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Inside...


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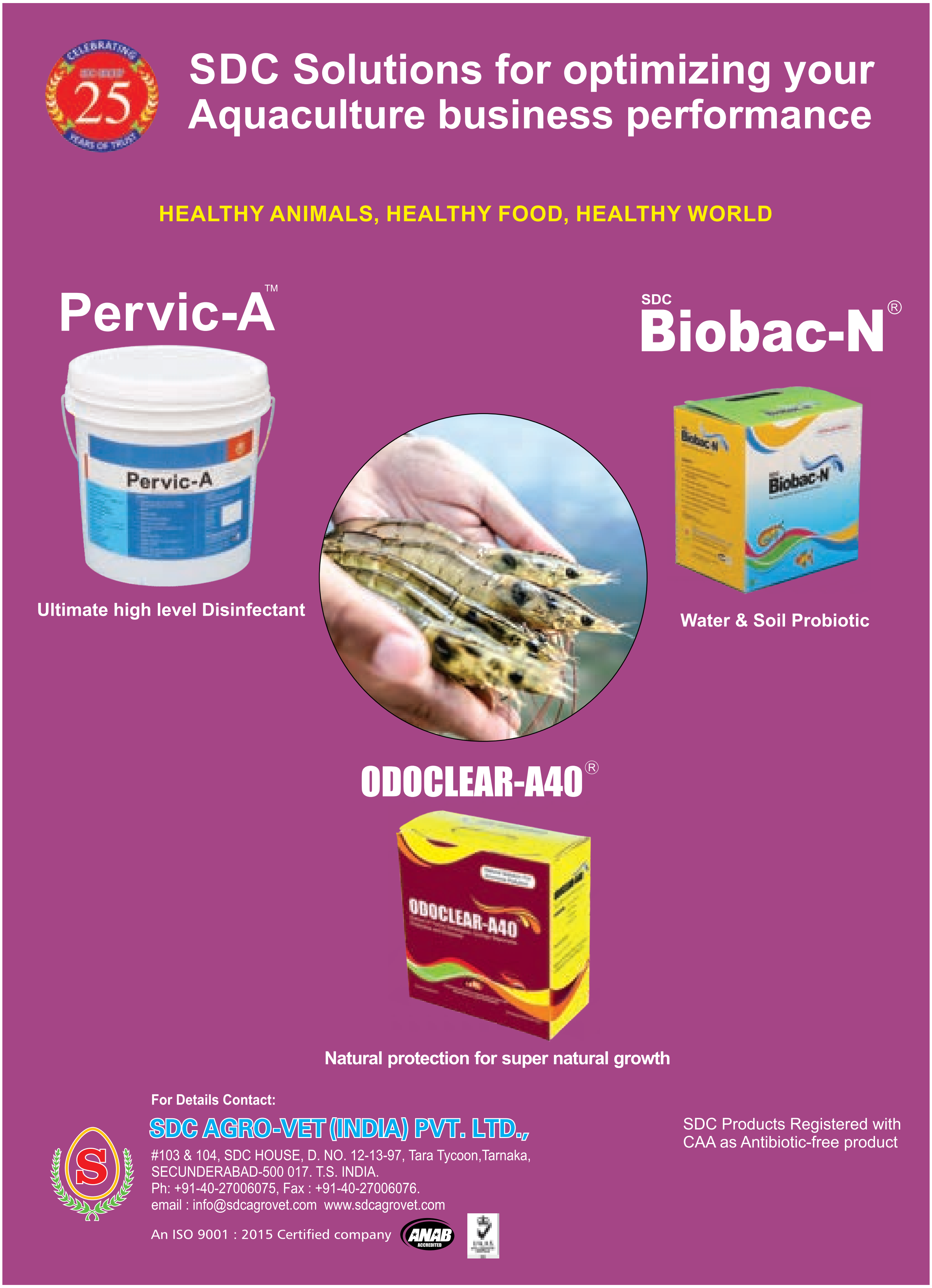
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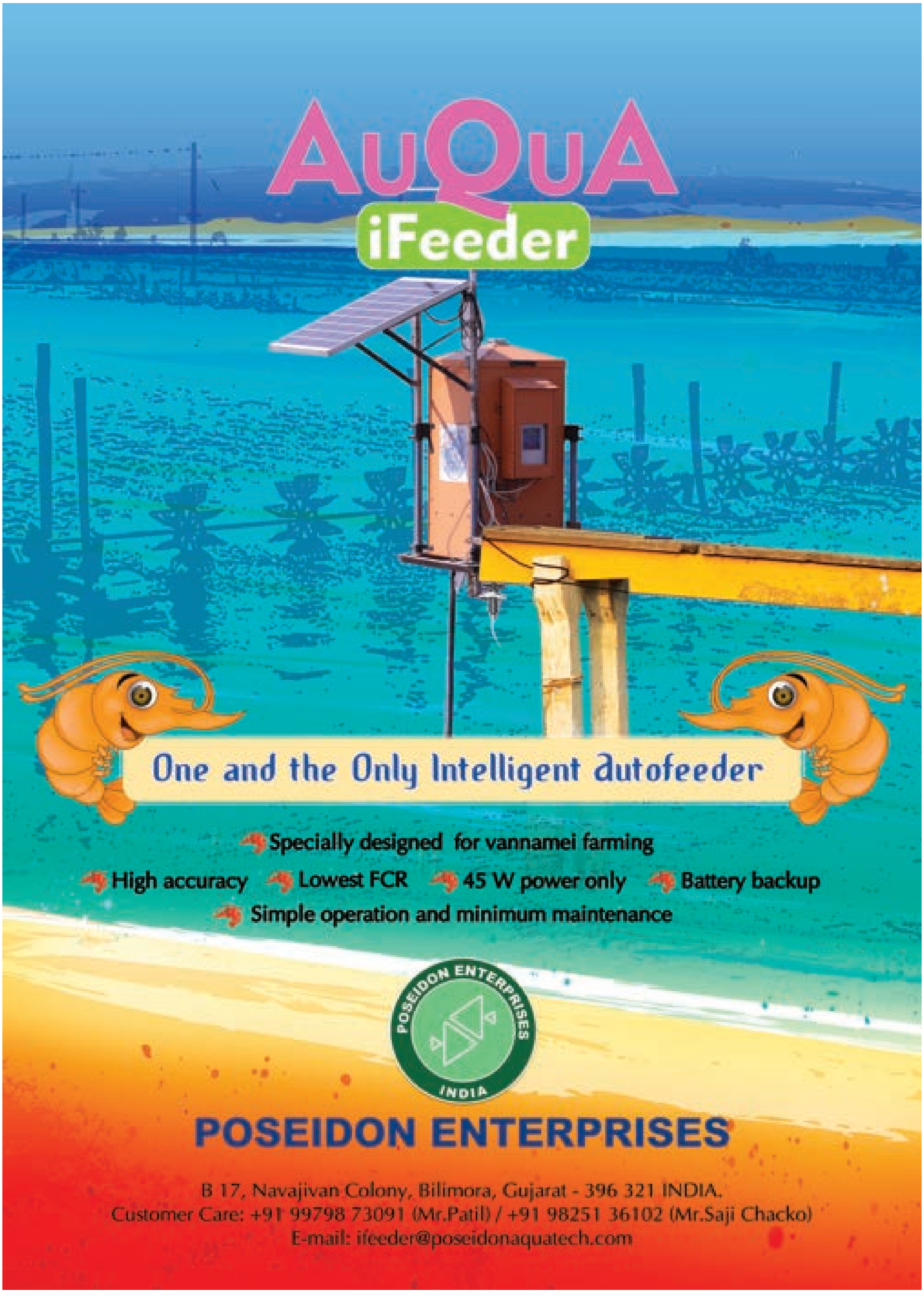
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Aqua International

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M. A. Nazeer

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CAFÉ, Kolkata Centre organizes online meet on Brackish Water Polyculture as a Sustainable Livelihood Option for Small and Marginal Farmers

Experts discussed on Environmental Impact of Aquaculture and highlighted information on the effects of different effluents in aquatic environment. This issue is taken into account on a global scale as well as local, and the effects are measured on organisms directly affected as well as those that are affected further down the food chain as dictated by trophic transfer.

Dear Readers,

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

In the News section, you may find news about –

The Farmers Advisory Meet on 'Brackish Water Polyculture as a Sustainable Livelihood Option for Small and Marginal Farmers' was organized by Kolkata Centre of ICAR - Central Institute of Fisheries Education online on 18 September 2021. Dr G. H. Pailan, Principal Scientist and OIC, Kolkata Centre of CIFE and Programme Organizer gave an overview of importance of brackish water polyculture, good market value of cultivable BW finfishes and shellfishes, importance of interaction and knowledge sharing between farmer to farmers and scientist to farmers on suitable species for BW aquaculture, culture methods, water quality maintenance and other aspects. Coordinator and Speaker of this programme Dr G. Biswas, Senior Scientist, Kolkata Centre of CIFE gave an audio - visual presentation on the afore mentioned topic. He discussed about status of BW aquaculture in India and contribution of BW aquaculture in Indian economy and foreign exchange earnings through export of frozen BW shrimp and total frozen aquatic products.

Eminent in land fishery and aquaculture expert in West Bengal and formerly Principal Scientist of ICAR-Central Inland Fisheries Research Institute Dr Amitabha Ghosh, ARS died on 26 August 2021 due to heart attack. He was 75 years. Dr Ghosh was Officer-in-Charge, Kolkata Research Centre of CIFRI and PS in Estuarine Fisheries Division of CIFRI at Barrackpore headquarters, retired from service in 2009. His pictorial book (CIFRI Bulletin) 'Fishes of Hooghly Estuary' is lucidly - written fish identification guide, will provoke much interest in UG and PG students in Fisheries Science and Aquaculture.

Marsco Aqua Clinics - Aqua One Centre in association with NFDB and MANAGE, Hyderabad organized the National Webinar Series - 5 on 'Molecular Diagnosis of Disease Management in Freshwater Aquaculture and Water Quality Management in Aquaculture' on September 25. Dr G. Dash, Professor, Department of Aquatic Animal Health, spoke on 'Recent advances in fish and shrimp health management for sustainable aquaculture'. He also discussed about how conventional disease diagnostic techniques been replaced by modern techniques; compared conversion efficiency of beef, pork and fish to protein food. As the second invited speaker, Dr (Mrs) K. Bhattacharya Sanyal, SRF in National Surveillance Programme for AA Health (NSPAAD) project gave a presentation on 'Water Quality Management in aquaculture'. She emphasized on parasitic infestations, bacterial diseases and altered (deteriorating) pond water quality as main problems in aquaculture. She also discussed about general aspects of fish pond management, stocking density, primary productivity, fish health management, supplementary feeding, pond preparation, water quality indices, pond bottom treatment and market prices of different water test kits that can be used by fish farmers.

Cortec Corporation launched its new organics recycling program at Cortec global headquarters near Saint Paul, Minnesota. The program will collect food and paper waste that is usually thrown into the facility's garbage and turn it into compost instead. This involved installing a new dumpster mezzanine area, purchasing new composting bins, training employees and paying for disposal hauling services and compostable products (e.g., cups, plates, utensils, etc.) for the first six months.

In the Articles section -- Article titled ***Environmental Impact of Aquaculture,*** written by Ms Sonal R Kalbande and other authors highlighted that this article is focused to gain information on the effects of different effluents in the aquatic environment. This issue is taken into account on a global scale as well as local

Contd on next page

NRS GROUP

Aqua International

Our Mission

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

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

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

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

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

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and the effects are measured on organisms directly affected as well as those that are affected further down the food chain as dictated by trophic transfer. Chemical soil degradation after erosion is the second most abundant form of soil and water degradation and as such poses a threat to our finite soil and aquatic resource, as it tends to render it less usable. It is, therefore, necessary to understand the means by which soils and water are degraded chemically. This topic sheds light on these drivers of degradation and also discusses some assessment methods developed to determine soil and water chemical degradation. In assessing chemical degradation, a combination of assessment tools and soil and water quality indicator parameters or single assessment tools may be employed. The use of human wastes in aquaculture or the contamination of aquaculture systems with agricultural or industrial pollution could result in product contamination and food safety concerns. This article also seeks to highlight some of the causes of soil and water chemical degradation.

Another article titled ***Bronze Featherback, Notopterus – Manifold benefit for Freshwater Aquaculture,*** written by Mr P. Yuvarajan and other authors highlighted that Bronze Featherback locally called as pholi, foli, seppili, serruppaachi, seppattai and seppaala and paravaala in various places of India. It is an additional food and ornamental fish for aquaculture. It has remarkable health benefits such as high protein, fatty acids and its soup and oil has been used as medicine for measles.

The other article titled ***Ballast Water: A Mask of Threat to Marine and Coastal Ecology*** written by Ms Manisha Panthi and other authors highlighted that Ballast water is the water put on board a vessel for safety, providing stability, reducing stress, improving propulsion and maneuverability, redress loss of fuel weight and water consumption. It is essential to commercial shipping. Ballast weight generally equates 25 to 30 per cent of a ship's dead weight tonnage. Thousands of aquatic species that may be carried in ship's ballast water, including bacteria and other microbes, micro-algae, different life history stages of aquatic plant and animal species from one port to another. Worldwide it is commended that discharge of ballast water into sea is potentially the greatest accidental manner of introducing the exotic organisms. Thus it impacts the ecological, economical and human health functions. As a result, various researchers, policy makers and resources managers / stakeholders are required to look into the technologies for the treatment and management of ballast water.

