

Aqua International

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Growing Yeast from trees

Sustainable Shrimp Farming Through Aquamimicry Technique



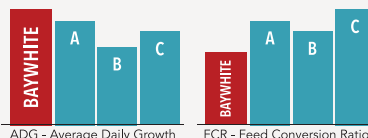
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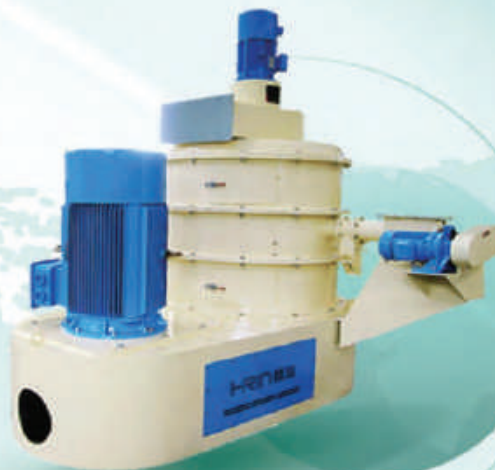
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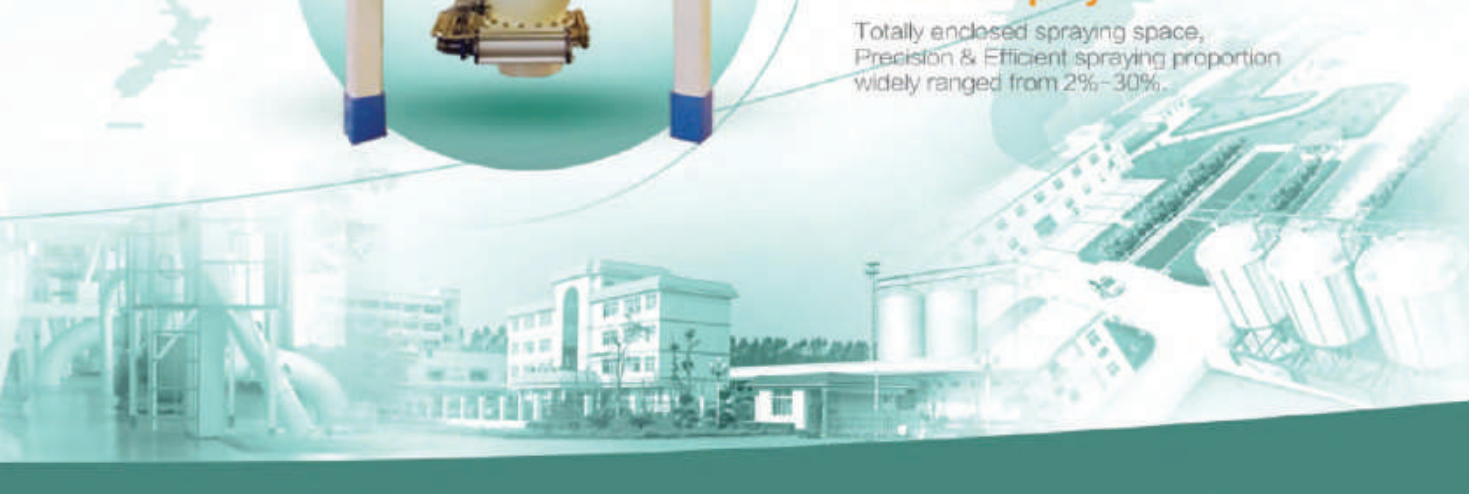
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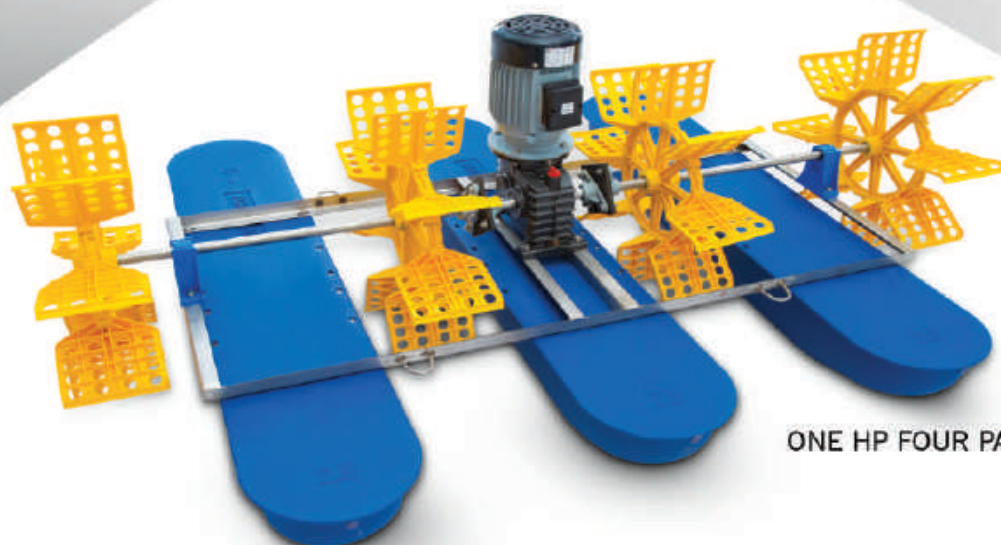
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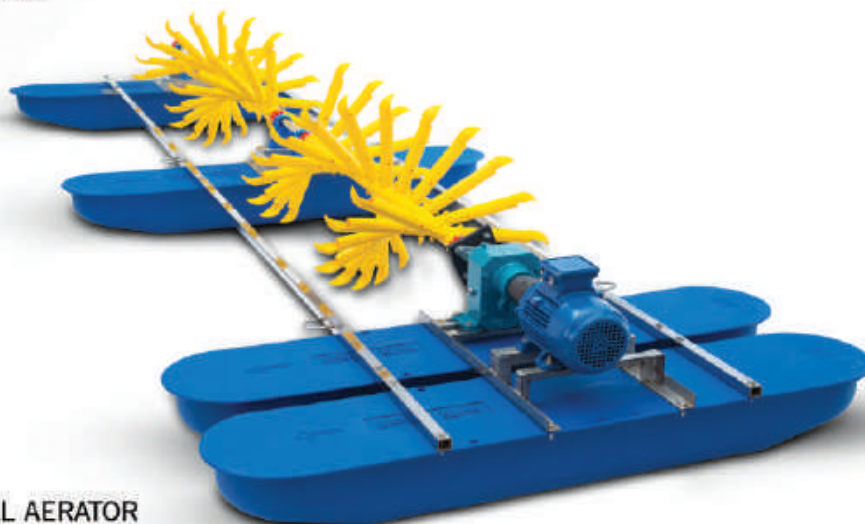
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The 8 Fisheries Research Institutes launched National Campaign on 'System Diversification in Aquaculture'

Natural estuarine condition is simulated for healthy shrimp culture. Natural food (Copepods) provides better health condition in shrimp with better disease resistance



Dear Readers,

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

In the News section, you may find news about –

The Fisheries Science Division of the Indian Council of Agricultural Research, New Delhi in collaboration with its 8 Fisheries Research Institutes viz., ICAR-CIFA, ICAR-CIFRI, ICAR-CMFRI, ICAR-NBFGR, ICAR-DCFR, ICAR-CIFE, ICAR-CIBA and ICAR-CIFT launched the National Campaign on "System Diversification in Aquaculture" on 1 September 2021. The programme was organized as a part of the "Azadi Ka Amrit Mahotsav" to commemorate 75 Years of India's Independence.

Central Institute of Freshwater Aquaculture, a premier institute for research in freshwater aquaculture, inaugurated the first Ornamental Aquaculture Field School of Odisha at the farm of Sri Rajesh Ranjan Mohapatra of Kochila Nuagaon Village, Cuttack district, Odisha.

On the occasion of 4th Rashtriya Poshan Maah 2021, the Webinar on 'Consumption of fish and other aquatic foods for improving food and nutritional security' was organized by National Fisheries Development Board, Hyderabad, India on September 6. Dr C. Suvarna, Chief Executive, NFDB explained highlighted initiatives taken by NFDB in popularization of fish consumption throughout India. She stressed upon importance of fish, fisheries and aquaculture in food and nutritional security of the nation and employment; Omega-3 fatty acids and Small Indigenous Fishes in child growth.

Growing yeast from trees - first successful scale-up of microbial feed ingredients from sustainable resources. An important milestone has been reached by the partners in the centre for research-based innovation, Foods of Norway: A successful industrial scale-up of 1,600 kg of

yeast produced from sugars from Norwegian spruce trees. Production was a joint effort by Lallemand Animal Nutrition, Borregaard and the Norwegian University of Life Sciences, all partners in Foods of Norway at NMBU.

Angel Yeast Co., Ltd, a listed high-tech yeast company in China, has recently announced that it has established a joint venture company to invest RMB 100 million (\$15.4 million) to acquire Shandong Bio Sunkeen Co, Ltd ("Bio Sunkeen"). In doing so, the company seeks to optimize its production capacity and further consolidate and strengthen its position in the industry.

In the Articles section -- Article titled **Aquaculture Fish Gems**, written by Mayank Soni and other authors highlighted that Ornamental fishes are the integral part of aquaculture, and they are as dazzling as genuine gems. Because of the rise in aquaculture hobbyists, ornamental fish cultivation is expanding at an unprecedented rate. Everyone wants a beautiful aquarium in their house. Some people desire a single fish, while others desire a large number of fish. People make decisions based on their preferences.

Many fish farmers, entrepreneurs, small business owners, and merchants all around the world are employed by this industry. This business is incredibly cost-effective and may be completed in a short period of time. Far more tiny fishes than food fishes become beneficial from this. In India, the selling price of a 10-100 gram of fish is between Rs 60 and Rs 400, whereas the cost price is Rs 1 to Rs10. In comparison to food fish, it is a considerably more successful business with much lower administration costs; anyone can start this operation in a 10 x 10 feet room with 10 to 100 fish, where there is a local market. Then the dilemma comes as to what kind of fish the farmer selects and what level of quality is required and what are the things needed for ornamental fish culture.

Contd on next page



Aqua International
Our Mission

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

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

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

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

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

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Another article titled **Sustainable Shrimp Farming through Aquamimicry Technique**, written by K.S. Vijay Amirtharaj and other authors highlighted that Natural estuarine condition is simulated for healthy shrimp culture. Natural food (Copepods) provides better health condition in shrimp with better disease resistance. Supplementary feed utilization is reduced in this aquamimicry based culture system with a better Food Conversion Ratio. Water quality parameters like pH and Dissolved Oxygen are maintained with minimum fluctuation due to the appropriate composition of microalgae and zooplankton. The culture pond bottom is maintained in good quality due to the growth of beneficial bacteria.

The other article titled **Eco-acoustics: Sound's ecological significance in aquatic ecosystems**, written by Rinkesh N. Wanjari and other authors highlighted that Eco-acoustics is the study and understanding of ambient sound from an ecological perspective. Sounds propagate in the air at 343 m/s at 0°, and propagate five times faster (1484 m/s) in water with high variability. Dolphin produced wide frequency band which extends from 2 to over 200 kHz and a source level variable between 140 and 220 dB. Eco-acoustic theatre new experience of nature through sound.

Article titled **Fuzzy Logic and its Application in Fish Processing**, written by Ganesan P. and other authors highlighted that Fuzzy logic deals information arising from computational perception and cognition, that is, uncertain, imprecise, vague, partially true, or without sharp boundaries. Fuzzy logic allows inclusion of vague human assessments in computing problems. Fuzzy logic provides the degree of truthfulness and falsehood of an experiment, achieved through just feeding the crisp fuzzy values of an experiment into it. Fuzzy concepts are being recently applied in sensory evaluation.

