation of good quality dried fish. Good dried fishes demand during monsoon season, when all fishing activities were closed. Already College of Fisheries Science (Veraval) were celebrated dried fish product related activities during December month.

Conclusion

Celebration of dried fish day boost dried fish products awareness among common people, who away from dried fish due to strong smell of product and also more concentration on dried fish packaging, ready to eat product & preservation technique. Celebration can increase dried fish product consumption, where dried fish product activities is very less and utilization of fisheries waste.

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Highlighted points:

- Dried fish as an important part of diet.
- Focusing to propose celebration of dried fish day improve quality of dried seafood.

Ten most beautiful fish in the world

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1. Clown Fish

The clownfish is also known as anemone fish which is popular for its vibrant color in the shades of white and orange. This fish gained popularity in 2003 through the movie 'Finding Nemo'. The main character of the movie was a clown fish named Nemo. They can grow up to nine centimetres in length. The females are comparatively larger than the males therefore they can reach a length of nine centimetres. Clownfish males comprise both male and female reproductive organs therefore the breeding males come under the category of second largest after female clown fish.

2. Sea Horse

Many people aren't familiar with the fact that they are also a type of fish. They are miniature and magnificent creations of nature. They are usually pink, yellow, grey, and orange. They grow in length ranging from two to thirty-five centimetres. The male and female are set apart by the belly pouch of the males. This pouch is where the male fertilizes the eggs. In sea horses the male gives birth. They are mainly found in tropical areas comprising shallow and salty waters. They use sheltered areas to form their habitat. Species of sea horses are found in Pacific waters from north to South America.

3. Bluefin Notho

This fish is also known by the name of Nothobranchius Rachovii originated from Mozambique. This fish has a unique and breathtaking physical appearance. They have a red base along with vibrant flashes of electric blue and turquoise. Can't be missed on a cutest fish list. These fish can grow up to 6cm in length. Males of such kind are larger and more attractive than females. They live up to a year, therefore, their breeding is very important. They attain maturity for breeding in a few weeks after being born. Bluefin Notho is mainly found on the lowlands bordering the river. During the hot seasons, the water levels of such areas decrease. These lands are mainly used by locals to cultivate rice. That time of the year is the kill fish season for this species and a few other kinds of fish in the lowlands of water.

4. Mandarinfish

These fish belongs to the Dragonet family and are one of the most exquisite creations of nature. Their vibrant color patterns set them apart from other sea creatures. It has an electric blue body with bright orange and green print on top. This blend of colors is mesmerisingly eye-catching. Mandarinfish can grow up to eight centimeters in length. The males are larger than the females consisting of a vibrant pattern of green and orange color combination. The life span of these fish is up to fifteen years. They are usually found in the region of the western Pacific Ocean. They are mainly found in the depths of the ocean as they swim at the bottom of the ocean.

6. Regal Angelfish

The name 'regal' speaks for itself as it's a beautiful fish that has vibrant patterns in shades of blue, yellow, orange, and white. A real great part of the cutest fish! These color patterns are what sets an angelfish aside from all the other fish in terms of magnificence. They can reach the length of twenty to thirty centimeters. They are usually found in groups having one male accompanying one or multiple females. If kept in wild waters it can have a life span of ten years. The color of these fish varies from their geographical regions. For instance, the regale angelfish which belongs to the Red Sea and Maldives region has a yellow-colored pattern on its chest while the angelfish belonging to the Indo-Pacific region has a bluish-grey chest.

5. Blue Tang

This fish has a bright blue base with yellow and black patterns. The character 'Dory' in the movie "Finding Nemo" gained popularity in 2003. The fish was a blue tang. They can grow in the length of twenty-five to thirty-one centimeters. The Male blue tangs are considered mature when they reach the length of thirteen centimeters while the females attain maturity after reaching the length of eleven centimeters. If they are kept in wild water then their life expectancy is up to thirty years. They are mainly found in the region of the western Atlantic ocean and its nearby countries. It is found in popularity in Florida, the Bahamas, and the Caribbean Sea. These are mainly found in banks consisting of clear water.

7. Betta

Betta fish are also known as Siamese fight fish which means fighting for life. These fish are sensitive and very beautiful with vibrant colors making them undoubtedly the cutest and most striking fish. These fish comes in red, blue, orange, white, and turquoise color shades. These fish cannot grow longer than three inches in size. The male Betta fish is larger than the female Betta fish. Females can grow from two to two and a half inches while males can grow in size ranging from two and a half to three inches. They are found in still ponds and slow-moving streams. Their life expectancy is from two to five years.

9. Fancy Guppy

Fancy guppy is also recognized by the name of rainbow fish. It comes in beautiful color patterns which are an absolute eye-catcher. Guppy fish comprises three hundred species. Females are larger than males and can grow up to three to six centimeters while males can grow up to three centimeters. Their growth highly depends on the area, if they are placed in a confined space they will grow less as compared to being placed in freshwater such as a river. It is a popular freshwater aquarium fish. They originate from South Africa. They are highly flexible species that can survive in different environmental conditions. Their lifespan ranges from one to three years.

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8. Rainbow Kribensis

These are attractive species of fish having blue, yellow, green, and red color combinations. Females who are in their breeding season portray a very attractive and bright cherry-red color on their bodies. These fish can grow in length ranging from seven to ten centimeters. Females are smaller than males and have big round stomachs. The belly is bright colored in shades of red and purple, especially in the breeding season. They are mainly found in the mouth of the Ethiope River near the Niger Delta. There are a variety of water conditions in that region, where the water is slightly alkaline. They prefer living in dense vegetation areas with a life expectancy of five years.

10. Butterfly Fish

The butterfly fish is a bright-colored fish that is mainly found in black, white, yellow, red, orange, and blue colors. They have a remarkable pattern on their bodies. This fish can live up to seven years if in the wild. Butterfly fish have a hundred and twenty-nine species. These fish can grow up to twelve to twenty-two centimeters in length. Few other species can look like lined butterflies, also it can grow in length of up to thirty centimeters. The butterfly fish belongs to a group of freshwater fish family Chaetodontidae. They are mainly found in the oceans of the Indian, Atlantic, and Pacific regions. It's a freshwater fish.

Prospects and Culture Technology of Lobster Farming in India

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Introduction

Due to the majority of stocks being fully harvested and close to their long-term equilibrium yield, the prospect for raising the yield from the wild is minimal. Stock improvement or aquaculture is the most appropriate way to meet the rising demand for expensive marine food like lobsters because capture fisheries recorded their pinnacle in terms of productivity. For aquaculture, there is an urgent need to find a solution to the conflict between encouraging expansion and calling for the creation of environmentally friendly technology and farming methods. Market demand and prices for lobsters are high, and live lobsters are especially popular. Consumers in wealthy nations are willing to pay more for fresh fish. Exports of lobsters include live, frozen, chilled, baked, and as whole meat. Lobsters of variable categories on the basis of size are caught and wholesaled because to the rising demand, and the resource is under heavy fishing burden. It is possible to add value to the lobsters via short-term fattening until hatchery technology is marketed. Both technically and financially possible options seem to be holding low-value lobsters with the intention of adding value and gathering wild pueruli for commercial grow-out.

Distribution

The three deep water lobsters, Puerulus sewelli, Panulirus polyphagus, and P. homarus, as well as the other nine lobster species that may be found near the Indian coast, are the most significant commercial species. Along the northwest coast, which includes the coasts of Gujarat and Maharashtra, the mud spiny lobster, P. polyphagus, is a significant fishery. The southwest and southeast coasts of India are where the scalloped spiny lobster P. homarus is most commonly found (Tamilnadu coast). P. ornatus, the ornate spiny lobster, is primarily caught in the Gulf of Mannar of India. A tiny component of the lobster production is also made up of the species P. versicolor, P. penicillatus, and P. longipes.

Hatchery Production of Lobster

The captive breeding of P. homarus, P. polyphagus, P. ornatus, P. longipes, and P. versicolor has been accomplished in India. The broodstock holding systems lobsters mate and spawn when the appropriate environmental conditions exist. Young P. homarus and P. ornatus are reared in captivity until they mature and India has also had success with its successful reproduction. The lobsters used for egg hatching and raising are obtained from fishermen. A mixed diet of Artemia and plankton is used to grow P. Homarus, phyllosoma larvae to stage 8 in 42 days. The larvae of lobster are carnivores. Though, the survival rate varies from 0.01 to 10% and is mostly impacted by the contamination of the culture atmosphere by microorganisms, like protozoans. Due to their lengthy larval phase (>300 days) and low survival rates, most lobsters are still not suitable for commercial seed production. As a result, wild pueruli seeds that are readily available in nature are predominantly used in lobster farming.

Seed availability

Puerulus, the last stage of the phyllosoma larva, swims towards the shore to find suitable benthic habitats close to the shore. Trammel gill nets are used to catch about 50% of lobster. Between October and March, between 2 and 3 million pueruli are collected annually, of which P. ornatus accounts for 70% and P. homarus for 25%.