Article titled ***Uses of Green Fluorescent Protein,*** written by Mr Samuel Moses and other authors highlighted that the Green Fluorescent Protein is called as a marker of gene expression. GFP plays a role in producing green glow of the intact cells. The major application of GFP is the production of Glofish, which is genetically engineered fluorescent fish.

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

M.A.Nazeer
Editor & Publisher
Aqua International

Farmers Advisory Meet held on Brackish Water Polyculture of Finfish and Shelfish

Kolkata: The Farmers Advisory Meet on 'Brackish Water Polyculture as a Sustainable Livelihood Option for Small and Marginal Farmers' was organized by Kolkata Centre of ICAR - Central Institute of Fisheries Education online (Zoom platform) on 18 September 2021. Dr G. H. Pailan, Principal Scientist and OIC, Kolkata Centre of CIFE and Programme Organizer gave an overview of importance of brackish water (BW) polyculture, good market value of cultivable BW finfishes and shellfishes, importance of interaction and knowledge sharing between farmer to farmers and scientist to farmers on suitable species for BW aquaculture, culture methods, water quality maintenance and other aspects.

Coordinator and Speaker of this programme Dr G. Biswas, Senior Scientist, Kolkata Centre of CIFE gave an audio - visual presentation on the afore mentioned topic. He discussed about status of BW aquaculture in India; coastal BW resource (12 lakh hectare) and the inland salt - affected water area in north - western Indian states; state - wise estimated potential BW area under culture; contribution of BW aquaculture in Indian economy; foreign exchange earnings through export of frozen BW shrimp and total frozen aquatic products.

Participants were informed about candidate species for BW aquaculture (having easy marketability, high price in domestic / export market, fast growth rate and high survival, reliable seed source, compatible with other fish / shellfish species, hardy enough to disease); feeding habit, habitat, growth rate, culture, marketable size and market demand of Mugil cephalus, Liza tade, L. parsia, Mystus gulio, Etroplus suratensis, Chanos chanos, Penaeus indicus, P. vannamei, Scylla olivacea, S. serrata; optimum water quality parameters; culture methods in general in BW polyculture. Species cultured should accept common supplementary feed and have no competition in food and space. In improved scientific polyculture, selective stocking, fertilization, feeding, health monitoring is done whereas not followed in traditional 'Bheri' and 'Pokkali' system.

Dr Biswas further discussed about different viable BW polyculture models, viz., M. cephalus+E. suratensis+P. monodon; M. cephalus+L. parsia+L. tade+P. monodon; P. indicus+C. chanos; P. vannamei+C. chanos; growth of species at harvest, days of culture, stocking density of individual species, size at stocking and total production rate in each of the models; growth of species and total production in BW polyculture in farmers' ponds at end of 325 days; polyculture of BW finfishes and mud crabs; box culture of mud crab juveniles in polyculture pond for 4 - 6 months; experiments and trials on periphyton - based BW polyculture; substrates used for periphyton growth; utilization of periphyton biomass for partial replacement of supplementary fish feed (enhancement of BW fish production with less use of feed). It was a very informative session. Towards end, Dr Biswas as resource person and Dr Pailan patiently gave answers to several queries raised by participating progressive aqua - entrepreneurs and elderly fish farmers during interaction. News communicator Subrato Ghosh participated in it attentively.

Ex-Principal Scientist, ICAR-CIFRI Dr Amitabha Ghosh Passes Away

Kolkata: Eminent inland fishery and aquaculture expert in West Bengal and formerly Principal Scientist (PS) of ICAR-Central Inland Fisheries Research Institute (CIFRI) Dr Amitabha Ghosh, ARS died at his residence at Santasreepally, Barrackpore, Kolkata on 26 August 2021 due to heart attack. He was 75 years in age. Dr Ghosh was previously Officer-in-Charge, Kolkata Research Centre (RC) of CIFRI and PS in Estuarine Fisheries Division of CIFRI at Barrackpore headquarters, retired from service in year 2009. His pictorial book (CIFRI Bulletin) 'Fishes of Hooghly Estuary' is lucidly-written fish identification guide, will provoke much interest in UG and PG students in Fisheries Science and Aquaculture. Another Bulletin co-authored by him was 'Management of Estuarine Wetlands'.

He was Councillor of Inland Fisheries Society of India. While preparing two abstract papers for submission in the National Seminars at CIFRI during April 16 - 17, 2005 and December 14 - 16, 2007, News communicator Subrato Ghosh (who came under Sir's likings) received valuable advice and guidance from Dr Ghosh (in Editorial Board) on both occasions; my abstracts were accepted for presentation and published.

Dr Ghosh was transferred


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Improve water color
Before
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7 days before stocking | 800 g - 1,000 g | 1,200 - 1,500 g | 1,200 - 1,500 g
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from Malda RC of CIFRI to Kolkata RC as Senior Scientist in 1998. His areas of intensive investigation, study and research contributions include: Possibility of rearing giant prawn and Pangas catfish in sewage - fed estuarine wetlands in east Kolkata; fish culture methods and faunal diversity of sewage - fed pisciculture system in vast East Kolkata wetlands; fisheries resource management in sewage - fed wetlands of Calcutta spill area; ecology and fisheries of estuarine wetlands (freshwater bheries and bheries of low, medium and high salinities) in WB; assessment of aqua crop production from such water bodies; occurrence of small mullet Sicamugil cascasia in freshwater zone of Hooghly estuary; distribution of codlet Bregmaceros mcclelandi in lower Hooghly estuary and Sundarban mangroves; fish diversity in fresh water zone of this estuary and same in Godavari estuary; ecology, limnological parameters and fish diversity in Subarnarekha and Icchamati estuaries; biology and migration of Hooghly hilsa in context of Farakka barrage.

Few of his initial research publications include: 'On some diseases of carps' in Souv. 9th Annual Reunion, Zoology Dept, Kalyani University in 1973; 'Observations on the carbohydrate digesting enzymes in catfish Heteropneustes fossilis' in 1974; 'Morphohistology of digestive tract of Liza parsia in relation to (irt) its food habits'; 'Ecological investigations of jute-retted pond under pisciculture'; 'Observations on digestive enzymes of Notopterus chitala its food habits'; 'Control of Oreochromis mossambicus in sewage - fed impoundments using Lates calcarifer'. After the death of Professor N. R. Chatterjee (expert in aquaculture biotechnology, pisciculture and induced breeding and former Head of Dept of Aquaculture, WBUAFS, Kolkata), death of another expert in this subject in WB Dr Amitabha Ghosh has occurred.

Webinar held on Molecular Diagnosis of Disease Management and Water Quality Management in Freshwater Aquaculture

Odisha: Marsco Aqua Clinics - Aqua One Centre in association with NFDB and MANAGE, Hyderabad organized the National Webinar Series - 5 on 'Molecular Diagnosis of Disease Management in Freshwater Aquaculture and Water Quality Management in Aquaculture' on 25 September 2021. As the 1st invited speaker, Dr G. Dash, Professor, Department of Aquatic Animal Health, Faculty of Fishery Sciences (FFS), WBUAFS, Kolkata spoke on 'Recent advances in fish and shrimp health management for sustainable aquaculture'.

In this audio - visual presentation, Dr Dash discussed about how conventional disease diagnostic techniques been replaced by modern techniques; compared conversion efficiency of beef, pork and fish to protein food (fish being the best); India's average of 12 kg per capita consumption of fish and fishery products annually; that people have to put their innovative ideas to produce more fish and shellfish; Exotic (OIE listed), Endemic and Emerging (eg. Tilapia Lake Virus) infectious diseases in Indian aquaculture; contribution of host, physiological status (acquired immunity), pathogen, nutrition, environment and other facilities to fish health status; expanding range of new farmed aquatic animal (AA) species may lead to new and emerging AA disease; improved diagnostic and surveillance efforts in connection with increased aquaculture production; highlighted on spreading of diseases WSSV, TSV, Gyrodactylosis, etc.

Dr Dash comprehensively gave an account of OIE - listed and non – OIE - listed AA diseases in fishes, molluscs and crustaceans; highly transmissible and infectious transboundary AA diseases viz., EUS, TiLV, AHPND, IMNV (in vannamei shrimp), Koi Herpes Virus; pathways, factors and drivers for disease emergence in aquaculture; need of having knowledge of pathogens and their hosts, ecosystem change, aquaculture management practices and health control, trading in live animals and products; essential elements of any AA health protection programme and their relation to PMP / AB; historical overview of laboratory diagnosis from culture - based assays to nucleic acid based assays.

He emphasized that prevention and pro - active approach is much better than reactive approach, and that risks have to be managed at all levels of aquatic chain. Dr Dash further explained about Gross observation and clinical signs (Level - 1), Histopathology and basic bacteriology (Level - 2) and In-situ hybridization, PCR, molecular methods (Level - 3 diagnosis); horizontal and vertical transmission of AA diseases; role of improved nutrition, probiotics, immunostimulants, detection of pathogens in health control in aquaculture; morphological, immunological and molecular methods of pathogen detection adopted in various labs; combination of methods for definitive disease diagnosis.

Dr Dash highlighted novel technologies like Nex Gen Sequencing, RT - PCR, immunohistochemistry, Immuno - chromatography, Western Blot having potential for use in aquaculture; ISAV Rapid Test Kit method.

He discussed about practical application of nanotechnology and nanomaterials used in fish / shellfish pathogen detection; biosensors as fish health assessment tool and for stress monitoring, fish spawning prediction, pathogenic bacteria detection, identifying pesticide residues; confirmatory tests, laboratory screening and serological diagnostic tests for AA disease control; development of fish vaccine technologies in

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• Improves growth of plankton.
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• Improves better utilization of nutrients and feed conversion ratio (FCR).
• Balance the ratio of essential minerals in pond water.
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Pond preparation | 4 to 6 kg per acre
During Culture | 2 to 4 kg per acre
Schedule | Every 7 days
Or as advised by the Qualified Aquaculture Consultant
* Dosage should be adjusted according to stocking density, phytoplankton density,water and pond bottom conditions. Highly recommended to use Min Total as a regular program to achive optimal perfomance.
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world.
He focused on need of standardization of diagnostic tests, preventive health management, BMP (Better Management Practices) and methods of preventing entry of infectious agents in fish farm environment; averting the threat before it occurs, preventing stressful situations; use of SPF fish and shrimp seeds; adopting Good Aquaculture Practices and biosecurity; disinfection of cast nets and other materials; use of calcium hypochlorite - treated water in fish farms. Dr Dash nicely explained dosages of application of pond soil, water and feed probiotics, immunostimulants, Vitamin - Mineral with feed; Progressive Management Pathway for improving aquaculture biosecurity.
Instead of using veterinary medicinal products, we should develop novel aquaculture products and companies should be registered under CAA. He informed about USFDA approved fish drugs, FDA low regulatory priority aquaculture drugs, best practice guidance for protecting fish farm and aquatic environment, sustainable environment-friendly treatment strategies for fish diseases for sustainable fish production.
In the end, Dr Dash spoke about utilizing ITK of fish farmers and research development should take place based on farmers' needs. Farmers can avail help from Aqua One Centres, Field Schools, NASCA - MPEDA, State Government laboratories, private clinics owned by fishery professionals. He thanked Mr M. Bolem, Founder and Director, Marsco Group of Companies for organizing this Webinar.
As the 2nd invited speaker, Dr (Mrs) K. Bhattacharya Sanyal, SRF in National Surveillance Programme for AA Health (NSPAAD) project, FFS, WBUAFS gave a presentation on 'Water quality management (WQM) in aquaculture'. She emphasized on parasitic infestations, bacterial diseases and altered (deteriorating) pond water quality as main problems in aquaculture. Ecological parameters, fish seed and feed do affect fish health. She informed about desirable limits, means of controlling and rectifying the level and methods of estimation of dissolved oxygen, nitrogen, nitrite, nitrate, pH, alkalinity, salinity, water temperature and turbidity of fish pond water.
Dr Bhattacharya Sanyal also discussed about general aspects of fish pond management, stocking density, primary productivity, fish health management, supplementary feeding, pond preparation, water quality indices, pond bottom treatment and market prices of different water test kits that can be used by fish farmers.
In the end, she mentioned that standard WQM and water quality monitoring are required throughout culture period till harvest for successful fish production. News communicator Subrato Ghosh learnt many basic but important things from esteemed resource persons. For 20 – 25 minutes, Dr Dash and Dr Bhattacharya Sanyal patiently gave answers to numerous queries put up in Chat Box by participating fish farmers and entrepreneurs in Webex platform.