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

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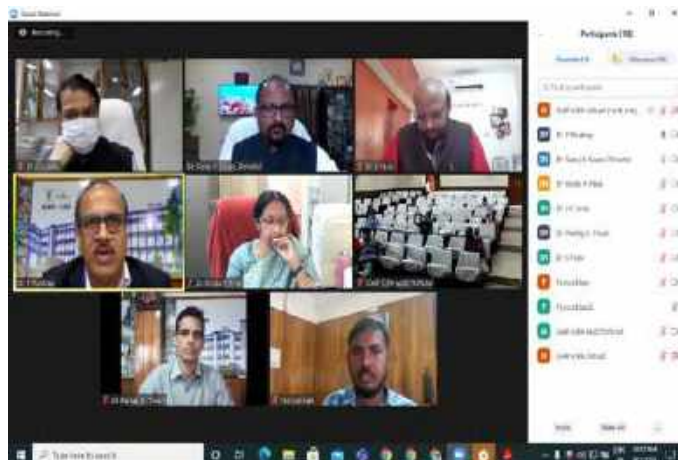
National Campaign on “System Diversification in Aquaculture” launched @ Azadi Ka Amrit Mahotsav



Bhubaneswar: The Fisheries Science Division of the Indian Council of Agricultural Research, New Delhi in collaboration with its 8 Fisheries Research Institutes viz., ICAR-CIFA, ICAR-CIFRI, ICAR-CMFRI, ICAR-NBFGR, ICAR-DCFR, ICAR-CIFE, ICAR-CIBA and ICAR-CIFT launched the National Campaign on “System Diversification in Aquaculture” on 1 September 2021. The programme was organized as a part of the “Azadi Ka Amrit Mahotsav” to commemorate 75 Years of India’s Independence. The Chief Guest, Dr Joykrushna Jena, Deputy Director General (Fisheries Science), ICAR stated that Aquaculture System Diversification, incorporating modern tools and Artificial Intelligence, is one of the key strategies for enhancing aquaculture production. Hi-end novel technologies such as RAS, Biofloc, Aquaponics, FIMTA, Flow-through etc., are increasingly attracting attention of young entrepreneurs. Dr B. P. Mohanty, ADG (Inland Fishery), briefed about the importance of the system diversification for resources optimized Aquaculture technologies.

Earlier Dr Saroj Kumar Swain, Director, ICAR-CIFA, Bhubaneswar briefed about the significance of the National Campaign. He narrated about the importance of the system diversification for sustainable aquaculture development in India. Dr S. Felix, Former Vice Chancellor, TNJFU and Dr B. C. Mohapatra, Principal Scientist, ICAR-CIFA were the lead speakers on the occasion.

Dr Felix presented on the Technological forefront for facelifting the Indian Aquaculture system. Dr B. C. Mohapatra presented about the CIFA’s significant role and achievement in System diversification in Freshwater Aquaculture. Dr B. R. Pillai, HoD, ICAR-CIFA and Co-convenor of this programme coordinated this event. Earlier, Dr P. Routray, Principal Scientist, APED, welcomed the guests and speakers. The presentation by the lead speakers was followed by a question answer session, where the questions posed by the participants were answered by the expert scientists of ICAR-CIFA. Dr Himansu Kumar De, Principal Scientist, Social Science Section, ICAR-



CIFA proposed the vote of thanks. More than 6,000 fishers, students, Entrepreneurs attended the programme. The campaign is also organized by regional research stations and Krishi Vigyan Kendras located in various

parts of the country.

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First Ornamental Aquaculture Field School of Odisha Inaugurated at Kochila Nuagaon, Cuttack

Bhubaneswar, Odisha, ICAR-Central Institute of Freshwater Aquaculture, a premier institute for research in freshwater aquaculture, inaugurated the first Ornamental Aquaculture Field School of Odisha at the farm of Sri Rajesh Ranjan Mohapatra

scheduled caste ornamental fish farmers / farm women of nearby villages contributing greatly to extension and advisory services delivery. The field school was inaugurated by Dr Saroj Kumar Swain, Director, ICAR-CIFA, Bhubaneswar.



of Kochila Nuagaon village, Tangi Chowdwar Block, Cuttack district, Odisha. Sri Mohapatra has received training and guidance from CIFA in freshwater aquaculture ventures and now he owns two farms spread over 6 acres. This unique field school is established to facilitate farmer-farmer learning and dissemination of ornamental fish culture technique. The school envisages empowering

Dr Swain while addressing the gathering urged the farmers and farm women to take up ornamental fish farming as a means to strengthening their livelihood and assured them technical support from ICAR-CIFA.

He mentioned that the AFS piloted by the institute in Odisha, West Bengal, Assam, Arunachal Pradesh and Chhattisgarh have been extremely popular.



Dr H. K. De, Principal Scientist & Chairman, SCSP gave an overview of Aquaculture Field School - An innovative extension methodology. Dr Ashis Saha, Co-Chairman, SCSP gave an overview of SCSP activities being carried out by ICAR-CIFA in Odisha. Dr Sujata Sethy, Officer In-charge, Krishi Vigyan Kendra, Cuttack graced the occasion and

fish farming was organised for the farmers, maintaining COVID-19 guidelines. The training was attended by 50 farmers and farm women. A farmers-scientists interface was also organised on this occasion and queries of fish farmers were addressed.

A soil water testing camp was also organised for the benefit of the farmers.



complimented ICAR-CIFA for the initiatives in supporting aquaculture development.

Mr I. B. Kumar, Senior Administrative Officer, ICAR-CIFA and the SCSP team from ICAR-CIFA attended the programme. A one-day training programme on ornamental

The programme was coordinated by Dr S. N. Sethi, Principal Scientist of ICAR-CIFA.

For details contact Director, ICAR-Central Institute of Freshwater Aquaculture, Kausalyaganga, Bhubaneswar – 751 009, Odisha.

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Angel Yeast Announces Acquisition of Bio Sunkeen

Yichang, China: Angel Yeast Co., Ltd ("Angel Yeast") (en.angelyeast.com), a listed high-tech yeast company in China, has recently announced it has established a joint venture company to invest RMB 100 million (\$15.4 million) to acquire Shandong Bio Sunkeen Co, Ltd ("Bio Sunkeen"). In doing so, the company seeks to optimize its production capacity and further consolidate and strengthen its position in the industry.

Angel Yeast has partnered with Shandong Lufa Holding company ("Shandong Lufa") to establish Angel Yeast (Jining) Co., Ltd. Angel Yeast (Jining) will acquire the relevant assets of Bio Sunkeen's yeast product production, while simultaneously transforming and upgrading its technological capabilities.

"Angel Yeast will utilize Bio Sunkeen's existing facilities, with further expansion plans in the future. This joint venture project is in line with Angel Yeast's 2025 strategy focusing on yeast biotechnology, nutrition and health products, and food ingredients," said Chen Hongwei, General Manager of Angel Yeast (Jining).

As a national high-tech enterprise, Bio Sunkeen currently has an annual capacity of 15,000 tons of yeast and yeast extract (YE) through its production facilities. Its main products

include yeast and YE, edible sweet potato starch, feeding products, compound seasoning, and other yeast augmented products. Angel Yeast will acquire Bio Sunkeen's yeast and yeast extract-related assets group in order to implement technological transformation and upgrade its processes and facilities. Eventually, the company hopes to build it into an important production base for its yeast products and related raw materials for food, organic feed, and organic fertilizer.

Angel Yeast's acquisition of Bio Sunkeen will help the company rapidly address potential capacity gaps as the market continues to grow. According to analysis and predictions of the period between 2021 to 2025, there will be an increasingly prominent gap between the growth rate of the yeast market and the available supply based on the group's annual production capacity. By acquiring Bio Sunkeen's biological products, Angel Yeast can rapidly increase its production capacity by 15,000 tons for yeast and YE—reducing its construction period by nearly two years and increasing the ratio of input to output when compared to building a new factory. At the same time, the acquisition will assist in consolidating the yeast industry and enhancing China's position on the global stage. Angel

Yeast's acquisition of Bio Sunkeen's assets will strengthen its position in the industry as it reduces market competition by converting competitors into partners. Together with the capabilities of Bio Sunkeen, Angel Yeast (Jining) will also be able to expand its channels for the production of yeast from hydrolyzed corn glycogen, in order to fully leverage the abundance of local corn resources and address the industry's molasses shortage.

Angel Yeast has contributed RMB 60 million (\$9.2 million) to the acquisition costs and Shandong Lufa has contributed RMB 40 million (\$6.2 million). After the acquisition goes into effect, Angel Yeast has guaranteed employment in principle for

all of Bio Sunkeen's current on-the-job employees related to the operation of its underlying assets.

About Angel Yeast Founded in 1986, Angel Yeast Co., Ltd specializes in the production of yeast and yeast derivatives. Its product range includes baker's yeast and ingredients, Chinese dim sum solutions, yeast extract-savory, human health, animal nutrition, plant care, brewing & biofuels, microbial nutrition, and enzymes. At present, Angel Yeast has 11 international advanced production bases in China, Egypt, and Russia, and provides products and services for more than 150 countries and regions globally.

SOURCE: Angel Yeast

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Consumption of Fish and other Aquatic Food helps to Improve Food and Nutritional Security

Hyderabad: On the occasion of 4th Rashtriya Poshan Maah 2021, the Webinar on 'Consumption of fish and other aquatic foods for improving food and nutritional security' was organized by National Fisheries Development Board, Hyderabad on 6 September 2021. In the beginning, Dr (Ms) C. Suvarna, IFS, Chief Executive, NFDB explained webinar objectives and highlighted initiatives taken by NFDB in popularization of fish consumption (FC) throughout India. She stressed upon importance of fish, fisheries and aquaculture in food and nutritional security (F & NS) of the nation and employment; omega-3 fatty acids and Small Indigenous Fishes in child growth. Mr S. Mehra, Joint Secretary (Inland Fisheries), Department of Fisheries (DoF), Ministry of Animal Husbandry, Dairying and Fisheries, GoI in his talk entitled 'Enhancing fish production as key objective of PMMSY - measures to promote fish consumption by States, UTs and allied industries' stated that from current 8 – 9 kg / person / year, FC will be enhanced to 12+ kg / person / year in flagship PMMSY scheme. Mr Mehra emphasized on overall improvements needed in marketing, value addition (VA), processing, packaging, fish Kiosk establishment, infrastructure development; discussed about transfer of technologies, benefits of fish and fishery products,

mobilizing fishermen and fish farmers, convergence and collaboration needed between ICAR institutes, State Governments and others, preserved and processed FC in domestic market, promoting FC for F&NS in India and the need as well as measures for enhancing fish protein consumption.

The Key-note address was given by Dr Shakuntala H. Thilsted, Global Lead for Nutrition and Public Health at World Fish and World Food Prize Laureate (2021). In her presentation entitled 'Consumption of aquatic foods (AF) for nourishing women and children'.

Dr Thilsted spoke about perspectives in F & NS both globally and in India; ensuring sustainable supply of AF; need for building resilient AF supply chain; Impact of COVID-19 on F & NS; explained the complex web of Elements, Activities and Outcomes in AF systems; micronutrients (bioavailable Fe, Zn, P, Se, I, Vitamin A, A2, B12, D and E), essential fatty acids (EFA) and protein that we get from AF; present FC as 6.5kg/person/year across India; role of AF as sustainable healthy diets. Dr Thilsted informed about concentration of micronutrients and EFA in small pelagics, clams, mussels, oysters, large pelagics, salmonids, carps, Tilapia, cod and shrimps; value-added products fish chutney and dry fish powder prepared from AF in Bangladesh; she spoke about nutrition-sensitive AF system;

ensuring its sustainable supply via homestead pond polyculture, integrated agriculture-AF systems and integrated multi-trophic aquaculture systems; F & NS for poor and vulnerable communities; developing partnership for sharing knowledge and importance of traditional knowledge. She conveyed few key messages, viz., national and state-level comprehensive policies and investments for inclusion of AF in solutions for improved F & NS; include diverse AF in national and state food-based dietary guidelines; ensure programmes adhere to the right to food, leaving no one behind - especially the poor, marginalized and vulnerable; conduct context-specific and regionally-appropriate research on the multiple benefits of AF.

Mr J. N. Swain, IAS, Secretary, DoF, GoI gave a presentation on 'Laying focus on domestic fish consumption for human nutrition'. Sri Swain spoke about Poshan Maah, the annual celebration of nutrition month by Ministry of Women and Child Development, GoI. He described malnutrition as a major problem; low income of people limits access to nutritious food and discussed about means to make access of AF to country's population at large in quality and quantity; developing an entire value chain of different species; fish eating habits in population in different areas of India; consumer preference

towards fish and fisheries; He discussed about making fish available as a wholesome commodity to people who need it in addition to its introduction and inclusion in Mid-Day Meal and Anganwadi centres in remote areas throughout India; fish and other aquatic products must have longer shelf life; tackling the problem of malnutrition must be a focus area in addition to doubling farmers' income. Mr Swain also stated that people must adopt and have access to more AF in their menu. DoF under GoI is focusing on promoting FC and wholesome development of AF sector. Planners should create a roadmap and system of nutrition so that poorest people may avail good fish-based nutrition.