Juvenile collection and transportation

Prior to sale or arrival of traders, they are maintained in wet sand. Until they are kept for sale, they are housed in cages with increased stocking densities or holding tanks with recirculating facilities. A larger lobster cost more. When the lobster is raised in poor water quality conditions and at a high stocking density, it is weak and prone to disease. Therefore, these are not appropriate for growing purposes. It may also progressively die after being stored when being carried over extended distances. To prevent the harm below the abdomen, extreme caution should be used when removing the net. There are chances of increased mortality owing to infection by various pathogenic microorganisms when these are held in poor conditions and become infected by lethal diseases through these wounds.

Grow-out in Land-Based Holding System

In land-based holding systems with the appropriate environmental conditions, lobster rearing is successfully accomplished. The amount of dissolved oxygen, ammonia, nitrite, and carbon dioxide concentrations are crucial water quality factors. Additionally, necessary are the system's nitrate, pH, salinity, and alkalinity concentrations.

Indoor Culture of Lobster

Recirculating and flow through systems are both utilised to grow out lobsters. After the waste items are removed, the major part of the water is reused in the recirculating aquaculture system. The water that returns to the fattening system is aerated, ammonia and nitrite, carbon dioxide, and all solid waste are removed by the recirculating system. Mechanical filtration is used to remove solid matter, filtration through biological means is used to remove nitrite and ammonia, and an air-water interface is used to remove carbon dioxide. The water is pumped into a different tank using flow through systems. The stocking density of lobster and feeding rate/intensity determine the rate of water flow. Incoming water should be free of sediments and any other unwanted materials

Table: Water Quality Standards for Cultivating Lobster.

PARAMETERS	RANGE
Temperature (°C)	25 to 30
Dissolved Oxygen	(% saturation) Min.70 %, mostly 80 %
Salinity (ppt)	30 to 38
Ammonical-nitrogen (mg/l)	less than 2
Nitrite-nitrogen (mg/l)	less than 2
Nitrate-nitrogen (mg/l)	less than 100
pH	7.8 to 8.4
Hardness (ppm)	100 to 200

Feeding Procedures and Stocking Density

After being divided into various size groups, good, active healthy lobsters can be stocked at a stocking density of 1.0–1.25 kg/m2; the gap between higher and lower weight shouldn't exceed 20g. To prevent energy loss, hideaways are available for the lobster to be assembled throughout the day. For feeding both natural (mussels, clams, squid, uneconomical fish, small crab and meat of shrimp) and artificial feed can be used to feed lobsters (shrimp pellets). It is advised to feed lobster at night in order to cut down on feed loss and spoilage.

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Highlighted points:

- Types of lobster culture practices.
- Commercial aspects by maintaining optimum culture parameters.

Matsya Jagat. Bio-fouling in aquatic environment. Vol 1 Issue 1, Jan-Mar 2023, pp 34-35

Bio-Fouling in Aquatic Environment

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Introduction

Bio-fouling in marine aquaculture is a specific problem where both the target culture species and/or infrastructure are exposed to a diverse array of fouling organisms, with significant production impacts. The term "fouling" describes the buildup and deposition of live organisms (bio-fouling) as well as some non-living substances on hard surfaces, most frequently in an aquatic environment.

Marine fouling is the settlement and expansion of flora and fauna on man-made sea structures. Biofouling or biological fouling primarily affects two surface types: soft surfaces like sand and mud and hard surfaces like rocks and wood. This can include, among other things, the accumulation of plaque on teeth or deposits on solar panels on Mars. Other examples include the fouling of heat-transferring components by substances found in cooling water or gases, the fouling of ships, fishing gear, and natural surfaces in the marine environment (marine fouling).

Biofouling is currently a significant biosecurity risk for the aquaculture sector, with direct effects on culture species (such as suffocation, competition for food and space), deterioration of farm infrastructure (submerged structures like cages, netting, and pantoons), and effects on the natural ecosystem functioning of nearby areas. Marine aquaculture has been greatly concerned about biofouling on net pens. Marine organisms like mussels, kelp, and hydroids can quickly gather on wetted structures, adding weight and drag to the system, reducing water flow that is necessary for fish health, and raising cleaning expenses.

Types of Bio-Fouling

There are two main categories of fouling organisms:

Micro-fouling organisms:

These are primarily bacterial and microbial in origin and quickly colonise any submerged object to form a bio-film, or slime. Large macro-fouling organisms can attach and feed on the bio-film, a sticky coating that builds up on the surface and serves as a handy interface. Typical slimes consist of: Bacteria, protozoa, and diatoms

Macro-fouling organisms:

These bigger creatures and plants stick together either as lone wolves or in sizable colonies. Comparatively speaking to the microfouling kind, these larger species present more frequent and serious issues. In addition to the immersed materials, these species can find their way into cooling systems when water is drawn directly from natural sources such as lakes, rivers or coastal waters. Common organisms include:

Animal fouling organisms

Oysters, Clams, Tube worms, Mussels, Barnacles, Hydroids, Bryozoans

Plant fouling organisms

Ectocarpus (brown algae), Enteromorpha (green algae), Rhodophycea (red algae)

Fig. 1. Biofouling *(Source: International Maritime Organization) West Bengal*

Action Mechanism

A main film of bacteria, diatoms, algal spores, and debris is present on the surface. Primary film generation is crucial because it affects future macro fouling. Bacteria multiply quickly once attached to surfaces and are a crucial component of the main film (also called slim film). Once the bacteria were put down, they stayed put. The cells grew to an average size of 1-2 microns and divided in as little as one hour. As a result, the population doubles every four hours.

(a) (b)

Fig. 2. *(a) Mytilus edulis (b) Ectopleura larynx*

Adverse Effects of Bio-Fouling:

1. Increased weight and drag

Biofouling adds significant weight and drag to shellfish culture infrastructure, rapidly becoming a management issue. The need for additional flotation and repairs to equipment leads to subsequent increases in operational costs.

2. Restriction of water exchange

due to the growth of fouling organisms causing net occlusion.

3. Disease risk in cultured species

Fouling communities act as reservoirs for pathogenic microorganisms on cage netting or lowered dissolved oxygen levels from poor water exchange increasing the stress levels of fish, lowering immunity and increasing vulnerability to disease;

4. Cage deformation

Structural fatigue of cages occurs due to the extra weight imposed by fouling. increased mesh occlusion increases drag forces on netting; current-induced forces on a fouled net may be 12.5 times that of a clean net (Milne 1970).

As a result, the maintenance and loss of equipment directly contributes to production costs for the industry.

Control Measures

Bio fouling controls on exterior measures, three phases of fouling control.

1. Physical removal (air exposure, power washing, manual: non-mechanized, heat treatment, spray and immersion methods)
2. Biological control (use of crabs, sea urchins and periwinkles).
3. Protection of wooden ships using metallic sheathing.
4. Replacements of wooden hulls by non copper applications produced galvanic problems.
5. Coatings (anti Fouling paints, biodegradable, wax-based, impervious, non-toxic coating)

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Highlighted points:

- Introduction to bio fouling and its types.
- Action mechanism and risk associated with bio fouling.
- Control measures.

Mycotoxins in fish feed and their mitigation

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Introduction

The quality of feed depends on various factors and mycotoxin is one to assure the quality. Fish poisoning from mycotoxin has a higher risk as plant-based ingredients have been used more frequently in aquaculture. By inflicting tissue damage or suppressing the immune system, feeding fish feed contaminated with mycotoxin can cause a health breakdown. Both effects have the potential to increase mortality. For mycotoxins in foods and feedstuffs, several nations had established precise limits. The acceptable level of mycotoxins is adhered to by many nations without question. Since the synthesis of mycotoxins is favoured by ideal substrates for the growth of fungi, the quality of the products used in feeds has turned into a limiting factor for activity.

Objectives

The main goal of fish nutrition is to provide finished feed that is a nutritionally balanced combination of ingredients to support:-

- The maintenance

The aqua feed industry can benefit from a clear understanding of such cutting-edge detoxification techniques and growth trends. It will help guarantee proper management and processing procedures both before and after the harvest. This article summarizes the detoxification techniques and industrial applications reported recently.

Physical methods

- Flesh quality
- The health of the animals at an acceptable cost
- Growth, reproductive performance

Mycotoxins

Mycotoxins are secondary metabolites produced by specific fungi. Important mycotoxins in aquaculture are:

- Aflatoxin B1 (AFB1),
- Ochratoxin A (OTA),
- Fumonisin B1 (FUB1),
- Zearalenone (ZEA),
- Deoxynivalenol (DON),
- Citrinin (CIT) Nivalenol (NIV),
- Patulin (PAT) etc.

The increased frequency of mycotoxin contaminations has led to financial losses and health concerns, which has sparked interest in finding new inactivation and detoxification techniques

- Quick drying
- Floating
- UV treatments
- Adsorption.