Royal Dutch Jaarbeurs | VNU Group Appoints Heiko M. Stutzinger as Chief Operating Officer

New COO will succeed Peter van der Veer

Utrecht, The Netherlands: Heiko M. Stutzinger has been appointed Chief Operating Officer (COO) and Member of the Executive Board of international venue and event organizer Royal Dutch Jaarbeurs | VNU Group, as of December 1, 2021.
Based in the Jaarbeurs head office in Utrecht, Mr Stutzinger will contribute to the organization's ambitious post-pandemic growth strategy, which underpins the company's commitment to sustainability, digital and technological innovation, employee wellbeing and overall business growth.
As COO, Stutzinger will be responsible for the Jaarbeurs' high - profile national shows portfolio, guest and partner events, venue management and strategic business development. He will retain his current position as member of the Board of Directors of VNU Asia Pacific, as well as lead the VIV worldwide Agribusiness event series, currently staged in eight countries around the world.
Albert Arp, CEO of the Jaarbeurs | VNU Group: "We are thrilled to welcome Heiko. He joins us at an exciting and crucial moment, as we accelerate the implementation of our business strategy in response to the upcoming rapidly changing market. Over the past 18 months, the event and hospitality industry has been challenged by the global pandemic. Now it is time to push our business forward in an innovative and sustainable way with a strong commitment to safety. Heiko's extensive experience and outstanding capability in new business development and digital transformation is an invaluable contribution to that. In South East Asia, he has achieved great results over the past three years".
Jaarbeurs | VNU Group COO, Heiko M. Stutzinger, added: "I'm delighted to join Jaarbeurs at this pivotal time in the business and work full - speed to deliver the visionary road map ahead, whilst evolving the company's credentials as the leading sustainable venue and event operator in Europe".
In his new role, Stutzinger will succeed Peter van der Veer, who joined the Group in 2019 for a period of two years. Mr Van der Veer will hand over from his position in November. Arp added: "We are very thankful to Peter, who has been a highly valued partner in the past two years. He brought a lot of creativity to our team and introduced us to new markets".

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New Organics Recycling Program Allows Cortec Corporation to Use Its Own Compostable Bags

Minnesota: Cortec Corporation is pleased to announce the launch of its new organics recycling program at Cortec global headquarters near Saint Paul, Minnesota. The program will collect food and paper waste that is usually thrown into the facility's garbage and turn it into compost instead. An especially exciting feature of this new program is the opportunity to make use of Eco Film commercially compostable bags manufactured at Cortec's own film extrusion plant in Cambridge, Minnesota.

Cortec launched its organics recycling this year after being awarded a grant from Ramsey County to help with initial setup. This involved installing a new dumpster mezzanine area, purchasing new composting bins, training employees and paying for disposal hauling services and compostable products (e.g., cups, plates, utensils, etc.) for the first six months. The organic waste will be collected in Eco Film Bags lining bins throughout Cortec's facility and then sent to an industrial composting site in Rosemount, Minnesota, to be converted into soil amendments for local communities.

Corey Cremers, Senior Environmental Specialist at Cortec Corporation, has spearheaded this and many other environmental initiatives at Cortec. He commented, "Participating in the organics recycling program is an important step in reducing our environmental impact here at Cortec Instead of sending waste materials to landfills we can migrate the waste to a beneficial resource like compost which can be used by the local community. It is cool to see all facets of employees from the office to the production floor participating in the program and adding value to our environmental management system".

As mentioned, a particularly special feature of this program is the chance for Cortec to put its own Eco Film Bags to good use. Eco Film Bags are certified compostable under BPI certificate #890974 for disposal in a commercial composting facility and are therefore perfect for use as liners in Cortec's organics collection bins. In the past, Cortec has sourced Eco Film Bags to help other organizations such as the Minnesota Zoo launch or explore their organics composting programs, so it gives Cortec special satisfaction to finally be able to use this commercially compostable film in its own organics recycling program at Cortec headquarters.

As a chemical manufacturing company, Cortec has shown exceptional leadership in launching many "green" initiatives over the years. These include the R&D of many commercially compostable films and a wide range of USDA Certified Biobased Products for rust prevention. Even as Cortec celebrates its new organics recycling program, the company continues to look for additional ways to lower its environmental impact and that of product end users by a special focus on "green" chemistry initiatives that promote a "circular" economy.

Learn more about some of Cortec's sustainable technologies for corrosion and cleanup here: https://www.biocortec.com/.

First VCI recycling program in Europe

Cortec's European plant EcoCortec, also implemented a European-wide initiative to collect and recycle used VCI films and bags which allows their customers to send their used film back to the plant. This was the first recycling recycling programof this type implemented in Europe. Within the "Plastic Recycling Project," EcoCortec's customers send their waste material back to the Croatian plant, where it is then completely recycled and used for manufacturing a new product. This creates a win - win situation for customers, the manufacturer and the environment, encourages environmental responsibility and reduces carbon footprint in the process.

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Misconceptions about offshore aquaculture refuted in new paper

United States: The offshore aquaculture sector has faced dogged criticism that undermines public support, but a new paper addresses many of these misconceptions and outlines the industry's role in shoring up food security in the United States.

A team of authors with backgrounds in aquaculture production and industry regulation have published a new paper that refutes persistent myths and unfounded criticisms of marine aquaculture. The paper, published in Reviews in Fisheries Science and Aquaculture, shines a light on repeated – and in some cases unfounded – allegations of environmental degradation and poor animal welfare at offshore aquaculture facilities.

The open access paper counters the industry's most prevalent critiques by reviewing current policies and regulations in the United States as well as sector production practices. Criticisms like lax regulatory oversight, concerns over high stocking densities for farmed fish, untreated discharge, use of antibiotic and antifungal treatments, entanglement of marine mammals in equipment are addressed. The authors also examine offshore aquaculture's impacts on wild fish stocks and habitats, the use of feed additives to pigment fish flesh, unsustainable use of fish meal in feed formulations and the market disruption caused from cheap and low-quality fish. It also analyses the extent to which commercial aquaculture ventures and fisheries can coexist as for-profit businesses.

The authors stress that marine aquaculture is not risk-free – it comes with potential environment, economic social and cultural impacts. Aquaculture producers and governance bodies must take active steps to ensure that the industry meets its sustainability goals. However, the researchers argue that these challenges can be addressed within existing regulatory and scientific community.

Offshore aquaculture as part of the solution

The authors outline four key reasons for offshore farming's probable upward trajectory in the United States.


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Environmental Impact of Aquaculture

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Highlight Points

This article is focused to gain information on the effects of different effluents in the aquatic environment. This issue is taken into account on a global scale as well as local and the effects are measured on organisms directly affected as well as those that are affected further down the food chain as dictated by trophic transfer. Chemical soil degradation after erosion is the second most abundant form of soil and water degradation and as such poses a threat to our finite soil and aquatic resource, as it tends to render it less usable. It is, therefore, necessary to understand the means by which soils and water are degraded chemically. This topic sheds light on these drivers of degradation and also discusses some assessment methods developed to determine soil and water chemical degradation. In assessing chemical degradation, a combination of assessment tools and soil and water quality indicator parameters or single assessment tools may be employed. The use of human wastes in aquaculture or the contamination of aquaculture systems with agricultural or industrial pollution could result in product contamination and food safety concerns. This article also seeks to highlight some of the causes of soil and water chemical degradation.

Keywords: Chemical degradation,Ecosystem, Effluents, Waste water.

1. INTRODUCTION

Aquaculture is one of the fastest-growing food sectors and a substantial economic activity for many countries, contributing significantly to global food production. Aquaculture is predicted to surpass capture fisheries production by 2030 as a result of the world's population growth, rising incomes and urbanisation. Aquaculture's continuing expansion places a greater pressure on natural resources, such as water, feed and energy. Water eutrophication water quality, alteration or destruction of natural habitats and the introduction and transmission of aquatic animal diseases are among the most prominent negative environmental impacts linked with aquaculture. The environmental impact of aquaculture, on the other hand, is entirely dependent on the species farmed, the level of output and the farm's location. New strategies and technology have also evolved, proving that sustainable aquaculture is possible. Disposal of various waste materials into rivers, estuaries and marine waters is not a modern phenomenon; this practice has been used as a preferred disposal option virtually since the beginning of human civilization. Nevertheless, when the full spectrum of emissions from land-based activities is taken into account, the use of coastal waters as a repository for anthropogenic waste has not previously been practiced on as large or intense a global scale as in recent decades. Contaminants enter our waterways through two generic vectors: point and nonpoint sources. Pollutants of nonpoint source origins tend to enter aquatic systems as relatively diffuse contaminant streams primarily from atmospheric and terrestrial sources. In contrast, point source pollutants generally are introduced via some type of pipe, culvert, or similar outfall structure. These discharge facilities typically are associated with domestic or industrial activities, or in conjunction with collected run of from roadways and other developed portions of the coastal landscape.

Determining the eventual fate and effect of naturally occurring and synthetic contaminants in coastal environments and biota is a highly dynamic proposition that requires interdisciplinary evaluation. It is essential that all processes sensitive to pollutants be identified and that investigators realize that the resulting adverse effects may be manifested at the biochemical level in organisms in a manner particular to the species or life stage exposed. The nature and extent of a pollutant's dispersal in our waterways are collectively dependent on a variety of factors including site-specific ecological conditions,

the physical state in which the contaminant is introduced into the aquatic environment and the inherent chemical properties of the substance in question.

Chemical soil degradation after erosion is the second most abundant form of soil degradation and as such poses a threat to our finite soil resource, as it tends to render it less usable. Properties of the pond bottom soil (sediments) and processes occurring at the bottom soil and in the soil-water interface are very important regarding the well-being and growth of culture species in aquaculture system. Sometimes, heavy metals and pesticides enter aquaculture ponds with water used for filling, maintaining water levels, or water exchange. Aquaculturists are usually aware of human dangers encountered when handling chemicals, but they often overlook the potential impact of substances used in pond management on the surrounding environment and on the quality of aquatic food products.

2. IMPACTS OF EFFLUENTS ON ECOSYSTEM

2.1 Eutrophication

Eutrophication

Eutrophication is characterized by excessive plant and algal growth due to the increased availability of one or more limiting growth factors needed for photosynthesis such as sunlight, carbon dioxide and nutrient fertilizers. Eutrophication occurs naturally over centuries as lakes age and are filled in with sediments. However, human activities have accelerated the rate and extent of eutrophication through both point-source discharges and non-point loadings of limiting nutrients, such as nitrogen and phosphorus, into aquatic ecosystems (i.e., cultural eutrophication), with dramatic consequences for drinking water sources, fisheries and recreational water bodies.

2.1.1 Effects on lakes and reservoirs

Excessive nutrient enrichment also has many additional effects on the biology chemistry and human use of lakes and reservoirs, however. These secondary effects are frequently deleterious and may be of great concern to users of the resource. For example, eutrophic lakes are typically characterized by shifts towards dominance of the phytoplankton by blue-greenalgae (cyanobacteria), some of which produce compounds that are more toxic than cobra venom.

2.1.2 Effects of nutrient inputs on rivers and streams

Although many streams and rivers worldwide currently exhibit high nutrient concentrations, a prevailing view for many years held that many rivers are insensitive to nutrient inputs (e.g. Hynes, 1969). This argument was based upon the assumption that other physical, chemical and biotic factors potentially restrict the effects of nutrient enrichment on algal growth in rivers and streams. Restriction of light penetration into the water column by high concentrations of inorganic suspended solids also can potentially limit the growth of both benthic and suspended algae in rivers, just as it can restrict phytoplankton biomass in turbid reservoirs.

2.1.3 Effects on estuarine and coastal marine ecosystems

The problem of marine eutrophication has been highlighted in recent years by the occurrence of increasingly severe toxic phytoplankton blooms in many near-shore waters worldwide. Toxic phytoplankton blooms in the sea are of even greater concern than in fresh water ecosystems. The diversity of toxic species is much larger, and their presence can lead to significant impacts on the edibility and marketability of marine food stuffs.

2.2 Pulp and paper mill effluents

Pulp and paper mill effluents from coastal mills were usually acutely toxic at source and in many cases had marked deleterious effects on receiving waters due to toxicity, high biochemical oxygen demand(BOD) and total suspended solids (TSS) loadings. Extreme reductions in ambient dissolved oxygen, impacts on benthic and intertidal organisms, changes in water colour and primary productivity, have been demonstrated over the years and continue to cause environmental damage.

2.2.1 BOD loading

Pulp and paper mill effluent is a complex mixture of many substances including carbohydrates, lignins, organic acids and alcohols. Oxygen is consumed when bacteria degrade these materials. Mill effluent not only exerts an oxygen demand, it can reduce oxygen supply in receiving waters. Ecosystem level impairment can occur. Effluent colour can shade phytoplankton, thus reduce reoxygenation via photosynthesis and thereby reduce primary productivity in the aquatic ecosystem. Responses of fish to lethal and sublethal decreases in dissolved oxygen can include changes in behaviour, growth, swimming, respiration, fecundity disease resistance and feeding.

2.2.2 Total suspended solids

Suspended solids associated with pulp and paper mill effluent are largely composed of cellulose fibres, wood chips and bark fines. A smaller portion of the solids is


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composed of in organic constituents such as boiler ash, calcium carbonate and other inorganic constituents. A typical black, anaerobic deposit is often found near the outfall of most coastal mills. These deposits are often in the form of a jelly-like fibre mat which can be from several centimeters to 15 meters in depth. The generation of methane gas, hydrogen sulphide gas, along with organic contaminants, such as chloroveratroles are a serious threat to marine and estuarine ecosystems. Resource species, as well as smaller invertebrates used as food sources, may be replaced by fewer kinds of less desirable, pollution-tolerant species when organic deposits change the characteristics of the sediment.

2.3 Effluents from oil refinery

Pollution of the aquatic environment occurs from many different sources including from oil refineries. Oil refinery effluents contain many different chemicals at different concentrations including ammonia, sulphides, phenol and hydrocarbons. As not all refineries have the same processes, the effluents that are produced will have different chemical compositions depending on the type of treatment they receive. Petroleum refinery waste waters are made up of many different chemicals which include oil and greases, phenols (creosols and xylenols), sulphides, ammonia, suspended solids, cyanides, nitrogen compounds and heavy metals like chromium, iron, nickel, copper, molybdenum, selenium, vanadium and zinc. Oil consists of five types of components, saturated non-cyclic hydrocarbons (paraffins), cyclic hydrocarbons (cycloalkanes), olefinic hydrocarbons (alkenes), aromatics and non-hydrocarbons (sulphur compounds, nitrogen-oxygen compounds and heavy metals). Refinery effluents tend to have fewer of the lighter hydrocarbons than crude oil but more polycyclic aromatics which tend to be more toxic and more persistent in the environment.

