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Inside...

35th Edition

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9 & 10 March 2021

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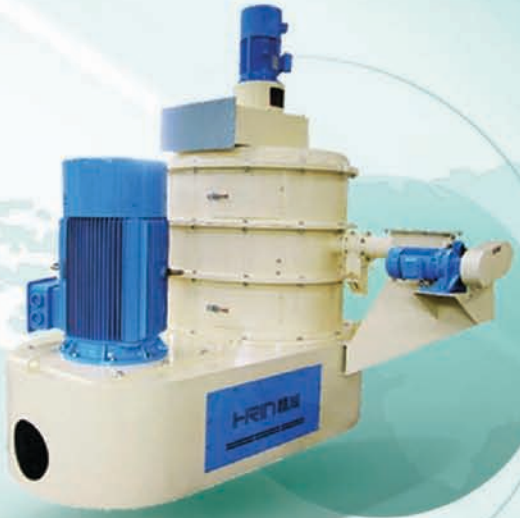

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Aqua International

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(Established in May 1993)

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M. A. Nazeer

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AP Govt forms 'Andhra Pradesh Aquaculture Authority'

Feed and Nutrition are two of the most important input factors in the production of salmonids as they affect both growth, health and welfare, product quality, economy, productivity and the environment

Dear Readers,

The February 2021 issue of ***Aqua International*** is in your hands.

In the News section, you may find news – The Marine Products Export Development Authority functioning under the Ministry of Commerce & Industry, Govt. of India, has conducted a farmers meet on "Antibiotic issues, Better Management Practices and Diversification in Aquaculture" on 6 November 2020 at Nirmala Nagar, Andhra Pradesh.

Andhra Pradesh government has formed Andhra Pradesh Aquaculture Authority which will be regulating and streamlining aquaculture activity in Andhra Pradesh and this will lead to further increase in aquaculture production and seafood export from the state. Around 70 % of Indian shrimps exported are produced in Andhra Pradesh and 30 Lakh tonnes of fishes are exported to other states of the country.

Skretting announced a collaboration with Proteon Pharmaceuticals aimed at providing functional solutions to tackle health challenges in aquaculture industry. The companies will co-develop products using bacteriophage technology to support farmers as part of a holistic health strategy. They will work in a parallel R&D pipeline for the project to target pathogenic bacteria. And they said, with bacterial challenges being some of the most prevalent in aquaculture worldwide, the products will be a welcome addition to the holistic health toolbox for farmers. Phages are the most numerous and oldest organisms on the planet. They are organic, natural and omnipresent in the environment.

The Indian fisheries sector contributes about 1% to India's GDP playing a significant role in the Indian economy. And Garware Technical Fibres Ltd (GTFL) is one of India's largest technical textiles manufacturer which dominates the mechanized fishing market space as a solution provider to the Indian fishermen community at large. Shujaul Rehman, CEO, Garware Technical Fibres informed that "the best and scientifically designed fishing nets made by Garware are designed in a way to ensure that only the right type of fish is caught.

A new study by Earlham Institute, in collaboration with the University of East Anglia and Wisconsin Institute for Discovery, showed that "genetic rewiring" at non-coding regions, rather than mutations to protein-coding regions of genes, may play an important role in how cichlid fish are able to rapidly adapt to fill a staggeringly wide range of environmental niches in the East African Rift lakes. Results could help future studies improve the breeding of economically important cichlid species such as tilapia - a staple in aquaculture.

Feed and Nutrition are two of the most important input factors in the production of salmonids because they affect both growth, health and welfare, product quality, economy, productivity and the environment. As a result, there has always been significant research efforts in this area. Over the past decade, the Norwegian Fisheries and Aquaculture Industry's Research Funding (FHF) has made a strategic commitment to strengthen knowledge about salmon's nutritional needs for lipids, as a result of the transition to plant-based feed recipes. This research showed the complexity of fish nutritional needs and how this is affected by other factors, both biological and environmental.

A Special Feature titled "An overview of Dry Fish production and marketing strategy of North East India" written by Rupali Das and others highlighted that the dry fish market plays a vital role in the economy of Indian fisheries (20% of the total fish production in the country). Dry fish is an important source of macro and micronutrients as a concentrated food item and has considerable health benefits. More than thousands of people in North East regions are actively involved in the production and marketing channel of dry fishes and maintained their livelihoods.

Another special feature "A Review on applications of Geographic Information System in Fisheries

Contd on next page

NRS GROUP

Our Mission

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

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

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

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

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

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AQUA INTERNATIONAL, BG-4, Venkataramana Apartments, 11-4-634, A.C.Guards, Near Income Tax Towers, Masab Tank, Hyderabad - 500 004, T.S, India.
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and Aquatic Resources" written by Rupam Jyoti Nath and others highlighted that GIS is a technology that can be applied to clarify issues, leading to solutions by treating several spatial components simultaneously. GIS has been used in aquaculture studies for the past 15 years to evaluate the suitability of coastal areas for farming activities.

In the Article section, article titled Feed Additives in Aquaculture written by Amit Ranjan and other authors highlighted that feed additives play an important role in modern aquaculture. Feed additives represent various classes of molecules, compounds or organisms that promote ingestion, absorption, assimilation of nutrients, growth and health. They affect physiological processes such as immune function, stress resistance and reproduction. Feed additives include feeding attractants, immunostimulants, prebiotics, probiotics, acidifiers, essential oils or other inclusions.

Another article titled Need of Diligent Knowledge on Transforming Biofloc Technology to the Indian Aquaculture Farmers written by Dr S. Felix and Dr M. Menaga highlighted that the paper sets an awareness call to caution the stakeholders involved in the aquaculture to take up the biofloc technology in a right direction. It also debated the status of the adoption of this technology in India including its challenges along with suitable recommendations. The paper also discussed the cases for change to improve management and economic viability when operated at high densities with no water exchange under biofloc dominated conditions.

Another article Seed Production and culture aspects of Pangasius Pangasius written by A. Anix Vivek Santhiya and other authors highlighted that Pangasius Pangasius is an important and fast growing food fish with an ability to grow in low dissolved oxygen levels (0.05 to 0.10 mg/litre). Induced spawning and hatchery seed production of mature Pangasius Pangasius provides commercial availability of Pangas seed for farming of this species. Grow out of this fish can be done in different systems like earthen ponds, net cages and net pens at a stocking density upto 120 fish/cm3.

Article titled Threatened, Endangered and Vulnerable Aquatic Organisms with Special Reference to Elasmobranches written by Suyani Nitin Kanji and other authors highlighted that the improper interventions of human beings in nature are pushing several of the aquatic species in the ecosystem to the brink of extinction. According to IUCN, hundreds of marine species across the world come under the categories of endangered and critically endangered species.

The unprecedented unnatural extinction of aquatic organisms not only endangered the functioning of the ecosystem, but also affected the ecological issues to a large extent. This article throws light on threatened aquatic organisms with special emphasis on Elasmobranchs, their status according to IUCN Red list and suggestions for conservation.

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

M.A.Nazeer
Editor & Publisher
Aqua International

MPEDA Organises Farmers meet on "Antibiotic Issues, Better Management Practices and Diversification in Aquaculture" at Nirmala Nagar, Guntur District

Dr Sankar Rao P, Joint Director of Fisheries, Vijayawada inaugurates Famers Meet at Nirmala Nagar, Guntur District. R.A.Gupta, Deputy Director, MPEDA, Appala Naidu, APM, RGCA are seen to his left and right.

Vijayawada: The Marine Products Export Development Authority functioning under the Ministry of Commerce & Industry, Govt. of India, has conducted a farmers meet on "Antibiotic issues, Better Management Practices and Diversification in Aquaculture" on 6 November 2020 at RCM Church Hall, Nirmala Nagar, Tummala, Repalle Mandal, Guntur District in Andhra Pradesh. The Meet was inaugurated by Dr P.Shankar Rao, Joint Director of Fisheries, Govt. of AP.

In his inaugural address Dr P.Sankar Rao, Joint Director briefed about the present scenario in aquaculture in the state of Andhra Pradesh. He told that in India, AP is the first state which started aquaculture. Around 70 % of Indian shrimps exported from India are produced in AP only and 30,00,000 tonnes of fishes are exported to other states of our country. He told that AP being the aquahub of India, it is the leading producer of seafood products. He further stated that the AP government has formed Andhra Pradesh Aquaculture Authority which will be regulating and streamlining the aquaculture in Andhra Pradesh and this will lead to further increase in aquaculture production and seafood export from Andhra Pradesh. He also briefed about how the AP govt. Played a vital role during Covid19 lockdown period by fixing standard market price for the farmed shrimp. He expressed that during the Covid 19 lock down crisis, the support extended by MPEDA, RGCA, CAA & NaCSA is highly appreciable.

Covid 19 Pledge

K.Sivarajan, Deputy Director, MPEDA, Vijayawada in his welcome address, briefed about the present status of aquaculture in India and contribution of Andhra Pradesh to our export market, and MPEDA's efforts in aquaculture promotional activities for quality, sustainability and economical viability.

The inauguration started with the Covid19 Pledge of the government of India prepared in Telugu administered by the Joint Director of fisheries.

The technical session covered the subjects "overview of Aquaculture with focus on regulation of antibiotic usage in Andhra Pradesh,"Group farming and formation of aquaculture societies," "antibiotic and quality issues in aquaculture, traceability, monitoring and enrolment of aquaculture farms and hatcheries," "diversification in aquaculture," "Mangrove Crab- An alternate species in coastal Indian villages," "BMPs in aquaculture," "GIS mapping and its applications in aquaculture" etc. Dr P.Sankar Rao, Joint Director of Fisheries, Mr K.Sivarajan, Deputy Director, Mr R.A.Gupta,

Technical sessions during the Farmers' Meet

Uni-President

AQUACULTURE PROBIOTICS EXPERT

Nu Ri
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Probiotics for water treatment

1. WATER QUALITY CONDITIONING

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

2. HIGH ACTIVITY OF SPORES

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

3. DECREASE AMMONIA CONTENT

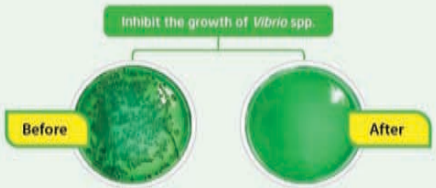
Prevent the accumulation of toxic substances such as NH_3, NO_2, etc.

4. IMPROVE WATER COLOR

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

5. ESTABLISH BALANCED POND BACTERIA SYSTEM

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



6. INCREASE AQUACULTURE PRODUCTION

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

* COMPOSITION:

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

* STORAGE:

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

* DIRECTION OF USE:

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

UNI-LIGHT PSB Funtion:

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

BSL Dosage:

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

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

UNI-PRESIDENT VIETNAM CO., LTD

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aquafeed@upvn.com.vn
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The venue at Nirmala Nagar, Repalle Mandal

Deputy Director, MPEDA, Shri Shanmukha Rao, Chief Executive Officer, NaCSA, Shri Pandyarajan, Assistant Director, MPEDA, Nagapattinam, Shri B. Appala Naidu, Assistant Project Manager, RGCA etc. engaged classes.

The farmers meet was attended by more than 100 farmers and officials.

Arivukkarasu, Assistant Director, MPEDA extended vote of thanks at the end of the Farmers Meet.

Aker Biomarine Unveils Protein Supplement

Aker BioMarine has launched a new protein supplement, rich in amino acids and minerals including calcium and magnesium

INVI can be incorporated into powder and ready-to-drink beverages and has broader food and drink applications for brands looking for a sustainable protein source. It is a highly concentrated, hydrolyzed protein isolate with a protein purity above 90% and contains all the essential amino acids the body needs.

"Five years ago, we set a goal to launch a best-in-class protein ingredient and I am excited to announce today that we have reached this milestone with the launch of INVI," said Matts Johansen, chief executive of Aker BioMarine.

INVI has been enzymatically hydrolyzed into predigested peptides, which promotes rapid uptake in the body and allows for easier mixing into food and drink. The supplement is heat-stable which allows for high temperature processing and its water-binding capacity gives a smoother texture and moistness.

"More consumers are opting for healthy protein options for personal, health and sustainability reasons," said Lalen Dogan, Vice President, protein human nutrition. "Many of the non-dairy alternatives like plant-based proteins are genetically modified and not complete proteins. INVI fills this gap, so consumers no longer need to make compromises when seeking an alternative to non-dairy protein source."

The size of the global retail protein market was estimated at US $ 34bn in 2020 and is forecast to grow to US $ 40bn in 2023.

What's the interaction between different feed nutrients in salmon ?

Feed and nutrition are two of the most important input factors in the production of salmonids because they affect both growth, health and welfare, product quality, economy, productivity and the environment. As a result, there has always been significant research efforts in this area.

Over the past decade, the Norwegian Fisheries and Aquaculture Industry's Research Funding (FHF) has made a strategic commitment to strengthen knowledge about salmon's nutritional needs for lipids, as a result of the transition to plant-based feed recipes. This research showed the complexity of fish nutritional needs and how this is affected by other factors, both biological and environmental. Furthermore, recent research showed that different nutrients have a mutual influence on each other and that the level of one nutrient can affect the uptake and turnover of another. Despite the available knowledge about the nutritional needs of the most important nutrients, there is a lack of understanding of the interaction effects between different nutrients.

"Now that we have established knowledge about critical levels of important fatty acids in salmon feed, it is necessary to understand how other essential nutrients such as minerals contribute to salmon robustness, but also how these nutrients affect each other so that we can optimize feed recipes and utilization of the feed raw materials," said Sven Martin Jorgensen, head of department at FHF.

A new project *Interaction between nutrients and significance for salmon health and quality* (ERN-INTERACTION), lead by Nofima in collaboration with the Institute of Marine Research, the University of Gothenburg, INRAE, NMBU, Skretting ARC and BioMar, will provide knowledge about how the interaction between fatty acids, zinc and cholesterol in the feed affects the fish's health and robustness in different parts of the production cycle.

Garware Technical Fibres leads the mechanized fishing market in India

The company is one of the largest fishnet manufacturers globally.

Pune, 18 January 2021: The Indian fisheries sector contributes about 1% to India's GDP playing a significant role in the Indian economy. And Garware Technical Fibres Ltd (GTFL) is one of India's largest technical textiles manufacturer which dominates the mechanized fishing market space as a solution provider to the Indian fishermen community at large.