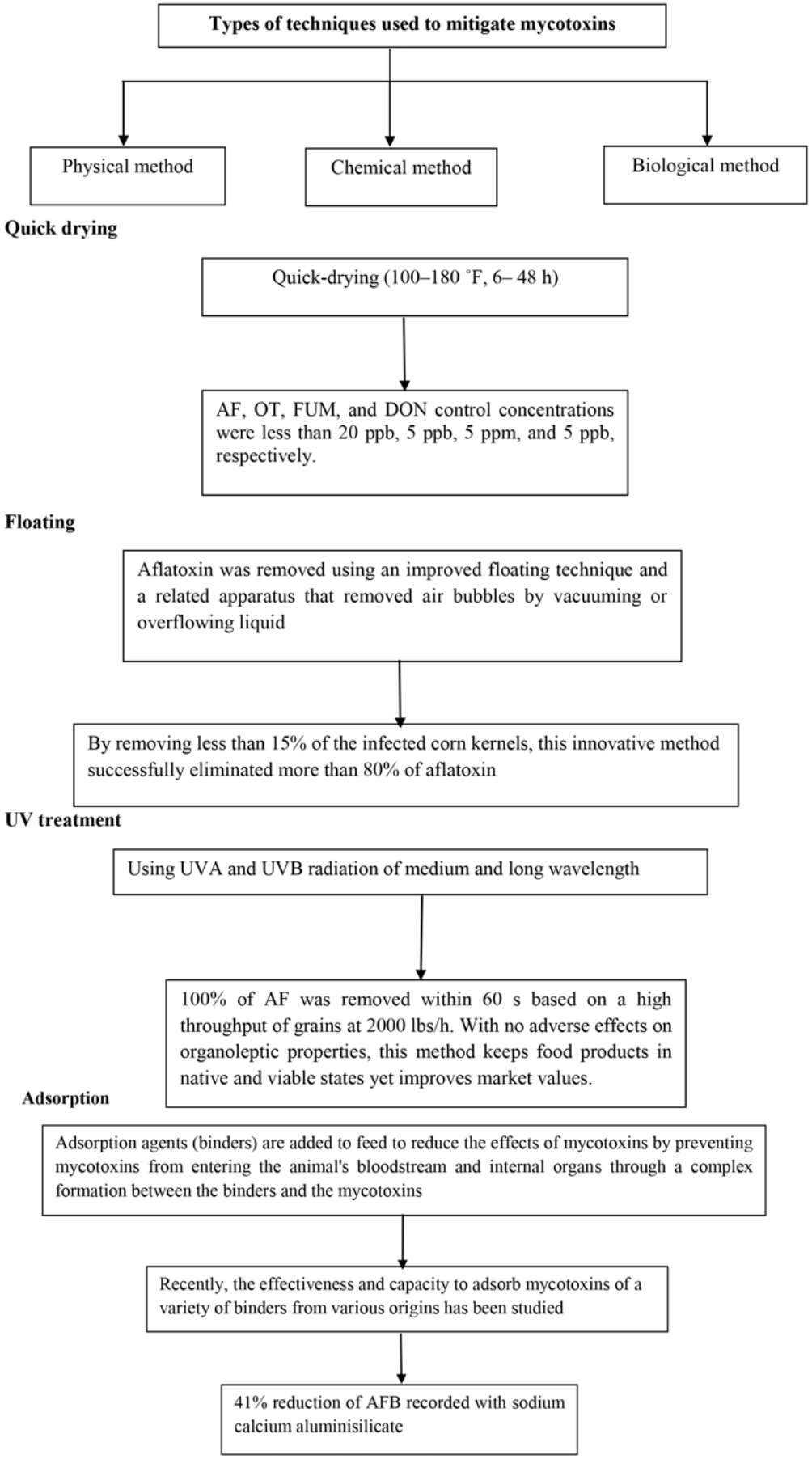
To alleviate mycotoxins during Post-harvest Processing,

Chemical methods

Involve bases, acids, oxidizing agents, aldehydes and bisulfite gases. The FDA, for example, classifies glycerol as a miscellaneous and general-purpose food additive. It is considered non-toxic to the gastrointestinal tract and serves as a valuable energy source in monogastric animal diets.

Common concern

- The chemical transformation has the potential to significantly reduce the nutritional value of feed ingredients and feeds, which is a common concern that has not been thoroughly investigated.
- In the products that have been treated, the transformation might also result in new toxic derivatives. Their use in the human and animal food chains is constrained by these side effects.


Types of techniques used to mitigate mycotoxins
Physical method
Chemical method
Biological method
Quick drying
Quick-drying (100–180 ˚F, 6– 48 h)
AF, OT, FUM, and DON control concentrations were less than 20 ppb, 5 ppb, 5 ppm, and 5 ppb, respectively.
Floating
Aflatoxin was removed using an improved floating technique and a related apparatus that removed air bubbles by vacuuming or overflowing liquid
By removing less than 15% of the infected corn kernels, this innovative method successfully eliminated more than 80% of aflatoxin
UV treatment
Using UVA and UVB radiation of medium and long wavelength
100% of AF was removed within 60 s based on a high throughput of grains at 2000 lbs/h. With no adverse effects on organoleptic properties, this method keeps food products in native and viable states yet improves market values.
Adsorption
Adsorption agents (binders) are added to feed to reduce the effects of mycotoxins by preventing mycotoxins from entering the animal's bloodstream and internal organs through a complex formation between the binders and the mycotoxins
Recently, the effectiveness and capacity to adsorb mycotoxins of a variety of binders from various origins has been studied
41% reduction of AFB recorded with sodium calcium aluminisilicate

Biological methods

Widely acknowledged as being precise, effective and environmentally friendly

- Retains nutritive and sensory qualities like colour and flavour without using hazardous chemicals.
- Bioactive material with or without DNA recombinant tech microorganisms that show bio-transformation capabilities against specific mycotoxins can be used to mitigate the mycotoxins.
- Unidentified Bacillus strain (IDAC 180507-1) - from Leghorn Hens. Stably showed 100% bio-transformation of deoxynivalenol (DON-100 ppm) for 10 generations in an anaerobic atmosphere. Significantly alleviated the adverse response toward DON in feeding trials.
- **Ochratoxin A** Brevibacterium casei, B. linens, B. iodinum. The identified strain showed 100% detoxification of OTA (40 ppb) after 10 days of incubation.
- **Zearalenone** Bacillus licheniformis CK1 (DSM 025954)- from soil showed 100% detoxification of ZEA (2 ppm) after 48 h incubation in LB broth and 98.1% detoxification of ZEA (1.79 ppm) after 36 h incubation.

Conclusion

Scientists are now focusing more on how isolated natural and environmental yeast and bacteria can solve the majority of issues in the aquaculture feed sector. The cost of producing feeds and feed additives can be reduced by implementing such innovative research initiatives and their findings at the commercial level. This article suggests that plant-origin ingredients must be used after the mitigation of the mycotoxins or refuse to purchase feed ingredients and feeds that are mouldy, even if they are offered at a discount

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Highlighted points:

- Focusing on how isolated natural and environmental yeast and bacteria can solve the majority of issues in the aquaculture feed sector.
- Types of techniques used to mitigate mycotoxins.

Marine Polychaetes and Its Ecological Significance

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Introduction

Polychaeta or polychaetes are dominant macro-fauna in the marine environment of the intertidal zone. Polychaetes belong to Kingdom Animalia, Phylum Annelida, and Class Polychaeta. Polychaete's body is segmented have a pair of fleshy protrusions called Parapodia (bear many bristles) that are made of chitin. The setae differ from species to species as well as different in size and shape of function in parapodia. The significant role of parapodia is identification. Polychaete worms also known as Bristle worms are classified based on phylogenetic relationships and are recognized to 17 orders and 7 suborders to include 71 families. The majority of these worms are benthic and some few are pelagic. The benthic polychaetes are most commonly encountered on sandy or muddy bottoms extending from the seashore to the greatest depths of the hadal zone, which have an average length of 1 mm to 3 m (9.8 ft). These are robust and widespread that live in the coldest ocean temperatures to extremely high temperatures. These are also found throughout the Earth's oceans at all depths. More than 10,000 species are described around the world out of which 400 species are recorded from India. Out of 168 species (less than 2% of all polychaetes) are known from fresh waters. The body structure is made up of the tube within a tube and the epidermis secretes the tough cuticle. The circulation system is simple but well-developed and blood flows entirely in closed vessels and some species have hearts. The blood may be colorless or have any of three different respiratory pigments - Haemoglobin, Haemerythrin, or Chlorocruorin. Polychaetes are having relatively well-developed heads, compared with other annelids. It projects forward over the mouth- lies on the animal's underside. Those are having two to four pairs of eyes while some species are blind. Eyes are fairly simple structures, capable of distinguishing only light and dark while some species have large eyes with lenses that may be capable of more sophisticated vision (Eg: Alciopid polychaetes). Important characteristics in the head are tentacle-like palps, and a pair of pits lined with cilia, known as nuchal organs- chemoreceptors.

Biology of Polychaetes

Feeding and behavior

Polychaetes have paddlelike bristles for swimming and leglike for walking across the seafloor or scooplike for burrowing in the mud. While some species the bristles contain venom. Polychaetes are diversity champions that vary widely from the generalized pattern and show a range of different body forms which are crawling polychaetes, Pelagic polychaetes, burrowing polychaetes, tube-dwelling or boring polychaetes. Feeding of Polychaetes have carnivores, herbivores, scavengers, deposit feeders, parasites, and filter feeders. With very few defenses, many remain in a burrow or secreted tube. Carnivores can capture prey with strong jaws and quickly drag it back to its burro. Can use a muscular pharynx which is an eversible proboscis.