2.3.1 Phytoplankton and algae

The refinery effluent inhibited the growth of the alga Selarolstrom apricorntum and the duckweed Lemna gibba. Reduced productivity of phytoplankton and / or algae will have a knock on effect to the other organisms in the environment, such as crustaceans and fish. Studies of the microalgae living in an oil refinery effluent holding pond have shown that selection can occur favouring resistant genotypes within a population and selection among species can result in changes in community structure.

2.3.2 Invertebrates

Many studies have used freshwater and marine invertebratesas test organisms to observe the effects of refinery effluent and its individual components. Crustaceansseem to be more sensitive than other aquaticorganisms. Tests of the toxicity of refinery effluent from BP Grange mouth on four species of marine invertebrate found that the most sensitive to the effluent was Praunus flexuosus>Corophium volutator>Macoma balthica> Hydrobia ulvae.

2.3.3 Fish

I. Showing signs of respiratory distress, surfacing and secretion of mucus.
II. The fish showed signs of respiratory distress and hampered growth.
III. Fecundity was affected by refinery wastewater.

The fish produced fewer eggs per spawn, spawned less frequently and had delayed spawning.

2.4 Pharmaceutical residues in wastewater treatment plant effluents

Pharmaceutical residues in the environment and their potential toxic effects, have been recognized as one of the emerging research area in the environmental chemistry. The increasing attention, on pharmaceutical residues as potential pollutants, is due that they often have similar physico-chemical behaviour than other harmful xenobiotics which are persistent or produce adverse effects. Pharmaceutical residues and / or their metabolites are usually detected in the environment at trace levels, but, even that, low concentration levels (ng/L or µg/L) can induce to toxic effects. In particular, this is the case of antibiotics and steroids that cause resistance in natural bacterial populations or endocrine disruption effects.

2.4.1 Antibiotics

Exposure of antibiotics, such as tylosin, oxytetracycline, chlortetracycline or erythromycine induces high toxicity to algae. Biossays performed with sulphadimethoxineor oxytetracycline showing the toxic character to invertebrates, conversely, flumequine presents harmful or not toxic effects as well as tylosin to invertebrates. In consequence, sufficiently low concentrations could altered community structures (even microbial community) and thereby affect the food chain.

2.4.2 Analgesics/anti-inflammatories

The effects of clofibric acidare also heterogeneous, showing high toxicity on bacteria and absence of toxicity on invertebrate and fish, depending of the tested fish species. Experiments on algae have showed harmful effects. Similar heterogenicity is showed on the effects of blockers to algae and invertebrate. Different effects have been observed for propanolol that show toxicity toalgae, in contrast with metoprolol, atenolol or betaxolol that arenot toxic. Dates of propanolol and metoprolol reveal different effects on different species from the same taxonomic group.

2.4.3 Antiepileptics and steroid hormones

The majority of toxicity data about steroids hormones are related to 17 α-ethinyl estradiol, diethylstilbestrol and diethylstilbestrol acetate and these are toxic to algae, invertebrate and fish. In the particular case of 17 α-ethinyl estradiol, different sensitivities were also observed for different alga and invertebrate species with higher toxicity.


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2.5 Heavy metals
Metal extraction is an important industry for ourmodern way of life. However, all phases in the life of a mine can discharge metals to estuaries, rivers, streams and lakes. Metals dissolvein water and are easily absorbed by fish and other aquatic organisms. Small concentrations can be toxic because metals undergo bioconcentration. Metal toxicity produces adverse biological effects on an organism's survival, activity, growth, metabolism, or reproduction. Metals can be lethalorharm the organism without killing it directly.

2.5.1 Aquatic Ecosystem Impacts of Mercury
Older fish have had more time in which to accumulate mercury in their tissues. Larger fish and predatory species eat further up on the food chain; hence, more biomagnification takes place in their tissues. Water temperature, pH and softness and presence of other metals affect mercury toxicity in fish. Mercury is more toxic when the water body is acidic because more methylation takes place at lower pH. Mercury is more toxicin soft water (water with low concentrations of calcium ions) than in hard water because calcium is believed to protect against the uptake of mercury across cell membranes.

2.5.2 Aquatic Ecosystem Impacts of Cadmium
The effects of cadmium on aquatic organisms can be directly or indirectly lethal and can impact populations and ecosystems as well as individuals. Skeletal deformities in fish can result in impaired ability of the fish to find food and to avoid predators; hence, this sublethal effect becomes a lethal effect. Cadmium impairs aquatic plant growth. This affects the entire ecosystem because green plants are at the base of all food chains. When aquatic plants that are exposed to cadmium do not grow normally, there will be less food available for aquatic animals.

2.5.3 Aquatic Ecosystem Impacts of Chromium
Low concentrations of hexavalent chromium cause sublethal toxic effects inaquatic plants and animals. For example, 62 ppb inhibits growth in algae and 16ppb inhibits growth in chinook salmon. Chinook salmon are more sensitive than algae. This is consistent with the overall finding that aquatic animals are more sensitive to metals than are aquatic plants.

2.5.4 Aquatic Ecosystem Impacts of Lead
Lead bioconcentrates in the skin, bones, kidneys and liver of fish rather than in muscle and does not biomagnify up the food chain. When lead concentrations in algae exceed 500 ppb, enzymes needed for photosynthesis are inhibited (Taub,2004). When less photosynthesis takes place, the algae will produce less food and therefore will not grow as much. Decreased algal growth means less food for animals. Fish are more sensitive than algae to lead. When lead concentrations exceed 100 ppb, gill function is affected. Embryos and fry are more sensitive to the toxic effects of lead than are adults.

2.6 Mining effluents
Many early mining activities relied heavily on a continual supply of water, either to assist with excavation (as in hydro-mining) or to transport mined material to the surface. Water chemistry associated with mining activities has been the focus of much investigation. Surface water and ground waters associated with mines are often affected by acidification, the presence of toxic metals, and sedimentation. Discharges emanating from coal mines can cause the most severe problems. Many coal seams, such as those in the Brunner Coal measures in North West land, contain pyrite, which has high levels of sulphur. When pyrite is exposed to water and oxygen, several well documented reactions can occur.

2.6.1 Bacteria and fungi
Alterations in water chemistry, particularly increased acidity and the release of metals, can have a profound effect on microbial communities. High acidity inhibits microbial enzymes and reduced litter breakdown rates have been linked to metal oxide deposition. Consequently, in lakes and rivers affected by mining and not subject to flushing flows from floods, coarse particulate organic matter may accumulate on the bed because natural decomposition is suppressed.

2.6.2 Aquatic plants
Vascular plants are usually absent from acidic streams, but bryophytes and periphyton can be locally very abundant. Like microbial communities, algae may proliferate at sites with low pH, stable flows and low metal oxide deposition (e.g., mine adits), but as soon as metal deposition rates increase (e.g., when pH rises above 3.5-4.3) algae can survive only if they are able to grow faster than the rate at which oxides smoother their surfaces. The liverworts Lophocolea, Jungermannia and Riccardia and mosses such as Blindaand Sphagnum, have been recorded in low pH streams.

2.6.3 Benthic invertebrate communities
The impacts of mine drainage on stream invertebrates are almost entirely negative and have been termed "acidaemia". The effects range from acute and direct toxicity caused by combinations of low pH and / or the presence of toxic metals, to indirect effects in areas where food resources are limited (by reducing organic matter processing and algal growth). Toxicity of metals can be a major problem in many mining-affected waters. Toxicological studies have shown insects, crustacea and fish are frequently susceptible to toxic metals.

2.6.4 Fish communities
Most fish species are negatively affected by acidification and mine leachate. These toxic effects may be acute causing death, or chronic resulting in impaired health(e.g., mucous secretion on gills impairing gas exchange), or physiological from stress that reduces fish condition. Accumulation of heavy metals within the flesh of fish may have long-term toxic effects. Furthermore, the presence of mine discharges may create a chemical barrier to diadromous species, reducing or preventing their migration to and from the sea.

3. WASTE WATER DISCHARGE

3.1 Sources of waste water

Waste Water

3.1.1 Domestic wastewater, storm water and urban runoff

Domestic wastewater consists of black water (excreta, urine and faecal sludge) and grey water (kitchen and bathing wastewater). The mix and composition will depend on the water supply and sanitation facilities available, water use practices and social norms. Currently, roughly half of the world's population has no means of disposing of sanitary wastewater from toilets and an even greater number lack adequate means of disposing of wastewater from kitchens and baths.

3.1.1.1 Sewerage systems

Broadly speaking there are two types of 'conventional' sewerage networks that have been developed and introduced over time; the 'combined' system and the 'separate' system. In the combined system both surface run-off and foul sewage are conveyed in the same pipe, while in the separate system different pipes are used to transport the sewage and the surface run-off. In addition to 'conventional sewerage', there are two other major types of wastewater sewerage systems, namely simplified or shallow sewerage (also known as condominial) and settled sewerage. Simplified sewerage is characterized by smaller diameter pipes which are buried at a shallower depth than those used in conventional sewerage. Settled sewerage is designed for conveying the effluent component of wastewater after the solids have been settled in, for example, a septic tank.

3.1.1.2 On-site systems

Worldwide, a large number of people rely on on-site systems for their sanitation with, for example, an estimated 2.5 billion people use unimproved facilities as the primary means of sanitation. In rural areas, on-site systems (such as pit latrines) may effectively operate without the need for formal removal / emptying and transport as the effluent from unlined pits will slowly percolate through soil (although this may contribute to pollution of groundwater) and full latrines can be covered and safely abandoned, with a new pit being constructed elsewhere.

3.1.1.3 Urban drainage and storm water flows

It is not only systems for the collection of domestic, commercial and industrial waste waters that are of concern. Surface water run-off and storm water drainage from paved areas in towns and cities is a major problem for a number of reasons. In addition to the potential hazards from flooding resulting from insufficient coverage and capacity of storm water drainage, serious health problems often arise with open channel surface water drains in developing world towns and cities where there is an absence of 'foul' or 'sanitary' sewers.

3.1.2 Industrial wastewater

Among the possible classifications of industrial waste waters, one distinguishes between diffuse industrial pollutants, such as those from mining and agri industries, and end-of-pipe point discharges and mostly illegal discharges from tankers. It is important to note that, in many cases, large volumes of industrial waste waters which are legally discharged to decaying and / or badly operated sewerage networks, both combined and separate, never actually reach a treatment plant. Various approaches to effective industrial wastewater control are available such as the use of appropriate technology (specified, for example, as the best economically available) or the issuing of 'permits' or 'consents' based on volumes and quality standards for discharges either to sewers or directly to water courses.

3.1.3 Agricultural wastewater

Agriculture has long been recognized as an important source of non-point or diffuse water pollution. Conventionally, in most countries, all types of agricultural practices and land use (including animal feeding operations) are treated as non-point source or diffuse pollution and in OECD countries, agricultural non-point pollution has overtaken contamination from point sources as the major factor in inland and coastal eutrophication. Although the impact of agriculture on water pollution (relative to other types of human impacts) has not been extensively researched and monitoring of agricultural pollution is uncommon, it is recognized that the problem is global. In OECD countries, agriculture is the main source of nitrogen loading.

3.2 Impacts of Sewage Discharge

Effect of water pollution on fishes

3.2.1 Release of nutrients and eutrophication
Elevated nitrogen and phosphorous concentrations in municipal wastewater effluents can cause pervasive ecological responses including exaggeration of phytoplankton and macroalgal populations; initiation of harmful algal blooms, adverse effects on the physiology, growth and survival of certain ecologically important aquatic plants, reduction of water transparency with accompanying adverse effects to submerged and emergent vascular plants or other disruptions to the normal ecological balance among vascular plants and algae, hypoxicor anoxic events that may cause significant fish and invertebrate mortalities.

3.2.2 Release of contaminants
Municipal treatment facilities discharge large volumes of effluent into the aquatic environment. The waste stream typically contains a complex mixture of domestic and industrial wastes that contain predominantly natural and synthetic organic substances, metals and trace elements, as well as pathogens. Similarly, introductions of certain pharmaceuticals via municipal wastewater discharges have become causes for concern because of their potential to act as endocrine disruptors in fish and other aquatic resources.

3.2.3 Alteration of water alkalinity
Municipal sewage effluent that does not meet water quality standards can alter the alkalinity of riverine receiving waters. However, freshwater and low-salinity waters with low buffering capacity are more susceptible to acidification than are marine waters. Acidification of river inehabitats has been linked to the disruption of reproduction, development and growth of anadromous fish.

3.2.4 Impacts to submerged aquatic vegetation
Submerged aquatic vegetation (SAV) requires relatively clear water in order to allow adequate light transmittance for metabolism and growth. Sewage effluent containing high concentrations of nutrients can lead to severely eutrophic conditions. The resulting depression of dissolved oxygen and diminished light transmittance through the water may result in local reduction or even extirpation of SAV beds that are present before habitat conditions become too degraded to support them.