Shujaul Rehman, CEO, Garware Technical Fibres said, "The best and scientifically designed fishing nets made by Garware are designed in a way to ensure that only the right type of fish is caught. The fishing nets made by GTFL have the capacity to carry huge tonnages and each kind of fishing application has a different type of fibre and netting design. Through close engagement with the fishing community and continuous dialogue we have helped them create net designs that reduce fuel consumption of trawlers and increase the scope for higher catches. For designing such solutions our R&D team works on the fishermen's challenges and uses technology and design to create effective solutions"

Over the years the company has grown by making customer-focused innovations for Indian fishermen. Elaborating on the success of Garware fishing nets, Shujaul Rehman added, "An Indian fisherman spends almost 70% of his expenses on diesel, which is used to power a typical fishing trawler. Our solution lies in creating nets that reduce drag and thus fuel consumption, by which fishermen can now save up to 50 to 100 litres of diesel per trip, with total savings that can go up to Rupees One Lakh per year per fishing trawler. The GTFL innovation lies in designing fishing nets in such a way, that drag itself is reduced without losing either the fish or impacting the speed of the vessel while ensuring the right type of fish. To achieve this, a combination of the right material, configuration of the net and the design are critical, and this is the reason Garware fishing nets are preferred by fishermen across India".

About Garware Technical Fibres Ltd

Garware Technical Fibres Ltd. (formerly Garware-Wall Ropes Ltd.), an ISO 14001:2015 and ISO 9001:2015 certified company is a leading player in Technical Textiles specializing in providing customized solutions to its customers worldwide. Globally, the company is known for its applied innovation in the field of aqua culture, sports, fisheries, shipping, agriculture, coated fabrics and geo-synthetics. The company`s products are manufactured in the state-of-art facilities at Wai and Pune in Maharashtra and marketed in more than 75 countries.

Mr Vayu Garware, 46, is the Chairman and Managing Director of Garware Technical Fibres Ltd. He is a Graduate Cum Laude in BSc Economics (Specialization in Finance) from Wharton Business School of the University of Pennsylvania, U.S.A. He joined Garware Technical Fibres Ltd in December of 1995 as a Director. Under his leadership, Garware Technical Fibres Ltd. expanded its product geographies from India to more than 75 countries globally.

He has been intimately involved in the growth of the company and responsible for the transformation from cordage focused to a technical textile company. Under his stewardship, delivering innovative application focused solutions to customers has been ingrained as part of the DNA of the company. The R&D centres at Pune and Wai are recognized by the Govt. of India.

Vayu Garware, CMD, Garware Technical Fibres Ltd.

A firm believer on systemized processes to drive operational excellence in delivering value to customers, processes like TPM, Kaizen, 8D, and many more have been institutionalized during his tenure. Elevated as Chairman and Managing Director in November of 2011, the company has diversified into new business segments in line with the objective of delivering innovative solutions worldwide.

A philanthropist, under his guidance, the company focuses on social engineering through skill development initiatives and education for under privileged children.

GARWARE TECHNICAL FIBRES

Vayu's vision is to make the company a leading player in the technical textile space globally.

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Bird-flu impacts chicken sales; demand high for mutton, seafood

With confirmed cases of avian flu in about ten States, organised players in the fresh meat space are witnessing a drop in poultry sales even as they step up efforts to reassure consumers on their safety standards.

It is also posing some challenges for the restaurant industry which has witnessed a drop in chicken-based dishes, as safety concerns linger in consumers' mind, even though authorities have said that well-cooked chicken products are safe for consumption.

Deepanshu Manchanda, Co-Founder and CEO, Zappfresh, said, "There is a lull in chicken consumption and we are seeing increase in demand for mutton, seafood and exotic meats. So, the overall demand for meat remains intact as we see the shortfall on chicken getting set-off with higher demand in other meats." The meat delivery platform said it has rolled out an extensive communication programme to dispel myths about bird flu and is also sharing the test reports of its meats with its customers.

Siddhant Wangdi, CEO, Meatigo, said, "we have witnessed a drop in sales of raw chicken by 15 per cent on a week-on-week basis. But, at the same time, sales of other raw meat products such as mutton, pork as well as seafood have increased by 10 per cent." He added that the company is actively engaging with its consumers to assure them on its safety protocols and recommending them to only eat cooked chicken over the next few days till authorities are able to control the spread.

Venky's (India) Pvt Ltd on Monday said that till date in the organised poultry sector not even a single poultry bird was found to be infected by bird flu. According to rating agency Crisil, the avian flu outbreak in India "could pare poultry sales by a third this month." Dinesh Jain, Director, CRISIL Ratings Ltd, said: "The impact of the current avian flu outbreak on the poultry industry will depend on its intensity and duration. In recent past, the impact of such outbreaks has been temporary due to swift implementation of testing, culling and containment protocols by the authorities. Fears against chicken consumption do not last for more than a few weeks as the infection rate abates."

Nishanth Chandran, Founder and CEO, TenderCuts, added, "The impact on chicken sales is less than 5 per cent and we have seen an increase in sale of mutton and seafood. We are also seeing an increase in number of new customers, who were buying from unorganised shops, and now have begun buying from us."

While the Ministry of Fisheries, Animal Husbandry and Dairying reiterated on Saturday that consumption of well-cooked chicken and eggs is safe for humans, restaurant industry said they are witnessing some drop in sales of chicken-based dishes. Certain policy flip-flops by State governments like Delhi (on first banning the sale of chicken and later reversing the ban) has added to the confusion among consumers, restaurant industry players pointed out.

Kabir Jeet Singh, CEO & Co-founder at Burger Singh, said, "Chicken sales are down by 45 per cent and demand for vegetarian products has gone up by 25 per cent. We are educating our consumers on the process we use to source chicken and we have valid certificates from all our vendors confirming that their flock of chickens have had no cases of bird flu."

Study finds hazardous levels of metals in fish, shrimp farms in India

A new study by the Federation of Indian Animal Protection Organisations (FIAPO) and All Creatures Great and Small (ACGS) found that all fish and shrimp farms in India have hazardous levels of lead and cadmium.

"With careless use of antibiotics and insecticides, uncontrollable disease outbreaks, no attention to fish welfare and a looming threat of anti-microbial resistance (AMR), aquaculture is a ticking time bomb," said Varda Mehrotra, executive director of FIAPO. The organization has requested a central and state regulatory framework for freshwater and brackishwater aquaculture.

FIAPO and ACGS studied about 250 fish and shrimp farms across the ten highest fish producing states of Andhra Pradesh, Tamil Nadu, Pondicherry, Gujarat, West Bengal, Odisha along with freshwater farms in Bihar, Jharkhand, Chhattisgarh and Assam. They found that 100% of fish and shrimp farms in these states have toxic levels of lead and cadmium and all shrimp farms were found to be releasing this toxic wastewater directly into the nearby canals or estuaries.

"Such haphazard management practices also invite the risk of AMR, which is the next health catastrophe waiting to be unleashed, and it might be more disastrous than COVID-19. Recently, a group of fisheries scientists called for greater awareness about AMR, addressing the need to curb the transmission of AMR bacteria to humans from fish and shrimps," said FIAPO.

Insolvency process initiated against Bhimavaram firm

Hyderabad, January 17, 2021: Upholding the claims of a Vietnamese prawn feed supplier company that moved the National Company Law Tribunal (NCLT) against a Bhimavaram based shrimp farming firm, the Hyderabad bench of NCLT initiated the corporate insolvency process against the shrimp firm for failing to clear the dues it owed to the Vietnamese firm.

The bench of K Anantha Padmanabha Swamy, member (judicial), and Veera Brahma Rao Arekapudi, member (technical) pronounced this order after hearing a petition filed by Uni-President Vietnam Company said that it supplied prawn feed worth Rs1.58 crore in two consignments in March 2018 to Gayatri Seafoods and Feeds company, Bhimavaram. But despite repeated reminders, the Bhimavaram company failed to pay the cost of the feed, it said. The Bhimavaram company in its argument said that it received substandard feed due to which it incurred losses.

Despite assuring that it will replace it with fresh and flawless stock, the Vietnam company did not do that, it alleged. The bench went through the record and found that while the Vietnamese company has produced documentary evidence to all its claims while the Bhimavaram company could not substantiate its allegations with any evidence. The tribunal noticed that there was an agreement between both the parties for the supply of feed from Vietnam. The bench, recorded the contention of Anjali Agarwal, the counsel for the Vietnamese firm that the borrower company from Bhimavaram sent an email to Vietnam admitting dues, and hence it cannot contradict them now.

The argument about substandard feed supply and the consequent losses suffered by the shrimp firm looks like an after thought, the bench said and appointed Kasi Srinivas as an insolvency resolution professional. The bench declared a moratorium and restrained all lenders to proceed further against the shrimp firm during the process of insolvency resolution.

Ayodhya's Muslims open purses for Ram temple

Ayodhya: *Muslims in Ayodhya are donating to VHP's crowd funding drive for the Ram temple, striking a blow for the holy city's syncretism and secular moorings. Prominent among the Muslim donors so far are Faizabad native Wasi Haider and Shah Bano, who have donated Rs 12,000 and Rs 11,000 respectively.*

Iqbal Ansari, one of the oldest surviving litigants in the Ayodhya title suit that had dragged for decades, welcomed VHP's campaign since Friday to reach 55 crore people across the country. "I will definitely donate," he said, "If Muslims donate for the construction of the Ram temple, it will strengthen harmony and cement their bonding with Hindus."

Anil Singh, an RSS functionary based in Ayodhya, confirmed to Times of India that many Muslims in the temple town had either donated already or sent feelers that they would like to pitch in. "We will definitely go to our Muslim brothers and accept whatever they give for the temple," he said.

Sirajuddin, a local cleric, said the quantum of donation would not matter if Muslims were willing to be part of the drive. "We must respect the beliefs of our Hindu brothers and join their moment of happiness. We should donate, even it's one rupee."

Lawyer and social activist Sayyad Tahir Ali said, "While we may be opposed to the ideology of an organisation, remember that only a handful of Hindus subscribe to that agenda. The majority of Hindus are secular and we should show respect to their faith in Lord Ram and donate."

On the eve of the launch of the crowd funding campaign, Samajwadi Party parliamentarian S T Hasan had laced his appeal to maintain calm with a warning that BJP might deploy stone-pelters to incite communal violence during the course of the drive, according to news in **Times of India** *on 17 January 2021.*

CBI books shrimp exporting co in Chennai for Rs 225 cr loan fraud

Chennai: The Central Bureau of Investigation (CBI) booked a case against a Choolaimedu-based company and four of its directors including the managing director for an alleged loan fraud to the tune of Rs 225 crore based on a complaint given by Indian Overseas Bank.

According to the FIR, the investigating agency said that the bank filed a complaint against Oceanic Edibles International Ltd and its directors Joseb Raj Arokiasamy, Vimalla Joseb, Arockiasamy James Walter and Arokiasamy Dominic Savio. The company and the directors had availed of credit facilities to the tune of Rs 104.2 crore.

The company ran shrimp hatchery units and established units for processing and marketing of vegetables, fruits and marine products at Marakanam, Villupuram. The company had also availed of credit facilities from SBI, IDBI, ICICI and Central Bank of India, CBI said.

Loan amounts were diverted to either their own or third party accounts or paid overseas without any genuine business as claimed and were misappropriated.

Securities pledged with the bank were not available despite being hypothecated to the banks for availing of credit.

This had caused a loss of Rs 225.2 crore which is the total outstanding owed to all banks.

According to CBI, IOB's complaint had prima facie evidence of criminal conspiracy, fraud, cheating and corruption.

The account of this company was declared as fraud on December 20, 2019.

In internal notes, the banks noted that the company did not deposit any amount immediately after demonetisation in 2016 which raised suspicion of the genuineness of the cash balance on its books.

Transactions with a sister concern were recorded only in the books of the latter company, which, the banks noted, was a suspicious transaction.

Payments were diverted to private accounts of the directors as well.

There were other suspicious transactions including crores of rupees transferred to individuals and entities which were not related to the company's business.

The banks also grew suspicious as electrical appliances in their office were found to be safe during 2015 floods due to a forewarning from Tamil Nadu Electricity Board, but their contention that book of accounts had been lost was untenable.

Study finds genetic rewiring behind tilapia evolution in East Africa

A new study by Earlham Institute, in collaboration with the University of East Anglia and Wisconsin Institute for Discovery, showed that "genetic rewiring" at non-coding regions, rather than mutations to protein-coding regions of genes, may play an important role in how cichlid fish are able to rapidly adapt to fill a staggeringly wide range of environmental niches in the East African Rift lakes. Results could help future studies improve the breeding of economically important cichlid species such as tilapia - a staple in aquaculture.

Darwin's famous finches are one of the most well-known examples of evolution by natural selection and specifically adaptive radiation. The birds he observed on the Galapagos archipelago had differences in their beaks that could be matched to fit their specific feeding habits - whether they ate big or small seeds, insects, or even used tools to find food. Amazingly, in the 2-3 million years it took 14 species of finch to evolve on the Galapagos Islands, around 1,000 species of cichlid evolved in Lake Malawi alone.

"In the Great Lakes of East Africa, and within the last few million years, a few ancestral lineages of cichlid fish have independently radiated and given rise to well over 2,000 species - and we're still finding new ones," said first author, Tarang Mehta, a postdoctoral scientist in Earlham Institute's Haerty Group. "They occupy a really large diversity of freshwater ecological niches in lakes, rivers and even swamps. This includes sandy substrates, mud, rocks and vegetated bottoms. As a result, they are all adapted to different dietary habits and niches in these areas."

By looking at gene expression across different cichlid tissues in five representative species from East African rivers and the Great Rift Lakes, the team discovered an evolutionary rewiring of several important genes linked to the adaptability seen in cichlids. The effect was particularly prominent in the fish species' vision.

"We found out that the most rewired genes are associated with the visual system," explained Mehta. "Essentially, if you look at the different species of fish we used in the study, you could see major differences in the regulation network around opsin genes they use for vision depending on where they live and what they eat. For example, the Lake Malawi rock-dwelling species, M. zebra, feeds on UV-absorbing phytoplankton algae. That generally requires increased expression of a particular opsin, SWS1, which helps with sensitivity to UV light. That may well explain why it has a more complex regulatory network around SWS1 compared with the Lake Tanganyika benthivore,

N. brichardi, which does not share the same diet or habitat."

Armed with some genes of interest, the team confirmed the mechanisms behind these gene regulatory differences in the lab. Looking at the fine scale, they identified small changes in the DNA sequence of regulatory regions at the start of genes important for trait differences between species, including the visual system.

Rather than the gene itself being modified, it was the regions of DNA, known as binding sites, that were targeted by transcription factors - the proteins which determine whether a gene is turned on or turned off. In this way, the different species of fish can be said to have had their visual system "rewired" for different functions.

Taking this further, the team was able to show that these changes could be commonly associated throughout cichlid fish in Lake Malawi, with diet and ecology-dependent rewiring showing that changes in transcription factor binding could be key to fine-tuning visual sensitivity.

Depending on the trait, cichlids appear to utilize an array of genetic mechanisms to generate phenotypic novelty, however, the "tinkering" of regulatory systems appears more widespread in cichlid fish than previously discovered. This evolutionary plasticity could well explain the explosion of species in such a small area over a relatively short time.