Reproduction

Reproduction is separate sexes and pairs of gonads in every segment most species exhibit some degree of specialization. The gonads shed immature gametes directly into the body cavity with mature gametes shed into the surrounding water. A few species copulate, but most fertilize their eggs externally. Some polychaetes exhibit remarkable reproductive strategies known as Epitoky. Asexual reproduction by budding (sabellid and serpulid fanworms), fission or fragmentation is quite common. Bristleworms (Eurythoe), common inhabitants of saltwater tanks, reproduce readily by fragmentation. In many asexually reproducing worms, new anterior (palps, eyes) and posterior (growth zone) structures are well-formed before the individuals separate.

Significance of Polychaetes

Polychaetes are a paraphyletic group of organisms, which are a very important indicator in polluted conditions while in unpolluted conditions conservation of polychaetes species bloom well and species diversity of greatest (Fig. 1). The significant role of the world's most heat-resistant animals is a deep sea polychaete which is the Pompeii worm (Alvinella pompejana) which are tubeworm that lives at hydrothermal vents deep on the ocean floor, where its tails rest in hot water at temperatures of over 140 degrees Fahrenheit and also the symbiotic relationship with bacteria. Those species can survive without oxygen for 96 hours. In 1997, a research team came across an enormous methane hydrate deposit extruding from the seafloor of the Gulf of Mexico these are Hesiocaeca methanicola survives by feeding on free-living bacteria on the gas hydrate's surface. The biggest polychaete is the Bobbit worm (Eunice aphroditois) which are reaching a length of ten feet with a predator-feeding habitat.

1. As a food resource

Most polychaetes are small and short-lived with high secondary production. They are an important link in marine food webs. Due to the high calorific value and rich protein content, both stages of the adult and larvae of the family Nereidae has been reported to be the main food for many economically important fishes. They are a delicacy in Coastal areas of Fujian, Guangdong, Guangxi, and Southeast Asia. In China, is exported to Japan as bait for recreational fishing. They can be harvested artificially or directly. A large amount of Nereidae is used as bait for recreational fishing.

2. The dominant benthic fauna in the marine environment

Polychaetes are the most abundant and diverse group in all marine sediments from intertidal to deep-sea. Around 10 000 species have been described worldwide. They show great variations in morphology, feeding, and reproductive modes that make them adapt to different marine conditions, especially in sand and mud. They are vital to the structure, production, dynamics, and health of the marine benthos and environment. They aid the deposition, breakdown, incorporation and turnover of the organic matter in the seabed that helps to recycle nutrients to the overlying water column.

3. As an indicator of toxic materials and pollution

Polychaetes are very useful organisms that can be used as an indicator for monitoring the marine environment. They are sensitive to changes in environmental conditions. For instance, the dominance of tolerant species, such as Capitella capitata in Victoria Habour and Minuspio cirrifera in Tolo Habour, Tolo Channel and Mirs Bay, are indicators of organic pollution while Nereidaeand Dorvilleidae is known to indicate heavy metal pollution. Other species such as Diopatra chiliensis, Marphysa sanguinea and Perinereis aibuhitensis can be used as indicators of seawater temperature.

4. Production of pesticide

Nereistoxin extracted from Lumbrineris heteropodais is used to produce a pesticide. It is useful to kill pests but safe for humans and domestic animals because it can be decomposed and excreted.

5. As harmful organisms

Some polychaetes are fouling organisms that damage ships' hulls, piers, water pipes, and any artificial surfaces submerged in seawater, causing increased maintenance costs and the risk of mechanical failure. These polychaetes include Syllidae, Serpulidae, Spirorbidae, Sabellidae, Tellbellidae, and Nereididae. The Nereididae, Tylorrhychus heterochaetus and Perinereis nuntia, are pests that damage crops. They can live in low salinity and fresh water. They feed on crops in the fields near the coast of South China. In China, the yield of economically important seashells is reduced by Serpulidae which usually attaches to rocks, coral, ships' hulls, piers, and seashells.

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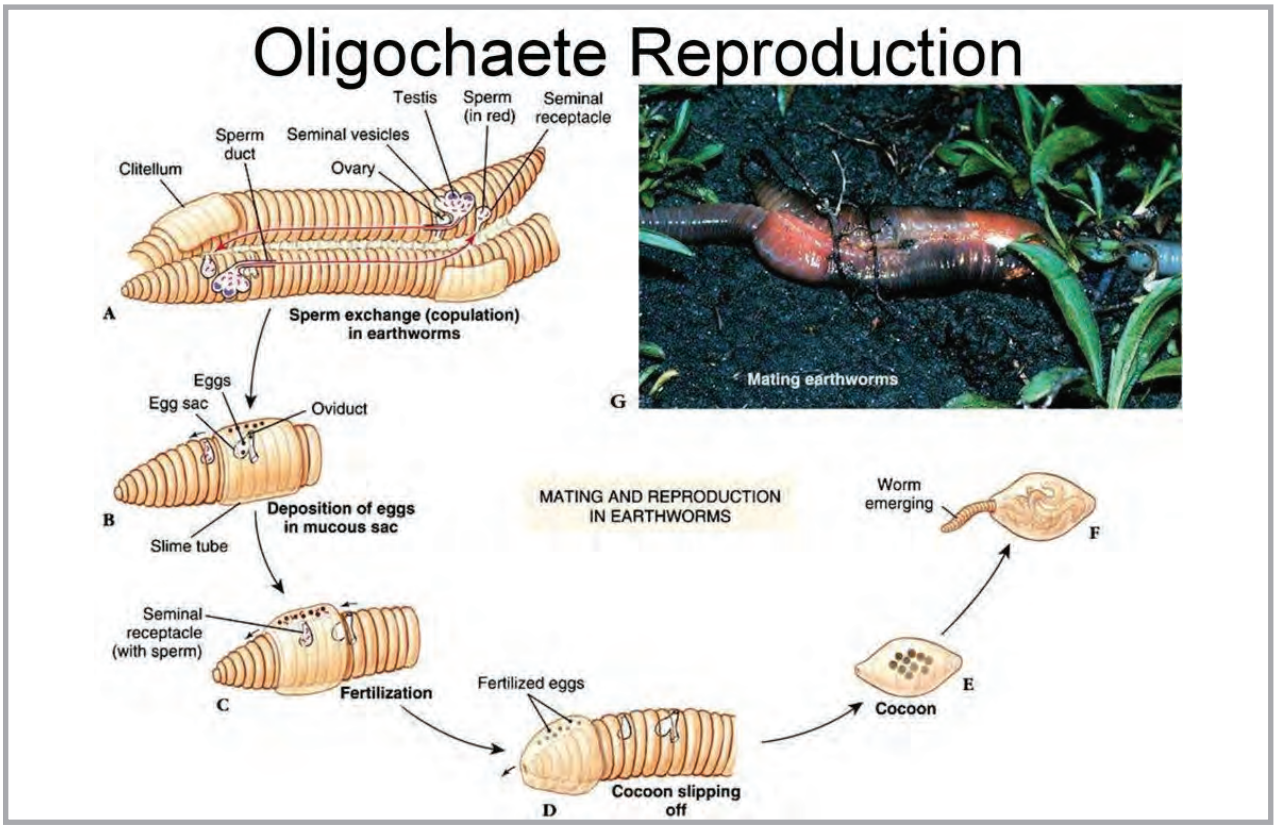

Fig. 1. *Life cycle of Polychaetes*

Highlighted points:

- Types of marine polychaetes, their types and behaviour.
- Significance of polychaetes.

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Climate smart fisheries and aquaculture

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Introduction

Fisheries and aquaculture provides us the nutrition, support livelihoods and also contribute to country's GDP. However the sector has significant challenges like increasing global demand for fish, ocean acidification and climate variability etc.The obvious changes in the current climatic conditions and the unpredictable effects associated with them support the commonly held belief that climate change is now an actual hazard rather than just a prospective one. The effects of GHG buildup in the atmosphere and water are related to changes in climatic variables, such as slow changes in water temperature, acidity of water bodies, changes in ocean currents, and rising sea levels. The frequency, severity, and location of extreme weather occurrences are all impacted by these physical modifications to the environment. Given the significance of fisheries and aquaculture to food security, it is crucial to design a strategy for the industry's resilience to the effects of climate change. Additionally, it is crucial to apply climate smart strategy, which is available in climate smart aquaculture, to ensure the industry produces sustainable benefits. So, this article provides you the climate smart approaches and practical themes for developing climate - smart fisheries and aquaculture.

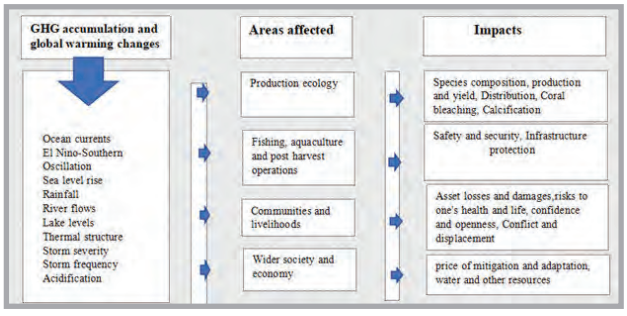
Climate smart Fisheries and aquaculture addresses three key objectives:

1. Achieving sustainable food systems, which include the environmental, social, and economic aspects of artisanal and commercial fishing, as well as aquaculture, is the first goal.
2. The second goal is to lessen the effects of climate change and strengthen the sector's resilience to climate variability, natural disasters, and climate change while maintaining resource availability.
3. The third goal is to make it possible for the industry to contribute to a decrease in greenhouse gas emissions throughout the whole value chain, including during the production and harvesting phases.