Dr (Ms) B. Meenakumari, Former DDG, (Fisheries Science), ICAR at New Delhi emphasized on fish as 'heart-healthy' food in this planet; omega-3 fatty acids obtained from fish prevent heart attack and stroke; fish has to be staple food for all of us and integral part of our diet. People in Tripura, Kerala, Assam, Manipur are the most fish-eaters.

Dr C. R. K. Reddy, CEO and Former Chief Scientist, CSIR-CSMCRI at Bhavnagar spoke on 'Seaweed a super food: its nutritional aspects and health benefits'. He informed about features of nine seaweed-based food products and salad supplements; food additives and dairy, non-dairy, pharmaceutical,

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medical and industrial products prepared from seaweeds; nutritional chart of some edible seaweeds in India; proximate composition of carbohydrate, protein and lipid in different seaweeds under Rhodophyta, Phaeophyta, Chlorophyta; human health benefits (reduced incidences of asthma and risk of osteoporosis, promotes heart, brain and gut health and function) of consuming seaweeds.

Dr (Ms) S. Mathew, Principal Scientist, ICAR-CIFT, Kochi spoke on 'Sea food - value-added and fish products for prospective entrepreneurs/industry'. Dr Mathew discussed about VA through post-harvest processing, market potential of prepared products; breaded and battered (BB) products from low-valued fish; uniqueness, processes of preparation and approximate costs of production of fish fingers, fish balls and fish cutlets; features of antimicrobial and anti-oxidant films from chitosan incorporated with ginger and rosemary essential oils, CIFT-developed easy hand-operated finfish descaling machines, temperature indicator using gold nano particles as intelligent packaging, refrigerator enabled mobile fish vending Kiosk and technologies offered by the institute in VA; The products include microencapsulated sardine oil, seaweed NutriDrink, ready-to-serve fish curry in retortable pouches and smoked products in TFS cans, Fish Kure – extruded product, seaweed and fish enriched noodles, seaweed enriched cookies, fish

sausage, cured and dried fish products, smoked masmin flakes, fish wafers, fish pickle, BB products, laminated Bombay Duck and diversified products from black clam.

Dr C. T. Nithin, Processing-cum-Quality Assurance Supervisor, NIFPHATT, Kochi spoke on 'Effect of common processing methods, wrt to freezing on the nutritional and sensory qualities of fish'. Dr Nithin discussed about freezing, canning, chilling, curing (salting, smoking, drying) as common fish processing (FP) methods; moisture, protein, lipid and mineral content in fishes. He spoke about increase in solute concentration, dehydration of cells, auto-oxidative and colour changes as effects of freezing and measures to control quality changes during freezing (use of cryoprotectants, glazing) and thawing.

He emphasized on requirement of awareness creation on promoting freezing in retail marketing, post-harvest infrastructure development including cold chain as pre-requisite, maintaining trade-off between nutritional loss and intended purpose of FP methods.

Finally Dr A. Padiyar, Project Manager, Odisha - WorldFish Project spoke on 'Inclusion of fish-based nutrition in ICDS and Anganwadi centres in Odisha'. News communicator Subrato Ghosh participated in this Webinar in Webex platform; an elaborate and extensive coverage on the subject of health benefits of eating AF including fish made by all eminent speakers, very informative and enriching programme.

Growing Yeast from Trees

First successful scale-up of microbial feed ingredients from sustainable resources

Yeast made from Norwegian spruce trees is a high-quality feed ingredient that can replace imported protein. A fruitful collaboration between industry and research has for the first time successfully achieved a large-scale production of yeast from local, sustainable resources.



Salutaguse plant

An important milestone has been reached by the partners in the centre for research-based innovation, Foods of Norway: a successful industrial scale-up of 1,600 kg of yeast produced from sugars from Norwegian spruce trees. Production was a joint effort by Lallemand Animal Nutrition, Borregaard and the Norwegian University of Life Sciences (NMBU), all partners in Foods of Norway at NMBU.



Adding yeast to fermenter

Sugar from Norwegian spruce trees was produced by biorefinery company Borregaard, and this was used to grow the yeast at the Lallemand production site in Estonia. The processes could be scaled up thanks to the extensive work done by scientists at NMBU and Lallemand, coordinated by Foods of Norway. The yeast will be used in large-scale feeding trials with pigs and Atlantic salmon, in collaboration with leading feed companies in Foods of Norway.



Yeast Fermenter

From lab to industrial production

"We are entering an exciting phase where we will be evaluating yeast in diets for salmon in seawater and for piglets under farm conditions", says Professor Margareth Øverland, the head of Foods of Norway. "Our work in Foods of Norway follows the entire value chain from the tree biomass to the final meat and fish products. The larger-scale trials will provide important information on how these

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novel feeds will affect the growth, health and product quality of the animals as well as the production cost and sustainability of using these ingredients”, she says.



Hydrolysed yeast product

Professor Svein Jarle Horn, who heads the Foods of Norway team responsible for yeast fermentation research at NMBU, says: “It is very exciting and unique that laboratory results can be directly applied and scaled up by the industry. The research and development performed in Foods of Norway has clearly shown how biotechnology can be used to develop novel sustainable feed ingredients”.



Biorefinery demo

Demonstrates potential

“We are proud of this important milestone on our journey towards the development of alternative feed ingredients using local Norwegian resources. There is still a lot to be done before commercial development

can be realised, but this achievement reinforces the technical feasibility of the concept developed through Foods of Norway towards a more sustainable feed production,” says Mathieu Castex, Director of Research and Development at Lallemand Animal Nutrition.



NMBU Biorefinery

Gudbrand Rødsrud, Technology Director at Borregaard, agrees: “This large-scale production experiment demonstrates the opportunities that exist for developing sustainable feed products from wood and it will enable documentation of business potentials through large scale feeding trials.”

Dr Ildar Nisamedtinov is vice president of research and development at Lallemand. He says: “Our partners at NMBU have previously carried out thorough studies when it comes to using Borregaard’s spruce syrup in the cultivation of different yeast species. That knowledge was a good starting point for us to further design and optimize the process that could be industrially utilised. In my opinion, this is an excellent example of how collaboration between academia and industry can

lead to new products”.

More information:

- **The industrial scale-up** was a collaboration between the Norwegian University of Life Sciences (NMBU), Lallemand Animal Nutrition and Borregaard, all partners in Foods of Norway. The sugar production was financed by the Forest Initiative Fund (Skogtiltaksfondet), with funds applied for by Viken Skog.
- **Yeast as a feed ingredient:** Yeast is a microbial protein source with a protein content of 50-60 per cent. A main area of Foods of Norway’s expertise is to develop yeast as a local feed ingredient produced from renewable natural resources, such as by-products from the forestry and food industries.
- **Foods of Norway** is a Centre for Research-based Innovation (CRI) at the Norwegian University of Life Sciences, funded by The Research Council of Norway and 20 industry partners. The centre aims to contribute to growth and increased value creation in the Norwegian aquaculture and agriculture industries by developing sustainable feed ingredients from natural bioresources not suitable for direct

human consumption.

- **Lallemand Animal Nutrition** optimizes animal performance and well-being with specific natural microbial products and service solutions. Lallemand Animal Nutrition develops, produces and markets high-value yeast and bacteria products T including probiotics, forage inoculants and yeast products. These innovative solutions benefit animal nutrition and well-being, forage management and animal environment.
- **Borregaard** is a biorefinery company which produces advanced and environmentally friendly biochemicals that can replace oil-based products in a variety of applications in sectors such as agriculture and aquaculture, construction, pharmaceuticals and cosmetics, foodstuffs, batteries and biofuels by using natural, renewable raw materials.

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Cortec Corporation Doubles Investments in Europe! New Acquisition in Croatia and Opening of New Markets

Split, Croatia: Corte Cros, a member of the Cortec Corporation group, has acquired a new facility building in Split, Croatia, from CROSCO d.o.o., subsidiary of INA, a Croatian multinational oil company. Corte Cros is now the 100 percent owner of the logistics and distribution center in Split, which has recently expanded its production facility and storage capacity. Split is now

technologies. Five years later, I can proudly say that we succeeded”.

The company is supplying three continents—Europe, Asia and USA—from its facilities in Croatia. Capacities in Croatia include Eco Cortec’s anticorrosion films and bioplastics plant located at the east of the country and Corte Cros’s logistics and production center near the coastal town of Split. The company’s offices are



Corte Cros's logistics and distribution center is strategically located in the port near Split, enabling fast shipment and distribution of Cortec's products throughout Europe and the world.

Europe's main production and distribution point for Cortec’s corrosion protection chemistries. Patented VpCI Technologies licensed under Cortec Corporation are some of the most widely used and renowned corrosion protection products in the world. Cortec Corporation has 10 locations around the globe with headquarters in St. Paul, MN. With this acquisition in Croatia, Cortec’s CEO and owner, Boris Miksic, doubled his business in Europe: “When we started to work on the construction and logistics of the center in Split, our goal was to position Croatia as the main strategic point in Europe for environmentally safe corrosion protection

located in Croatia’s capital, Zagreb.

With this new expansion, Croatia became a strategic base for Cortec Corporation and is now a central point for the production and distribution of Cortec’s solutions in this part of the world. Companies in the Cortec Europe group are growing continuously; Corte Cros recorded 20 percent revenue growth despite last year’s pandemic challenges, while Eco Cortec’s revenue has increased 45 percent ! In addition to manufacturing and testing, Corte Cros provides integrated solutions and full technical support for Cortec's products and services. Newly equipped ASTM and ISO certified laboratory is also located in



Production facilities, offices and laboratory are located on the green EcoCortec complex in Beli Manastir, Croatia.

the logistics center in Split. All products are registered according to the REACH standard. Corte Cros also offers a wide range of biotechnology solutions from Cortec’s Canadian subsidiary, Bionetix International, which uses a variety of microorganisms and nutrients to create biological products used in thousands of field applications worldwide. “We are the main supplier of corrosion protection solutions for the world's largest car manufacturers: Mercedes, Volvo, Ford, Toyota and other important systems such as Bosch, IBM, General Electric, Caterpillar, Rolls Royce Group, Russian Railways, MOD, Exxon Mobil, Airbus

the contrary, we achieved growth in the past year”, says Cortec’s CEO, Boris Miksic.

Plans for the Future

Miksichas invested over 20 million Euros in Croatia so far and plans another expansion in the near future. “We will increase our capacities in Split and are planning to build new compounding and reprocessing plants next year, near existing Eco Cortec facilities. One plant will produce Cortec's patented VpCI corrosion protection additive, which will contribute to the self-sustainability of Eco Cortec while the other one will be a recycling plant. We are on [an] excellent path of branding Croatia as a



CorteGros facility in Split

and others. The pandemic, which unfortunately had devastating effects on the whole world did not affect our business. On

central point in this part of the Tworld for green corrosion protection technologies”, concludes Miksic.



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Poultry Industry calls for MPEDA - like body

CLFMA holds its 54th AGM and 62nd National Symposium



Tarun Sridhar, IAS (Retired), Former Secretary, Dept of AH&D, Ministry of Fisheries, AH&D, GoI; B. Soundararajan, B.S. Yadav, Bahadur Ali, Dr T. Krishnaiah, IAS (Retired) and Rahul Kumar during Panel Discussion at CLFMA's 62nd National Symposium held on 24 & 25 September 2021 at Hyderabad. K.V. Kurmanath, Senior Deputy Editor, The Hindu Business Line moderated the discussion.

Hyderabad: CLFMA of India organized its 54th Annual General Meeting and 62nd National Symposium on 24th & 25th September 2021 at Hotel Taj Deccan, Hyderabad, India. The theme of the event was “Feeding the growing livestock population: Current and future challenges”.



Parshottam Rupala,
Minister of Fisheries, Animal Husbandry and Dairying, GoI

Union Minister for Fisheries Parshottam Rupala has stressed the need for creating awareness among the livestock farmers about the importance of providing quality feed to the animals. Inaugurating

the two-day CLFMA of India national conference, he said it was important to explore tapping of alternative feed options such as stubble which is abundantly available in some areas. “It will offer a cheaper option for farmers in places where they face shortages,” he stated. They would also need proteins which would require more number of livestock population, he added.

Mr Balram Singh Yadav, Managing Director, Godrej Agrovet Ltd, in the 62nd National Symposium organized by CLFMA presented the special address on Sustainability & Future of Online Sales of Poultry Products. Mr B. S. Yadav, stated that “The government formed MPEDA and ensured the marine products space became end-to-end competitive. How do they do that? They ensure that we get the right germ plasm. Then, they also conducted training programmes for farmers on better management practices” He told the government also equipped the processors with relevant skills, provided them with

market access and gave them subsidies. “We need something like this. There is a huge market for our poultry products abroad, particularly in geographies like the Gulf”, he said. “They will make us competitive by helping us manage the diseases better. The entire value-chain management will happen in coordination with the government”, he added.