"It's a proof of concept," said Mehta. "As more data comes out, we'll be able to look at this in-depth in representative clades from each of the different radiations, not just in Lake Malawi but also Lake Tanganyika, Lake Victoria and even in some of the cichlids in South America."

Professor Federica Di Palma, professorial fellow of Biodiversity at UEA, said that they "have released an impressive amount of expression data which will further aid studies into the adaptive radiation of cichlids for the future. We are now deciphering the complexity of these cis-regulatory regions by using genome-wide CRISPR screens. The wider impact of our regulatory gene network approach will also help inform the evolution of agriculturally important traits for tilapia such as growth rate and tolerance to different local water conditions, as well as for general aquaculture and fisheries."

Skretting and Proteon Pharmaceuticals to introduce novel phage technology for aquaculture

Mumbai: Skretting announces a collaboration with Proteon Pharmaceuticals aimed at providing functional solutions to tackle health challenges in the aquaculture industry. The companies will co-develop products using bacteriophage technology to support farmers as part of a holistic health strategy.

The companies will work in a parallel R&D pipeline for the project to target pathogenic bacteria. with bacterial challenges being some of the most prevalent in aquaculture worldwide, the products will be a welcome addition to the holistic health toolbox for farmers.

Part of integrated health management

According to a note from Skretting, the companies predict that the technology will become a valuable component of integrated management strategies on-farm with both feed and water applications under investigation.

Matthew Tebeau, COO at Proteon Pharmaceuticals says, "Phages are a part of the natural microecosystem. Each target specific bacteria in order to keep the healthy balance in nature. Bacteriophages have been known for over 100 years, however, using phage technology for aquaculture is an exciting development. With Proteon's expertise in phage development

and Skretting's expertise in health, we will work together to identify phages that will target specific bacteria, which we hope will significantly reduce these health challenges for farmers."

In the initial phases of the project, Skretting will isolate the most prevalent specific strains of bacteria, while Proteon will determine the most effective complementary groups of phages. Skretting Aquaculture Research Centre (ARC) researchers will then examine the efficacy of the phages during challenge trials.

What is phage technology?

Phages are the most numerous and oldest organisms on the planet. They are organic, natural and omnipresent in the environment. A critical part of the global microbiome, phages naturally protect animals and humans from bacteria. Controlled delivery of phages, using precision biological tools promises to reduce antibiotic usage, overcoming the growing threat of antibiotic resistant bacteria, as well as to increase sustainability in aqua and agriculture and to improve human health.

Proteon Pharmaceuticals has been developing their phage-based products for over 10 years. They have been tested in Europe and Asia and proven in terms of efficacy and stability.

"Products based on bacteriophages are an effective tool for fighting bacterial diseases in farmed fish and shrimp, as they can eliminate only the specific

pathogenic bacteria while not damaging the animal's microbiome," says Truls Dahl, Business Developer at Skretting.

The big picture

The project timeline is around 4-5 years, but both Skretting and Proteon Pharmaceuticals are confident that the resultant health solutions are worth the wait. With anti-microbial resistance (AMR) still looming as a serious threat facing the global population, natural health strategies are increasingly important for food producing industries.

"Having alternatives to antibiotics to support the health of fish and shrimp is a very exciting part of the development," continues Dahl. "Vaccines, antibiotics and indeed phage technologies have been around for a long time, but the use of phages is still quite new for aquaculture."

"It's not every day you introduce a new technology to improve animal health," adds Therese Log Bergjord, Skretting CEO. "This is a milestone, and highlights our commitment to continue to invest in health research for the sustainability of the aquaculture industry as a whole.

About Skretting

Skretting is the global leader in providing innovative and sustainable nutritional solutions and services for the aquaculture industry. Skretting has production facilities in 19 countries on five continents, and manufactures and delivers high quality feeds from hatching to harvest for more than 60 species. The total annual production volume of feed is more than 2 million tonnes. The head office is located in Stavanger, Norway. Skretting is the aquaculture division of Nutreco, a world leader in animal nutrition. Our mission is Feeding the Future. More information can be found on www.skretting.com.

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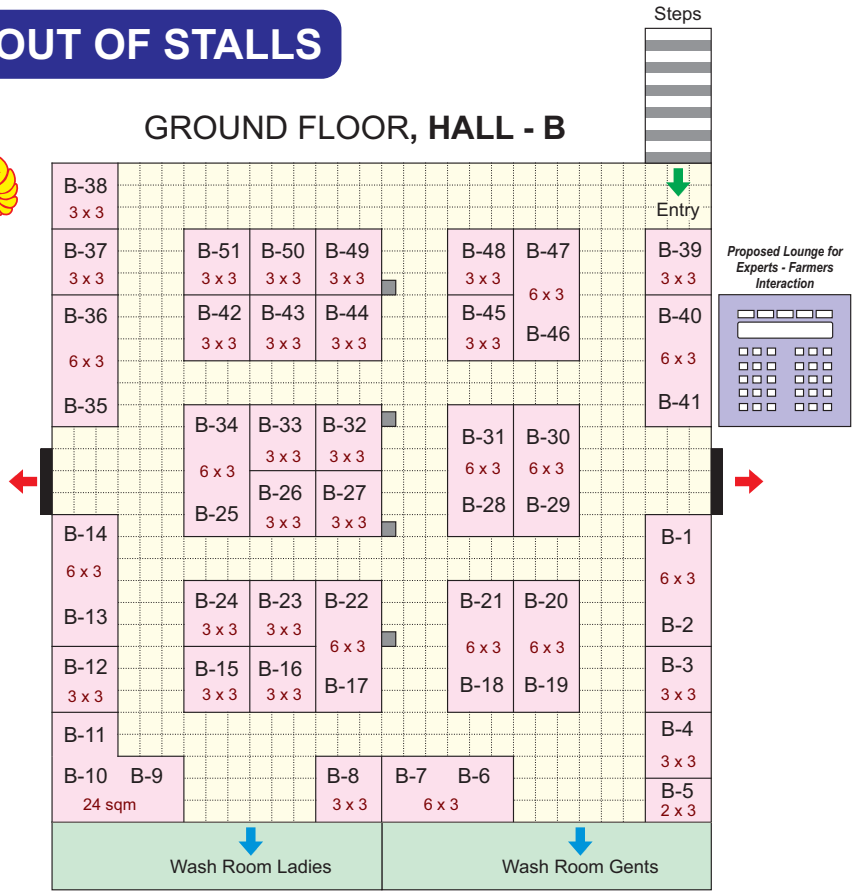

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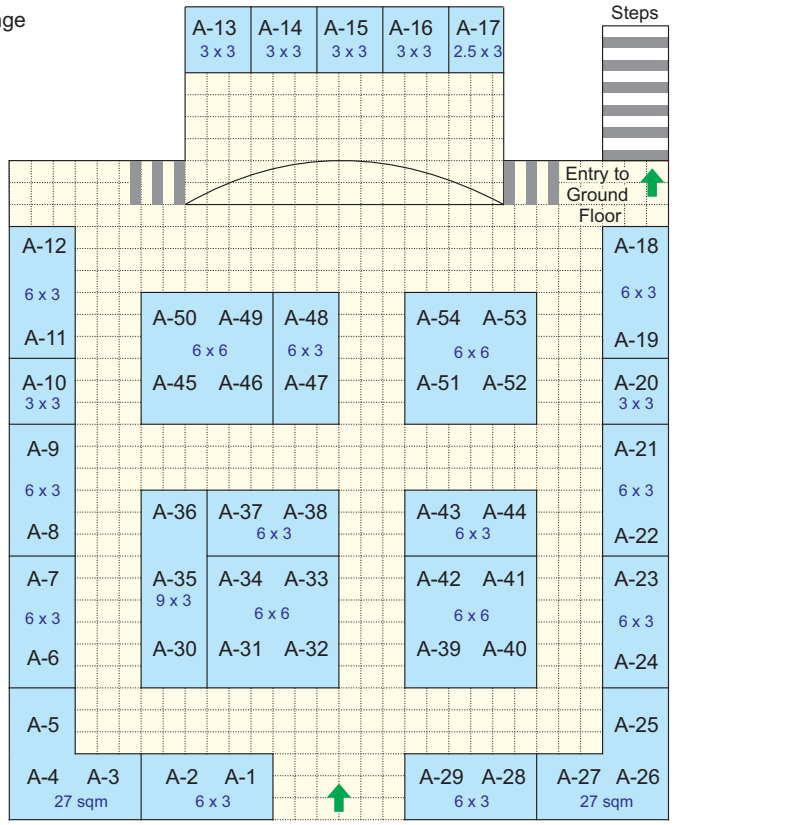

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An overview of dry fish production and marketing strategy of North East India

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Fig: Dry fish market survey

Johnius carutta

Hilsa toli

Harpadon nehereus

HIGHLIGHT POINTS

- *The dry fish market plays a vital role in the economy of Indian fisheries (20% of the total fish production in the country).*
- *Dry fish is an important source of macro and micronutrients as a concentrated food item and has considerable health benefits.*
- *More than thousands of people in North East regions are actively involved in the production and marketing channel of dry fishes and maintained their livelihoods.*

Introduction

Drying is one of the world's oldest known food preservation methods and still being practiced in many parts of the world. It works by removing water from food, which ultimately inhibits the growth of microorganisms. Compared with other methods, drying is quite simple and dried fish has a considerable storage life at normal room temperature. Moreover, the nutritional quality of dried fish remains intact, sometimes retains higher quality standards compared to fresh fish (as per unit weight). In India about 20% of the total catch is being used for the production of dry fishes, whereas about 17 mt of fish (12%) of the world catch for human consumption are dried, salted, smoked, or other cured forms (FAO, 2016). Dry fish trade from India in 2017–18 was 88997 tons with a value of worth Rs. 1042.37 crores (MPEDA 2018). In North East India, most of the fish produced are freshwater and consumed as fresh as possible but an appreciable amount of the fish are dried using various traditional and modern drying methods. Dried fishes are traded to the different states within India as well as exported to many South East Asian countries for earning foreign currency.

More than thousands of people of North East India are actively involved in the production and marketing channel of dry fishes and they have smoothly maintained their livelihoods. They prepare and consume different types of traditionally processed dried fish products like gnuchi and suka ko maacha, sidra and sukuti, karati, bordia and lashim etc, (Thapa, 2016).

Commonly practice method of drying in North East, India

In North East India the common practice method of drying involve sun drying or natural drying by utilizing the atmospheric conditions like temperature, relative humidity, and airflow. Fishes are washed, and rubbed with salt then sundried for 4-7 days and stored at room temperature for 3-4 months for consumption.

Traditional fish products of North East India

North East India people mainly prepared and consumed a different kind of dried and smoked fish products as a side-dish item which includes gnuchi, suka ko maacha, sidra, sukuti, karati, bordia and lashim etc.

Status of dry fish production and trade in North East India

In the country annually about 3.22 lakh tones of unsalted dry fish and 2.93 lakh tones salted dried fish and smoked fish produced. Out of the total production of these two categories of products, Gujarat alone shares 68% of unsalted dried fish and 46% of dried salted or smoked fish. Therefore Gujarat is the major producer of dried fish products. The other maritime states like Andhra Pradesh, Kerala, Maharashtra, West Bengal, Orissa, Karnataka play a major role in dry fish production as compared to Bihar, Haryana, Manipur, Nagaland, in the landlocked states. Assam has one of the largest dry fish markets not only in North East state but also in India. 500 tons of dry fish per three days of a week (1000-1200 trucks) come to the market every year. The major chunk of salted and unsalted dried fish products of coastal states and landlocked states are being traded to the Northeastern region through the well-established value chain.

Quality standard for cured fish products

North East region is a highly humid zone due to heavy rainfall, the quality shelf life of dried fishes during retail trading is very limited due to reabsorption of moisture followed by the consequent increase of microbial load and other deterioration. Spoilage of dried fish due to bacterial, fungal or yeast, rancidity, autolysis, browning and other reactions all of which are temperature and water activity-dependent (Deo,1977). The main problems affecting cured fish are histamine, mycotoxins, 3, 4 benzopyrene. Periodic quality evaluation of cured fish products has become a necessity for the growth of the fish curing industry in India.

Packaging and storage of cured fish products

Packaging has a vital role to play in dried fish production and storage. Traditional packaging materials include cane baskets, leaves, and jute bags. Alternatives include flexible packaging such as polythene bags, or wooden and cardboard packs. The processor did not store dry fishes, the wholesaler has mainly stored their products for two to three months for marketing. Due to a lack of proper storage facilities, about 5 percent of dry fish got wasted in the process of marketing.

Dry fish marketing channel in North East, India

The value chain of dry fish comprises a large network of distributional channels and it connects coastal belts (marine fishes) and northern states (freshwater fishes) to the points of consumption which is located in remote corners of the whole North East region. Therefore, the dry fish value chain is widely scattered. The different stages of dry fish value chain include procurement of raw fish by processors at landing center, processing of fishes, assembling and trading of fishes, wholesaling of dry fish products at assembling markets of NE region, wholesaling of dry fishes at distributing markets, and retailing. All the dry fish traders supplied their dry fishes to the wholesale market and subsequently, it is distributed to the whole North East region. Hence, wholesalers of the market play a vital role and provide a link between producing markets and consuming markets.