3.2.5 Reduced dissolved oxygen
The decline and loss of fish populations and habitats because of low dissolved oxygen concentrations is “one of the most severe problems associated with eutrophication in coastal waters”. The effect of chronic, diurnally fluctuating levels of dissolved oxygen has been shown to reduce the growth of young-of-the-year winter flounder. High nutrient loads into aquatic habitats can cause hypoxic or anoxic conditions, resulting in fish kills in rivers and estuaries.

3.2.6 Siltation, sedimentation, and turbidity
Increased suspended particles within aquatic habitats can cause elevated turbidity levels, reduced light transmittance, and increased sedimentation of benthic habitat which may lead to the loss of SAV,shellfish beds, and other productive fishery habitats. Other affects from elevated suspended particles include respiration disruption of fishes, reduction in filtering efficiencies and respiration of invertebrates, disruption of ichthyoplankton development, reduction of growth and survival of filter feeders.

3.2.7 Introduction of pathogens
Pathogens are generally a concern to human health because of consumption of contaminated shellfish and finfish and exposure at beaches and swimming areas. Microorganism sentering aquatic habitats in sewage effluents do pose some level of biological risk since they have been shown to infect marine mammals.

3.2.8 Introduction of harmful algal blooms
Sewage treatment facilities releasing effluent with a high BOD that may enter estuarine and coastal habitats have been associated with harmful algal bloom events, which can deplete the oxygen in the water during bacterial degradation of algal tissue and result in hypoxic or anoxi“dead zones” and large-scale fish kills. There is evidence that nutrient over enrichment has led to increased incidence, extent and persistence of nuisance and / ornoxious or toxic species of phytoplankton; increased frequency, severity, spatial extent and persistence of hypoxia; alterations in the dominant phytoplankton species and size compositions; and greatly increased turbidity of surface waters from plankton algae.

3.2.9 Impacts to benthic habitat
Municipal sewage outfalls can release suspended sediments into the water column and the adjacent benthic habitat. Increased suspended particles within aquatic habitat can cause elevated turbidity levels, reduced light transmittance, which may lead to the reduction or loss of SAV, shellfish beds and other productive benthic habitats.

3.2.10 Changes in species composition
These effects may lead to alterations in the composition of species inhabiting coastal aquatic habitats and can result in community and trophic level changes. For example, highly eutrophic water bodies have been found to contain exaggerated phytoplankton and macroalgal populations that can lead to harmful algal blooms. Sewage treatment facilities may initially attract fish around the point of discharge until hypoxia, toxin production and algal bloom development render the aquatic area less productive. Reduced light penetration in the water column from nutrient enrichment and sedimentation has been shown to contribute to the loss of eelgrass beds in coastal estuaries.

3.2.11 Contaminant bioaccumulation and biomagnification
Sewage is believed to be the primary source of silver contamination. Metals may move upward through trophic levels and accumulate in fish and some invertebrates (bioaccumulation) at levels which can eventually cause health problems in human consumers. Other chemicals are known to bioaccumulate and biomagnify in the ecosystem, including pesticides (e.g., DDT) and PCB congeners.

3.2.12 Release of pharmaceuticals
Concerns have been emerging over the past few years regarding the continual exposure of aquatic organisms to the complex spectrum of active ingredients in pharmaceuticals and personal care products (PPCP), which can persist in treated effluent from sewage facilities. PPCPs comprise thousands of chemical substances, including prescription and over-the-counter therapeutic drugs,veterinary drugs, fragrances, lotions and cosmetics. However, aquatic organisms may be adversely affected because they can have continual and multi generational exposures, exposure sat high concentrations from untreated water and they may have low dose effects.

3.2.13 Endocrine disruptors
Growing concerns have mounted in response to the effects of endocrine-disrupting chemicals on humans, fish and wildlife. These chemicals act as "environmental hormones" that may mimic the function of the sex hormones androgen and estrogen. Adverse effects include reduced or altered reproductive functions, which could result in population-level impacts. Several studies have implicated endocrine-disrupting chemicals with the presence of elevated levels of vitellogellin in male fish, a yolk precursor protein that is normallyonly found in mature female fish. Some of the chemicals shown to beestrogenic include PCB congeners, dieldrin, DDT, phthalates and alkylphenols.

3.3 Impacts of Industrial Discharge

3.3.1 Release of metals
Transitional metals, such as copper, cobalt, iron and manganese, are essential for metabolic function of organisms at low concentrations butmay be toxic at high concentrations. Metalloids, such as arsenic, cadmium, lead, mercury and tin, are generally not required for metabolic function and may be toxic even at low concentrations. Metals are known to produce skeletal deformities and various develop mental abnormalities in marine fish. The early life history stages of fish can be quite susceptible to the toxic impacts associated with metals.

3.3.2 Release of organic compounds
A variety of synthetic organic compounds are released by industrial facilities, find their way into aquatic environments and can be taken up by resident biota. These compounds are some of the most persistent, ubiquitous and toxic pollutants known to occur in marine ecosystems. Organo chlorines, such as DDT, chlordane and PCBs, are some of the most highly toxic, persistent, and well documented and studied synthetic organic compounds.

3.3.3 Release of petroleum products
Oil, characterized as petroleum and any derivatives, consists of thousands of chemical compounds and can be a major stress or on inshore fish habitats. Industrial wastewater, as well as combined wastewater from municipal and storm water drains, contributes to the release of oil into coastal waters. Petroleum hydrocarbons can adsorb readily to particulate matter in the water column and accumulate in bottom sediments, where they may be taken up by benthic organisms. Short-term impacts include interference with the reproduction, development, growth and behavior (e.g., spawning, feeding) of fishes, especially early life-history stages. Oil has been demonstrated to disrupt the growth of vegetation in estuarine habitats.

3.3.4 Alteration of water alkalinity
Both riverine and estuarine strata are particularly susceptible to point source acidification because their low buffering capacity can be quickly overwhelmed by acid discharges; however, even marine habitats can be significantly and adversely affected when continual influx of acidified liquid wastewater outstrips the natural buffering capability of seawater. Low pH in estuarine waters may lead to cellular changes in muscle tissues, which could reduce swimming ability in fish.

3.3.5 Release of nutrients and other organic wastes
Industrial facilities that process animal or plant by-products can release effluent with high BOD which may have deleterious effects to receiving waters. Wood processing facilities, paper and pulp mills and animal tissue rendering plants can release nutrients, reduced sulfur and organic compounds and other contaminants through wastewater outfall pipes. For example, wood processing plants and pulp mills release effluents with tannins and lignin products containing high organic loads and BOD into aquatic habitats. These chemicals have been implicated in various abnormalities in fish, including skin and organ tissue lesions, fin necrosis, gill hyperplasia, elevated detoxifying enzymes,impaired liver functions, skeletal deformities, increased incidence of parasites, disruption of the immune system, presence of tumors and impaired growth and reproduction.

3.4 Best management practices for sewage and industrial discharge facilities

1. Locate discharge points in coastal waters well away from shellfish beds, submerged aquatic vegetation, reefs, fish spawning grounds and similar fragile and productive habitats.
2. Determine benthic productivity by sampling prior to any construction activity related to installation of new or modified facilities. Implement all appropriate best management practices to maintain habitat quality during construction including any seasonal restrictions, use of cofferdams, working in the dry at low tide, etc., as is necessary and practicable.
3. Use seasonal restrictions during construction and maintenance operations to avoid impacts to habitat during species' critical life history stages (e.g., spawning and egg development periods), when appropriate. Recommended seasonal work windows are generally specific to regional or watershed-level environmental conditions and species requirements.


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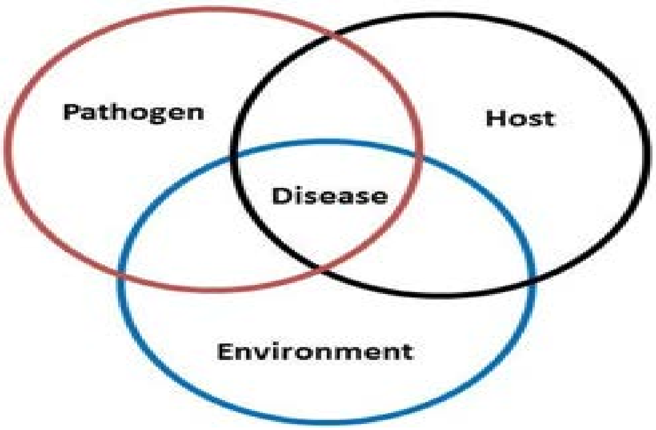
4. Develop appropriate modeling studies for plume effects and other parameters of concern in cooperation with the involved resource agencies before finalizing outfall design. Any appropriate recommendations that involve agencies and developed as a consequence of the study results should be incorporated in the construction plans and operation plan for these facilities as enforceable permit conditions.
5. Institute all appropriate source control measures and/or elevate the treatment level to reduce the polluting substances in all effluents to the extent practicable. Ensure that discharge facilities obtain and adhere to NPDES program permits, as appropriate.
6. Ensure that maximum permissible discharges are appropriate for the given project setting and specify any and all operation procedures, performance standards, or best management practices that must be observed to address all reasonably foreseeable contingencies over the life of the project. Consider implementing an adaptive management plan that includes representatives from appropriate agencies to participate in future consultations for administering the management plan. Management plans should include monitoring protocols designed to measure discharge and potential impacts to sensitive resources and habitats.
7. Use best available technologies to treat discharges to the maximal effective and practicable extent, including measures that reduce discharges of biocides and other toxic substances.
8. Take precautions to mitigate the ecological damage arising from outfall maintenance activities. Facility maintenance plans should include measures such as: (a) ensuring biocides selected for a particular application are specifically designed for their intended use; (b) applying no more than the minimal effective dose, and; (c) closely following instructions for use in aquatic applications and ultimate disposal.
9. Use land treatment and upland disposal or storage for any sludge or other remaining wastes after wastewater processing is concluded. Use of vegetated wet lands as biofilters and pollutant assimilators for large-scale discharges should be limited only to circumstances where other less damaging alternatives are not available and the overall environmental suitability of such an action has been demonstrated.
10. Avoid locating pipelines and treatment facilities in wetlands and streams. Discharges should not be sited near eroding waterfronts or where receiving waters cannot reasonably assimilate the amount of anticipated discharge.
11. Ensure that the design capacity for all facilities will address present and reasonably foreseeable needs and that the best available technologies are implemented.

4. CHEMICAL DEGRADATION OF SOIL



A triad showing contribution of environment, host and pathogen interaction for disease development. The relative contribution of each component to the disease development may be highly influenced by factors affecting each component on aquaculture.

Soil degradation and land degradation have been clearly differentiated by several scientists over the course of time. FAO (2014) defines soil degradation as a change in the soil health status resulting in a diminished capacity of the ecosystem to provide goods and services for its beneficiaries while land degradation encompasses all the negative changes in the capacity of the ecosystem to provide goods and services. Nutrients and organic residues tend to accumulate at the bottom and are, thus, to some extent, removed from the water phase. However, an excessive accumulation beyond what could be defined as the carrying capacity of the sediments may result in the deterioration of the pond system. Reactions and fluxes within and across the water–soil interface are very significant in natural aquatic systems and even more in intensive aquaculture systems. Organic matter settles and accumulates on the pond bottom in extensive, semi-intensive and intensive culture systems.

4.1 Factors responsible for chemical degradation of soil

4.1.1 Salinization and sodification

Salinization is a process of chemical soil degradation, which greatly reduces soil productivity. Salinization is the accumulation of water-soluble salts (including sodium, potassium, magnesium and calcium, sulphate, carbonate and bicarbonate) on or near the surface of the soil. Salinization involves the accumulation of different salts, but the increased content of exchangeable sodium (Na^+) in a soil resulting to a completely unproductive soil is referred to as sodification. There are several means by which salt accumulates in the soil and this is compounded by the activities of humans. The source of soluble salts in the soil besides irrigation water are mineral weathering, fertilizers, salts used on frozen roads, atmospheric transfer of sea spray and lateral movement of ground water from salt containing areas.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4.1.2 Acidification

Acidification is the change in the chemical composition of the soil, which may trigger the circulation of toxic metals. Acidification impacts negatively on the soil ecosystem thereby causing damage to plants. It also results in the alteration of soil water chemistry. Soil acidification results from pH decline or from acid deposition. The phenomenon of acid deposition arises from the deposition of emissions from vehicles such as SO_2, power stations, other industrial processes and natural bio-geochemical cycles onto the soil surface mainly via rainfall and dry deposition

4.1.3 Chemical fertilizer

Non-organic fertilizers mainly contain phosphates, nitrate, ammonium and potassium salts. The fertilizer also contains large majority of heavy metals like Hg, Cd, Hs, Pb, Cu, Ni and Cu. All these elements are known to cause soil degradation. One major component of soil that is degraded through fertilizer use is soil structure. Fertilizing soils especially with industrial fertilizers such as $NaNO_3$, NH_4NO_3, KCl, K_2SO_4, NH_4Cl is known to cause deterioration in the soil structure. The continuous use of acid forming nitrogen fertilizers causes a decrease in soil pH.

4.1.4 Pesticides

Pesticides enter soils mainly from agriculture sources. Moreover, most of these pesticides become persistent in the soil at varying degrees. The persistence of pesticides also limits the degree to which the chemical composition can be degraded as well as transported in the soil. Pesticides in soils have been identified to have major effect on soil microbes. Pesticides can cause significant irreversible changes in soil microbial populations. These soil microbes are important in maintaining soil fertility, thus pesticides, which seriously affect soil micro flora and micro fauna, may harm soil fertility.