Increasing sustainability and productivity in food systems in fisheries and aquaculture through smart approaches :

Reducing overfishing and fishing effort should have improved fisheries management for capture fisheries, preserving healthy and productive stocks and systems. The fuel consumption should be reduced so that fuel costs will be less, and it will improve the economic efficiency and reduces greenhouse gas emissions. The handling practices should be improved that, reduces losses during harvesting and lowering the amount of bycatch and improving its utilisation. Utilizing more thoroughly integrated systems, increasing the productivity of farmed strains, improving the efficiency of feeding, and lowering disease-related losses all boost the sustainability and productivity of aquaculture. The efficiency of aquaculture may be increased by relocating the aquaculture production system. Within aquaculture subsector, aquaponics is a potential option for increasing efficiency. Aquaponics promotes an effective and integrated use of resources, which improves food security and nutrition and makes it a viable route to achieving global food and nutrition security.

Reducing impacts of climate change and increasing resilience :



Potential climate change impact pathways for fisheries and aquaculture

The above figure depicts the climate change effects, there are some ways to reduce the vulnerabilty of climate change. In capture fisheries , we can use weather warning systems, improve vessel stability/ safety , etc. Enhance farm siting and design, individual/cluster insurance, and employ indigenous stocks in aquaculture to reduce adverse effects on biodiversity. For post harvest or value addition, better forcasting information, change or improve processes and technologies should be developed.

Increasing resilience to climate change :

There are many ways to increasing resilience to climate change -

- The population should have to adapt the financial, technical, and instituitional resources which they need during climate change.
- The government should give direct support to households and businesses.
- Manage impacts at the macro level.
- People with stable livelihood are better able to repair the harm and adjust to change.

Reducing emissions of greenhouse gases (GHGs) :

The GHG emissions from aquaculture and fisheries are linked to a number of production and distribution processes. Emissions from capture fisheries are influenced by fuel use as well as the type of vessel and gear utilised. So by reducing fuel consumption we can reduce emission of GHGs. The other possible mitigation option is aquatic biofuel production.Potential links with mitigation initiatives in the energy sector include hydroelectric, coastal, and offshore renewable energy. Some other ways are : Use of low-GHG alternative energy sources is recommended by the sector due to its own contribution to lowering GHG emissions and the possibility for doing so. The largest cause of GHG emissions in aquaculture is thought to be feed, with fertilisers coming in second. For reducing the emission we should use organic fertilizers and reduction of fuel consumption in feed making machines. The post harvesting sector also contribute in GHGs emission. GHG emissions during transit are typically closely tied to the energy and fuel used for handling and freezers.

Conclusion:

Climate change affects the productivity and catching efficiency in aquaculture and fisheries. This article talks about the impacts of climate change and also gives us idea to cope up with these effect. Climate smart does not means that, we are creating a new climate or using machines, rather we improve our resource utilisation and develop new technologies to increase the production and sustainability.Adopting a climate smart strategy is necessary because it combines adoption and alleaviation in a way that will improve the sustainability of fisheries output in the face of climate change. Additionally, there is a lack of knowledge about the climate smart approach. The livelihoods of farmers and the security of their food supply may be enhanced by a greater understanding of climate-smart fishing practices.

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Highlighted points:

- Reducing impacts of climate change and increasing resilience.
- Key objectives of climate smart Fisheries and aquaculture.

Fisheries News

India pushes for new biodiversity fund

(The Hindu, 22 December 2022)

Union Environment Minister addressing the stocktaking plenary at the UN Biodiversity Conference, COP15 in Montreal, Canada on December 18, 2022. Photo: Twitter/@byadavbjp

There is an urgent need to create a new and dedicated fund to help developing countries successfully implement a post-2020 global framework to halt and reverse biodiversity loss, and conservation of biodiversity must also be based on 'Common but Differentiated Responsibilities and Respective Capabilities' (CBDR) as climate change also impacts nature India has said at the U.N. biodiversity conference in Canada's Montreal.

As the 196 parties to the Convention on Biological Diversity (CBD) finalise negotiations for a post-2020 Global Biodiversity Framework (GBF)—a new set of goals and targets to halt and reverse biodiversity loss—there have been repeated calls for the inclusion of the CBDR principle in finance-related targets.

At CBD COP15, developing countries have been demanding a new and dedicated biodiversity fund, saying the existing multilateral sources are not up to the task of meeting the requirements of the GBF. Differences with rich countries on the matter had prompted representatives from developing nations to walk out of crucial financing talks last week. India said the developing countries bear most of the burden of implementing the targets for conservation of biodiversity and, therefore, require adequate funds and technology transfer for this purpose.

Fisheries News

Indian Immunologicals Ltd. ties up with ICAR-CIFE to develop India's first fish vaccine

(The Times of India, 28 November 2022)

Leading vaccine manufacturer Indian Immunologicals Limited (IIL) has joined hands with ICAR-Central Institute of Fisheries Education(ICAR-CIFE), Mumbai, to commercially develop a vaccine against common bacterial diseases in freshwater fish. Indian Immunological Limited had recently forayed into Aqua business by launching products for aquaculture health market in October 2022. With the launch of freshwater fish vaccines in India, IIL plans to curb economic losses due to infections caused by several bacterial, viral, fungal, and other a etiological agents which are currently being managed by anti-infectives and other conventional measures with varying degree of success.

The vaccine makers will explore solutions for Indian fish farmers, while ICAR-CIFE will provide technology for two inactivated bacterial vaccines, one for Columnaris Disease, a serious condition affecting numerous freshwater fish species, and other for Edwardsiellosis that cause high degree of mortality, leading to severe economic losses. Both the diseases are extremely common in freshwater fishes and is generally considered to be ubiquitous.

Director and Vice Chancellor of ICAr-CIFE Dr. CN Ravishankar, said "In support to India's Blue Revolution, I am glad that ICAR- CIFE and IIL have come together to partner in developing India's fist bacterial fish vaccine".

Fisheries News

India is on its way to be global leader in fisheries
(Hindustan times, 13 September 2022)

Across the country the government scheme has got overwhelming responses from all states and UTs, and in the last two years, the department has sanctioned projects worth Rs. 8562.72 crore for sectoral development. (Anshuman Poyrekar/ HT Photo)

Fisheries play a crucial role in development. Considered a sunrise sector, it envisages bringing in great potential in an equitable, responsible, and inclusive manner. The sector employs approximately 28 million fish farmers and fishers and almost twice the number along the value chain.

In December 2014, Prime Minister (PM) Narendra Modi called for a “blue revolution” and took several measures to harness the potential of fisheries. Some key measures include: The creation of a separate ministry of fisheries, animal husbandry and dairying; the formation of the department of fisheries with an independent administrative structure; bringing about policy reforms initiatives; and the creation of a fisheries and aquaculture infrastructure development fund in FY 2018-19 worth ₹7,522.48 crore. So far, proposals worth ₹4,923.94 crore have been recommended to states and Union Territories (UTs), including 20 fishing harbours and 16 fish landing centres and 25 proposals from private beneficiaries worth ₹120.23 crore.

The Government of India (GoI) has also launched its flagship scheme, Pradhan Mantri Matsya Sampada Yojana (PMMSY), with the highest ever investment of ₹20,050 crore in the fisheries sector. PMMSY was launched by the PM, on September 10, 2020, under the Atmanirbhar Bharat (self-reliant) package, aiming to double the incomes of small and artisanal fish farmers. It aims to transform the sector holistically, focusing on production and productivity growth, increased domestic consumption and export earnings, and reduced post-harvest losses. To enhance fish production and reduce post-harvest losses, the uptake of modern aquaculture, capture fishing, and post-harvest management practices are essential. For this, PMMSY lays special focus on skill and capacity-building.

Across the country, the scheme has got overwhelming responses from all states and UTs, and in the last two years, the department has sanctioned projects worth ₹8,562.72 crore for sectoral development. It is inspiring to share that fish production has increased from 141.64 lakh tonnes during 2019-20 to 162.53 lakh tonnes, as of date. On the other hand, India's fisheries exports stood at an all-time high of ₹57,586.48 crore. The Indian export market is dominated by shrimps, particularly L vannamei. To achieve the target of exports worth ₹1 lakh crore under PMMSY, the department has been focusing on diversifying the export basket by increasing the production and quality of tilapia, trout, pangasius and other species. The activities and projects sanctioned to date have generated employment for around 350,000 people directly, and over 970,000 across the value chain. The central assistance of ₹3,000 per beneficiary per year has provided livelihood and nutritional support to a total of 677,462 marginalised fish farmers and their families during the fishing ban/lean period.