Price pattern of dry fishes in North East India

Demand, supply and quality of dry fish influence the price. Factors on rising demand were seriously considered by the traders to determine the price. It may be noted here that there is no actual pricing system in case of dry fish marketing, which involved in the buying and selling of dry fish followed the open bargaining for fixing the price

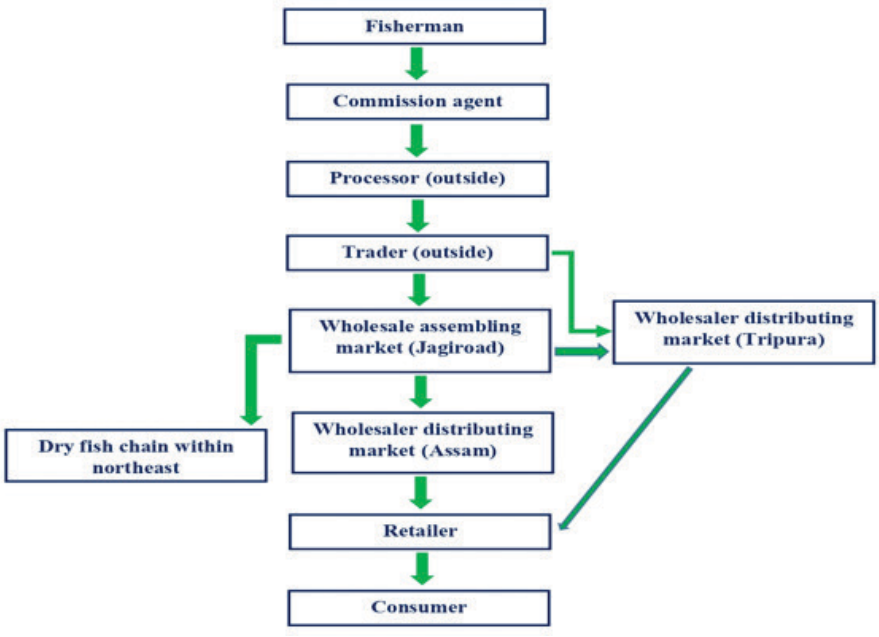

Fig1: Dry Fish Marketing Channels of North East India

SL. NO.	Local name	Scientific name	Price (Rs./ kg)	Sources of Arrival
1	Loita	*Harpadon nehereus*	220-250	Gujarat
2	Chandana	*Hilsa toli*	350-700	Bangladesh
3	Karut croaker	*Johnius carutta*	150-250	Gujarat
4	Chapila	*Gudusia chapra*	120-150	Bangladesh
5	Nag puti	*Puntius sp.*	150-170	Chennai
6	Gulia	*Mystus golio*	300-350	Kolkata
7	Keski	*Corica sorborna*	200-220	Orissa
8	Chandana	*Chanda nama*	200-250	Chennai
9	Kakiya	*Xenentodon cancila*	150-200	Assam

of the products. It means that dry fish price was determined by the number of buyers attending the market and the volume of products offered for sale. Prices also varied from 20% to 40% between the peak period and a lean period. The price variations within the product categories (dry, smoked and fermented) and at different stages of marketing were different. The wholesale price of the different varieties of dry fishes ranges between Rs. 75 to Rs. 600 per kg. Apart from fish species, price the products also depends on the market situation, product quality (size, color, moisture content) overall appearance of the product and the season. Dry fish prices significantly differ in the state to state as well as in the different stages of the value chain.

Table1. Price pattern of dry fishes with a different source of arrival

Conclusion

Dried fish marketing plays an important role in the economy of Indian fisheries, contributing to increased food production, diversification of the economy and increased employment opportunities. Research shows that dried fish provide essential macro and micronutrients as a concentrated food item and has considerable health benefit towards obesity, coronary disease, and diabetes, etc. However, there are always concerns about the long-term sustainability of dry fish marketing due to unhygienic handling and poor infrastructure of the market. The North East dry fish market provides a good opportunity to fish exporters to establish a sustainable marketing structure. It is, therefore, necessary to provide institutional and organizational support, government support, extension services, and more research along with knowledge of dried fish marketing.

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A REVIEW ON APPLICATIONS OF GEOGRAPHIC INFORMATION SYSTEM (GIS) IN FISHERIES AND AQUATIC RESOURCES

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Abstract:

GIS is a technology that can be applied to clarify issues, leading to solutions by treating several spatial components simultaneously. GIS has been used in aquaculture studies for the past 15 years to evaluate the suitability of coastal areas for farming activities. Aquaculture management issues such as the multiple uses of estuarine waters, studies relating to the impact of water quality on finfish and shellfish aquaculture, and habitat availability can be studied using GIS. Generally encountered issues between aquaculture operations and marine waterfowl habitats have also been addressed using GIS. FAO has established a web-based portal, GIS Fish, which can obtain the global experience on Geographic Information Systems (GIS), Remote Sensing and Mapping as applied to Aquaculture and Inland Fisheries. Several studies have been implemented on wetlands by giving importance to its conservation and management aspects, and positive results were obtained.

Keywords: GIS, Remote Sensing, Geospatial, PFZ, Wetland, Fisheries.

Introduction: Geographic Information System (GIS) is a tool for making and using spatial information, and it is mainly concerned with the location of the features as well as properties/ attributes of those features. It helps us gather, analyze, and visualize spatial data for different purposes. By recording their coordinates, a GIS quantifies the locations of features, which are the numbers that explain the position of these features on Earth (Shelton, 2018).

Due to the difficulty in attaining spatial data on organisms/habitats in underwater environments, GIS was not a practical source of analysis in the past. When GIS, combined with other analytical tools and models, it allows for improved spatial monitoring and studies and, eventually, better and more effective management practices (Subhendu, 2013). Biologists have been able to track fish species and create databases with the advancement of radio telemetry, hydroacoustic telemetry, and side-scan sonar, and it incorporated into a GIS program to create a geographical representation.

Why GIS is important in Fisheries?

Fisheries planning and management have many spatial components and severe issues. Spatial components are movements and migrations of resources; the definition of fishing grounds, transportation networks, markets, and habitat loss, and environmental degradation can be grouped into Spatial issues. Therefore, Fisheries biologists, Aquatic resource managers, and decision-makers have to address the problems of serious difficulty, especially in developing countries. By the way, GIS is a technology that can aid in clarifying the problems and lead to solutions with the help of many spatial components. However, many people are still unaware or afraid of the technology and its potential for fisheries management. GIS has been used in aquaculture studies for at least 15 years to evaluate the suitability of coastal areas for fish farming activities (Simms, 2002). Aquaculture management issues such as the multiple uses of estuarine waters, the impact of water quality on shellfish leases, aquaculture, and habitat availability, and conflict issues between aquaculture operations and marine waterfowl habitats have been addressed using GIS (Simms, 2002). By using GIS, intertidal areas (mudflats) were evaluated for the development of brackishwater aquaculture (shrimp farming). The data were used for the analysis of site selection in India with the basis of some crucial parameters under six significant categories, i.e., engineering, water quality, soil

quality, infrastructure facility, social restriction, and meteorological parameters (Karthik et al. 2005).

GIS as a management tool:

Monitoring and analyzing spatially-distributed factors such as resources abundance and composition, feeding and reproduction, nurseries, fishing efforts, harvest, tagging and recaptures, recruitment, regulatory zoning, control and surveillance, conflicts between gear and fleets, ecosystem conditions, etc. pose significant operational and management challenges to fisheries. The essential usefulness of GIS lies in its ability to manipulate and overlay data in several ways and to perform many analytical functions so that it can contribute to a faster and more efficient decision-making process in fisheries. (Subhendu, 2013).

FAO has recently released a web-based portal, GIS Fish, which can obtain the global experience on Geographic Information Systems (GIS), Remote Sensing and Mapping as applied to Aquaculture and Inland fisheries

Application of Remote Sensing and GIS in Fisheries :

- **Site selection for aquaculture or mariculture:** This is an original use of GIS in fisheries-related work. For any successful aquaculture activity, a suitable site is a pre-requisite. An optimal aquaculture site aids in better management of the aquaculture resources, and it ensures the sustainability of the farming activity. There are many criteria, guidelines, and essential factors for the selection of a site for aquaculture such as the topography of site, slope of land, water flow, volume availability, water quality, weather parameters, access and location of utilities, legislation concerning water rights, etc. helps in the decision making process. GIS gives the best platform to combine all this information and identify the areas that qualify the optimal set of parameters, which would be the best-suited areas for aquaculture (Shelton, 2018).
- **Modeling fish activity and movement:** These applications area is just getting underway. Here the aim is to attach numerical models to a GIS to simulate, describe, or predict a range of processes. Examples include – movement models.
- **Analysis of fisheries catches and effort:** Fishery managers are interested in where fishing effort is concentrated; how much fish is caught where; what is the relationship between catch and effort, etc., and much exciting work is now being produced. Statistical output can be obtained from many GIS programs. Catches can be explained in terms of various environmental parameters or terms of fish life cycles.
- **Matching fish distributions to environmental parameters:** It will be of the utmost interest for those working in fisheries management or science to know the relationships between fish distributions and various environmental parameters. The types of parameters being commonly used include water temperatures (especially thermal fronts), upwelling indices, water depth, marine chlorophyll abundance, bottom sediment type, and salinity.
- **Establishing regional and national fisheries databases:** Although not directly a GIS application to fisheries management, it is clear that without substantial data inputs, then fisheries GISs could not function. So in some major fishery regions, a massive effort has gone into establishing databases, metadata sets, and in setting up regional data centers, e.g., in eastern Canada or at the various World Data Centres. Fisheries related data sets are slowly becoming accessible over the Internet.
- **Identification of potential fishing zones by remote sensing:** Remote sensing of ocean color is the only approach to provide a synoptic view of the abundance of the marine autotrophic community, which is at the basis of the marine food web. Areas with high phytoplankton biomass, as well as temperature fronts, have been related to increased abundance in fish. An Indian program, forecasting Potential Fishing Zones (PFZ), provides this useful information, free of charge, three times a week to artisanal fishers to increase their fishing efficiency and reduce their use of fuel. The locations of the PFZs are distributed to the fishing community through different media, in many cases, in the local language to facilitate the use of the information. Results strikingly show the benefits of using PFZ information, with a significant increase in fish catch and a reduction in search time. When the dissemination of the PFZ information is interrupted in areas (known as nurseries) and at time spawning peaks are identified; therefore, there is a need for the generation of a responsible fisheries forecasting program.
- **Applications in habitat mapping and change detection:** The advantages of Remote sensing, like synoptic view, multispectral data, multi-temporal coverage, and cost-effectiveness, plays a significant role in change detection and habitat mapping. It a practical approach to collect data from diverse, inaccessible ecosystems and to study complex geographic terrain types. The amalgamation of GIS and Remote sensing is successfully applied in monitoring and mapping of the coastal and marine ecosystem. Since 1972, Satellite imagery is available for most of the world, with the launch of LANDSAT by the USA. This treasure trove of information helps us to map and monitor the changes that happened to our coastal areas. The changes include the destruction of mangroves, land reclamation, shrinkage of lakes, estuaries, and other water bodies that are directly linked to the fisheries sector. Satellite imagery permits monitoring different features of the landscape and helps to quantify the rates of change and eventually detect significant land cover changes. GIS and remote sensing are extensively used to map and monitor the habitats namely seagrass/seaweed/coral reef.

Application of GIS in Marine fisheries management and conservation of marine resources: The GIS-based studies will give a clear picture of the Spatio-temporal distribution of fishes in the selected study area and help in identification of critical fishing grounds in terms of fishery and marine biodiversity (Dinesh, Thomas, and Rohit, 2014). The analysis of information collected in layers will

help in identifying spawning period, spawning area, juvenile segregation, juvenile migration, *in situ* growth of different species, resident taxa of particular fishing ground, multi group assemblages, and the basis for the multi-group gatherings and their dependencies. Application of GIS in marine fisheries is being implemented as a project for the first time in India along Karnataka coast, where this study based on the database created on the trawl fisheries of the Karnataka coast (Shubhankar *et al.*, 2018). The other uses of GIS are for defining fish habitat and organizing and executing living marine resources (i.e., the dynamics of marine objects), tracking marine mammals and analyzing their hunting and migrant lines; which can assess the efficiency of marine protected areas, and answer to problems related to environmental ruins. (NOAA, 2017). Participatory GIS applications have been developed recently, which can be useful in the fisheries management sector. These application tries to collect and integrate local knowledge along with verified scientific data. In this type of application, marking specific locations or features is very much important based on a base map of the definite fishing grounds, and for that, a resource user is an utmost necessity.

Mapping and Geospatial Technique in Wetland: It is important to have an inventory of wetlands and their catchments in terms of conservation and management of wetland resources. Digital maps are potent tools to achieve this. Therefore, Maps are essential for monitoring and quantifying the change over time scale, and it helps in decision making. The technique used in the preparation of the map started with the ground survey. The Survey of India (SOI) topographical maps are the earliest correct maps of India, which shows various land use/cover classes, including wetlands. Remote sensing is recognized as an essential tool for making decisions, viewing, analyzing, and characterizing land, water, and atmospheric components. Space Applications Centre (ISRO), Ahmedabad, which has carried out the first scientific mapping of wetlands of India by using remote sensing data from Indian Remote Sensing satellites (IRS-Series) during 1992-93.

Role of GIS in the Wetland ecosystem: The wetland boundary should ideally include all open water, aquatic vegetation as the wetlands all these (eg., aquatic vegetation like submerged, floating, and emergent weeds) and satellite images must give a clear sign of the wetland extent. The presence of vegetation in wetlands provides necessary information about its trophic condition. By using optical remote sensing data, there is a possibility to delineate floating and emergent types of vegetation

Assam Remote Sensing Applications Centre, Guwahati (ARSAC): ARSAC is an autonomous Council which established in the year 1987 under ASTEC (Assam Science Technology and Environment Council). It has three main objectives, which are:

1. To develop remote sensing techniques and all the applications of all the methods for natural resources management in the State.

2. To provide consultancy facilities and training in remote sensing related fields, especially to the user agencies, by giving both visual as well as digital interpretation tools.

3. To help Govt. & Non-Govt. agencies in the preparation of their development plans with geometric accuracy based data and information through remote sensing techniques.

The wetland atlas of Assam:

The total number of the wetland is 5097, where 6081 (< 2.25 ha) are Small wetland. The total estimated wetland area is 764372 ha. Lake/ Ponds, Waterlogged, Ox-bow lakes occupy 51257 ha, 47141 ha 14173 ha respectively (NWIA Assam,2010).