He mentioned that the export of poultry products from the country was very low at just Rs 435 crore. That was just a fraction when compared to the overall size of the industry in the country.



Balram Singh Yadav,
Managing Director, Godrej Agrovet Ltd.

“There is a huge scope. It will be tough for individual players to tap this huge opportunity. If a sovereign country does it, it will be easier”, he told, adding that the industry didn’t want the export subsidies for ever. “We need the government support for a few years. After that industry will be on its own”, he further informed.



Dr O. P. Chaudhary,
Joint Secretary,
Department of Animal Husbandry &
Dairying, Ministry of Fisheries, Animal
Husbandry & Dairying, Govt.

The keynote address was delivered by Dr O. P. Chaudhary, Joint Secretary (NLM / PC), Department of Animal Husbandry & Dairying, Ministry of Fisheries, Government of India. Livestock industry, feed sector in particular, has been quite resilient to the COVID-19 crisis. However, the sector is not free from the implications of post covid challenges. This, coupled with the task of feeding of 536.76 million livestock calls for appropriate interventions at various levels.

Animal Husbandry Infrastructure Development Fund is another flagship scheme of this Department promoting entrepreneurship and employment. The scheme may be well exploited by the feed industry to set up diverse livestock feed plants capable of producing conventional / value added feed.



Neeraj Kumar Srivastava,
Chairman, CLFMA of India.

By 2050 the world’s population will likely increase by more than 35%. To feed that population, crop production will need to double and production will have to far outpace population growth as the developing world grows prosperous enough to eat more meat. Trading on this tightrope is not going to be an easy task and it requires a major shift in how we are consuming and producing our food today?

We will have 9 billion human population on our planet and additional 2 billion more mouths to feed by mid-century. The spread of prosperity across the world, especially in China and India, is driving an increased demand for meat, eggs and dairy boosting pressure to grow more corn and soybeans to feed more cattle, pigs and chickens. If these trends continue, the double jeopardy of population growth and richer diets will require us to roughly double the amount of crops we grow by 2050.



Divya Kumar Gulati,
Convenor,
CLFMA of India.

For the last 54 years, CLFMA has been proactively working together with the Government of India and other trade bodies making its presence felt both nationally and internationally. The classic example of this is that it was actively involved with the government authorities to solve the Soybean Price Rise issues. The CLFMA delegation conducted multiple meetings and discussions with various Government Ministers in an effort to solve the soybean meal issues. Post which the government made a monumental decision, allowing import of crushed and de-oiled GM soy cake-NLO.

In this year, industry faced a big challenge in producing protein source basically soya meal. Soya Meal prices soared to a high of Rs 90,000/- mt

from Rs 38,000/- mt. A rise by almost 136 percentage. This was also just in a span of 8 weeks.



Vijay D. Bhandare,
President – South Zone & Joint Convenor,
CLFMA of India.

This happened for the first time in the history of Animal Feed Industry. As the market forces act, there was cascading effect on the rise of prices of other protein sources propelling the entire feed industry to panic and confusion. This resulted in the phenomenal increase in the production cost of milk, eggs and poultry meat, hurting the demand and consumer uptake.



Suresh Deora,
Secretary, CLFMA of India.

The Symposium will have deliberations addressing Demand, supply commodity outlook for Corn and Soybean, as these commodities contribute significantly to the compound feed production, sustainability of online sales of poultry products, online trading of Agri commodities and Policies related to imports and exports of corn.

India has one of the largest livestock populations in the world and proper feeding of the livestock faces huge challenges, particularly in the light of growing food demand for human population, diversion of food grains for bio-fuels etc. Also, volatility in prices of food and feed commodities and also constraints of supplies due to scarcity will continue in the coming years and as a consequence, affect livestock production.



Dr Sanjeev Kumar Balyan,
*Minister of State for Fisheries, Animal
Husbandry and Dairying, Gov.*

I hope that the symposium with the theme “Feeding the Growing Livestock Population: Current & Future Challenges” could play a vital role as a platform in sharing new ideas and techniques for enhancing production and availability of various

feed resources for livestock so as to face the future challenges in feeding the growing livestock in India.

Daniel Bercovici,
Chairman,
International Feed Industry
Federation.

On behalf of the International Feed Industry Federation (IFIF) I would like to thank you for your kind invitation to the inaugural session of your 62nd National Symposium on 24th September 2021.

It would have been an honour for us to attend and join you and the Indian Feed Industry colleagues at this special association. Unfortunately, we are not available on that date as we are holding our annual IFIF meeting with the UN FAO at the same time.

Livestock Industry.

Mr Balram began his career with Godrej in 1990 and over the years, he has handled roles of increasing responsibility across businesses and regions in the company. He became the Head in 1999 when he was asked to establish and lead the Poultry Business.



G. Chandrashekhar, Economist,
Senior Editor & Policy Commentator.

G. Chandrashekhar is a global agribusiness and commodities market specialist with decades of rich experience. He provides policy inputs for the Indian Government through his newspaper columns, talks on business television and personal interaction with policy makers. Chandrashekhar holds many public positions. Currently, he is:

- Economic Advisor, IMC Chamber of Commerce and Industry.
- Independent Member, SEBI Commodity Derivatives Advisory Committee and SEBI Research Advisory Committee.
- Consultant, UN International Trade Centre, Geneva.



Mrugank Paranjape,
Managing Director & CEO,
NCDEX e Markets Ltd.

Speakers in CLFMA's 62nd National Symposium

Ms Prerana, Head of Research, Samunnati Agri, has a vast experience of commodity research of more than 25 years. She specializes in Agri Commodity Research. As a part of her vast experience she has done commodity research for various value chain participants like manufacturer, trader, exchange, commodity broker, NBFC and now farmers.



Unupom Kausik, President, NMCL.

Mr Unupom Kausik serves as the President at NMCL. He brings in a wealth of experience for having worked in the commodities domain for almost a decade out of his overall

experience of more than 25 years. His skills sets comprise risk management, commodity trading, logistics and supply chain management, building online market places, financial services, hedging and derivative advisories on commodity exchanges, managing large and complex supply chains for integrated textile operations.

Balram Singh Yadav is the Managing Director of Godrej Agrovet Ltd (GAVL), one of India's foremost diversified agribusiness companies. He also serves as Managing Director of Godrej Tyson Foods Ltd. Besides, he is a Director of numerous firms including ACI Godrej Agrovet Pvt Ltd – Bangladesh, Creamline Dairy Products Ltd – Hyderabad, Astec Life Sciences Ltd and Godrej Maxximilk – Mumbai. He has been the Chairman of CLFMA of India (Twice), an Association of

Mrugank Paranjape is the Managing Director and Chief Executive Officer of NCDEX e Markets Ltd, the Non Executive Independent Director in the Central Board of the State Bank of India, the Chair of the Board of the Mumbai School of Economics and public policy and a Trustee on the Board of Sewa International. Mr Mrugank has earlier worked with ICICI Prudential AMC, Reliance Logistics, India Infoline, W I Carr, ING Barings, IIT Inves Trust and Citibank. He is an alumnus of IIT Mumbai (B Tech, Electrical Engineering) and IIM Ahmedabad (PGDM with Specialization in Information Systems).



B. Soundararajan,
Founder and Chairman,
Suguna Group.

Born in 1961, **Mr B. Soundararajan** is a first-generation entrepreneur, whose life's motto has always been the same from the beginning, which is to enrich the lives of rural India. Originally hailing from Udumalpet, a town not far away from Coimbatore, Tamil Nadu, he went on to found Suguna Group Companies along with his younger brother Mr G.B. Sundararajan. He currently serves as the Managing Director at Suguna Holdings Pvt Ltd and as a Director in its subsidiaries including overseas Companies. Under his leadership, Suguna Foods has provided livelihood to 39,000+ farmers and has been ranked 3rd in Asia's top poultry producers list and also ranked as the 9th largest poultry company globally.



Bahadur Ali,
Founder & Managing Director,
IB Group.

A man of the people, **Mr Bahadur Ali**, has been a visionary leader, successfully leading IB Group through its capricious journey. He was called as a "Father of Modern Indian Poultry". He envisioned the easy availability of Protein as an eminent source of nutrition at an affordable price to Indian population. Mr Ali has led IB Group through numerous business expansion plans and International Partnerships.

He conceived the importance of quality feed for their better growth and performance thereby entering into Poultry Feed business. His journey from once a remote village of Rajnandgaon as a small-scale poultry merchant to the protein and agri conglomerate which is globally recognized and has put Rajnandgaon and Chhattisgarh state on a Global map supported agriculture and rural development not just in Chhattisgarh state but all across India.



Rahul Kumar,
Managing Director,
Lactalis India.

Mr Rahul Kumar is working as a Managing Director of Lactalis India and managing 3 companies, tirumala, anik and prabhat. Lactalis is the largest dairy group in the world having annual turnover of 23 billion USD. Previously he has worked as a Managing Director, Amul Dairy for 11 years from 2003 till 2014. Mr Rahul has versatile experience of 29 years in Dairy. After graduating with a degree in chemical engineering from Indian Institute of Technology, roorkee, he was chosen for a management course at the Institute of Rural Management Anand, after which he joined Amul.



Tarun Shridhar, Retired IAS,
Former Secretary, AH & D.

Tarun Shridhar was a Senior Adviser with the NCDC for about eight months. Subsequently, he has been appointed as a Member of the Central Administrative Tribunal (CAT); He is posted in Allahabad these days. He is also a former IAS officer of the 1984 batch of Himachal Pradesh cadre. Presently he is a Member of Central Administrative Tribunal. More than 35 years experience in high positions of policy making and implementation. Prior to holding the position of Secretary, government of India, he was Additional Chief Secretary in the Government of Himachal Pradesh. As Additional Chief Secretary, he looked after diverse sectors and departments such as power, personnel, revenue, environment and forest, animal husbandry, fisheries etc. Nearly ten years of combined experience in the state and central governments in Animal Husbandry, dairying and fisheries sectors.



Dr Beeda Masthan Rao,
Founding Chairman and Managing
Director, BMR Group.

Dr B. M. Rao, the founding Chairman of BMR Group of industries is a man of humble beginnings. Fondly known as BMR, Mr Rao began his seafood journey in 1991 in his hometown, iskapalli with "Seed Culture". Today,

almost 30 years later, the group has expanded into a conglomerate of Multiple Seed Hatcheries, shrimp processing facilities, feed manufacturing facilities and exports to major international cities.

Mr Rao was awarded the Doctorate (Aquaculture) by the International University of Contemporary Studies for his extraordinary contribution to Aqua Industry in the year 1998. He was also awarded the "Indian of the year Award" in the year 2017 in recognition of his achievements that have contributed towards building the reputation of our Country. (As Dr B. M. Rao was not present, Dr T. Krishnaiah, Advisor, SFMA represented on his behalf in the 62nd National Symposium 2021).

a small company with a modest turnover of Rs 12 lakh per annum and in 25 years it became among the largest company in India in the space of Animal Health and Speciality Nutrition with a turnover of Rs 360 crore at the time he handed over the charge, in September 2009.

Mr Bharat became the first Chairman of Livestock Industry Association- even though he was not from a 'Feed Manufacturing Company.

Currently, Mr Bharat is the Founder / Chairman of Fibroheal Woundcare () Ltd (FWPL). The company has several patents in hand and in the pipeline all related to silk in non-textile applications. He received CLFMA Life Time Achievement Award.

CLFMA Award Winners

Dr Subhash V. Vaidya, Chairman, Noble VetScience LLP is a graduate in Veterinary Science from Nagpur Veterinary College, post graduate from Jabalpur Veterinary College and Ph.D. in Poultry Science from IVRI, Izatnagar, Uttar Pradesh. He joined the Poultry sector of the industry in 1975.

In 1977 he joined Hindustan Lever Ltd as Assistant Development Manager. It was in this company that his Professional Career blossomed. He later joined Pranav Agro in 1993 as Chief Executive and rose to become Managing Director by 1998.

It was in this assignment in Pranav Agro that Dr S. V. Vaidya with his inputs made remarkable contribution in the field of Poultry Nutrition. Although there were quite a few nutritionists who were trying to use soya-based feed, it was him who made it possible on a very large scale.