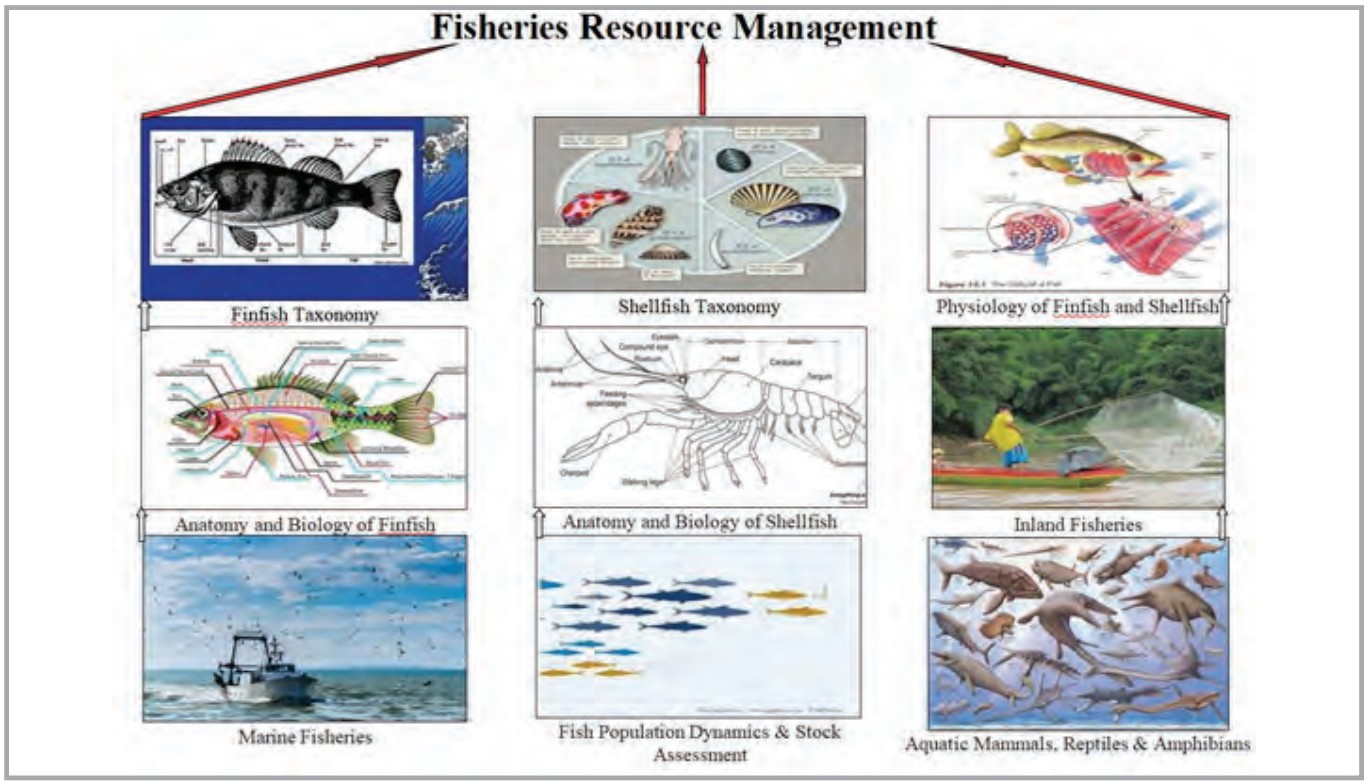
Encouraging private sector participation, PMMSY has earmarked a separate fund of ₹100 crore under the entrepreneur models and urges young entrepreneurs to offer solutions through technology interventions. To facilitate access to institutional credit and meet working capital requirements, the GoI has extended kisan credit card (KCC) facilities to fish farmers from FY 2018-19. KCC national campaigns are being organised with the finance ministry and state departments. The national fisheries development board (NFDB), the nodal agency for PMMSY, has been organising fish festivals, culinary seminars, and exposure visits. The department released a book named Fish & Seafood – a collection of 75 gourmet recipes on August 10. Along with these interventions, the GoI has been making efforts to develop Indian fisheries towards becoming a global leader in the sustainable fisheries and aquaculture sector. Parshottam Rupala is minister of fisheries, animal husbandry and dairying.

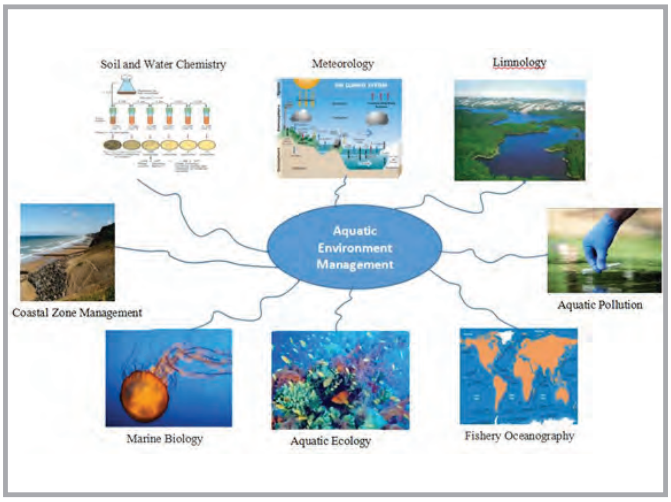
Budget 2023: New sub-scheme under PM Matsya Sampada Yojana with targeted investment of Rs 6,000 crore (CNBCTV18, 1 February 2023)

Finance Minister Ms. Nirmala Sitharaman has launched a new sub-scheme under the PM Matsya Sampada Yojana while presenting her fifth straight Budget. With a targeted investment of Rs 6,000 crore, the FM said this sub-scheme would enable activities for fishermen, fish vendors and SME vendors while also helping them expand markets.

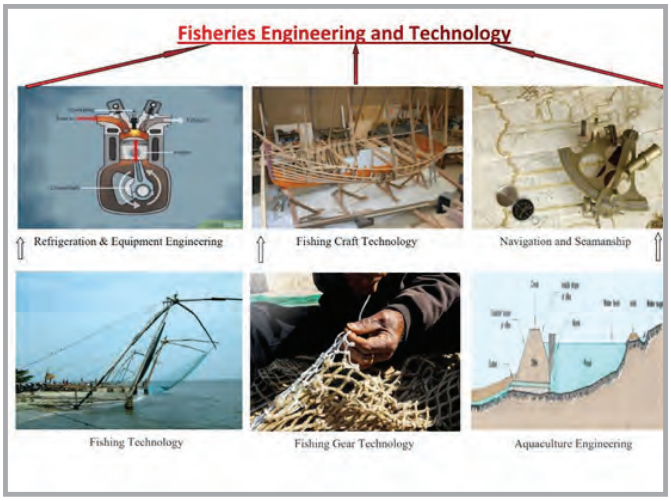
The Pradhan Mantri Matsya Sampada Yojana (PMMSY) scheme was launched in 2020 to boost the seafood industry by enhancing the production and productivity of fish and other aquatic resources. The scheme also looked to improve post-harvest management and marketing.