Area estimates of wetlands in Assam:

Sl. No	Wettcode	Wetland category	Number of wetlands	Total wetland area	% of wetland area	Open Water (Area in ha)	
						Post monsoon season	Pre-monsoon season
	1100	**Inland wetlands- natural**					
1	1101	Lakes /ponds	1175	51257	6.71	34408	14526
2	1102	Oxbowlakes/ cutoff meanders	873	14173	1.85	7721	5848
3	1103	High altitude wetlands	-	-			
4	1104	Riverine wetlands	139	4258	0.56	1669	942
5	1105	Waterlogged	2461	47141	6.17	33660	12630
6	1106	River/streams	213	637164	83.63	342197	353756
	1200	**Inland wetlands-man made**					
7	1201	Reservoir/barrages	2	2833	0.37	2185	1346
8	1202	Tanks/ponds	180	921	0.12	892	801
9	1203	Waterlogged	54	544	0.07	336	303
		Subtotal	5097	758291	99.20	423068	390152
		Wetland(<2.25ha) mainly tanks	6081	6081	0.80	-	-
Total			11178	764372	100.00	423068	390152

District wise Wetland distribution of Assam:

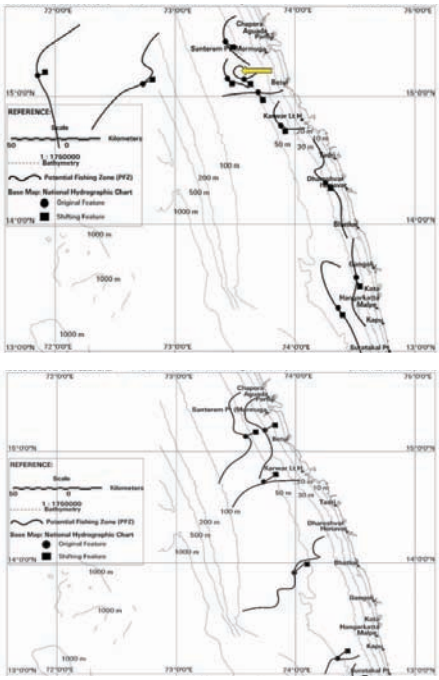
Sl .no	District	Geographic area (sq. km)	Wetland area (ha)	% of total wet-land area	% of district geo-graphic area
1	Kokrajhar	3129	24833	3.25	7.94
2	Dhubri	2838	56538	7.40	19.92
3	Goalpara	1824	33221	4.35	18.21
4	Bongaigaon	2510	22149	2.90	8.82
5	Barpeta	3245	59038	7.72	18.19
6	Kamrup	4345	43655	5.71	10.05
7	Nalbari	2257	20140	2.63	8.92
8	Darrang	3481	48983	6.41	14.07
9	Marigaon	1704	28737	3.76	16.86
10	Nagaon	3831	35695	4.67	9.32
11	Sonitpur	5324	83427	10.91	15.67
12	Lakhimpur	2277	27307	3.57	11.99
13	Dhemaji	3237	33468	4.38	10.34
14	Tinsukia	3790	40626	5.31	10.72
15	Dibrugarh	3381	72461	9.48	21.43
16	Sibsagar	2668	12582	1.65	4.72
17	Jorhat	2851	45979	6.02	16.13
18	Golaghat	3502	43635	5.71	12.46
19	Karbi Anglong	10434	5810	0.76	0.56
20	North Cachar Hills	4888	6619	0.87	1.35
21	Cachar	3786	10419	1.36	2.75
22	Karimganj	1809	6450	0.84	3.57
23	Hailakandi	1327	2600	0.34	1.96
Total		78438	764372	100.00	9.74

The maximum area of wetland present in Sonitpur District. The total wetland area in the district is 83427 ha that includes 980 small wetlands (<2.25 ha). River/stream occupies 94.52% of wetlands. The other major wetland type is Waterlogged - natural (2.22%) and Ox-bow lakes (1.04%).

Hailakandi has the lowest area of wetland (2600 ha), that includes 30 small wetlands (<2.25 ha). The major wetland type is River/stream (66.27%). Total 19 Lake/pond covering 575 ha area (22.12%). The other major wetland type is Waterlogged-natural (10.46%).

Some critical aspects of PFZ:

- When PFZ is in the form of a line, then fishing at the center of the line will give the maximum catch.
- If the PFZ to as a curve, then fishing inside the curved area will yield a maximum catch. (Fig:1)
- If two or more PFZ is there close to each other, than fishing in between those gives a better catch. (Fig:2)



Benefits of GIS:

1. GIS provides a vast range of tools that allow for accuracy of output and thoroughness of decision making.

2. To create a new map it is a simple task to update them, to change or to merge them with other maps, once maps have been established in a digital format.

3. The range of possible graphic displays is almost infinite, which allows maps to be customized to match situations and individuals, and for visualization experiments to take place.

4. The GIS contains the prerequisites for modeling scenarios concerning the research aspect and operational resource management tasks.

5. The GIS allows for the smooth and immediate integration of other large data sets.

6. The GIS allows for the display of spatially related data in a way that is easily understandable and comprehensible to most people.

7. The use of GIS significantly improves the speed of working in all map producing operations thus human productivity.

8. The GIS allows for a regular flow of spatially related information in a standardized arrangement. It might be for a particular time, where all maps are created together, or sometimes a different version of the same map can be uploaded.

9. The GIS allows for the production of one-off maps of a high quality, which would otherwise be non-cost effective.

Disadvantages of the GIS:

1. The input sources to a GIS may be of a varying standard. This means that a certain degree of error propagation will be inevitable, and the extent of this is difficult to measure.

2. GIS implementation will undoubtedly have an impact on the department, such that organizational changes will be compulsory. There could well be inevitable losses in this process.

3. The cost of data inputs can be high, either in terms of purchasing existing digital data or in maintaining and setting up data gathering systems. These costs may be unpredictable at an early stage. So the actual value of utilizing a GIS is challenging to found.

4. The means and degree of access to data sources will be variable. The legal position concerning this is sometimes poorly determined or unnecessarily restrictive. There are copyright problems in making newly created data available.

Conclusion: By delivering goods and services through proper route planning, GIS tools can save billions of dollars annually. GIS regularly helps in the day-to-day management of many natural and human-made resources, which includes sewer, water, power, and transportation networks. Applications of GIS in marine and coastal ecosystem study is an emerging field today. The marine geographical interpretation using GIS became a vital tool in the field of marine policy making, planning, and conservation. The critical role that GIS plays to the cooperation of organizations in various international agreements for the management and the use of the marine areas include maritime transport, fisheries, recreation, disposal of waste, conservation. For the purpose of resource availability analysis, though numerous technologies are being conceived still GIS is the most propitious one. GIS helps to access food fishery potential, judge the environmental health of river and lake basins and allocate resources between the management of fisheries and the development of aquaculture. It also helps us to identify the source, location, and extent of adverse environmental impacts. GIS enables us to devise practical plans for monitoring, managing, and mitigating environmental damage. Analysis of satellite data helps in assessing the productivity of resources, whereas GIS may help in the comprehensive development plan for fisheries. To apply GIS tools in the fishery sector, the central government should take a collaborative program, the state government through their remote sensing centers, universities. National Remote Sensing Agency and Space Application Centre, Planning Commission, should come forward to approve and provide funds for such a project. Several studies have been done in the marine sector using GIS, while studies in the Inland sector have been very minimal. Hence, more focus on the use of GIS in the Inland fisheries sector should also be taken to tap the maximum production potential.

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FEED ADDITIVES IN AQUACULTURE

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Highlight Points

Feed additives play an important role in modern aquaculture. Feed additives represent various classes of molecules, compounds, or organisms that promote ingestion, absorption, assimilation of nutrients, growth, and health. They affect physiological processes, such as immune function, stress resistance, and reproduction. Feed additives include feeding attractants, immunostimulants, prebiotics, probiotics, acidifiers, essential oils, or other inclusions.

Introduction:

Feed additives play an important role in modern aquaculture. They are products used in animal nutrition to improve the characteristics of feed, for instance to enhance flavour or to make feed materials more readily digestible. They are often used in intensive farming production on a large scale. Feed additives represent various classes of molecules, compounds, or organisms that promote ingestion, absorption, assimilation of nutrients, growth, and health. They affect physiological processes, such as immune function, stress resistance, and reproduction. Feed additives include feeding attractants, immunostimulants, prebiotics, probiotics, acidifiers, essential oils, or other inclusions. The feed additives industry is dominated by large multinational groups such BASF, DSM, CARGILL,Keminand EVONIK, to name a few.The global feed additives market was valued at USD 31.74 billion in 2018, and it is expected to register a compound annual growth rate of 4.6% during the forecast period (2019-2024). Asia-Pacific is projected to be the fastest-growing market for feed additives. Feed additives may not be put on the market unless authorization has been given following a scientific evaluation demonstrating that the additive has no harmful effects, on human and animal health and on the environment.

Definition:

According to AAFCO(Association of American Feed Control Officials) a feed additive is defined as an ingredient or combination of ingredients added to a basic feed mix or parts thereof to fulfill a specific need (usually used in micro quantities and requiring careful handling and mixing).

Feed additives include:

(1) The addition of specific nutrients in synthetic or purified form (includes specific amino acids, vitamins, minerals and trace elements, cholesterol, phospholipids, etc.).

(2) The addition of specific chemicals, nutrients or ingredients that aid in maintaining feed quality, stability, and/or attractibility (includes chemical preservatives, antioxidants, emulsifiers, antimicrobial compounds, pellet binders and feeding stimulants).

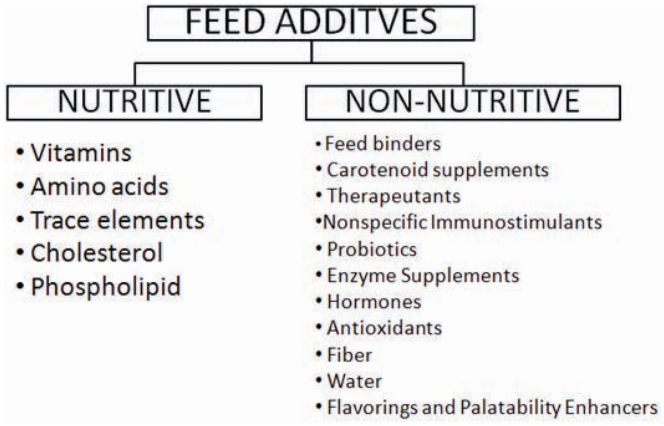
(3) The addition of specific compounds or substances that target feed digestibility, animal performance, health and/or flesh quality (includes enzymes, acidifiers, growth promoters [hormones, antibiotics], pigments, immune enhancers, probiotics, etc.).

Why feed additives are required?

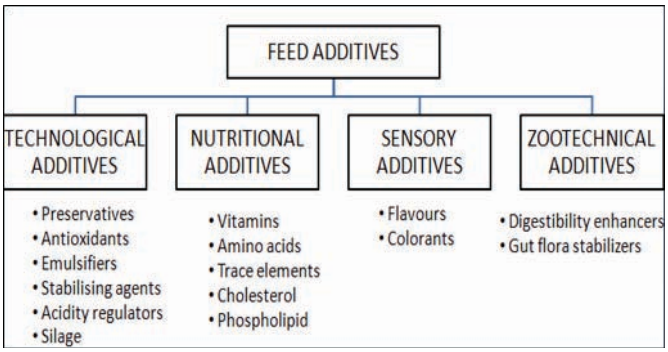
- To preserve feed nutritional characteristics prior to feeding (i.e., Antioxidants and mould inhibitors).
- To facilitate ingredient dispersion or feed pelleting (i.e., Emulsifiers, stabilisers and binders).
- To facilitate growth (i.e., Growth promoter, including antibiotics and hormones).
- To facilitate feed ingestion and consumer acceptance of the product (i.e., feeding stimulants and food colourants).
- To supply essential nutrients in purified form (i.e., Vitamins, minerals, amino acids, cholesterol and phospholipids).

CLASSIFICATION OF FEED ADDITIVES

A) BASED ON NUTRITIONAL PARTITONING



B) BASED ON FUNCTION



Nutritive Feed Additives

Vitamin Premixes

Vitamin premixes are concentrates in which stable forms of essential vitamins are mixed with a carrier, usually a basal feed such as a wheat by-product. Choline chloride is not included in vitamin premixes, although it is a stable product, because it has been shown to reduce the stability of other vitamins Thus, it is added to feeds separately. Ascorbic acid is included in some vitamin premixes but is added separately to others. In the past, the concentration of vitamins in the premix was sufficiently high that the finished feed exceeded the recommended vitamin levels (NRC1993). In recent years, the level of vitamin supplementation has been lowered to match the recommended levels more closely. Vitamin premixes are added to practical diets at levels ranging from 0.5 to 4% of the diet, depending on the formulation of the vitamin premix.

Amino acids

Amino acids occupy a central position in cellular metabolism since almost all biochemical reactions are catalyzed by enzymes composed of amino acid residues. Amino acids are essential for carbohydrate and lipid metabolism, for the synthesis of tissue proteins and many important compounds (ie. adrenalin, thyroxine, melanin, histamine, porphyrins - haemoglobin, pyrimidines and purines - nucleic acids, choline, folic acid and nicotinic acid - vitamins, taurine - bile salts etc), and as a metabolic source of energy or fuel. Now a day the use of amino acids as nutritive feed additive is increasingly practice in aquafeed formulation. The use of plant ingredients such as soy protein derivatives has received increasing attention as potential substitutes for fish proteins. However, plant proteins often show deficiencies in some essential amino acids and several anti-nutritional factors. When compared to fish meal, soybean meal has low levels of digestible energy, available phosphorus and digestible methionine and higher contents of fiber. Recently, feather meal, blood meal, meat and bone meal have been used to substitute fish meal in commercial diets. However, the level of inclusion of amino acids in the commercial feed formulation is limited due to its higher cost. DL-Alanine, L-Arginine, L-Lysine Monohydrochloride, Monosodium L-glutamate, Taurine, 2-deamino-2-hydroxymethionine, DL-Tryptophan, L-Tryptophan, L-Threonine, L-Valine, DL-Methionine, L-Methionine, L-Lysine sulphate are example of some of the amino acids which is commercially produced and available in the market.

Mineral Premixes

Mineral premixes are concentrates of essential elements that are fortified in practical fish diets to make up for low levels in the formulation or to overcome antagonistic interactions among feed ingredients. The cost of trace element premixes is low, so including them in practical diets is inexpensive insurance against possible deficiencies. Additional mineral fortification is required in semi purified, experimental fish diets since their ingredients are highly refined and do not contain sufficient amounts of minerals to meet the nutritional requirements of fish.

Cholesterol

Cholesterol is a vital component of cell membranes. It also serves as a precursor for many physiologically active compounds, including sex and molting hormones, adrenal corticoids, bile acids and vitamin D. Most grain-based ingredients used in aquafeed are typically deficient in cholesterol. Crustaceans lack the ability of de novo sterol synthesis from acetate and a dietary cholesterol deficiency is most commonly manifested as a reduced growth rate. Dietary cholesterol is therefore considered essential for good growth and high survival in crustaceans. Feed grade Cholesterol is a whitish, almost odourless, crystalline powder. Cholesterol Feed grade is a natural sterol processed by extraction and refining from wool grease. It is soluble in most common solvents and vegetable oils, but insoluble in water. As one of shrimp feed additives, Cholesterol Feed grade is an essential ingredient for the synthesis of molting hormones, sex hormones, bile acids, vitamin D as well as a building block of shrimp tissues. Cholesterol Feed grade should be added before extrusion, together with other fatty compounds. Recommended dose for larval feed (1%) and for shrimp feed 0.3-0.5% depending on the growth stage.

Phospholipids

All products of plant and animal origin contain phospholipids, but not all contain high levels of specific phospholipids. In particular, vegetable phospholipids are deficient in long-chain polyunsaturated fatty acids (LC-PUFAs) like EPAand DHA. Soya phospholipids are the most widely used phospholipid source for animal nutrition, having a relatively low PC (phosphatidylcholine; a class of phospholipids) content and low omega-3 fatty acid levels.Phospholipids are required for optimal growth, survival, prevention of skeletal deformities and, possibly, stressresistance in larval and early juvenile fishes, both marine and freshwater species. In larvae fed diets rich intriacylglycerol, lack of sufficient dietary phospholipids limits lipoprotein synthesis in enterocytes, leading to impairedtransport of lipid to the tissues.For first-feeding carp larvae, the supplementation of 2 percentphospholipids to the diet highly improved both survival and final weight compared to that of carp fed phospholipids free diets. In shrimp diets supplementation of 3-4% phospholipid is necessary for optimal growth and survival.