Dr S. V. Vaidya started his contribution in CLFMA by making technical presentations and presenting them to various Government Departments. He worked as a Secretary, Deputy Chairman in CLFMA. He became

Chairman of CLFMA during 1999 and 2000. He received CLFMA Life Time Achievement Award.



Bharat Tandon,
Past Chairman, CLFMA of India,
Founder / Chairman of Fibroheal
Woundcare (P) Ltd (FWPL),
MD, Healthline Pvt Ltd (Sericare Division).

Mr Bharat Tandon started his career international pharma and worked for seven years in Pharmaceutical Company, which is now named Astra Zeneca Pharma Ltd. In 1984 he ventured out to start an Animal Health / Nutrition Company.

Mr Bharat was the Managing Director of Vetcare Group of Companies, Vetcare Organics and Tetragon Chemie Pvt Ltd. He started VETCARE,

V. Ramasubba Reddy is a Retired Professor (LPM Avian), BVSc & AH from SV University, Tirupati in 1964, MSC (Vety.) from AP Agricultural University in 1970 and Ph.D. from Agra University in 1976.

He got during his academic career OPGA of 4.00 out of 4.00 during Masters Program and best teacher and meritorious teacher awards. Also, he was the principal investigator in several research programs. He was rated as a good teacher for UG and PG students.

He was involved as a major and associate guide for 32 students and published 185 papers including 68 Research Publications.

He worked in State Department of Animal Husbandry, Andhra Pradesh; IVRI and CARL, Izatnagar; APSMPDC, Andhra Pradesh; and Agricultural University, Andhra Pradesh. He is having 57 years of experience in livestock, poultry and aqua production. He says that his efforts for Animal Food Production and for nutrient economy during Livestock Production will be continued throughout his life. He received CLFMA Award.



**Dr V. Sridhar, General Manager,
National Dairy Development Board.**

Dr V. Sridhar is a professional in the field of Animal Nutrition with experience of more than 23 years in applied dairy nutrition. He obtained his M.V.Sc degree in Animal Nutrition from the Andhra Pradesh Agricultural University, Hyderabad and a full-time M.B.A in General Management from the Sri Sathya Sai Institute of Higher Learning. Subsequently, Dr Sridhar underwent training in advanced dairy nutrition in the USA and Europe.

Over the past two and a half decades, Dr Sridhar has visited ten nations – counted as advanced nations in dairying – for understanding best practices in animal nutrition, dairy herd management and feed manufacturing. He has also participated in international conferences and symposia in the US, Europe, Asia and Brazil on topics ranging from climate change to feed quality management.

Currently he heads the Animal Nutrition Group at NDDB and is tasked with the development of scientific and practical solutions to the challenges faced by the dairy farmers in matters relating to feed and fodder. He is also a member of the FAD Council of the Bureau of Indian Standards (BIS) as well as the convener of the expert panel on feed ingredients. His work experience includes stints in the private and public sectors

handling responsibilities ranging from applied R&D, technical services, product management and handling a feed manufacturing unit with P&L responsibility. He received CLFMA Award.

Dr A. Natarajan, MVSc., Ph.D is a Professor and head in Animal Feed Analytical and Quality Assurance Laboratory, Veterinary College and Research Institute, Namakkal, Tamil Nadu Veterinary and Animal Sciences University.

Graduated in 1987, he mastered in Animal Nutrition (1991) and obtained his PhD (1998), from Madras Veterinary College, Chennai. He is totally involved in upgrading the 10% self-financed Animal Feed Analytical and Quality Assurance Laboratory in testing of feed and feed ingredients for livestock and poultry, since 1996, on cost-effective basis, in line with University Directions.

Started in 1994, in nation's biggest poultry belt, during the time of no facilities for testing, the

laboratory, has gone miles to create infrastructure to analyze huge number of tests in shortest possible time with validated results being quickly dispatched in every possible way using its own software-oriented LIMS, meant to accommodate data on customers, results, accounts and so on.

He and his team facilitated obtaining the prestigious ISO / IEC 17025: 2017 NABL accreditation in 2017, the first institute to do so for the University. His perseverance with Service Tax department resulted in inclusion of exemption of Service Tax to feed testing in 2013 for entire nation. He is Principal Member of FAD5 of Bureau of Indian Standards. His focus is to move forward to expand the residue testing facility.

His aim is always to upkeep the integrity with impartiality in every aspect surrounding the analyses. He received CLFMA Award.

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Aquaculture Fish Gems

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Introduction

Aquaculture provides the employment to over 800 million people in the world. It is the primary source for many farmers and related businesses. But some farms of aquaculture are less explored and underestimated. One form of aquaculture is ornamental fish culture which is always assumed to be hard and underestimated potential business. The objective of this article is to explore this form of aquaculture.

Quality of ornamental fish

This is the essential condition that ornamental fishes must meet in order to stay alive in artificial environment and provide a profit to fish sellers and farmers. These are also the fundamental requirements that make them simple to manage and appealing to hobbyists.

The qualities listed below are the basic qualities that fishes must have in order to meet the requirements for ornamental fishes.

1. It must be attractive
2. It must be kept in small tanks
3. They should be hardy
4. They must take artificial feed
5. Compatible with other fishes of their kind or other kind

Parts of ornamental fish industries

From brood stock gathering through early fry marketing, there are numerous aspects to the ornamental fish industry and each one is as vital as the ultimate result. Because the fish is so delicate and only limited chance are accessible due to high competition, there is no room for error in this task. So every part is divided between different stockholders. Any entrepreneur chooses their work according to their choice and qualification.

Highlight Points

Ornamental fishes are the integral part of aquaculture and they are as dazzling as genuine gems. Because of the rise in aquaculture hobbyists, ornamental fish cultivation is expanding at an unprecedented rate. Everyone wants a beautiful aquarium in their house. Some people desire a single fish, while others desire a large number of fish. People make decisions based on their preferences. Many fish farmers, entrepreneurs, small business owners and merchants all around the world are employed by this industry. This business is incredibly cost-effective and may be completed in a short period of time. Far more tiny fishes than food fishes become beneficial from this. In India, the selling price of a 10-100 gram of fish is between 60-400 Rs, whereas the cost price is 1-10 Rs. In comparison to food fish, it is a considerably more successful business with much lower administration costs; anyone can start this operation in a 10-10 feet room with 10-100 fish. Where there is a local market. Then the dilemma comes as to what kind of fish the farmer selects and what level of quality is required and what are the things needed for ornamental fish culture (Key words: - Aquaculture, Ornamental, Hobbyist, Gems, Aquarium)

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Part	Persons evolved in the work	Profit level
Brood stock collection/ importation	Farmers, ornamental hatcheries, independent entrepreneurs	low
Breeding	Farmers, ornamental hatcheries, independent entrepreneurs	Low
Rearing of frys	Farmers, ornamental hatcheries	Moderate
Harvesting and selling	Farmers, ornamental hatcheries, independent entrepreneurs	High
Rearing and harvesting and selling of juvenile fishes	Every one	Extremely high
Rearing of juvenile and selling	Small businesses, shops, independent entrepreneurs , middle man	High
Keeping aquariums	Hobbyist	No profit
Rearing and Selling brood stock to breeders	Hobbyist, Farmers, independent entrepreneurs, middle man	Low

Varieties for ornamental fishes

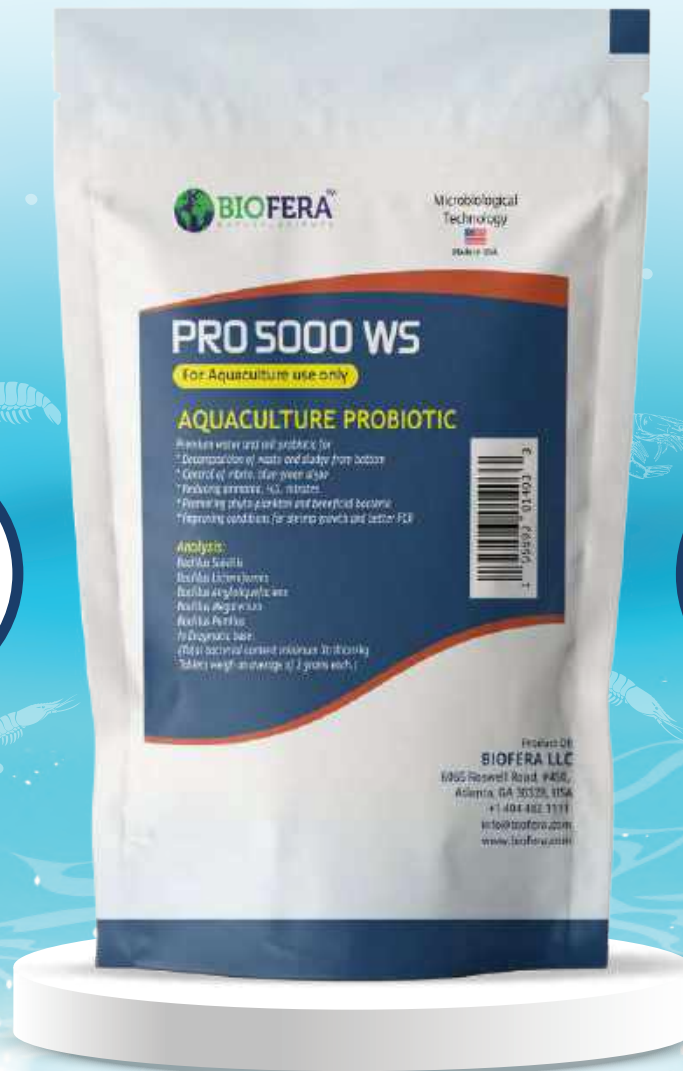
Variety	Scientific name	Quality	Preference	Market value	Picture
Gold fish	Carassius auratus	Popular, Appealing pet fish, various variations having colour, fin form, size and body structure	High	Low	
Sword tail	Xiphophorus hellerii	Present in wide range of colour and pattern finnage patterns. Red, Red Wag, Red Tux, Painted, Neon Green, Marigold (and wag), Pineapple, Black, Red Twin bar, Sunset, and Gold Tuxedo.	High	Low	
Angel fish	Pterophyllum scalare	come in single colours like black, silver, and gold, as well as multi-colored patterns like leopard, striped, or zebra, as well as lace-like, mottled or marble, half black.	High	Low	
Discus	Symphysodon sp	coloration of the blue discus varies, with some being more bluish and others having blue stripes on the body, head, and fins	High	high	
Tetra	Paracheirodon sp.	They are non-aggressive and do not pose a hazard to other fish in the aquarium	High	High	









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Guppy	Poecilia reticulata	They are also known as round tail, spear tail, fan tail, veil tail, pin tail, and other names according on the variances in the tail fins.	High	Low	
Molly	Poecilia sphenops	Small multicolour easy to handle	High	Low	
Gourami	Colisa sp.	They are non-aggressive and do not pose a hazard to other fish in the aquarium, multicolour and attractive	High	Low	
SHARK CAT-FISHES	Pangasius sp.	Multicoloured, artistic appearance	High	low	
Platy	Xiphophorus maculatus	Colour variations such as red, yellow, orange, blue and white	High	low	
Oscar	Astronotus ocellatus	Multicolour, respondent, large size	High	High	

Picture credit https://mpeda.gov.in/?page_id=791

Ornamental fish health monitoring

Captive aquarium/formed ornamental fish are usually healthy when diseases are present all of the time. The signature pathogens thrive as environmental strains arise and the equilibrium changes in favors of the disease. If the fish do not adapt properly or if correction steps are not taken quickly enough, disease outbreaks will occur. **Health monitoring** is one of the most critical facets of modern aquaculture systems, particularly composite fish culture.

A fish health monitoring programme should consist of the following components:

1. Daily observation of fish in each captive pond/ aquarium.
2. Sampling and examination of fish at regular intervals for health check and diagnosis of the disease if any.
3. Monitoring of captive pond/ aquarium quality and sanitation.
4. Sampling and examination of fish at the onset of distress, disease outbreak or mortality

Diseased fish may exhibit either or both clinical and behavioral signs, the most common of those are listed below:

Behavioral signs:

1. Slowing down or a complete stoppage of feeding;
2. Loss of equilibrium, swimming erratically or in spirals;
3. Surfacing for gulping air and scraping against the floor and sides of the pond.

Clinical symptoms:

1. Excess mucous secretion.
2. Change in normal colorations.
3. Erosion of scales, part of fins, skin.
4. Decolouration or paling of gills.
5. Abdominal swelling.
6. Bulging of eyes.
7. Presence of cysts.
8. Spots or patches over the body and gills.
9. Appearance of lesions, haemorrhagic spots and grayish or brownish areas over the body.