4.1.5 Accumulation of nutrients and organic matter in pond soils

Cultured aquatic animals accumulate between 5% and 40% of nutrients in the feed(carbon, nitrogen, phosphorus). Accumulations of carbon, nitrogen and phosphorus, as a fraction of the nutrient budget in fish pond soils, have been reported by several researchers. Most of the nitrogen (75%) and phosphorus (80%) not recovered in harvested fish was found in the pond bottom reported a higher concentration of nutrients in bottom soils of older compared to newer ponds. It was found that concentrations of several elements in the soil increased during one shrimp growing cycle. It was reported that the concentration of C, N, Mg, K, Na and B increased rapidly in new ponds reaching maximal levels following five production cycles. Concentrations of S, P and Zn in the sediments continued to increase. Soil pH decreased markedly after one growing cycle, but then stabilized.

4.1.6 Sediment oxygen demand

Dissolved oxygen concentration is one of the critical factors affecting processes and conditions at the sediment–water interface. Sediment oxygen demand (SOD) is an indicator of the intensity of the mineralization process and benthic community metabolism. The diffusion of oxygen from the sediment water interface to the deeper sediment layers is even slower. As a result, anoxic conditions prevail below the upper few millimeters of the sediment surface.

4.1.7 Redox reactions in the pond bottom soil

When oxygen is depleted, other terminal electron acceptors can be used to mediate the decomposition of organic matter. Many anaerobic processes taking place in the pond bottom lead to the production of reduced and potentially toxic compounds. When oxygen is depleted denitrification occurs, with nitrate as an electron acceptor. Subsequently, iron, manganese, sulphate and CO_2 serve as electron acceptors. Reduced inorganic species may affect biological activity. Reduced divalent manganese is toxic to fish. The release of hypolimnetic, anaerobic water from reservoirs to rivers ledto fish kills due to the high Mn concentrations. The undissociated species H_2S is highly toxic to fish and shrimp. Hydrogen sulfide can inhibit aerobicrespiration by binding to the heme of cytochrome c oxidase in place of molecular oxygen.

4.1.8 Effects of accumulated sediment

A typical feature of sludge accumulating in aquaculture ponds is the black color and a smell of hydrogen sulfide. Unlike fresh water systems with low sulfate concentrations, saline water used for aquaculture contains a high concentration of sulfate and thus a high potential for sulfide production. The development of reducing conditions in the pond bottom was found also to retard fish growth.

4.2 Best Management Practices

1. Concentrating the sludge in a limited, relatively small area in the pond facilitates further mechanical treatment. Sludge can be concentrated in a small fraction of the pond bottom through proper placement of aerators and proper design of the pond bottom topography.
2. A different approach based on currents induced by wind was developed in a fish pond where a western wind prevails during summer, leading to a surface water flow from west to east and a resultant return current from east to west. A trench was dug (using a drag line)along the western edge of the pond in a pond. The return currents directed the sediment westward to be intercepted by the trench, leading to an increase in the productivity of the pond.
3. Several means to chemically minimize the development of low redox and to minimize the buildup of soluble sulfides are available, though they need further study in order to be used as routine methods. Reducing conditions in the sediments can be poised using chemical treatments, such as nitrate application. Nitrate is a mild oxidant and can change the redox conditions even at low concentrations.

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4. Sulfide concentrations can be effectively controlled by adding iron compounds, inducing the formation of insoluble sulfide minerals. Connell and Patrick (1969) reduced soil H_2S by addition of finely ground reagent-grade Fe_2O_3.
5. A very important and common means to improve pond bottom conditions is the treatment of the sediment in between crops. These methods have usually a low cost-benefit ratio. Sludge was often removed with the drained water and by rinsing of the pond bottom.
6. Proper means to dispose or reuse the sludge are needed. One possibility is to return the dry and aerated sludge into ponds, where it may supply nutrients needed for the establishment of the flora and biota needed to build the food chain for the refilled ponds. Dry sediments can be moved to the pond embankments from where most of the accumulated sediment originated.

5. CHEMICAL DEGRADATION OF WATER

A number of chemicals and other substances are used in pond aquaculture as additives for improving soil and water quality and for controlling biological problems such as phytoplankton blooms, aquatic plant infestations, disease vectors and proliferation of wild fish. Sometimes,heavy metals and pesticides enter aquaculture ponds with water used for filling, maintaining water levels, or water exchange. Because of increasing concern over the potential harm of aquaculture effluents on receiving water bodies, worries over the contamination of aquatic food products with bio accumulative and potentially harmful chemicals and human risks associated with storing and handling some chemicals used in aquaculture. The following groups of substances will be included: fertilizers, liming materials, oxidants, coagulants, osmoregulators, algicides and herbicides, piscicides, probiotics, pesticides and heavy metals and are responsible for water degradation. Some of the factors responsible for chemical degradation of water are given below.

5.1 Fertilizers

Because fertilizers increase nutrient concentrations in the water, they can cause nutrient enrichment when pond effluents are released into water bodies. If there area few days between fertilizer application and water discharge to the surrounding environment, most fertilizer nutrients will have been absorbed by the pond organisms, adsorbed by sediments, or lost to the atmosphere through denitrification orammonia volatilization. Ponds are extremely efficient in assimilating nutrients if the average hydraulic residence time is several weeks. Pond bottoms are not infinite sinks for nutrients, but by periodically draining and drying pond bottoms, their capacity to assimilate nutrients can be extended. Nitrogen fertilizers have the potential to increase ammonia concentrations in the water, and excessive use can result in toxic ammonia concentrations within ponds. Ammonium fertilizers and urea are acidic in pond waters because nitrification releases hydrogen ions (Hunt and Boyd, 1981). Nitrate fertilizers(except ammonium nitrate) are basic because of bicarbonate produced when denitrification occurs.

5.2 Liming materials

Liming materials are applied to pond waters and soils to neutralize acidity and increase total alkalinity. Increased alkalinity buffers water against drastic daily changes in pH common in eutrophic ponds with soft water. Increasing the pH of an acidic bottom sediment enhances the availability of phosphorus added in fertilizers. If used excessively, these compounds increase water pH up to 10 or more and cause toxicity in aquatic plants and animals.

5.3 Oxidants

Oxidizing agents are used for controlling phytoplankton, killing disease organisms, or oxidizing bottom soils. Potassium permanganate is toxic to phytoplankton and will reduce the production of dissolved oxygen by photosynthesis. Potassium permanganate is highly explosive when in direct contact with organic substances. Care should be applied when handling it. There is a potential risk from spills into water because potassium permanganate can cause massive mortality of aquatic organisms.

5.4 Algicides and herbicides

Algicides and herbicides are applied to ponds to reduce the abundance of nuisance aquatic plants. Excessive phytoplankton may result in chronically low dissolved oxygen concentrations during the night, and blue-green algae are responsible for off-flavor in fish and crustaceans. Copper inhibits both respiration and photosynthesis in algae. High doses of copper sulfate may be acutely toxic to fish.

5.5 Insecticides and heavy metals

Insecticides have sometimes been applied to ponds to kill unwanted organisms before stocking with fish or shrimp. Many of these compounds are bioaccumulative and could contaminate the final product. The heavy metals that present the greatest threat to contamination of aquaculture products are lead,mercury, arsenic, beryllium, cadmium, chromium, manganese, silver and zinc. Aquaculturists are well aware of the potential threat of pollution to the survival of their crops, so it is rare that ponds are built in areas where a high degree.

5.6 Fuels and lubricants

As for any other farm operations, aquaculture production requires the use of fuel and lubricants for vehicles and power units used on the farm. Unless the materials are stored, used and disposed in a proper way, they present both an environmental and safety hazard. Spills of fuels and lubricants can contaminate surrounding water and soil, or through run off find their way into pond waters.

5.7 Best Management Practices

1. Where countries have approved lists of chemicals and chemical uses, only approved chemicals should be used in ponds and only for the use approved. Where such lists are not available, the aquaculture industry and individual producers should work with governments to prepare such lists.
2. Aquaculturists should follow information on product labels regarding dosage, withdrawal period, proper use, storage, disposal and other constraints on the use of a chemical including environmental and human safety precautions.
3. When potentially toxic or bioaccumulative chemicals are used in ponds, the water should not be discharged until the compounds have naturally decomposed to non-toxic forms.
4. Careful records should be maintained regarding use of chemicals in ponds as suggested by the Hazard Analysis and Critical Control Point (HACCP) method.
5. The aquaculture industry should work with governments to develop regulations for labeling the content and percentage of active ingredients in all chemicals including liming materials and fertilizers.

6. CONCLUSION

After a thorough reading of this chapter, there is no more doubt to understand the phenomenon related to effluents, waste water discharge and chemical degradation of soil and water. These all the processes are interlinked to each other and show the significant impacts on an aquatic environment. There is ahuge loss not only to the aquatic ecosystem but also to interlinked flora and fauna due to these hazardous activities. If proper care will not take about this, there will be great penalty pay by us in near future. So, we should aware about the aquatic environment and aquaculture policies should be followed strictly so that we can make the future of aquaculture will brighter for next generation.

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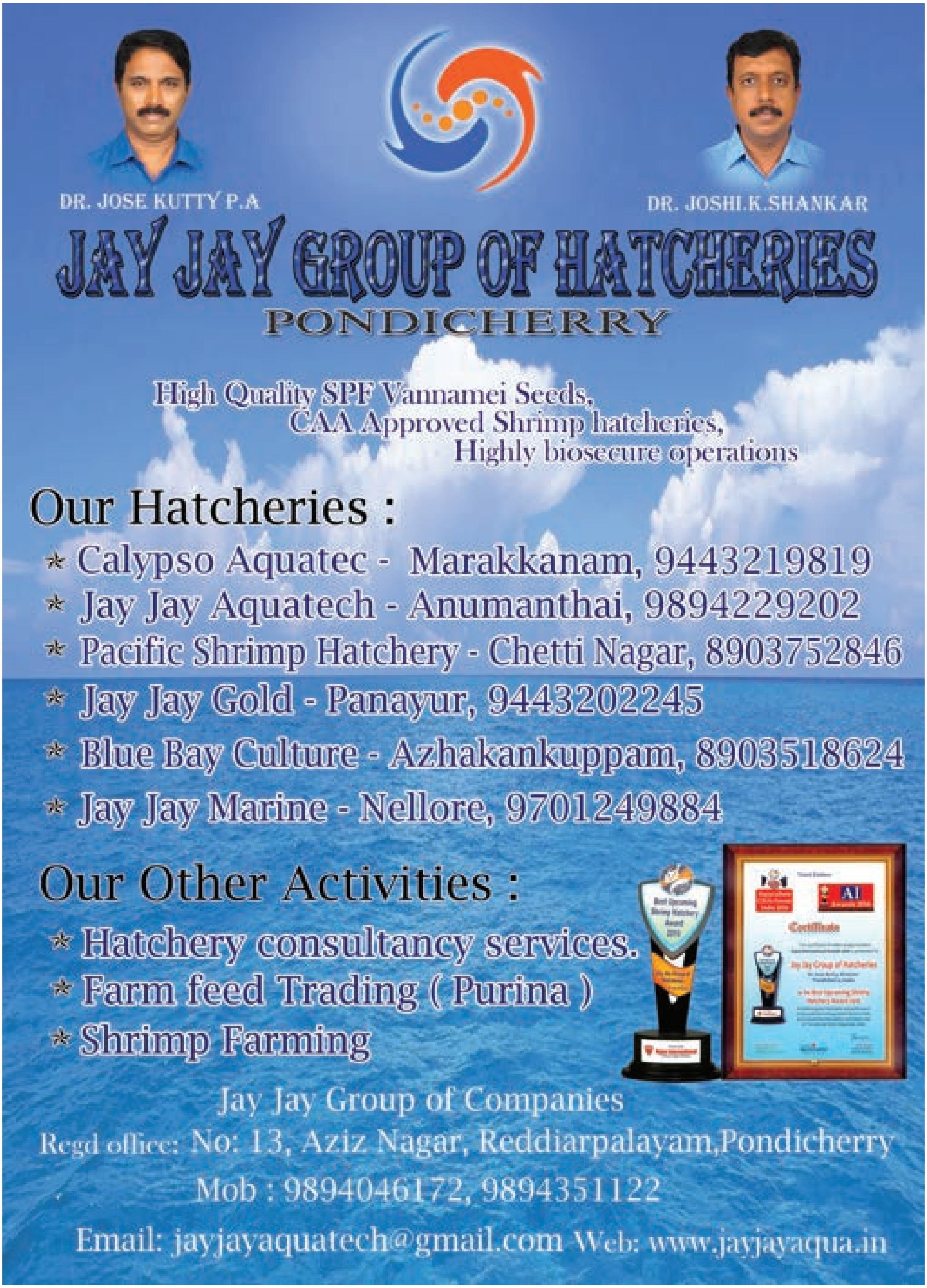
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BRONZE FEATHERBACK, NOTOPTERUS – MANIFOLD BENEFIT FOR FRESHWATER AQUACULTURE

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

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

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

Highlight Points:

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

Breeding of Bronze Featherback:
N. notopterus naturally breeds during rainy season (June to September) in India. Above 40 g size fishes can be selected as brooders and enriched with diets such as earthworms, chironomids, liver and fresh chicken intestine (Yanwirsal et al., 2017). After conditioning, matured brooders are kept in tank with the sex ratio of 2: 1 (Male:Female) and induced with synthetic hormone (ovaprim) based intramuscular injection with rate of 0.5ml for male and 1 ml for female. Since eggs are adhesive in nature, substratum should be placed in the breeding tank. About 1200 – 1300 eggs are released female (21-25cm)on the substratum during night time and males fertilize the eggs externally. Fertilized eggs would be hatched after 5 to 6 days with the temperature of 24 to 280 C and expected survival would be 80 -85% (Srivastava et al., 2010).