Non-nutritive Feed Additives

Non-nutritive feed ingredients are additives that are included in diets for reasons other than to provide nutrients. For the most part, these compounds have little or no nutritional value, yet they are important constituents of fish feeds, increasing pellet stability, diet safety, diet

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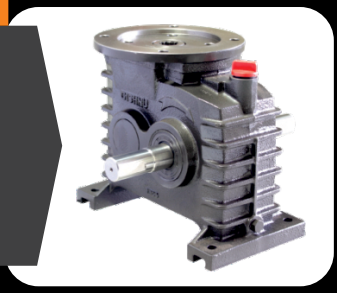
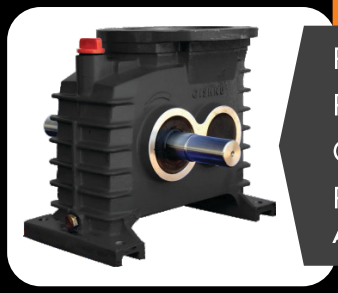




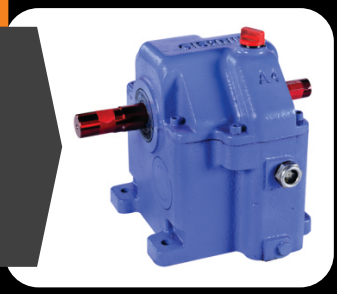
Type : A3 Aero RF (Aluminium)

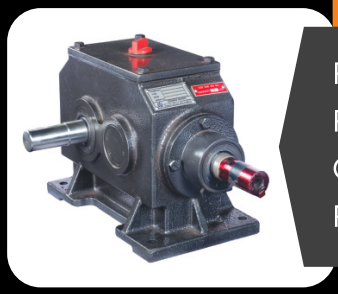
Range : 1 hp to 3 hp
Pedals : 4, 6 & 8
O/p RPM : 105 & 120
Power savings : 75%
Aluminium housing with Anti-rust coating

LONG ARM GEAR BOX

Type : A4 Single Side

Power savings : 70%
O/p RPM : 72 & 115
2 hp = 12 Pedals
3 hp = 16 Pedals





Type : GBH

Range : 3 hp & 5 hp
Pedals : 8+8 & 20+20
O/p RPM : 105 & 120
Power savings : 60%

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flavor, and animal and fish performance and health status and influencing the quality of the final product.

1. Feed Binders

Fish feeds must be formed in to particles or pellets that are strong enough to withstand normal handling and shipping without disintegrating. More-over, fish feeds must be somewhat water-stable. These requirements make it necessary for feeds to contain binders.

There are numerous materials that act as binders in fish feed, including regular feed ingredients and ingredients added solely for their binding properties. Some binders are by-products of cereal grains or plants and provide nutrients to the diet. For example, 20% pre-gelatinized potato starch is added to eel diets to increase the water stability of the dough and to provide energy. Other commonly used binders include bentonite, lignin sulfonate, and hemicellulose extract, none of which provides nutrients to the diet.Nutritive binders include oat groats, vital wheat gluten, finely milled wheat bran, cottonseed meal, gelatin, fish hydrolyzates, and pre gelatinized starches. Non-nutritive binders include tapioca, carboxymethylcellose, alginates, agar, and various gums. Chitosan, carageenan, and collagen have been evaluated as binders but are not commonly used.

2. Carotenoid Supplements

Over 300 pigments are found in various plants and animals, with xanthophylls and carotenoids being the most important classes of carotenoid pigments that add color to fish. Some finfish and shellfish possess the ability to convert certain xanthophyll pigments to carotenoid pigments. Gold fish and common carp can convert the yellow xanthophyll pigment, zeaxanthin, to the red carotenoid pigment, as taxanthin. Similarly, *Penaeusjaponicus*, a shrimp, can convert both β carotene and zeaxanth into astaxanthin. Salmon, trout, and red sea bream, which normally have pigmented flesh and skin, do not convert xanthophylls pigments to the carotenoids, canthaxanthin, and astaxanthin. In nature, they receive these pigments in their diet. Fish raised in hatcheries and farms must receive canthaxanthin and/or as taxanthin in their diets to become pigmented; in addition, carotenoid supplementation is necessary for salmonid offspring to produce viable offspring. In nature, carotenoid pigments are synthesized by algae and bio concentrated in the food chain, ultimately ending up in fish.

Carotenoid supplementation of fish diets is accomplished by adding natural materials containing the desired carotenoid pigments, carotenoid extracts of natural products, or chemically synthesized pigments. Natural materials that pigment fish include herring gull eggs, salmon eggs, paprika, zooplankton, krill products, *Haematococcus* algae, and processing waste from shrimp, crab, and crayfish processing.Concentrated carotenoid extracts of red crab and cray fish are effective dietary supplements for salmonids. The amount added to the diet depends on the concentration of carotenoid pigments in the extract, but dietary levels normally range from 3 to 7%, replacing added fats and oils. Synthetic canthaxanthin is a commercial product containing a minimum of 10% canthaxanthin and is added to commercial feeds at 0.05% to produce a dietary canthaxanthin level of about 50 mg/kg feed. Astaxanthin is themost widely used, manufactured carotenoid pigment. It contains 8% astaxanthin, by weight, encapsulated in gelatin, and is added to fish feeds at approximately 0.065% to produce a dietary astaxanthin level of 45mg/kg feed.

3. Therapeutants and Nonspecific Immunostimulants

Therapeutants are added to fish feeds to treat, cure, mitigate, or prevent disease. A number of drugs are effective against fish diseases, although in the United States, the only ones approved for use with fish feed are sulfamethazine, Terramycin and furox. Erythromycin and azithromycin have been used to treat bacterial kidney disease in captive brood stock of endangered salmon stocks, but they are not allowed in normal production.Non-specific immune stimulants, sometimes referred to as nutraceuticals, are another story. They are unregulated feed additives that are intended to enhance the health and well-being of farm and companion animals. In fish, the focus on nutraceuticals lies in making the fish less susceptible to infectious disease. The most common supplements are β-glucans, which are fragments of the cell walls of yeast and mycelial fungi.The rationale behind their use is that β-glucans supposedly come into contact with leukocytes in the intestinal mucosa. Glucans supposedly possess the same chemical signals as infectious disease agents and, therefore, activate the leukocytes. Glucans are also hypothesized to physically attach to pathogens and thus render them inactive.

4. Probiotics

Probiotics are live, microbial feed supplements that are thought to stimulate animal, and possibly fish growth, by affecting the microbial flora population in the gut of the animal. Probiotics may be a single species of microorganisms or a mixture of species. The concept behind their use is that the species of microorganisms present in the supplement colonizes the gut and outcompetes detrimental species of microorganisms, thus limiting their numbers and allowing the animal (fish) to avoid wasting metabolic energy fighting the effects of detrimental microorganisms. The probiotics should be added to feeds after pelleting.The commercial probiotics available in the market contains one or several strain of these microbes: *Bacillus coagulans, Bacillus subtilis, Bacillus cereus, Bacillus badius, Bifidobacterium thermophilum, Bifidobacterium pseudolongum, Lactobacillus acidophilus, Lactobacillus salivarius,* and *Saccharomyces cervisiae.*

5. Enzyme Supplements

Enzyme supplements are either single, purified enzymes or crude enzyme preparations containing multiple enzymes that are added to feeds to enhance the digestion of feed components that the fish either cannot digest or cannot digest efficiently.The top-three enzyme suppliers to the feed industry are the Alliance DSM-Novozymes, AB VISTA, and DUPONT, with a total estimated 80% market share. Other players of importance in feed enzymes are ADISSEO, BASF, ALLTECH, as well as numerous companies located in India and in China.Phytase is an example of a single enzyme supplement used fish feeds.Phytase hydrolyzes phytate, the storage form of phosphorus in seeds, i.e., grains and oilseeds.Phytase liberates phosphorus from phytate, thus making it available to the animal or fish.Similarly, Non-starch polysaccharide digesting enzymes (NSPase) are an example of multienzyme supplement which acts on non-starch polysaccharide, an insoluble component of

polysaccharides and breaks them to soluble component once applied. Enzyme supplements are available to assist in the digestion of complex carbohydrates, collagen in skin and bones, and other feed constituents. Enzymes are typically denatured at temperatures above 65°C, so adding them to feed mixtures before compression or extrusion pelleting destroys their activity. Thus, enzyme supplements are typically sprayed on feeds after pelleting.

6. Hormones

The use of anabolic steroids in domestic animal feeds is no longer permitted in many parts of the world due to concern about hormone residues in food products. The same concerns exist for fish products, and the addition of steroids and other hormones to the diets of fish raised for market will almost certainly never be approved. However, there are some aquaculture situations in which the addition of hormones to fish diets for a short period may pose no human health risk and may prove useful to fish culturists.

Hormones which is used as an additive fall into three categories:

- Those that affect growth and feed conversion,
- Those that affect sexual development,
- Those that affect osmoregulation.

7. Antioxidants

Antioxidants are chemical compounds that are added to feed ingredients to control oxidation of lipids. Other food components, such as carotenoid pigments and tocopherols, can also undergo oxidation. Antioxidants are added to lipids and feeds to prevent oxidation by reacting with free radicals are phenolics, such as butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA), and amines, such as ethoxyquin (Thorisson et al. 1992). BHA and BHT are added to feeds at a level of 0.1%, while ethoxyquin is added at 0.015%. Other antioxidants in use include dilaury-l- thiodipropionate, propyl gallate, and thiodipropionate. Antioxidants that prevent oxidation by chelating metallic pro-oxidantsinclude ascorbic acid, phytic acid, tartaric acid, oxalic acid, and ethylenediaminetetraacetic acid (EDTA). There is a synergistic effect when phenolicor amine antioxidants are combined with an antioxidant that chelates pro-oxidants.Many lipid sources contain naturally occurring antioxidants, mainly tocopherols. These compounds inhibit autoxidation of lipids until they areused up, at which time the rate of oxidation reactions increases very rapidly.

8. Fiber

Fiber is the non-nutritive portion of feed ingredients that is measured as crude fiber in proximate analysis. It is indigestible by salmonids and other carnivorous fish, but channel catfish have intestinal microflora capable of digesting a small portion of dietary fiber. Some herbivorous fish, such as grass carp, derive nutrients from fiber but some, such as Tilapia aurea, do not. Fiber is added to semi-purified diets to facilitate binding as well as to increase digestion efficiency. Generally, fiber is not added to practical diets; rather it is avoided because it passes through the fish and adds fecal solids to rearing water and farm effluents. Fiber levels as high as 8—12% are tolerated by most fish, but such levels often result in growth depression. Fish fed diets high in indigestible fiber increase their feed intake and gastric evacuation time, but the extent to which fish can compensate in this manner is limited.In diets for fish that do not possess the ability to digest fiber, levels of fiber above 3—5% are not recommended.

9. Water

The water content of feeds ranges from 6-10% for dry-compressed or extruded pellets to 65-70% for high-moisture, wet pellets. The moisture content of feeds is important because of the potential for microbial growthin high-moisture feeds, and the moisture content is critical in the pelleting process, where it is added to the mixture as live steam just prior to pelleting. Steam pelleting and cooking extrusion increase the moisture content of the feed mixture to approximately 18 and 23%, respectively, but the pellets are dried to < 11% immediately after pelleting.

10. Flavorings and Palatability Enhancers

Fish are very sensitive to certain tastes in their feed, a trait that can be both harmful and beneficial in diet formulation and manufacture. For example, Chinook salmon fry are extremely sensitive to the presence of low levels of dietary soybean meal and respond to its presence by reducing their intake. Flavorings are common feed additives in the pet food industry but their use in aquaculture diets is only beginning to be investigated. Generally, feed acceptance is not a major problem among cultured species of fish, with the exception of fry and certain species of cold-water fish. Extracts of crustaceans, such as krill, and certain amino acids may increase appetite in fry and crustaceans, respectively.

Classification of feed additives on basis of function:

1. Technological additives: this classification refers to a group of additives which influences the technological aspects of the feed. This does not directly influence the nutritional value of the feed but may do indirectly by improving its handling or hygiene characteristics, for example. An example of such an additive would be an organic acid for preservation of feed.

2. Sensory additives: This refers to a group of additives which improve the palatability (i.e. voluntary intake) of a diet by stimulating appetite, usually through the effect these products have on the flavour or colour of the diet.

3. Nutritional additives: Such additives supply specific nutrient(s) required by the animal for optimal growth. An example would be a vitamin, amino acid or trace mineral. In most cases, such additives are simply concentrated forms of nutrients supplied in natural ingredients in the diet.

4. Zootechnical additives: These additives improve the nutrient status of the animal, not by providing specific nutrients, but by enabling more efficient use of the nutrients present in the diet. An example of such an additive would be an enzyme or direct fed microbial product, both of which enhance the conditions of the intestinal tract, thus enabling more effective nutrient extraction from the diet. In this respect they are often referred to as pro-nutrients, i.e, products which improve the nutritional value of a diet without necessarily providing nutrients directly.

Conclusion:

The feed additives are very essential component of feed formulation. A large variety of feed additives are used in aquaculture practices due to their diverse and proven role in aquaculture. In coming years there use and importance will be further realized by the aquaculture industry.

Note: References can be provided on request.

Seed Production and culture aspects of *Pangasius pangasius*

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Highlight Points

- *Pangasius pangasius* is an important and fast growing food fish with an ability to grow in low dissolved oxygen levels (0.05 to 0.10 mg/litre)
- Induced spawning and hatchery seed production of mature *Pangasius pangasius* provides commercial availability of Pangas seed for farming of this species
- Grow out of this fish can be done in different systems like earthen ponds, net cages and net pens at a stocking density upto 120 fish/cm^3

Introduction:

Pangasius pangasius, the Pangas catfish, is a species of shark catfish native to fresh and brackish waters of Bangladesh, India, Myanmar and Pakistan. It has also been introduced to Cambodia and Vietnam. This species grows to a length of 3 metres (9.8 ft) SL. This species is important as a food fish. It was previously abundant in Ganges and Brahmaputra rivers, but serious declines have been reported (Hossain *et al*. 2009). There is no empirical evidence to support this decline for this species throughout its range. However, localized catch data suggests that this species is being overfished (Hoq 2007). It inhabits large rivers, streams, lakes, coastal waters and estuaries. It mainly inhabits estuaries where it breeds during the rains. It does not breed in ponds. It feeds on plants, molluscs, worms and shrimps (Hossain *et al*. 2009).