If there are any symptoms in the surroundings, it is recommended that trained specialists be consulted. And treated accordingly do not try to treat the disease by yourself it will dangerous for fish as well as dangerous for business.



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Advantages of ornamental fish industry

- Small culture period
- Small size big value system
- Small area required for maintenance of large no
- Easy and attractive job
- Small value more profitable
- Less labour intensive
- Full year sells

Limitation of ornamental fish industry

- They requires sophisticated environment so required skilled labour
- Fishes are so sensitive so timely management is required
- Choice of hobbyist may change from time to time so updating is always requires some work and cost intensive
- Creative skills are requires

Ornamental fish culture has large potential and it is so profitable, it comes with lots of opportunities and it is one of the satisfying businesses but it requires timely updates, creativity and monitoring to the business

Conclusion

Aquaculture is incomplete without ornamental fish, which are as sparkling as real gems. Ornamental fish farming is developing at an unprecedented rate as a result of the surge in aquaculture hobbyists. Everyone wishes to have a lovely aquarium in their home. The most important requirement is it must be captivating, housed in tiny tanks, and robust. They must consume artificial food that is compatible with other fish of their species or other species. These are the basic qualities that make them easy to maintain and appealing to amateurs. There are several components to the ornamental fish industry, from brood stock harvesting through early fry marketing, and each one is as important as the end outcome. The dangers of illnesses are prevalent all of the time in captive aquarium/formed ornamental fish. As environmental strains emerge and the illness's equilibrium shifts in favors of the illness, the hallmark pathogens prosper. One of the most important aspects of modern aquaculture systems is health monitoring particularly in ornamental fish culture, because prevention is better than cure. If there are any symptoms in the immediate area, qualified professionals should be called immediately and treat the disease according to recommendation.

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SUSTAINABLE SHRIMP FARMING THROUGH AQUAMIMICRY TECHNIQUE

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Highlight Points

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

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

Aquamimicry –Sustainable approaches in shrimp farming.

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

Pond Preparation

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

Pre stocking management of Liquid Fermented Rice Bran (LFRB)

Carbon sources like rice or wheat bran (without husk), water (1.5-10 ratio) and probiotics are mixed under aeration for 24 hours. The finely powdered bran along with entire mixture can be added to the pond, if it is crumbled, the "milk" or "juice" can be added to the pond and bran solids are fed to the fish on the bio-filter pond. Shrimps are stocked at a density of 30-100 animals /square meters. The amount of fermented carbon source that can be added depends on the system and turbidity level. Generally, the recommended dose of fermented carbon source is 1 ppm and 2-4 ppm for extensive and intensive systems respectively. The ideal turbidity should be around 30-40 cm. Rice bran should be adjusted based on the turbidity.

Post stocking management of Liquid Fermented Rice Bran (LFRB)

Maintains Liquid Fermented Rice Bran (LFRB) daily between 1-5 ppm (10-50 kg per hectare) depends on the pond turbidity preferably at 30 cm. If the turbidity is higher than 20-30 cm, reduce the amount of LFRB. If the turbidity is lower than 30-40 cm, increase the amount of LFRB. Turbidity (Bio colloids) should not be less than 30 cm throughout the cycle. Daily check for the early morning and late noon turbidity and LFRB application is done accordingly. Make sure the pH is not fluctuated more than 0.2 log with max of 0.3 log throughout day and night. Most preferably at 0.0-0.1 log. Dissolved oxygen (D.O) should be maintained at least 5 ppm during late night and should not exceed 10 ppm during the daytime between 5 – 8 ppm is most preferably. Divides the LFRB solution for 1-2 times per day (early morning and afternoon), dilute with pond water and slowly widespread the LFRB throughout the pond if

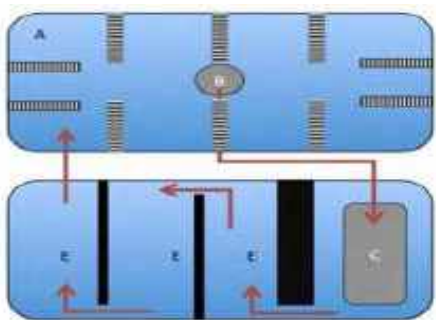
possible. If observed any depletion in dissolved oxygen, immediately stop adding LFRB. Fully aerate the system and chain dragging around the feeding zone for the first 15 days after stocking is still preferably (20% of total area/day). Avoid chain dragging around the center of the pond. Additional probiotics are added to the grow-out pond, to maintain water quality and increase the formation of bio-colloids (flocs consisting of detritus, zooplankton, bacteria etc). After 15 days of stocking, slowly dragging chains or ropes on the pond bottom is encouraged to decrease the formation of bio-films. Generally, an extensive system does not require further water quality management but there is a need to remove sediments two hours after feeding for an intensive system.



Liquid Fermented Rice Bran

Sedimentation Pond

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



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

Issues in Aquamimicry

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

Advantages of Aquamimicry Farming

- Maintained water quality at optimum level and reduced fluctuations. Stress-free environment is created as there is no fluctuation in the water medium as result in minimized water exchange.
- Increased nutritional composition of cultured shrimp, as it uses the live microbial compound as feed and improved FCR.
- Automatically bottom soil problem is rectified by beneficial microbes.
- It decreased production cost, as supplementary feed usage is reduced.
- Pond conditions should mimic the natural estuarine conditions resulting in good growth of shrimp.

Future Prospects

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

Conclusion

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

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Eco-acoustics: Sound's Ecological Significance in Aquatic Ecosystems

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Introduction

The global marine and freshwater ecosystems are experiencing an drastically decline and re-distribution of biodiversity, due to far reaching effects of human activities, including accelerated climate change and over-exploitation. Such Change in baselines in terms of species abundance and distribution will result from changes in aquatic diversity patterns, which must be monitored immediately. As a consequence, ecoacoustics is important for tracking large-scale changes. Ecoacoustics, also known as acoustic ecology or soundscape studies, is a discipline that studies the relationship between humans and their surroundings as mediated by sound. Ecoacoustics is the study and understanding of ambient sound from an ecological perspective. Is a field of study that is applicable to long-term monitoring, habitat health, biodiversity assessment, soundscape protection, and ecosystem management, as well as the uses of sound in aquatic ecosystems, methods for measuring aquatic animal sound, and ecoacoustics metrics for data analysis (Sueur and Farina, 2015). Sound of biological and physical origin has recently been recognised as an important component of ecological research, with researchers discovering, for example, that the changing sound output of many species that use sound to communicate, mate, and control social conflicts represents early signs of animal stress linked to climate change (Krause and Farina, 2016). The time it takes for a species to adapt to a new life trait is likely to be determined by its adaptive potential, and this mechanism necessitates a long period of system equilibrium in order for evolutionary changes to take place. Underwater noise has the potential to weaken and alter a habitat's natural acoustic signature (for example, through species migration and biodiversity loss), a process that can be documented using eco-acoustic methods. Beyond the continental shelf depths of 200 metres, open ocean and deep seafloor environments make up more than 70% of the total surface area of our world, but many of these regions are understudied due to their remoteness from land, with extreme depths reaching 10,000 metres in some areas of the deep ocean. Ecoacoustics is widely used in environmental science to measure the degree of acoustic complexity, and is thought to be a strong predictor of biodiversity. Ecoacoustics is a promising field that is gaining the recognition and appreciation it deserves as a realistic

Highlight Points

1. Ecoacoustics is the study and understanding of ambient sound from an ecological perspective.
2. Sounds propagate in the air at 343 m/s at 0_o, and propagate five times faster (1484 m/s) in water with high variability.
3. Dolphin produced wide frequency band which extends from 2 to over 200 kHz, and a source level variable between 140 and 220 dB.
4. Eco-acoustic theatre new experience of nature through sound.

science for investigating and analysing environmental degradation levels. Ecoacoustic codes are obligate and special mechanisms that transmit voluntary or involuntary information to an active listener from individuals, species assemblages, and the environment. Their ontogenesis, evolution, and adaptation vary by species, typology, local background of soniferous assemblages, geomorphology, vegetation conditions, and human intrusion degree (Francis et al., 2009, Wong and Candolin, 2014). Ecoacoustics may also look at the effects of the growing influence of anthropogenic sounds (noise) on the biogeography, biodiversity, and ecology of organisms living in both human-modified and unaltered terrestrial and marine systems (Lomolino et al., 2015).

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Historic background

Leonardo da Vinci is credited with the earliest known reference to underwater sound in 1490. Muller (1857) wrote a systematic overview of 'piscisvocales' (vocal fishes) in the mid-nineteenth century. Representatives from seven mostly marine families were on his list: dactylopterids, balistids, sciaenids, triglids, zeids, batrachoidids, cottids, tetraodontids and three freshwater families: cyprinids, mochokids, and cobitids. The use of the term "ecoacoustics" was suggested at a meeting in June 2014 at the museum of natural history in Paris where "soundscape ecology" was also suggested as an alternative. Sound waves actually travel five times faster in water than in air. The acoustic character of the environment has a long history, with research dating back at least 50–60 years. Sounds propagate in the air at 343 m/s at 0°C, and propagate five times faster (1484 m/s) in water with high variability. Courtship, spawning, agonistic action, competitive feeding, and when disturbed are all situations when fish make sounds. As a result, major types of sound-producing mechanisms were identified at the turn of the twentieth century, although others were only recently discovered.

Classification of sound and measuring tools

Sound can be divided into three categories: geophysical, biological, and anthropic. Geophysical sounds include waterfalls, ocean waves, winds, thunderstorms, lightning, and volcanoes (geophonies). Biological sounds (biophonies) are produced by active vocalisations of soniferous organisms (e.g., tymbals in cicadas, vocal chords in mammals, vocal sacs in frogs, syrinx in birds, etc.). Synthetic technologies/activities such as machineries and music, fires, cars, urban environments, and factories produce anthropogenic sounds (technophonies). Sonograms, which show frequency against time; oscillograms, which show amplitude against time; and frequency spectra, which show amplitude against frequency and indicate dominant frequencies within a sound, are three important tools for describing fish sounds.

How do fish make sounds?

Fish make a variety of sounds, each using a different mechanism and for different purposes. Sounds (vocalisations) may be created for a variety of reasons, including threatening predators or rivals, attracting mates, or as a flight response. Unintentional sounds are also produced, such as those made as a by-product of feeding or swimming. Drumming (using sonic muscles located on or near the swim bladder), striking or rubbing together skeletal components (stridulation), and rapidly shifting speed and direction when swimming are the three main ways fishes emit sound (hydrodynamics). Fishes make low-frequency sounds, usually less than 1000 Hz.

How is sound used to detect fish?

Sonars deliver sound waves or signals into the water, which bounce back when they hit something. Part of the signal is reflected back to the boat by the fish, while the rest is carried to the seafloor and then bounced back to the boat.

Fish finding sonar units send and receive signals many times per second. They concentrate sound into a beam that is transmitted from a transducer. These units include visual displays that print the echoes. The bottom appears as a continuous line drawn across the display. In addition, any objects that are in the water between the surface and the bottom may also be displayed. Sound transmitted from the boat's transducer spreads out in a conical shape. Fish that swim within this cone may reflect some of the sound back to the transducer. The sonar's chart screen displays the reflected signal or echo. Depending on how much of the school is inside the transducer's cone, a school of fish will appear in a variety of shapes or formations. A fish arch forms as the fish moves through the sonar beam. A mark appears on the chart display when the fish enters the outer edge of the cone. Fish finders operate at high frequencies of sound, approximately 20–200 kHz (20–200,000 cycles per second). Many marine and freshwater animals rely on sound for survival, and they have developed special adaptations that enable them to communicate, defend themselves, find food, navigate underwater, and/or understand their surroundings. They can make noises as well as listen to the sounds around them.



Fig. 1 Detection of fish shoals

Sound Emissions and their Ecological Role in aquatic ecosystem.

The first fish detection using active acoustics were reported in 1926 by the French explorer Rallier du Baty afterwards the first echogram to be published was recorded by Bokn in Frafjord, showing sprat schools. In 1929, the Japanese scientist Kimura reported disruptions in a continuous acoustic beam by sea bream swimming in an aquaculture pond. In 1935, Norwegian scientist Oscar Sund reported observations of cod schools from the research vessel. Fish Catalog underwater sounds were first conducted in the 1960s and 1970s, by Fish and Mowbray (1970) systematically cataloged sounds of western North Atlantic fishes, both in situ and in aquaria. Bony fishes have evolved a diversity of sound generating mechanisms and produce a variety of sounds. By contrast to sound generating mechanisms, which are lacking in several taxa, all fish species possess inner ears for sound detection. Fishes may also have various accessory structures such as auditory ossicles to improve hearing.