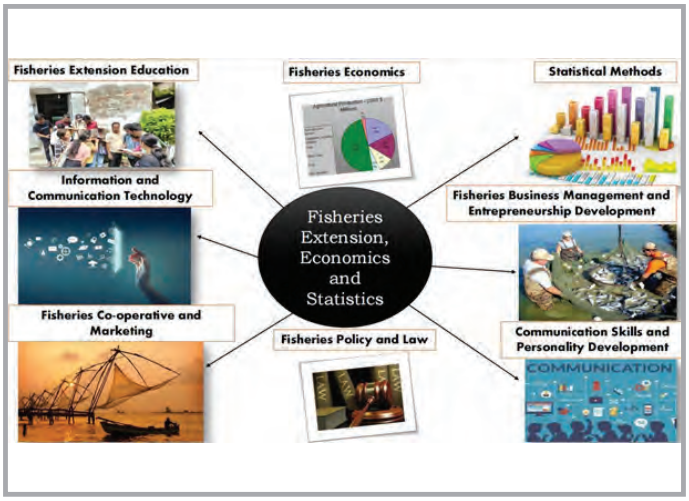
B. F.Sc. Courses

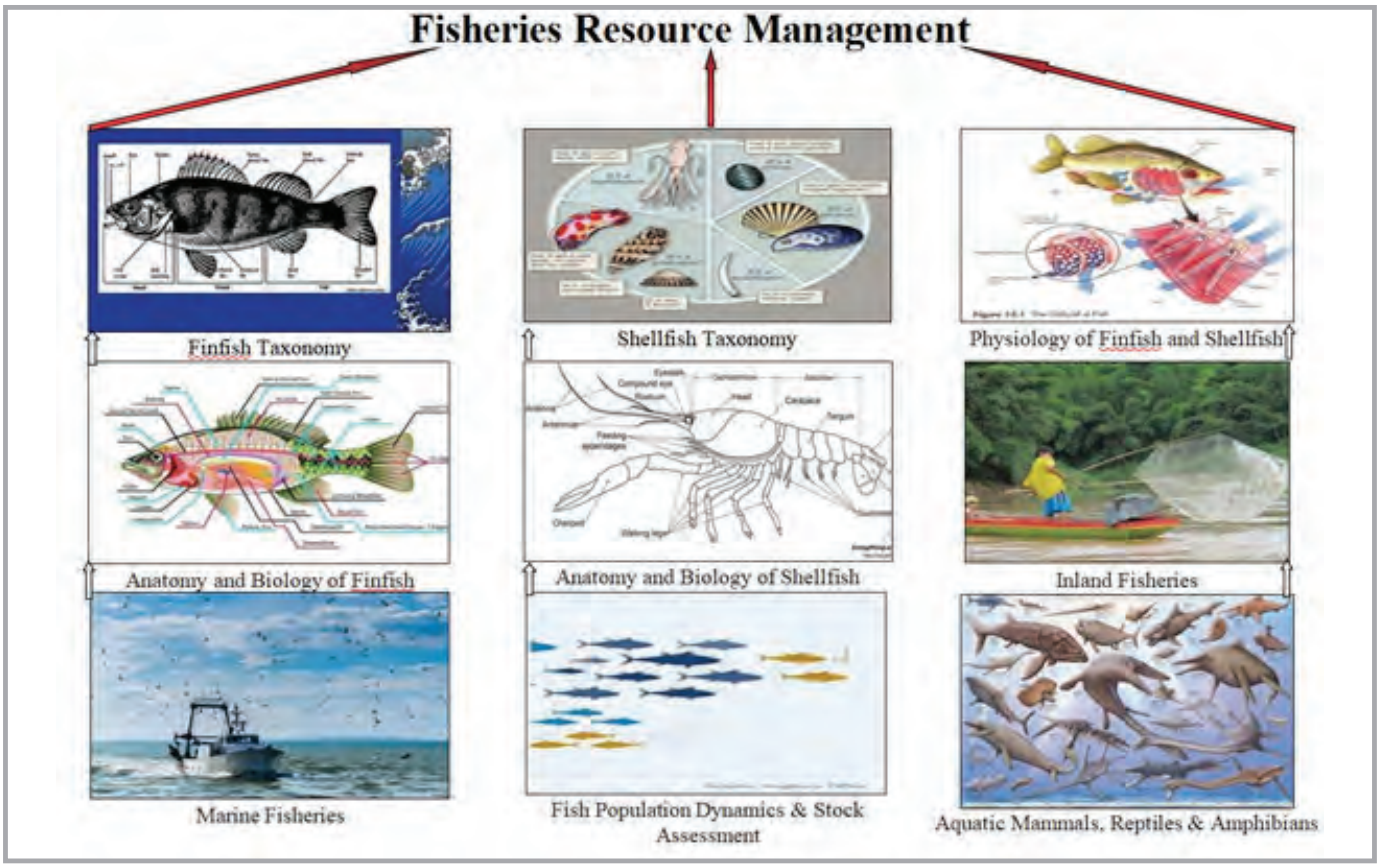



Soil and Water Chemistry
Meteorology
Limnology
Aquatic Environment Management
Coastal Zone Management
Aquatic Pollution
Marine Biology
Aquatic Ecology
Fishery Oceanography


FISH PROCESSING TECHNOLOGY
Fish in Nutrition
Food Chemistry
Freezing Technology
Fish Canning Technology
Fish Packaging Technology
Fish By-products and Waste Utilization
Microbial spoilage of fish and fish products
Fish Products and Value Addition
Microbiology of Fish and Fishery Products
Quality Assurance of Fish and Fishery Products


Fisheries Engineering and Technology
Refrigeration & Equipment Engineering
Fishing Craft Technology
Navigation and Seamanship
Fishing Technology
Fishing Gear Technology
Aquaculture Engineering


Fisheries Extension Education
Fisheries Economics
Statistical Methods
Information and Communication Technology
Fisheries Extension, Economics and Statistics
Fisheries Business Management and Entrepreneurship Development
Fisheries Co-operative and Marketing
Fisheries Policy and Law
Communication Skills and Personality Development
COMMUNICATION


Fisheries Resource Management
Finfish Taxonomy
Shellfish Taxonomy
Physiology of Finfish and Shellfish
Anatomy and Biology of Finfish
Anatomy and Biology of Shellfish
Inland Fisheries
Marine Fisheries
Fish Population Dynamics & Stock Assessment
Aquatic Mammals, Reptiles & Amphibians

Students Corner

Fisheries General Questions

1. When facing an extremely high risk of extinction with suspended reduction at least 80% over at least 10 years or 3 generation with <250 mature individuals
   a) Vulnerable b) Critically Endangered c) Extinct d) Extinct in the wild
2. Abbreviation of IUCN

a) International Union for Conservation of Nature and Natural Resources b) International Union for Convention of Naturec) a & b d) None

3. Indian Wild life (Protection) act came into
   a) 1970 b) 1971 c) 1972 d) 1973
4. IUCN established into
   a) 1945 b) 1946 c) 1947 d) 1948
5. When facing a very high risk of extinction with suspended reduction at least 50% over at least 10 years or 3 generation with <2500 mature individuals
   a) Vulnerable b) Critically Endangered c) Endangered d) Extinct in the wild
6. In the Group of Sirenia included as
   a) Manates b) Dugongs c) a & b d) None of these
7. Scientific name of Killer Whale
   a) *Orcinus orca* b) *Platanista gangetica* c) *Platanista gangetica minor* d) None of these
8. Scientific name of Ganges river dolphin
   a) *Platanista gangetica* b) *Platanistagangetica minor* c) *Orcinus orca* d) None of these
9. Threat of aquatic mammals
   a) Noise b) Entanglement in fishing c) Industrial activities d) All of these
10. Scientific name of Sperm whale
    a) *Orcinus orca* b) *Physeter macrocephalus* c)*Platanista gangetica*d) *Platanista gangetica minor*
11. Scientific name of Baleen whale
    a) *Platanista gangetica*b) *Megaptera nova eangliae* c) *Balaenoptera edeni brydei*
    d) *Balaenoptera musculus*
12. Scientific name of Seacow
    a) *Platanista gangetica* b) *Megaptera nova eangliae* c) *Dugong dugon* d)None of these
13. Leatherback sea turtle in the family
    a) Dermochelyidae b) Cheloniidae c) a &b d) None of these
14. Green sea turtle in the family
    a) Dermochelyidae b) Cheloniidae c) a &b d) None of these
15. Turtles have Scutes characteristics
    a) Dermochelyidae b) Cheloniidae c) a &b d) None of these
16. In turtles have Scutesless characteristics
    a) Dermochelyidae b) Cheloniidae c) a &b d) None of these
17. Turtles are comes under the class

Students Corner

a) Reptilia b) Dermochelyidae c) Cheloniidae d) None of these

18. How many numbers of heart chambers present in Reptiles

a) 1 b) 2 c) 3 d) 4

19. Scientific name of Loggerhead sea turtle

a) *Chelonia mydas* b) *Caretta carettac*) *Lepidochelys kempii* d) *Lepidochelys olivacea*

20. Scientific name of Green sea turtle

a) *Chelonia mydas* b) *Caretta carettac*) *Lepidochelys kempii* d) *Lepidochelys olivacea*

21. Oceanography is branch of science that deals the characteristics of

a) Physical b) Biological c) a & b d) None of these

22. World longest trench in the ocean

a) Marina b) Peru-chile c) a & b d) None of these

23. World deepest trench in the ocean

a) Marina b) Peru-chile c) a & b d) None of these

24. Depth of abyssopelagic hadal zone present upto

a) 200-1000 m b) 1000- 4000 m c) 4000-6000 m d) > 6000 m

25. Depth of bathypelagic zone upto

a) 0-200 m b) 200-1000 m c) 1000-4000 m d) 4000-6000 m

26. Epipelagic zone also known as

a) Photic zone b) Aphotic zone c) a & b d) None of these

27. Exclusive Economic Zone (EEZ) extends upto

a) 24 Nautical miles b) 12 Nautical miles c) 200 Nautical miles d) 11 Nautical miles

28. Exploitation of aquatic organisms without stocking known as

a) Culture fisheries b) Capture fisheries c) a & b d) None

29. According toFAO total major fishing area

a) 19 b) 27 c) 8 d) 26

30. According to FAO major inland fishing area

a) 19 b) 27 c) 8 d) 26

31. What is formula for estimation of fish yield (kg/ha) in reservoir

a) $0.9797\ MEI^{1.3888}$ b) $0.9890\ MEI^{1.3888}$ c) $0.9097\ MEI^{1.3888}$ d) $0.9897\ MEI^{1.3888}$

32. Reservoir water bodies also known as

a) Sleeping giant b) Lake c) Estuary d) Lagoon

33. Classification of small reservoir coving the area

a) < 1000 ha. b) 1000-5000 ha. c) >5000 d) None

34. Reservoir are primarily created for

a) Irrigation b) Power generation c) Drinking water d) All of these

35. In trophic level zooplankton are coming under

a) Primary producer b) Primary consumer c) secondary consumer d) Tertiary consumer

36. What types of pollution in reservoir

Students Corner

a) Thermal pollution b) Domestic pollution c) Industrial pollution d) All of these

37. Stanley reservoir found in

a) Tamil Nadu b) Andhra Pradesh c) Karnataka d) Goa

38. How many chamber of heart present in mammals

a) One chamber b) Two chambers c) Three chambers d) Four chambers

39. How many chamber of heart present in Amphibians and reptiles

a) One chamber b) Two chambers c) Three chambers d) Four chambers

40. In Amphibians and reptiles heart chamber are divided into

a) Two atria and one ventricle b) One atria and two ventricle c) Three atria and zero ventricle d) None of these