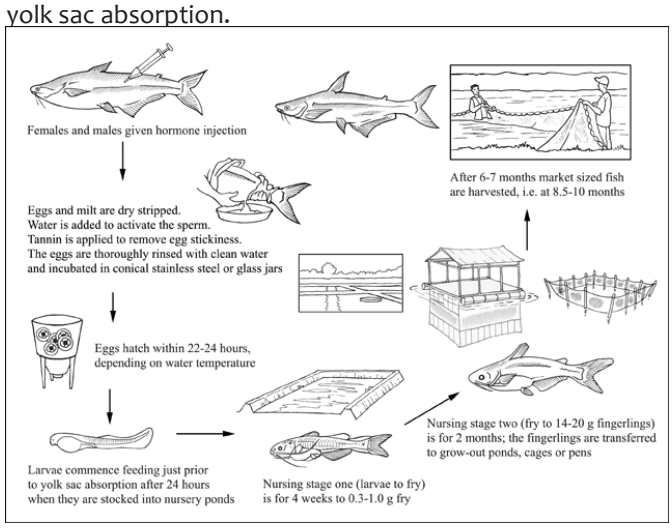
Biological Features:

Body long, latterly flattened with no scales. Head relatively small. Mouth broad with small sharp teeth on jaw, vornerine and palatal bones. Eyes relatively large. Two pairs of barbels, upper shorter than the lower. Fins dark grey or black. Six branched dorsal-fin rays. Gill rakers normally developed. Young fish have black stripe along lateral line and another long black stripe below lateral line; large adults uniformly grey but sometimes with greenish tint and sides silvery. Dark stripe on middle of anal fin; dark stripe in each caudal lobe; small gill rakers regularly interspersed with larger ones.

Production Systems:

Seed Supply:

Mature broodstock *P. pangasius* are induced to spawn in hatcheries using HCG or HCG and pituitary gland extract. Female broodstock are given between 2-4 hormone injections while males are injected only once when the female resolving dose is given. Broodstock are spawned in single pairs or in larger numbers and are usually dry stripped. The eggs are incubated in conical shaped jars made either of stainless steel or glass, with up-welling water flow to keep the eggs in suspension. Depending on water temperature, the eggs hatch usually hatch within 22-24 hours. Yolk sac absorption takes a further 24 hours. The larvae are transferred from the hatchery just prior to full yolk sac absorption.



Production Cycle

Nursery:

Nursing is done in 2 separate stages to reduce stocking density. Earthen nursery ponds, typically 1000-5000 m^2, are pre-prepared by drying (1-3 days, depending on season), liming (1t/ha), filling and stocking with *Moina* (20-30 kg/ha). Water supplied to nursery ponds is filtered through fine meshed cloth to exclude predators. In the first nursing phase larvae are stocked at 400-500/m^2 just prior to yolk sac absorption, so that natural feeds are available and the larvae have enough space to avoid cannibalism. Water is only topped up and is not exchanged during the nursery phase unless water quality deterioration is obviously causing stress. Boiled egg yolk and soybean meal mixed into an emulsion is fed 5 -6 times a day for the first 2 weeks. Thereafter commercial pellets are fed. After 4 weeks, following a 24 hour starvation period the nursery ponds are partially (about 1/3 depth) gravity drained and then pumped dry, and the 0.3-1 g fry are harvested by seine net and transferred and stocked at 150-200/m^2 in another pre-prepared pond without *Moina*. Typical larvae to fry survival rate during the first nursing stage is 40-50 per cent. In the second nursing stage, from fry to 14-20 g fingerlings, survival rates over the 2 month nursing period are typically 60-70 per cent. Fingerling transport is done early in the morning to avoid direct sunlight. Transportation of fingerlings overland is less commonly conducted; this involves using metal drums with car battery powered aeration. Additionally, transportation overland for very short distances can be carried out in metal drums without aeration.

On growing Techniques:

Being a facultative air breather *P. pangasius* tolerates dissolved oxygen as low as 0.05 to 0.10 mg/litre, highly polluted water (chemical oxygen demand = 25), and can be stocked at densities as high as 120/m^2. The three most common on-growing monoculture systems are earthen ponds, net cage and net pens.

Ponds:

Earthen ponds (typically ranging from 1 000 to 10 000 m^2) are of simple design and are sited adjacent to or near river tributaries. Producers aerate the ponds and exchange water for several hours daily during the culture period by tidal exchange and pumping; this reduces muddy off-flavour and produces whiter flesh. Despite recommendations from government extension agencies to stock 20-40 fish/m^2, intensive monoculture ponds are usually stocked at 40-60/m^2, with some grow-out farmers stocking even higher. Yields reach 250-300 tonnes/ha/crop, exceptionally reaching 500 tonnes/ha/crop in ponds. Striped catfish reach 1.0-1.5 kg after 6 months or less, depending on the size of fingerlings stocked.

Net Cages:

Net cages are sited on major river tributaries of and range in size from 50 to 1 600 m^3 with larger cages commonly having living quarters above the water. On growing cages are typically stocked at 100-150/m^3 and yields are typically 100-120 kg/m^3/crop.

Net pens:

Stocking densities for pen systems are typically 40-60/m^2, producing yields of 300-350 tonnes/ha/crop, although levels as high as 500 tonnes/ha/crop have been are reported.

Feed Supply:

The unit cost of farm-made feeds is cheaper but these feeds have FCRs of 2.8-3.0:1 and cause greater water quality deterioration. The feed conversion ratio of *P. pangasius* fed commercial pellets is typically 1.7-19:1. Larger-scale producers in Viet Nam only use commercial pellets, while medium-scale grow-out producers typically usually use commercial pellets for the first month and the last month of the on growing period and farm-made feeds for the middle four months. This technique reduces the cost of each kilogram of fish produced despite the higher FCRs of farm-made feeds. Depending on rearing intensity feed represents 65-85 percent of ongrowing costs.

Harvesting techniques:

Striped catfish are harvested from ponds by netting, following partial tidal gravity drainage and pumping. Cages are harvested by raising the cage netting by hand. It is normal for an entire pond or cage to be harvested at a single time to meet the large volume requirements of processing plants. Net pens are harvested by seine netting on spring low tides.

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Threatened, Endangered and Vulnerable Aquatic Organisms with Special Reference to Elasmobranches

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Highlight Points

- The improper interventions of human beings in nature are pushing several of the aquatic species in the ecosystem to the brink of extinction.
- According to IUCN, hundreds of marine species across the world come under the categories of endangered and critically endangered species.
- The unprecedented unnatural extinction of aquatic organisms not only endangered the functioning of the ecosystem but also affected the ecological issues to a large extent.
- This article throws light on threatened aquatic organisms with special emphasis on Elasmobranchs, their status according to IUCN Red list and suggestions for conservation.

Aquatic species are those organisms that live wholly or mostly in or on the water (fresh, brackish or salt). These birds, mammals, fish, reptiles, amphibians, invertebrates and plants depend on aquatic environments for food, shelter, protection from predators, and other requirements of life. The oceans are home to a large percentage of Earth's biodiversity, occupying 70 percent of its surface and, when volume is considered, an even larger percentage of habitable space. About 75% of earth surface is covered by water, where 97% of water are salt water, 2% of water are from glaciers, and only 1% of water is available as freshwater (IUCN, 2018).

Ecosystem is comprised of interdependent animals and plants which constitute a complex web of life. This variety of life on earth, the biodiversity that features numerous interactions among the species, is most vital to the existence of our planet and, particularly, of humanity. Thus, indeed the extinction of a single species may affect the whole biological system pertaining to life and living things (Shamseer, 2019). Unfortunately, the improper interventions of human beings in nature are pushing several of the species in the ecosystem to the brink of extinction. The unprecedented unnatural extinction of these species has not only the endangered functioning of the ecosystem but also affected the ecological issues to a large extent.

From unknown creatures to Charismatic megafauna, these disappearances in the ecosystem happen frequently. On land, animals like Orangutan (Chimpanzee, Monkey, Gorilla, etc.) Black Rhinos, Amur Leopard and Giant Pandas are some of the most critically endangered species in the world. Similarly, many marine species including marine mammals, sea turtles and salmonids are also on the edge of extinction as climate change and overfishing become a major threat to their existence (Shamseer, 2019). According to the International Union for Conservation of Nature (IUCN), hundreds of marine species across the world come under the categories of endangered and critically endangered species. IUCN, at regular intervals, determines the status of species considering the probability of their extinction, from least concern to extinct. The IUCN Red List of Threatened Species is the world's most comprehensive information source on the global conservation status of animal, fungi and plant species. By evaluating the extinction risk of thousands of species, it is a powerful tool to inform and catalyze action for biodiversity conservation. It also influences the policy changes that are critical to protecting the natural resources and processes that humans rely on.

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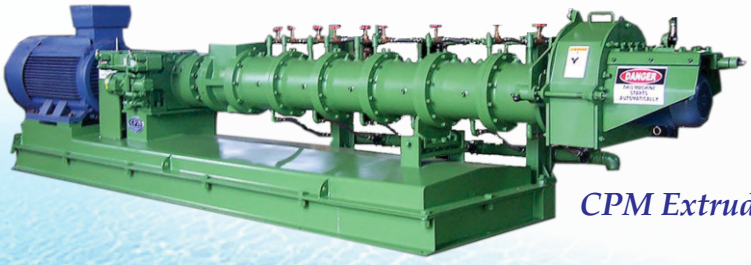

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Threatened & recognizable categories

Species are classified by the IUCN Red List into nine groups, specified through criteria such as rate of decline, population size, area of geographic distribution, and degree of population and distribution fragmentation. They are Extinct (EX), Extinct in the wild (EW), Critically Endangered (CE), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DD) and Not Evaluated (NE). According to IUCN, Threatened embraces the categories of Critically Endangered, Endangered and Vulnerable. CR is a particularly and extremely critical state. Population of less than 250 mature individuals & 80% reduction in population size over 10 years & 3 generations are considered as critically endangered. EN species are organisms (animals or plants) that are at risk of becoming extinct. Population of less than 2,500 mature individuals & 50% reduction in population size over 10 years & 3 generations are considered as endangered. VU are organisms that are at high risk of endangerment in the wild. Population having less than 10,000 mature individuals & 20% reduction in population size over 10 years & 3 generations are considered as vulnerable.

List of different environment and wildlife protection acts and conventions

i. Endangered Species Act, 1973: The Endangered Species Act (ESA) was enacted by Congress in 1973. Under the ESA, the federal government has the responsibility to protect endangered species (species that are likely to become extinct throughout all or a large portion of their range), threatened species (species that are likely to become endangered in the near future) and critical habitat (areas vital to the survival of endangered or threatened species).

ii. Wildlife Protection Act, 1972: The Wildlife Protection Act (WPA) was enacted on 9th September 1972. Main purpose of the act was to protect the wild flora and fauna.

iii. Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES): CITES is an international agreement between governments. It was opened for signature in 1973 and entered into force on 1st July 1975. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.

iv. International Union for Conservation of Nature (IUCN): IUCN was established in 1948. It is an international organization working in the field of nature conservation and sustainable use of natural resources. It is involved in data gathering and analysis, research, field projects, advocacy, and education. IUCN's mission is to influence, encourage and assist societies throughout the world to conserve nature and to ensure that any use of natural resources is equitable and ecologically sustainable.

v. Convention on Biological Diversity (CBD): CBD was opened for signature in 1992 and entered into force on 29th December 1993. Main goal of CBD is conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of benefits arising from genetic resources.

vi. Environment Protection Act (EPA): EPA was passed in March 1986 and came into force on 19th November 1986. Main aim of EPA is to provide for the protection and improvement of environment and for matters connected therewith.

vii. vii. International Whaling Commission (IWC): It is an international body set up by the terms of the International Convention for the Regulation of Whaling (ICRW), which was signed in Washington, D.C., United States, on 2 December 1946. Main aim of IWC is to provide for the proper conservation of whale stocks and thus make possible the orderly development of the whaling industry.

Lack of Protections

Cartilaginous fish are particularly vulnerable to overfishing because they typically grow slowly and produce few young. Many species are increasingly targeted due to new markets for meat & gills, and high demand for shark fin soup. Finning is banned in roughly 70 countries & by regional fishery bodies, but most enforcement standards are lenient. Regional fishery bodies & wildlife treaties offer international safeguards for a small fraction of shark & ray species. Most countries still do not accurately monitor and/or limit shark, ray, and/or chimaera catches. Rays are generally subject to as much (if not more) fishing than sharks under fewer, less stringent protections (Dulvy et. al., 2014). Chimaeras have fewer limits than do sharks or rays, but there are fewer species which are not as heavily fished.