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

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


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

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***More references can be Provided on Request**

Ballast Water: A Mask of Threat to Marine and Coastal Ecology

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Introduction:
Maritime transport is the mainstay of the increasingly globalized economy and the international trade system. Sea transport has invariably the most liberalized sector of transport. In addition to economy and trade the various other driving forces for sea transport include connectivity, access, infrastructure and warehouses, energy and labour costs, regulations related to the safety and quality of transport, responsiveness to the increased requirements of customers across supply chains and environmental and climate change hindrance (Profillidis and Botzoris, 2019). For centenary, ships carried hard ballast in the shape of rocks, sand, beach debris and various other heavy materials. During 1880s, the ships started using water as ballast weight, consequently avoiding time consuming loading of solid materials and instabilities resulting from the shifting of solid ballast during a voyage. With the introduction of steel-hulled ships and pumping technology, water became the choice of ballast because of easy pumping and lesser manpower. When ships need ballast, water is pumped from the sea where the ship is located into the ships' ballast water tanks, which adds weight to key parts of the ship. Ballast water is discharged at sea when it is no longer needed or when the weight of the ship needs to be lightened.

Ballast is elucidated as any solid or liquid placed in a ship to regulate the stability, increase the draft, to change the trim or to maintain stress loads within acceptable limits.

Highlight Points:

- Ballast water is the water put on board a vessel for safety, providing stability, reducing stress, improving propulsion and maneuverability, redress loss of fuel weight and water consumption. It is essential to commercial shipping. Ballast weight generally equates 25 to 30 per cent of a ship's dead weight tonnage. Thousands of aquatic species that may be carried in ship's ballast water, including bacteria and other microbes, micro-algae, different life history stages of aquatic plant and animal species from one port to another. Worldwide it is commended that discharge of ballast water into sea is potentially the greatest accidental manner of introducing the exotic organisms. Thus it impacts the ecological, economical and human health functions. As a result, various researchers, policy makers and resources managers / stakeholders are required to look into the technologies for the treatment and management of ballast water.

Ballast water (BW) is essential for the safe operation of ships. It is used to provide stability and maneuverability during a voyage when ships are not carrying cargo, not carrying heavy enough cargo, or when more stability is required due to rough seas. BW may also be used to add weight so that a ship sinks low enough in the water to pass under bridges and other structures. Today, ocean going vessels have ballast tanks incorporated into various designs. The number and size of ballast tanks varies according to type of ship and its design. Most ships are equipped with a range of ballast capabilities and capacities, but generally ballast equates to 25 to 30 per cent of a ship's dead weight tonnage. It includes water and sediment that accumulates in ballast tanks of ships, which may be discharged during voyage completion from port to port. This discharged BW could possibly contain bacteria, microbes, marine organisms, small invertebrates, eggs, cysts and larvae of various invasive species. Thus the release of BW may introduce non - native organisms or bioinvaders into the port of discharge. While most transported species do not survive when the ballast water is discharged, some thrive in their new environment. With absence of natural predators, they outcompete and kill native species. In such cases, they pose serious risks to local ecosystems, human health and regional economies. They can cause severe and irreversible damage and attempts to limit further destruction are often costly (Anon, 2017).

Importance:
BW is used to adjust the overall weight of the vessel and its internal distribution. It is used to compensate for different cargo loads that a ship may carry at different times during loading and unloading. It is essential for safe and efficient modern shipping operations.

Threats:
Presently, it is recognized that BW discharge into sea is potentially the greatest accidental manner of introducing undesirable exotic organisms into ports throughout the world. The introduction of non indigenous species is a leading agent of global biodiversity change. Ship-mediated vectors like hull bio fouling, ballast water and ballast sediments are considered primary pathways for unintentional introductions of aquatic organism worldwide (Williamset al., 2013). Worldwide it has been estimated that harshly 3,500 million tonnes of BW and associated biota including microbes, benthos, phytoplankton, zooplankton, fish and other aquatic organisms are transferred annually by merchant shipping vessels. Due to the great volume of water used as ballast in modern ships, the spreading of organisms around the globe has increased, causing damage to human health, biodiversity, fishing activities, mariculture activities etc.

Impacts:
BW was first suspected as a vector of biota in 1903, when the discovery of an Asian diatom (phytoplankton) in the North Sea had no other explanation than transport by ship (Carlton, 1985). According to International Maritime Organization (IMO) the impacts caused by BW is divided into three main categories.

Ecological: It includes disruption of native biodiversity and / or ecological processes by invading species. It includes predation, parasitism, competition, introduction of new pathogens, genetic changes, habitat alterations, species shifts or loss of biodiversity. Under suitable circumstances discharged organisms will survive and reproduce and become invasive species. In some cases there is a high probability that the organism will become a dominant species, potentially resulting in the extinction of native species, effects on local and regional biodiversity, habitat alteration and act as vectors for various diseases or parasites, hybridism with native species and increased risk for threatened organisms.

Economical: It impacts on industrial and municipal water uses, nuclear power plants and other water sports. It also poses risk to levees / dams, commercial and recreational activities.

Human Health: when toxic organisms, diseases and pathogens are introduced through ballast water, potentially causing illness and even death in humans. It includes Cholera risk, different shellfish poisoning like PSP, DSP, ASP and NSP through different harmful blooms.

Ballast water management and treatment:
In order to overwhelm the ballast water problem, International Convention for the Control and Management of Ship's Ballast Water and Sediments was adopted in 2004 which entered into force in 2017. The convention is also called as Ballast Water Management (BWM) Convention, which aims to prevent, minimize and eliminate the risk of introduction of harmful aquatic organisms from one region to another, by establishing standards and procedures for the management and control of ship ballast water and sediments. The primarily guidelines also suggests that all the vessels should exchange their BW in deep ocean area (depths > 2000 m) prior to discharge within the system.

There are various technologies for the treatment of BW, they are as follows:

- Filtration systems (physical)
- Chemical disinfection (oxidizing and non-oxidizing biocides)
- Ultra - violet treatment
- Deoxygenating treatment
- Heat (thermal treatment)
- Acoustic (cavitation treatment)
- Electric pulse / pulse plasma systems
- Magnetic Field Treatment

Conclusion:
Ballast water waste management is a serious maritime issue. It poses serious ecological, economical and public health concerns for host ecosystems and countries where these waste are deposited. As a result, it is crucial that such waste is processed and dispose of properly. The most appropriate technique for preventing the spread of exotic species is the change of BW in high sea. Also, it is apparent that the current legislations and policies in place are not being enforced properly. However, immense efforts and systematic examination for preventing the spread of contagious and non - indigenous organisms by virtue of BW are required.

References:

***More references can be Provided on Request**

USES OF GREEN FLUORESCENT PROTEIN

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Introduction:

After the discovery of Green Fluorescent Protein in 1962, within 3 years, it has become the most widely studied and exploited protein in the field of biochemistry and cell biology. The ability of a protein to produce a highly visible efficiently emitting internal fluorophore is interesting and also it is more valuable. High resolution crystal structure of GFP helps to understand the relation between protein structure and spectroscopic function. The Green Fluorescent Protein is called as a marker of gene expression and protein targeting in intact cells and organism. Mutagenesis and engineering of GFP into chimeric protein are opening new dimension in physiology indicators, biosensors and photochemical memories.

Discovery:

As a companion protein to aequorin, Green Fluorescent Protein was discovered by Shimomura et al (1962), which is obtained from Jellyfish called Aequorea victoria. In the purification of aequorin, it has been noted that "a protein giving solutions that look slightly greenish in sunlight through only yellowish under tungsten lights and exhibiting a very bright, greenish fluorescence in the ultraviolet of a mineralite, has also been isolated from "squeezates". This description given by them is still accurate and also published the emission spectrum which peaked at 508nm. The emission spectrum is peaked near 508nm in case of green bioluminescence of living aequora tissue and peaked near 470nm in case of chemiluminescence of pure aequoria which was blue and its emission spectrum is close to the excitation peaks of GFP. Therefore GFP plays a role in producing green glow of the intact cells and animals which was obtained by converting the blue emission of aequorin. Scientist has given further mechanism for exciting coelenterate GFPs in vivo which is a radiation less energy transfer.

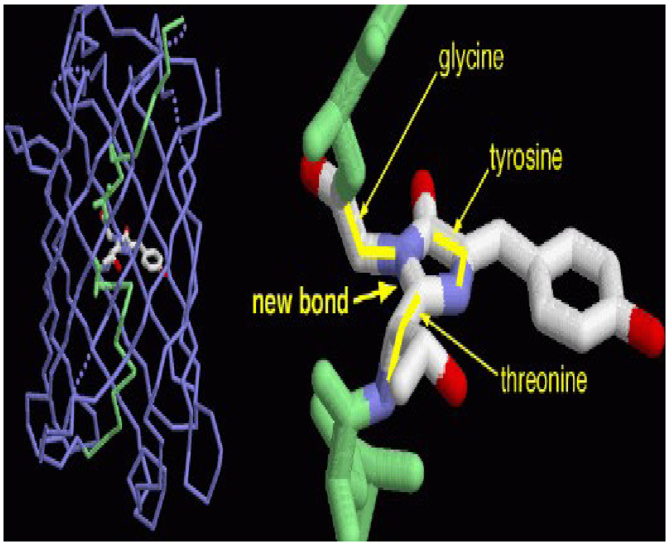
They purified and crystallized GFP and they measured the fluorescent quantum yield and absorbance spectrum and clarified that when two were co - adsorbed onto a cationic support, the aequorin can acquire an ability to transfer its luminescence energy into GFP. The first clear estimate for the monomer molecular weight was obtained by Prendergast and Mann. Scientist proteolysed GFP, which is already denatured and found the peptide which retained visible absorbance and with this analysis they proposed the chromophore is a 4 - (p-hydroxybenzy lidine) imidazolidine-5 ,one attached to the backbone of peptide through rings in 1 and 2 position. Later it has found that the chromophore is same for both aequoria and renilla GFPs; Aequorea properties such as sensitivity of pH, aggregation tendency and renaturation were characterized. But the research improvements in the cloning of gene by Prashera etal (1991) and the demonstration by Chalfie (1994) and Inouye and Tsuji (1994), it is has been discovered that gene expression of the other organisms also produces fluorescence. Thus specific enzymes of jellyfish is not requires because the gene itself contains all the information which is necessary for the post translation synthesis of the chromophore.

Highlight Points:

- **The Green Fluorescent Protein is called as a marker of gene expression.**
- **GFP plays a role in producing green glow of the intact cells.**
- **The major application of GFP is the production of Glofish, which is genetically engineered fluorescent fish.**

Structure and Mechanism of Fluorescence:

The chromophore of GFP in the backbone of the entire protein is shown here on the left in the following diagram. The protein chain forms a cylindrical can (displayed in blue), with one portion of the strand threading straight through the middle (displayed in green). The shielding of the chromophore from the environment is required for the fluorescence. After absorbing the photons the moving water molecules loot the chromophore of its energy but it is protected inside the protein and it releases photon of light which is less energetic than the chromophore. The chromophore (shown in the close-up on the right) is produced voluntarily from 3 amino acids in the protein chain: a glycine, a tyrosine and a threonine (or serine). An unusual five membered ring is synthesized due to the new bond formed by glycine and threonine.



Properties of Green Fluorescent Protein:
GFP is readily available fluorescent protein and it is also easy to use. Unlike most proteins that deal with light use exotic molecules to capture and release photons, for example the opsins in our eyes use retinol to sense light (see the Molecule of the Month on bacteriorhodopsin), these "chromophores" are built particularly for the function and it is incorporated into the proteins. Only with the use amino acids GFP generates its own light by handling mechanism built in. The short segments inside the proteins are buried due to the folding of protein chain in owing to this several chemical transformations occur: the glycine forms a chemical bond with the serine, forming a new closed ring, which then spontaneously dehydrates (as explained in structure). The fluorescent chromophore is finally formed by the new double bond created (by water molecules attacking the tyrosine) in the time period of one hour. GFP is ideal for genetic engineering as it produces its own chromophore and it folds up by itself and starts to glow.

Uses of GFP:
GFP and its application are used in various organisms such as bacteria, yeast, mice, human cells etc. One of the most common uses of GFP is in promoter and protein fusion constructs. Promoter fusions produce document patterns of gene expression with the use of GFP. Due to the dynamics of GFP production (the fluorophore takes some time to form) and stability (the protein appears to be long-lived, comprehensive studies of the onset and completion of gene expression (with a resolution of minutes) are not possible. For finding the subcellular localization of required protein and also for monitoring the localization changes during development protein fusions are used. The most useful fusions are those that also saves the mutant phenotype, because the rescues specify that the fusion protein functions pertinently.

Occasionally these fusion constructs are used in the analyses of a protein or required promoter. At other times these fusions helps in marking cells or cellular compartments by which biological phenomena can be examined or manipulated. GFP are used for labelling nuclei, endoplasmic reticulum, Golgi, mitochondria, peroxisomes and synaptic endings. After labelling the organism, they are layed open to different types of conditions and also they can be mutated to obtain mutants with altered or absent expression. For example, in the nematode Caenorhabditis elegans, GFP - labelled neurons have been used for mutations that alter cell fate, cell migration, or neuronal outgrowth.