Uses of sound in aquatic ecosystem

- Communication
- Protect themselves
- To locate food
- To navigate under water Environment
- To attract mates

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Marine mammals

Among all aquatic species, marine mammals, especially dolphins, have developed the most sophisticated and specialized sound-producing and receiving system in nature. Dolphins communicate using a combination of visual, tactile, acoustic, and possibly chemosensory channels (Herman and Tavolga, 1980). The echolocation clicks of most dolphin species are extremely short (from 50 to about 100 μ s) and generally show a wide frequency band which extends from 2 to over 200 kHz, and a source level variable between 140 and 220 dB 1 μ Pa at 1 m, as reported by Au (1993). Sounds at high frequency emitted by whales and dolphins are used as sonar to locate food and obstacles (Au, 1993 and Griffin, 1959). Sound is a primary vehicle used by soniferous species to provide information on individual fitness and can be considered an honest signal (Buchanan et al., 1999; 2002).



Fig. 2a *Delphinus spp.*



Fig. 2b *Toothed whales (odontocetes)*

Finfish and Shellfish (Lobster, Shrimp, Crab etc.)

Several marine invertebrates, such as spiny lobsters and fiddler crabs, have been reported to produce sounds for defence and courtship. Sound is used by some marine invertebrates for a variety of purposes. The cleaner shrimp announces itself as a cleaner and advertises its services by clapping one pair of its claws when reef fish approach. Fish produce sounds for several reasons, including staying in contact with the school, alerting conspecifics about the presence of treats, to attract, stimulate and communicate with conspecifics, to intimidate predators which might consume their eggs and juveniles and probably, in few species, to perform echolocation activity. Several catfish families have an enhanced first pectoral fin ray (pectoral spine) that can generate stridulatory sounds when rubbed against a groove of the shoulder girdle. The marine group of codfish also contain a large number of vocal species that emit sounds in agonistic and reproductive contexts. Agonistic sounds have been described for the cod (*Gadus morhua*), the Pollack (*Pollachius pollachius*), and the haddock (*Melanogrammus aeglefinus*), the more distantly related gadiformes. Pollack and tadpole fish emit grunts, cod and haddock produce knocks and grunts, and shore rockling makes thump-like sounds in agonistic or

alarm situations (Almada et al., 1996; Amorim 1996; Fish and Mowbray 1970; Hawkins and Rasmussen 1978; Midling et al., 2002). Several marine crustacean organisms have evolved a variety of sound-producing mechanisms such as stridulation (Boon et al., 2009), stick and slip friction (Meyer-Rochow and Penrose 1976; Patek 2001; Patek and Baio 2007), carapace vibrations (Patek and Caldwell 2006), snaps (Knowlton and Moulton 1963), percussion or rubbing (Imafuku and Ikeda 1990 mandible grinding (Meyer-Rochow and Penrose 1976), emission of bubbles (Crane 1966), and contraction of internal muscles (Henninger and Watson 2005). Spiny lobsters are able to produce highly specialized acoustic signals called rasp. Only the species of snapping shrimp belonging to the genera *Alpheus* and *Synalpheus* are capable of making loud snapping sounds (Johnson et al., 1947). Crabs that live on the surface make sounds that are transmitted through the air and the substrate. Some animals perceive airborne sound through pressure sensitive mechanoreceptors, while others perceive substrate vibration through mechanoreceptors.



Haddock fish.



Snapping shrimp



Mangrove crabs



Spiny lobster

Fig. 3 *Finfish and Shellfish species*



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Eco-acoustics characteristics

• Diurnal and seasonal change of acoustic activity

Sound generated from a location may be used to assess daily patterns of change in animal behaviour (Farina & Gage, 2017). Seasonal variations in animal behaviour occur in temperate regions as the seasons alter. Migratory populations of marine and terrestrial animals (mammals, fish, birds, etc.) migrate from overwintering environments to breeding habitats that can be far away and require a significant amount of energy expenditure in the spring.

• Acoustic interactions between species

Fish produce sounds for a number of reasons, including keeping in contact with their school, announcing the existence of treats to conspecifics, and attracting, enticing, and interacting with one another.

• Level of habitat health

The types of sounds emitted from a site are determined by habitat health, and these signals may indicate the quality of that location.

• The number of species present

Ecoacoustics measures the ecosystem's species diversity and richness.

• Trophic interactions

We may conclude that there are food resources nearby when we hear the thrush's song, and thus recognize trophic interactions.

• Biological diversity

It necessitates the documentation of all species found in a given area. Due to seasonal changes can also alter biological diversity (Farina & Ceraulo, 2017; Sueur et al., 2008; Tucker et al., 2014).

• Level of disturbance

The ecoacoustics can be determined by the amount of underwater background noise.

• Time arrival and migration of species

Sound measurements along routes can also be used to assess shifts in the areal pathways used by migratory animals to travel from wintering to breeding sites.

The Eco-acoustic theatre new experience of nature through sound

The first permanent Eco-acoustic Theatre opened to the public in 2017 at Naturama Natural History Museum, Denmark. The theatre features specific programs of Fragments of Extinction, as immersive listening experiences and educational documentaries on the consequences of the biodiversity crisis on soundscape heritage. The theatre is a unique facility dedicated to immersive listening experiences.



Fig. 4 Eco-acoustic theatre, Denmark

Eco-acoustic benefits and drawbacks

Benefits:

- The measurement of fish abundance is probably the most important application of acoustics in fisheries research.
- It eliminates visual sampling bias.
- Helps the fish for navigation, communication, predator-prey relationship, trophic interaction.
- Studying the effects the anthropogenic noise which can affect fish in multiple ways: by increasing stress levels, changing dispersal behaviours and interfering with communication.

Drawbacks:

- Lack of appropriate equipment for underwater playback experiments in the field.
- Cost of equipment is very high.
- The acoustic methods of observation are unsuited to the flatfish and other species which live in close association with the sea-bed.
- One of the reasons for the current lack of automatic detection methods requires a prior knowledge of the recorded sounds.

Conclusions

Global marine and freshwater ecosystems, like many terrestrial ecological environments, are experiencing unprecedented biodiversity and species abundance loss and relocation, which must be managed and taken into account into future conservation planning. As a result, many aspects of acoustic communication in both terrestrial and aquatic organisms remain to be studied, which we hope will lead to many exciting advancements in the future. To determine the modalities of polluting noise transmission, control noise abatement behaviour, examine and better understand animal communication for conservation purposes, and ensure sustainable growth, knowledge of the sonic characters is essential. Exploring the ecology of sounds is a great way to better understand adaptive processes and evolutionary exposure of organisms in the respond to environmental change since sounds play such a broad role in the environment. Ecoacoustics may address these concerns on a qualitative and quantitative level at a variety of functional scales, including individuals, populations, societies, habitats, and environments, as well as across a variety of epistemological domains. The key factors responsible for soniferous species' acoustic emission adaptation to environmental variability over time are defined in the acoustic adaptation domain. From a theoretical and applied perspective, ecoacoustics represents a modern and exciting ecological discipline that can ensure an effective and up-to-date environmental assessment and long-term monitoring.

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Artificial Intelligence:

Machine intelligence/ Artificial intelligence is that branch of science that address the use of computer to mimic the cognitive function of human. It bears the following tools such as Neural networking, fuzzy logic and probabilistic theory to perform the action.

Neural Networking: Artificial Neural networking is a computational tool to mimic the intellectual skill of human with the help of three main components namely input layer, hidden layer (where computation takes place) and the output layer. It is a trial and error method where series of algorithm is used that endeavors to recognize underlying relationships in a set of data through a process that mimics the way the human brain operates.

Probabilistic Theory: Probabilistic theory is a branch of mathematics where the outcome of the random event may be any one of several possible outcomes. This computational probability with the developed algorithm gives numerical solutions with minimized rounding errors.

Fuzzy Logic: Fuzzy logic is a branch of machine intelligence that helps us in understanding the variation in uncertain and vague situation. General areas of application of fuzzy logic includes clustering, pattern recognition, database, image processing, robotics, rulebased system and decision making.

Fuzzy rule-based system involves following steps

Crisp input
Fuzzy-fication
Fuzzy input
Inference
Fuzzy output
Defuzzy-fication
Crisp output

Crisp input consists of classical set of values from defined objects which possess truth value either '0' or '1' telling whether the member is present or absent. Whereas fuzzy input consists of fuzzy set of values obtained from linguistic terms possessing truth value between '0' and '1' which gives only the degree of membership rather than telling if the member is present or not.

Highlight Points

- Fuzzy logic deals information arising from computational perception and cognition, that is, uncertain, imprecise, vague, partially true, or without sharp boundaries.
- Fuzzy logic allows inclusion of vague human assessments in computing problems.
- Fuzzy logic provides the degree of truthfulness and falsehood of an experiment, achieved through just feeding the crisp fuzzy values of an experiment into it.
- Fuzzy concepts are being recently applied in sensory evaluation.

Multi- attribute decision making system requires the following three modules Linguistic decision matrix and fuzzy decision matrix to perform the fuzzification process Aggregation of attributes.

Ranking principle to perform defuzzification process converting fuzzy numbers into crisp values.

Linguistic Decision Matrix

Linguistic decision matrix is one which deals with number of attributes associated with different samples. Values from linguistic decision matrix are the crisp inputs which needs to be converted to fuzzy inputs (values between 0 and 1) by fuzzification process. For an instance, if a product is formulated under different proportions of ingredients and subjected to sensory analysis in order to choose the most preferable product, fuzzy model can be used to select the most likely sample, which converts the uncertain crisp values representing the linguistic terms to fuzzy values through the process of fuzzification. The process of fuzzification involves assigning membership function to each sample with the crisp value accorded with each of the attributes through which the best sample is examined. More the number of partitions, the greater the accuracy.

The below table shows an example of linguistic matrix for the samples S₁, S₂, S₃ and S₄ which are examined for the attributes such as color, flavor, texture, appearance and mouth feel in order to choose the most likely sample out of the four given samples.



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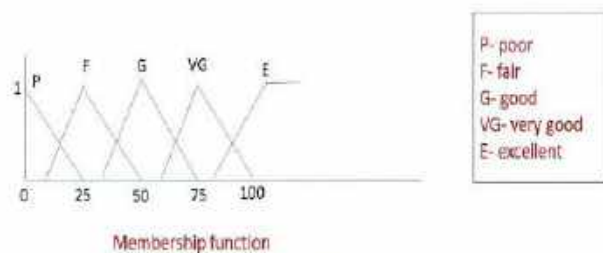
Email: jayjayaquatech@gmail.com Web: www.jayjayaqua.in

Samples (Alternatives) So	Attributes				
	Color	Flavor	Texture	Appearance	Mouth feel
S1	Poor	Poor	Good	Fair	Excellent
S2	Good	Fair	Excellent	Very good	Poor
S3	Very good	Fair	Good	Poor	Good
S4	Excellent	Very good	Very good	Good	Excellent
S5	Fair	Poor	Good	Poor	Fair

Fuzzy Decision Matrix

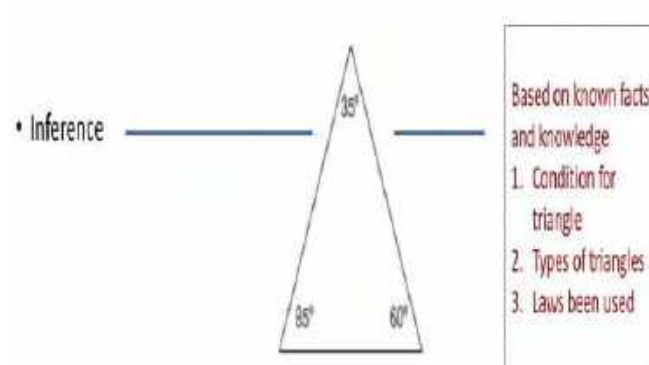
It involves assigning membership functions from the crisp value assigned to each attribute that are used to evaluate the samples. General methods of assigning membership functions are, intuition, inference, ranking order, neural networking, genetic algorithm. Membership value must equal to 1 on any case for easy operation of fuzzy model.

Intuition: Fuzzy decision matrix by intuition relies on fitting linguistic response of the attributes to any one of the geometric shapes such as triangular, parabolic, rectangular, trapezoidal and those values are based on the information at the core point.