Table 1. Number of species evaluated in relation to the overall number of described species, and numbers of threatened species by major group of organisms

Group	Estimated no. of described species	No. of species evaluated by 2019	% of described species evaluated by 2019	No. of Threatened species by 2019
Vertebrates				
Mammals	5801	5801	100%	1220
Birds	11126	11126	100%	1492
Reptiles	10793	7541	70%	1367
Amphibians	8043	6771	84%	2157
Fishes	34200	18449	54%	2494
Subtotal	**69963**	**49688**	**71%**	**8730**
Invertebrates				
Corals	2175	864	40%	237
Mollusks	80325	8728	11%	2231
Crustaceans	47000	3181	7%	733

(Source: IUCN Red List Version 2019 – 2)

Table 2. Extinction risk and conservation of the world's sharks and rays

a) Most & least Threatened families of sharks, rays &chimaeras (Cartilaginous fishes)

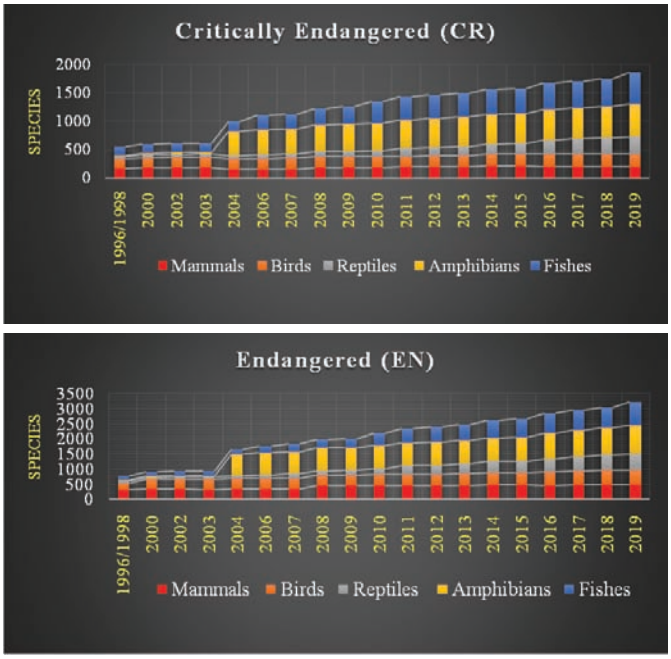
Most Threatened families	
No.	**Families**
1.	Sawfishes (Pristidae)
2.	Angel sharks (Squatinidae)
3.	Wedgefishes (Rhynchobatidae)
4.	Sleeper rays (Narkidae)
5.	Whiptail stingrays (Dasyatidae)
6.	Guitarfishes (Rhinobatidae)
7.	Thresher sharks (Alopiidae)
Least Threatened families	
8.	Lantern sharks (Etmopteridae)
9.	Cat sharks (Scyliorhinidae)
10.	Softnose guitarfish (Arhynchobatidae)
11.	Softnose chimaeras (Chimaeridae)
12.	Kitefin sharks (Dalatiidae)

(Source: Dulvy et al., 2014)

b) Sharks and rays species changing IUCN Red List status (2018-2019)

Scientific name	Common name	IUCN Red List (2018) category	IUCN Red List (2019) category
Bathyraja smithii	Softnose Guitarfish	DD	LC
Bathyraja tunae	Cristina's Guitarfish	DD	LC
Carcharhinus dussumieri	Whitecheek Shark	NT	EN
Centrophorus seychellorum	Seychelles Gulper Shark	DD	LC
Cephaloscyllium albipinnum	WhitefinSwellshark	NT	CR
Chlamydoselachus africana	Southern African Frilled Shark	DD	LC
Euprotomicroides zantedeschia	Taillight Shark	DD	LC
Glaucostegus cemiculus	Blackchin Guitarfish	EN	CR
Glaucostegus granulatus	Sharpnose Guitarfish	VU	CR
Glaucostegus halavi	Halavi Guitarfish	VU	CR
Glaucostegus obtusus	Widenose Guitarfish	VU	CR
Glaucostegus thouin	Clubnose Guitarfish	VU	CR
Glaucostegus typus	Giant Guitarfish	VU	CR
Isurus oxyrinchus	ShortfinMako	VU	EN
Isurus paucus	LongfinMako	VU	EN
Narcine bancroftii	Caribbean Numbfish	CR	LC
Odontaspis noronha	Bigeye Sand Tiger	DD	LC
Pseudocarcharias kamoharai	Crocodile Shark	NT	LC
Rhina ancylostoma	Bowmouth Guitarfish	VU	CR
Rhynchobatus australiae	Bottlenose Wedgefish	VU	CR
Rhynchobatus cooki	Clown Wedgefish	VU	CR
Rhynchobatus djiddensis	Whitespotted-Wedgefish	VU	CR
Rhynchobatus laevis	SmoothnoseWedgefish	VU	CR
Rhynchobatus luebberti	African Wedgefish	EN	CR
Rhynchobatus springeri	BroadnoseWedgefish	VU	CR
Squalus albifrons	Eastern Highfin-Spurdog	DD	LC
Squalus chlorocculus	GreeneyeSpurdog	NT	EN
Squalus crassispinus	FatspineSpurdog	DD	LC
Squalus nasutus	Western LongnoseSpurdog	DD	NT
Squalus notocaudatus	BartailSpurdog	DD	LC
Squatina africana	African Angelshark	DD	NT
Squatina argentina	Argentine Angelshark	EN	CR
Squatina dumeril	Atlantic Angelshark	DD	LC
Squatina occulta	Hidden Angelshark	EN	CR
Trygonoptera galba	Yellow Shovelnose Stingaree	DD	LC
Trygonoptera imitata	Eastern Shovelnose Stingaree	NT	LC
Trygonoptera testacea	Common Stingaree	LC	NT

(Source: IUCN Red List Version 2019 – 2)



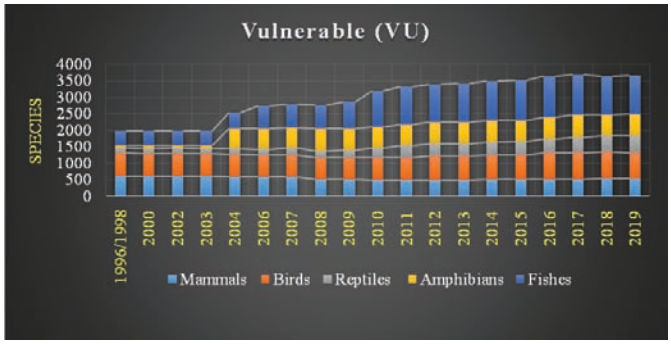


Fig. 1. Changes in numbers of species in the threatened categories (CR, EN, VU) from 1996 to 2019 for the major taxonomic groups on the Red List

Conservation strategies

Promptly & accurately report species-specific cartilaginous fish catches to proper authorities. Implement all existing scientific advice regarding cartilaginous fish & their habitats. Develop/implement national & regional plans of action pursuant to the International Plan of Action for Sharks. Set cartilaginous fish catch limits based on scientific advice and the precautionary approach. Fully protect shark & ray species that are at high risk such as those deemed critically endangered and endangered. Improve monitoring and enforcement in fisheries taking cartilaginous fishes (including by ending at-sea fin removal). Regularly assess the health of cartilaginous fish populations & effects of new factors. Promote research toward minimizing incidental catch & discard mortality. Employ the tools associated with wildlife treaties to complement fisheries management, and facilitate cooperation among countries to conserve shared population

References can be provided on request.

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Need of Diligent Knowledge on Transforming Biofloc Technology to the Indian Aquaculture Farmers

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Introduction

One of the first references in the popular scientific literature to what now is referred to as "biofloc" by the aquaculture community might be traced to a short piece entitled " Food Bubble" that appeared in the Nov, 1964 issue of the scientific American Magazine. One of the first applications of biofloc technology for aquaculture was in the early 1970'2 at the IFREMER-COP (French Research Institute for Exploitation of the Sea, Oceanic Centre of the Pacific Research Facility in Tahiti (Emerenciano et al., 2013). This ground-breaking work remains the base for the development of this innovative technology in aquaculture. Interest in biofloc continued to spread all over the world rapidly. Biofloc Technology in outdoor ponds and tanks and indoor raceways and tanks continues to advance as a result of the work of a number of research teams and commercial groups.

The rapid expansion of the useful biofloc technology, fuelled by private entrepreneurs demand for an appropriate Policy and Authorities/Approval bodies to unlock aquaculture's potential for supporting sustainable and resilient food

Highlight Points

The paper sets an awareness call to caution the stakeholders involved in the aquaculture to take up the biofloc technology in a right direction. This paper also discusses the status of the adoption of this technology in India including its challenges along with suitable recommendations. This paper also discuss the cases for change to improve management and economic viability when operated at high densities with no water exchange under biofloc dominated conditions.

systems and livelihood. Although momentum to promote equitable (and sustainable) aquaculture as a means to progress towards the Sustainable Development Goals (SDGS), it is essential to develop Minimal Water Exchange Technology such as Biofloc Technology to upgrade the low tech and small scale based aquaculture systems substantially to increase productivity, sustainability and profitability.

Status of Biofloc Technology in India

- Biofloc in nursery rearing of shrimps is quite popular in India and it is also widely adopted in shrimp hatcheries and shrimp farms of India
- A concept of "Semi Floc" system is slowly picking up for the grow out culture of shrimps due to the shoot up level of nitrite and floc volume in the later part of the culture days.
- As for as India is concerned, the biofloc technology is not yet widely accepted by the farmers mainly cause of the technical intricacies that the technology hold.
- This technology is widely now adopted by the farmers of Odisha, Andhra Pradesh, and West Bengal followed by Tamil Nadu and Haryana. Many farmers in the rest part of India struggle with the right flocking equilibrium in ponds, and the method is still not in wide use among Indian farmers
- The adoption of technology in a larger scale is highly hindered by the high energy cost as it demands heavy aeration for the flocs to remain in suspension continuously throughout the crop in the culture system.
- There is a big debate on the use of probiotics in biofloc technology which is currently attracting a attention of the researchers and still it remains a hypothetical question.
- Besides the use of probiotics, use of other functional feed ingredients such as enzymes, amino acids and immune boosters are also seen in some parts of India.
- The indiscriminate use of probiotics and other functional feed ingredients are driven by commercial demands rather than for the technical need of the biofloc system.
- Many small scale farmers or the new beginners go for budgetary circular tanks in trial and error mode. Use of iron meshed frames or the GI based sheets as the frames for the circular tanks are also observed which seldom give viable results in terms of productivity due to the inherent deficiencies of these make- shift-culture systems.
- Choice of species for the biofloc is paramount importance and the success of the crop is depending mainly on the species chosen. Government institutes and agencies gives due importance for the species like Improved Tilapia breeds (GIFT, Chitralata, etc)and shrimp(Penaeus vannamei particularly) as they are known to give better results in terms of growth and FCR. Not all the cultivable species can be promoted under the biofloc system.
- Farmers mindset and their 'Fear' on sludge and floc management in biofloc systems is also widely observed.A fear of dejection of shrimp consignment possibly due to the accumulation of floc in the shrimp hepatopancreas is one of the reasons for the farmers hesitation in taking up this technology.

Challenges in Moving Forward

- Advances in biofloc systems have been impressive, but current knowledge certainly is not adequate. For example, the failure of some indoor biofloc projects can be traced to the complex interrelationships that characterize the diverse and difficult-to-control microbial biofloc community. This assemblage can be unstable in relatively small tanks stocked at high densities and driven by the large input of feed required for a fairly good shrimp growth. If the microbial community of the biofloc system is not balanced properly, harmful chemicals can accumulate, particularly ammonia, nitrite, and nitrate. Water quality changes are exacerbated when water is reused over multiple crop cycles.
- Handling of biofloc system demands adequate technical acumen and expertise and its not meant for beginners or for those without the basic knowledge of aquaculture and biofloc techniques. As biofloc comprises predominantly a complex of bacteria and algal communities , balancing them in a culture system requires the knowledge of continuous monitoring of various parameters(water, sludge and floc).
- There are two types of biofloc systems one can adopt. The first one is , ' Green biofloc system' which refers to the out door ponds and tanks meant for the biofloc production. This requires sunlight as the algal composition needs to be balanced along with the bacterial growth in such systems.
- The second type will be 'Brown biofloc system' which refers to the indoor raceways and tanks meant for the production of biofloc. Since the algal growth will be minimum in such indoor systems, floc has to be predominantly developed and maintained in such systems with the help of heterotrophic bacterial colonies.
- Such complicated technical intricacies involved in biofloc system management may not be promoted by carrying out various essential paraments (for production and management)using the ready-made commercial kits as

its promoted largely in India now by many firms. Biofloc system can be managed successfully only by C:N ratio management and this could be possible precisely by the close monitoring of parameters of water, sludge and floc of the system.

- Trouble shooting the problems in water quality, disease management, culture systems maintenance. Biofloc driven culture systems and farms require a minimum lab facility enable them to monitor the essential parameters continuously. The lack of a stable grid connection is an additional layer of complexity.
- It's being observed that many young professionals are starting new small scale aquaculture projects in the name of Biofloc and RAS systems, even though it's good to see building up interest in IT, and non-fisheries start-ups to enter into fish/shrimp culture, it's been observed that many of them are dependent on YouTube and Facebook videos and also the self-claimed technicians in YouTube many of whom doesn't even understand aquaculture leave alone biofloc system. Finally the projects are lacking any suitable business goals/views and will become just a projects for photos and add up-to one more YouTube video but unable to achieve any results.
- Indiscriminate use of unapproved drugs/chemicals in the name of probiotics is widely seen as these 'pseudo' consultants are branding it without knowing its composition. In addition, there is a lack of evidence as to the mechanism of action and of the effects on aquaculture animals.
- Adoption of circular tanks for biofloc technology is the most welcome gesture and this sort of customization has taken the technology to the nooks and corners of the country. But farmers/new beginners should not forget, only a limited production can be obtained through these PVC based/HDPE based liner tanks. Biofloc no-doubt is an ideal and proven technology for enhancing fish production to a greater extend but it cannot do 'magic' as its being projected falsely by many firms with questionable reputation to lure the people!
- The HDPE synthetic sheets of 650 GSM is being used widely as the liner material to fabricate larger tanks. The initial investment will be more and it should not be exposed to sunlight which will affect its durability. Here again the firms have hiked the prices exorbitantly of these materials when they sell them in aquaculture sector.
- A package of water quality parameters kit and unauthorised probes and water quality testing kits are widely being popularised by these 'pseudo' consultants.
- There are lot of popular such 'pseudo' consultants on YouTube /Face book and social media who are continuously exploiting and misguiding people for hiked consultancy charges and commissions. They are mushrooming and minting money with their 'so called' training programs.

Recommendations for Future Growth

- A dedicated Aquaculture Policy to promote and secure the right prototype for the adoption of this technology for finfish and shellfish culture.
- Dissemination of Standard Operating Procedures (SOPs) the Biofloc driven culture can be released by the appellate Governing bodies.
- Recommendations for the optimum stocking density of the different culture systems using biofloc technology
- The Fisheries Depts can play a vital role in this aspect and they need to equip the officials with adequate knowledge of the biofloc technology and its intricacies. Regular training programmes have to be organised by them and other Fisheries Institutes by the expert teams in such technical matters. Model indoor and out door facilities for bio floc production are to be developed by them to extend hands- on- training to the needy people.
- Apart from training the farmers and entrepreneurs, Trainers Training programs also can be offered to develop adequate man powerto disseminate the technology rapidly to all the needly people across the country. Such trainers canbe given a Certificate/License by the recognised Fisheries Institute.
- State Fisheries Dept can issue an appropriate Govt order as per the local needs in this regard to promote biofloc driven aquaculture on scientific line with the guidance of approved agencies/institutes for the benefit of the stakeholders.
- Importance of this technology by highlighting its benefits and management strategies should reach the farmers vividly with the support of Government agencies, KVKs, Professional NGOs and Research Institutes.
- A considerable investment in the R & D of the biofloc technology to quench its possibilities for reducing the input cost in aquaculture production along with bioremediation measures is highly required for the developing country like India.
- 'Traceability of Biofloc Farms' by means of certifying the farms by the government bodies will enable the monitoring bodies to vent out the void in perfecting the system prototype.

Conclusion

The information presented in this paper summarizes the experience we have in operating such model commercial systems and observations transferred during several farmers' interaction meets.Producing food in the anthropogenic era poses massive planetary challenges that aquaculture is uniquely posed to meet. Next generation farming, marked by total recirculation, total waste capture and recycling, increased automation, more environmental controls and annual production levels has to be adopted for doubling the fish production. Biofloc Technology stands very clear in meeting out the demands of the sustainable development goals for the millennium aquaculture practices. Nevertheless, successful innovations can beget new problems and associated scarifies that call for further refinement at all stages and we are still committed to undertake such refinements in the future to serve even better for the farming community.

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