For identifying the presence of viruses and microorganisms GFP is used as an indicator.GFP is a beneficial transfection marker as it is used for labelling the viral proteins in molecular biology research. These labelling of microorganisms and living cells are important in studying interactions between and within populations, e.g., symbiosis and host - parasite interactions. One of the applications of GFP includes tracking of infectious process in plants and animal.

GFP fusion proteins are produced by various combinations of fluorescence of GFP in the particular biological conditions. Such hybrid molecules respond with altered fluorescence to differences in membrane potential, calcium concentration and pH. These molecules and others like them promise to greatly expand the usefulness of GFP into the realm of biological sensors.

Application of GFP in Ornamental Fishes:
The major application of GFP is the production of Glofish. Genetically engineered fluorescent fishes are popularly called Glofish. The Fluorescent Angel fish was first discovered by Jylin company in November, 2010, the company which is responsible for the production of Glofish / flurofish. The fluorescent property of the angel fish is created by electroporation method (Electric pulse) by making a passage through the cell wall of their reproductive organ. The genes responsible for the fluorescence is injected into the pores, Hence upon mating, the genetically modified angel fish produce fluorescent offspring. Various diversity of transgenic zebra fishes were produced by transferring the green fluorescent protein gene.

These zebra fishes exhibits various fluorescent colours like green, red, orange and yellow not only in UV light but also in day light. In the recent times “Electric green”, ”Moonrise pink”, ”Star fired red”, ”Galactic purple”, ”Cosmic blue”, ”Sunburst orange” coloured tetra (Gymnocorymbus ternetzi), an “Electric green” tiger barb (Puntius tetrazona) and “Glo-Rainbow shark” (Epalzeorhynchos frenatum) were produced by incorporating fluorescent protein.

Alternatives to GFP:
Despite giving florescence, Chromophores can also be used for many other functions such as phosphorescence (emission from the triplet state), generation of reactive oxygen species such as singlet oxygen or hydroxyl radical and photochemical cleavage. Phosphorescence also allows the exploration of protein dynamics on longer time scales as it gives lifetimes in microseconds rather than nanoseconds and therefore allows exploration. The position of the chromophore can be evidences at ultra - structural resolution by a process where controlled generation of singlet oxygen are used to polymerize diaminobenzidine locally into a polymer and that are visible by electron microscopy, The proteins that produces hydroxyl radicals or other reactive species can be killed within a few nanometres of a suitable chromophore by using the laser pulses.

Photochemical cleavage is one of the basic methods to build instant variations in the concentration of signalling molecules. These techniques would be revolutionized if their critical molecules could be synthesized or at least localized in situ under molecular biological control, in the same way as GFP. The rigid outer covering of the chromophore of GFP protects intrinsically from the environment and this is also applicable for mutagenized GFPs.

References:
***More references can be Provided on Request**

Metabolomic Studies of Carbohydrate Metabolism in Fish

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Fish nutrition is the complex and meticulous branch of science, where newer inventions taking place now and then, so it is evident that for an appropriate, effective feed formulation, one should have a thorough idea of the nutrition and feeding habits of the cultured animal, with trials being made to replace fish meal by plant - based ingredients and through the usage of other sustainable sources hence advanced knowledge regarding how the nutrients interact with each other and within the cells of the body, how they are digested, absorbed across the enterocytes and how they are transported to their active sites and further whether they end up in anabolism / catabolism pathway. There comes the omics techniques to enhance our understanding of several nutrients, metabolites, genetic approaches etc.

What is meant by metabolomics ?

Metabolomics is the scientific study of substances with lower molecular weight (anything lesser than 5000 Da /<1500 Da), which means the study of metabolites / metabolome / substrate of metabolism present in the biofluids, cells etc. metabolites comprise of various compounds, including amino acids, carotenoids, flavonoids, carbohydrates, nucleotides / nucleosides etc. This approach has a wide application in the fields of health, nutrition and molecular biology. Nowadays, more advanced research has been carried out in humans; also, it is extended to livestock and fish nutrition.

CHO metabolism in fish:

Fishes are the only vertebrates that are energy - efficient, and they require a high protein diet compared to terrestrial animals. Hence aquatic animals generally have no specific requirements towards CHO inclusion in the diet. Still, CHO plays a vital role in regulating the cost of the feed and is involved in the protein - sparing effect to some extent, whereas in the case of shrimp, they can utilize CHO even better than lipids, and certain herbivores fishes can utilize CHO efficiently, unlike carnivorous fishes like salmon, sea bass etc.

Highlight Points:

Fish nutrition is the complex and meticulous branch of science where newer inventions taking place now and then, so it is evident that for an appropriate, effective feed formulation, one should have a thorough idea of the nutrition and feeding habits of the cultured animal. There comes the omics techniques to enhance our understanding of several nutrients, metabolites, genetic approaches on the target animal.

Fishes are generally considered to have a low tolerance to insulin because the time taken for glucose clearance is high. Generally, fishes are considered naturally diabetic, but fishes do produce insulin, but their affinity is not like mammals. Insulin level in unfed fish is 1 - 3ng / ml, whereas in the case of fed fish, its Slightly higher 5 - 48ng / ml (Kaushik et al..,1999). Once the CHO has been digested and absorbed, it reaches the blood stream as monosaccharides, where the other process occurs in the liver because most of the enzymes required for metabolism are present there. Specific tissues like the brain use glucose as the source of energy in the fish body. Sometimes Excess CHO can be stored as lipid in the liver and adipose tissues through lipogenesis.

Four major CHO metabolic pathways are present in fish of that glycolysis is the most significant catabolic pathway.

Glycolysis (glycolytic enzymes skeletal muscles > heart > brain > kidney > gill > liver)	Breakdown of glucose for energy purposes.
Gluconeogenesis (the reverse process of glycolysis) – liver / kidney	Formation of glucose from non-CHO substrates (pyruvate, amino acids, lactate)
Glycogenesis	Formation of glycogen from excess glucose in the body which will be stored in muscle in the case of large fish and mainly in the liver in the case of small fish of Carassius. (Matti Vornanen et al..,2011)
Glycogenolysis (mobilization of reserves)	Breakdown of stored glycogen to glucose (another major catabolic pathway in fish next to glycolysis)

Metabolomic studies in fish Nutrition:
Two significant instruments that have a significant role in fish nutrition for metabolomic studies include MS (Mass spectroscopy) and NMR (nuclear magnetic resonance). Because these analytical methods are sensitive and provide holistic ideas about the unknown compound, among these two, MS has a higher sensitivity because of the ability to identify metabolites in biofluids present in a minor concentration of the range of the uM.

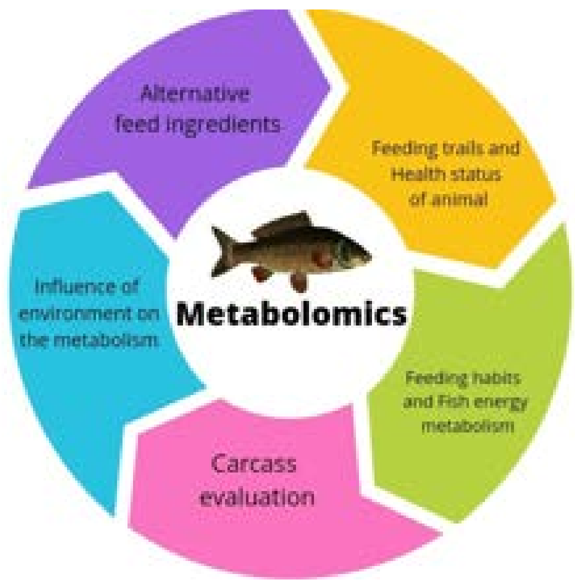
Using metabolomics in CHO metabolism:
With this approach, we can assess the effects of fish feed with different dietary composition and their effect on the metabolism in the fish body by assessing the significant tissues involved in metabolism; in the case of CHO, we can use liver, muscle etc. especially white skeletal muscle and biofluids like blood, mucus, faeces can also be assessed without sacrificing the animal.

In the case of diets rich in CHO when administered to fish using the metabolomic approach, it is found that there is an increase in glycogen stores. High lactate concentration is the end product of glycolysis under anaerobic conditions that occur due to chronic stress in fish.

Almost more than a decade lot of research had been carried out to replace marine ingredients with plant - based when using them in diets apart from ANF and digestibility level of CHO in ingredients is also high, hence by applying the metabolomics approach, it is easy and accurate to determine the different types of metabolites which are the end product of metabolism and it is influenced by the type of diet given we can compare the test diet with the control diet having the marine ingredients and draw a conclusion regarding the influence of high or low CHO diet on metabolites produced, it has been observed that glycolysis and gluconeogenesis pathway is influenced by plant-based diet (Roques et al..,2019).

The post - prandial rise in glucose level may arise because of feed metabolome or may be due to catecholamines produced during stress that influence the glycogenolysis pathway (Cheng et al..,2016). When herbivores fish is fed upon a diet high in CHO, it was observed that there was a hike in the hepato-somatic index (Prathomya et al..,2017). Specific nutrient-nutrient interactions with the body of fish can also be assessed by metabolomics; one such instance is the decrease in glucose when tyrosine and betaine are added to higher levels in the diet.

Significance of Metabolomics in Fish Nutrition:



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Conclusion:
With the help of the metabolomics approach in fish nutrition, we can redefine our understanding of metabolism to an advanced level added. It helps us understand the overall nutritional status of the fish and the health of the animal. As far as CHO metabolism is concerned, there is a lot to crack, particularly with the carnivorous fishes and will definitely play a role in widening our understanding of novel - feed formulation strategies.

Reference:
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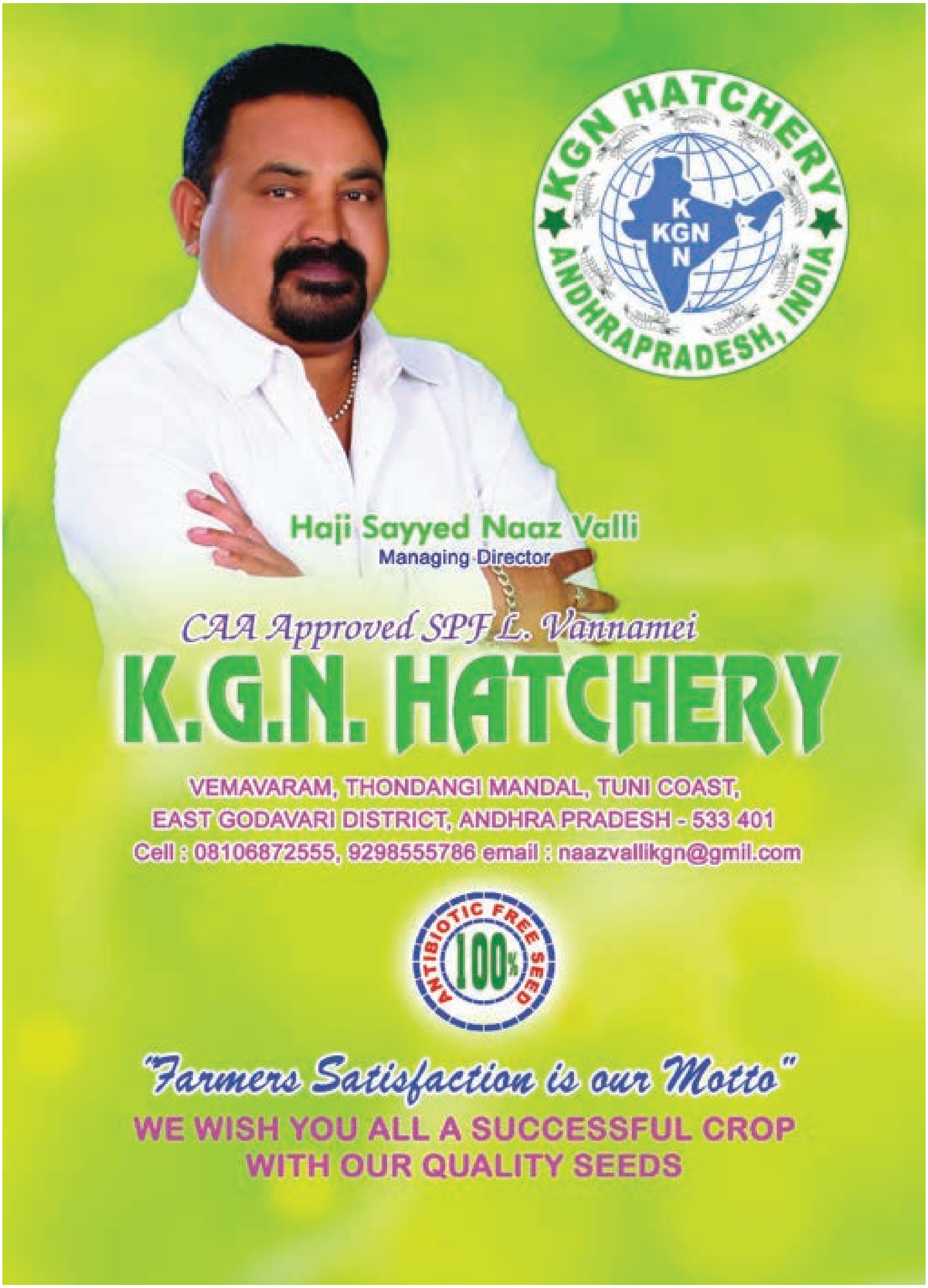
***More references can be Provided on Request**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