41. In India total numbers of medium reservoir

a) 180 b) 300 c) 500 d) 380

42. In India total numbers of large reservoir

a) 56 b) 120 c) 200 d) 300

43. In India total numbers of small reservoir

a) 19134 b) 18000 c) 15000 d) 25000

44. The Average Production of reservoir is about

a) 20 Kg./ha./yr b) 15 Kg./ha./yr c) 10 Kg./ha./yr d) 25 Kg./ha./yr

45. How many major rivers System of the country Comprises at.

a) 10 b) 20 c) 14 d) 16

46. Brahmaputra river originates from in

a) Bexar b) Bhagalpur c) Allahabad d) Tibet

47. The Jhelum is a tributary of Indus River Systems & these tributaries flow in which State are

a) Rajasthan b) Bihar c) Punjab d) Jammu & Kashmir

48. How many species of Freshwater dolphins?

a) 7 b) 10 c) 5 d) 15

49. Scientific name of Olive Ridley Sea turtle

a) *Chelonia mydas* b) *Caretta carettac*) *Lepidochelys kempii* d) *Lepidochelys olivacea*

50. The new born baby is fed by milk secreted by the mother's ----------.

a) Mammary glands b) Milk bottle c) Salivary glands d) None of these

Students Corner

Answer

1	2	3	4	5	6	7	8	9	10
b	**a**	**c**	**d**	**c**	**c**	**a**	**a**	**d**	**b**
11	12	13	14	15	16	17	18	19	20
d	**c**	**a**	**b**	**b**	**a**	**a**	**c**	**b**	**a**
21	22	23	24	25	26	27	28	29	30
c	**b**	**a**	**c**	**c**	**a**	**c**	**b**	**b**	**c**
31	32	33	34	35	36	37	38	39	40
d	**a**	**a**	**d**	**b**	**d**	**a**	**d**	**c**	**a**
41	42	43	44	45	46	47	48	49	50
a	**a**	**a**	**a**	**c**	**d**	**d**	**c**	**d**	**a**

Activities

Stocking of Fish fry in the pond

Chinese hatchery setup in The Neotia University

Guest lecture of external subject expert

Demonstration of Chinese hatchery

Students training program at Resional research Station of ICAR-CIFA, Rahara

Fish Seed acclimatization by students

Fish harvesting by Fisheries students

Students field visit

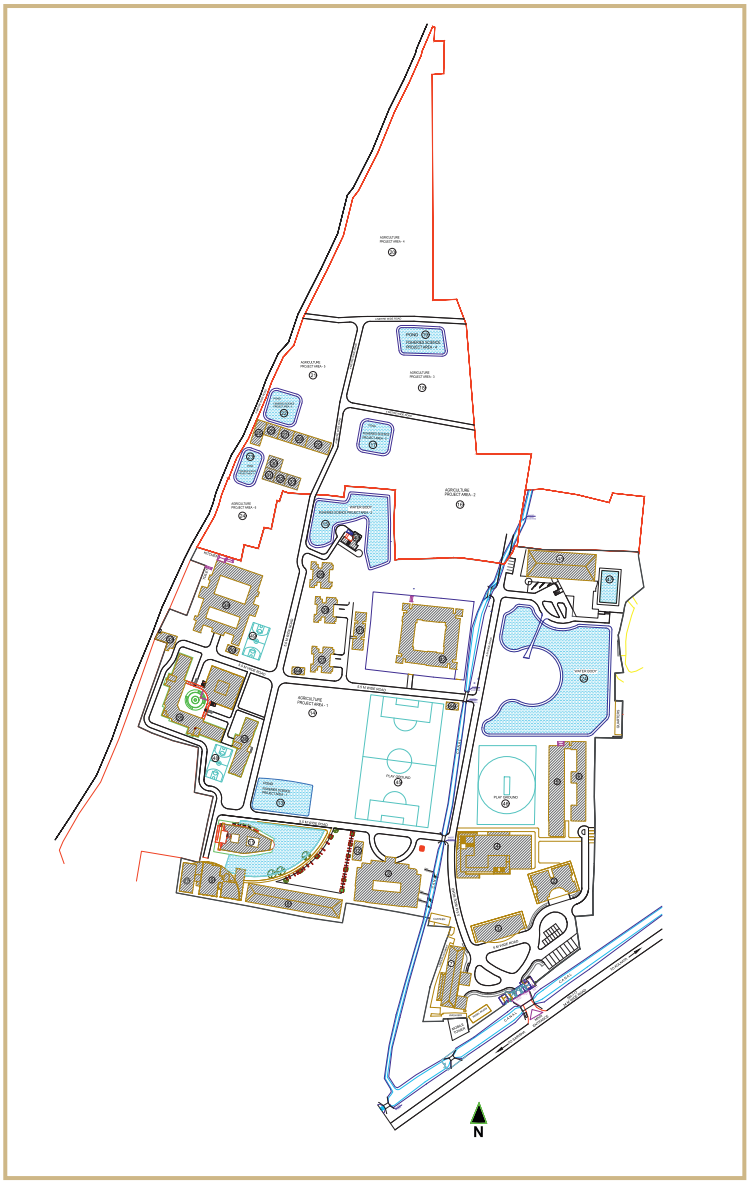
Demonstration of machinery and interaction of students and Scientist

Interaction of scientist and student during internship program

Demonstration of measurements of water quality parameters

Hands on training program

Guest lecture of field expert



LEGEND- BUILDING

A. ADMINISTRATIVE BLOCK

1. ADMINISTRATIVE BUILDING (G + V)

B. ACADEMICS BLOCK

2. SCHOLASTIC BUILDING - 1 (G + III)
3. SCHOLASTIC BUILDING - 2 (G + II)
4. SCHOLASTIC BUILDING - 3 (G + III)
5. SCHOLASTIC BUILDING - 4 (G + III)
6. SCHOLASTIC BUILDING - 5 (G + III)
7. WORKSHOP BUILDING
8. NEW WORKSHOP BUILDING
9. NEW PHARMACY BUILDING (G + III)
10. PHARMACY BUILDING (G + III)
11. SHIP IN CAMPUS (G + III)

C. AGRICULTURE & FISHERY SCIENCE BLOCK

12. POLY HOUSE & NET HOUSE
13. FISHERY SCIENCE PROJECT AREA - 1
14. AGRICULTURE PROJECT AREA - 1
15. FISHERY SCIENCE PROJECT AREA - 2
16. AGRICULTURE PROJECT AREA - 2
17. FISHERY SCIENCE PROJECT AREA - 3
18. AGRICULTURE PROJECT AREA - 3
19. FISHERY SCIENCE PROJECT AREA - 4
20. AGRICULTURE PROJECT AREA - 4
21. AGRICULTURE PROJECT AREA - 5
22. FISHERY SCIENCE PROJECT AREA - 5
23. FISHERY SCIENCE PROJECT AREA - 6
24. AGRICULTURE PROJECT AREA - 6
25. MUSHROOM UNIT
26. FIELD LAB
27. STORE HOUSE
28. SERICULTURE UNIT
29. THRESHING FLOOR
30. BIO GAS PLANT
31. CATTLE SHED
32. VERMI COMPOST PIT
33. BIO FERTILIZER PLANT

D. RESIDENTIAL BLOCK

34. BOY'S HOSTEL - 1 & 2 (G + III)
35. BOY'S HOSTEL - 1 & 2 (G + III)
36. BOY'S HOSTEL - 1 & 2 (G + III)
37. OLD STAFF QUARTERS (G + III)
38. NEW STAFF QUARTERS (G + III)
39. NEW STAFF QUARTERS (G + III)
40. DIRECTOR'S RESIDENCE (G + I)
41. OLD STAFF QUARTERS (G + III)
42. GIRL'S HOSTEL - 3 (G + II)

E. UTILITY & SERVICES BLOCK

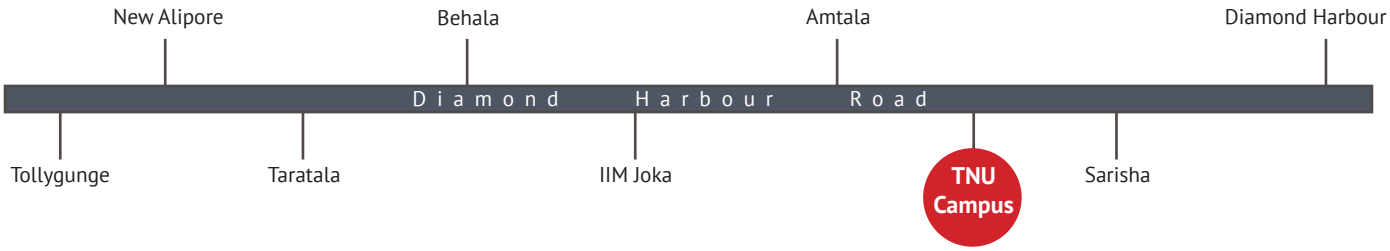
43. ELECTRICAL ROOM
44. PUMP ROOM

F. RECREATIONAL BLOCK

45. FOOTBALL GROUND
46. CRICKET GROUND
47. SWIMMING POOL
48. MULTI PURPOSE HALL
49. BASKETBALL COURT (3 NOS.)

G. HEALTH BLOCK

50. MEDICAL UNIT



AmbujaNeotia

THE NEOTIA UNIVERSITY
ज्ञानम् आत्म प्रदीपाय
UGC Enlisted & Recognised

NEOTIA INSTITUTE OF TECHNOLOGY MANAGEMENT AND SCIENCE
(Formerly ITME. Since 2002.)

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