P, F, G, VG and E of the above diagram represents the information at core points bearing values as 0, 25, 50, 75, 100 respectively. Where P, F, G, VG and E are the labels which used to value the attributes in linguistic terms namely poor, fair, good, very good and excellent respectively. This is the simplest method of developing a membership function based on the understanding and intelligence of human.

Inference: In the inference method we infer a conclusion based on the known facts or knowledge on a particular problem. In case of considering a geometric shape say triangle, we rely on conditions for triangle, types of triangle and the laws been used. Based on these rules we arrive at the membership function.



Ranking Order:

Pairwise preference among 3 samples

Alternatives	Number of times, the sample been preferred over other samples					
	S1	S2	S3	Total	Per-centage	Ranking
S1	-	541	465	1006	36.66	1
S2	430	-	444	874	30.98	3
S3	609	332	-	941	33.36	2
Total	2821					

Vannamin® feeding

Lowers Cortisol Stress upto **-53.62%**

- Dr C S Bedi, Guybro Animal Health Pvt. Ltd., Mumbai



Stress is physiological response to Stressors. When fish/Shrimp are under stress, to fight stress effectively the body releases stress hormone – Cortisol at a rate of 0.02 - 0.20 mg/g body weight.

Essentially there are two types of Cortisol

- Resting (basal) cortisol which in everyday life is required for normal functions.
- Reactive cortisol level, which increases in response to stressors.

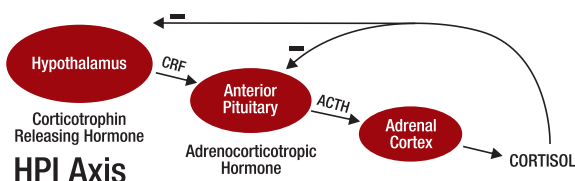
When fish/shrimp are under stress, they secrete cortisol. As the stress goes up, cortisol level goes up. To relieve stress they release cortisol in pond water through urine, faeces, seminal fluid, skin, gills in order to be free of stress – but they invite more problem – the water gets cortisol – the stress hormone which itself is a stressor to Fish/Shrimp feed.

The Solution is –

- Change or partly change pond water to reduce cortisol and/or
- Add **Vannamin** in pond water, also add **Vannamin** in feed

Vannamin with 77 hydrophilic Organic Minerals in Pond water is absorbed through oral Skin/Gill and meets total nutritional needs of aquatic animals and lowers cortisol level.

Reduced cortisol stress level, makes fish/shrimp free from stress – promoting growth.



Trials conducted found **Vannamin** feeding –

- Reduces Cortisol level **-53.62%**

Stress is the main cause of high level Cortisol hormone released by hypothalamus-pituitary-internal axis(HPI). Hypothalamus releases corticotrophin releasing factor (CRF) towards blood plasma circulation, further stimulates secretion of adrenocorticotrophic hormone (ACTH) from anterior pituitary gland which finally activates release of cortisol.

Vannamin feeding makes fish/shrimp free of stress – saves water exchange and promotes growth.

Corisol (nmo/l) In fish before & after being stressed			
	Pre stress	Post stress	% change
Handling	5	449	8980%
Crowding	13	358	2753.85%
Capture & Transport	33	480	1455%
Handling & Confinement	77	698	906.50%
Sea Lice Challenge	99	339	343%

Ref. : i) Fish Handling affects cortisol in water of recirculating aqua system Aquaculture Vol. 468, Part J, 1 Feb 2007 Pg 255-261

ii) Measuring Cortisol in the water as indicator of stress caused by increased leading density in common carp. Aquaculture 218 (1) 685 – 693 March 2003 Neil Ruane and Hans. Komen

High level of Cortisol is bad for health :

- Stimulates catabolism
- Liver muscle enlargement
- Oxidative degeneration of fat
- Increased blood glucose

Effects on Fish & Shrimp :

- Sharp reduction in body weight
- Elevated FCR
- Low energy, low growth
- Morbidity/Mortality

Vannamin Feeding Suggestions :

Through Water : per Acre/2 Ft depth/50000 PL :	
Antistress & Anticramping	5 Kg every week till the normalcy restored
Full Moon & No Moon stress	5 Kg 2 days before & 2 days after
Through Feed :	
Running Mortality/ Moulting Mortality Syndrome	10 gm or more per Kg feed

Vannamin Conc. with 77 hydrophilic organic minerals lowers cortisol stress and meets total mineral nutrient needs resulting in optimum development, growth and performance.

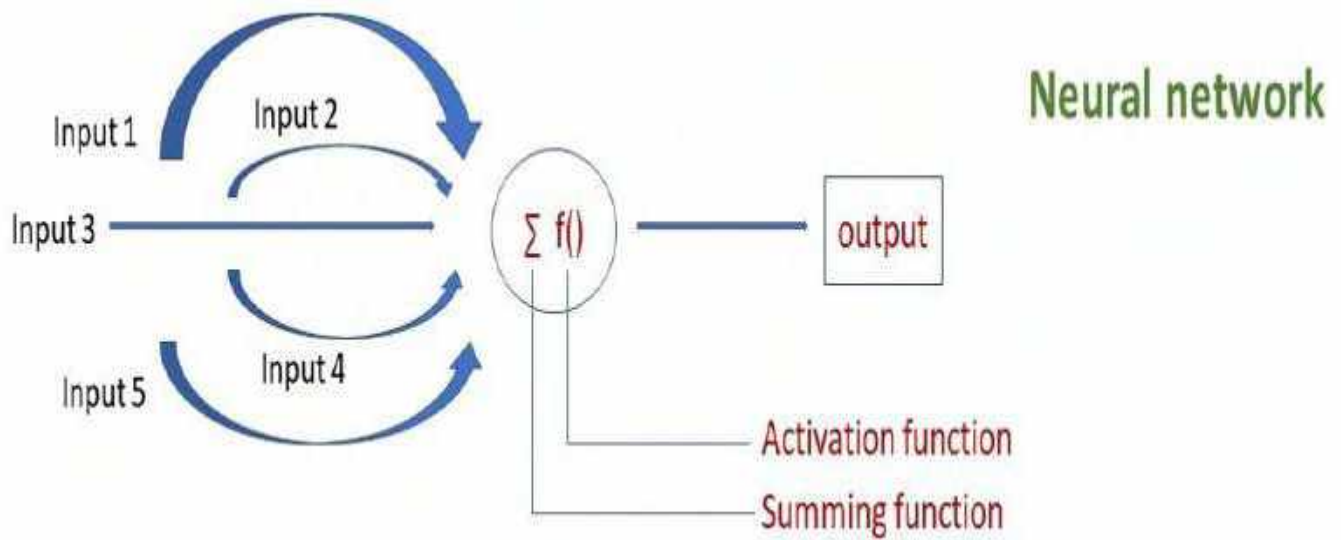
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In this method the membership function is developed through a pairwise preference among the samples. Here, the number of counts of panelist who prefers each sample against the other samples are taken into account and their percentage are calculated. The samples are then ranked from the percentage of weightage they score in respect with the other samples.



As discussed before neural networking is a computational tool that mimics the cognitive skill of human with the help of three main components namely input layer where set of input data were fed in to the hidden layer which is said to constitute the neurons on which computation will take place in terms of activation and summation functions. As it is a trial and error basis concept complete data were initially divided into two groups (2/3rd for training and 1/3rd for validation), where one set of data is named training set and the other one named as validation set. Once the system is trained and validated this way, then the new set of inputs were fed into the system to give outputs after performing the computational workings in hidden layer and match the most reliable output reflected from the response of trained set of data. This way membership functions are developed for the fuzzy decision matrix through the neural networking method.

Genetic Algorithm: Genetic algorithm method of developing membership function is based on Darwin's theory of evolution on concept to survival of the fittest. It is similar to the fact that the new classes of living things come into existence through reproduction, crossover and mutation of existing ones. In the same way membership functions are assumed with the coded bit strings. These strings are then joined through a fitness function to give the membership values.

The fuzzy decision matrix can then be arrived after developing the membership function by any of the above said methods. Below is an example of a fuzzy decision matrix where $S_1, S_2 \dots S_6$ are the samples under study and C_1 & C_2 are the test attributes with which the samples are compared. Here matrix have been constructed in response from the three panelists. Each of the panelist records their feedback for the six samples ($S_1, S_2 \dots S_6$) with respect to the attributes C_1 & C_2 . After arriving to the fuzzy decision matrix, the crisp numbers say, 0, 25, etc are converted to the real fuzzy number by dividing each of the crisp number of the matrix with the high end crisp value which can be given as feedback to the test attributes of the samples. This way all values are brought between '0' & '1' lying in same domain. As of next step weightage for each attribute (C_1 & C_2) are given. For an instance say 0.4 to C_1 & 0.6 to C_2 . This clearly shows that the attribute C_2 has got more importance in judging the samples than the attribute C_1 . These weightages are then multiplied with the response feedback of all the panelists i.e., $(0.4 * (0, 0, 25))$ of C_1 & $(0.6 * (0, 0, 25))$ of C_2 . Once after the weightage manipulation, operation of data within the attributes takes place either by multiplying or summing them. Thus, finally we get a one by six matrix with respect to this case, giving a output as a fuzzy preference number (x, y, z) as $S_1(x_1, y_1, z_1), S_2(x_2, y_2, z_2)$ and so on.

	C1	C2
S1	(0, 0, 25)	(0, 0, 25)
S2	(50, 05, 25)	(50, 05, 25)
S6	(10, 25, 25)	(10, 25, 25)

recognition combined with artificial neural networking, fuzzy logic based sensory evaluation of marine products through intuition (mainly triangular) membership function, sorting and grading of fishes using image analysis (pattern recognition) by fuzzy inference system, fuzzy rule based system and decision making system in determining the parameters like time, temperature, rpm, concentration etc., of the unit operations to arrive at the safety and quality point during the production & storage of marine products.

By Ranking Principle, these fuzzy numbers then undergo defuzzification process to give crisp numbers with which we can rank the samples in a precise manner. Different methods by which defuzzification can be carried are max- membership principle, centroid method, weighted average method, mean- max membership, centre of sums, centre of largest area and first of maxima or last of maxima methods. The above explained fuzzy concept for big data is possible through computation i.e., by writing algorithm.

Fuzzy Logic in Fish Processing

Application of fuzzy logic in fish processing includes fish classification based on its freshness indicator combined with image processing relating the RGB value of colored images of eyes and gills of the fishes, fuzzy based control task in robotics in mapping the topographical fish concentration and as already discussed other such applications includes fuzzy logic in pattern

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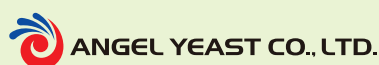
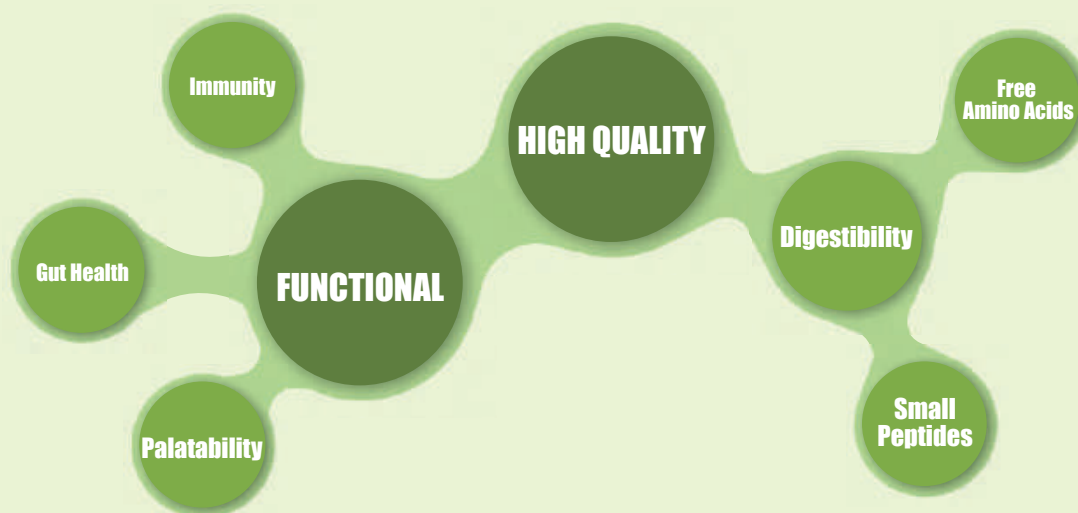


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