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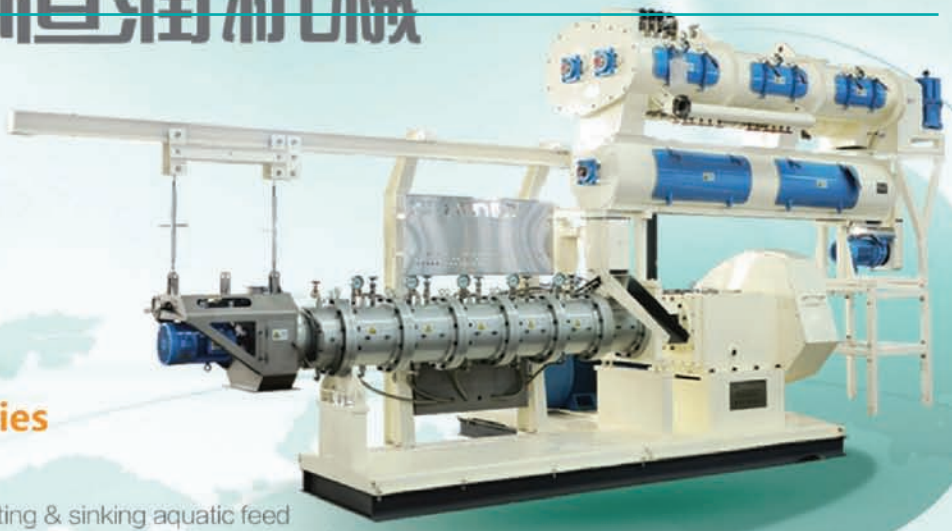

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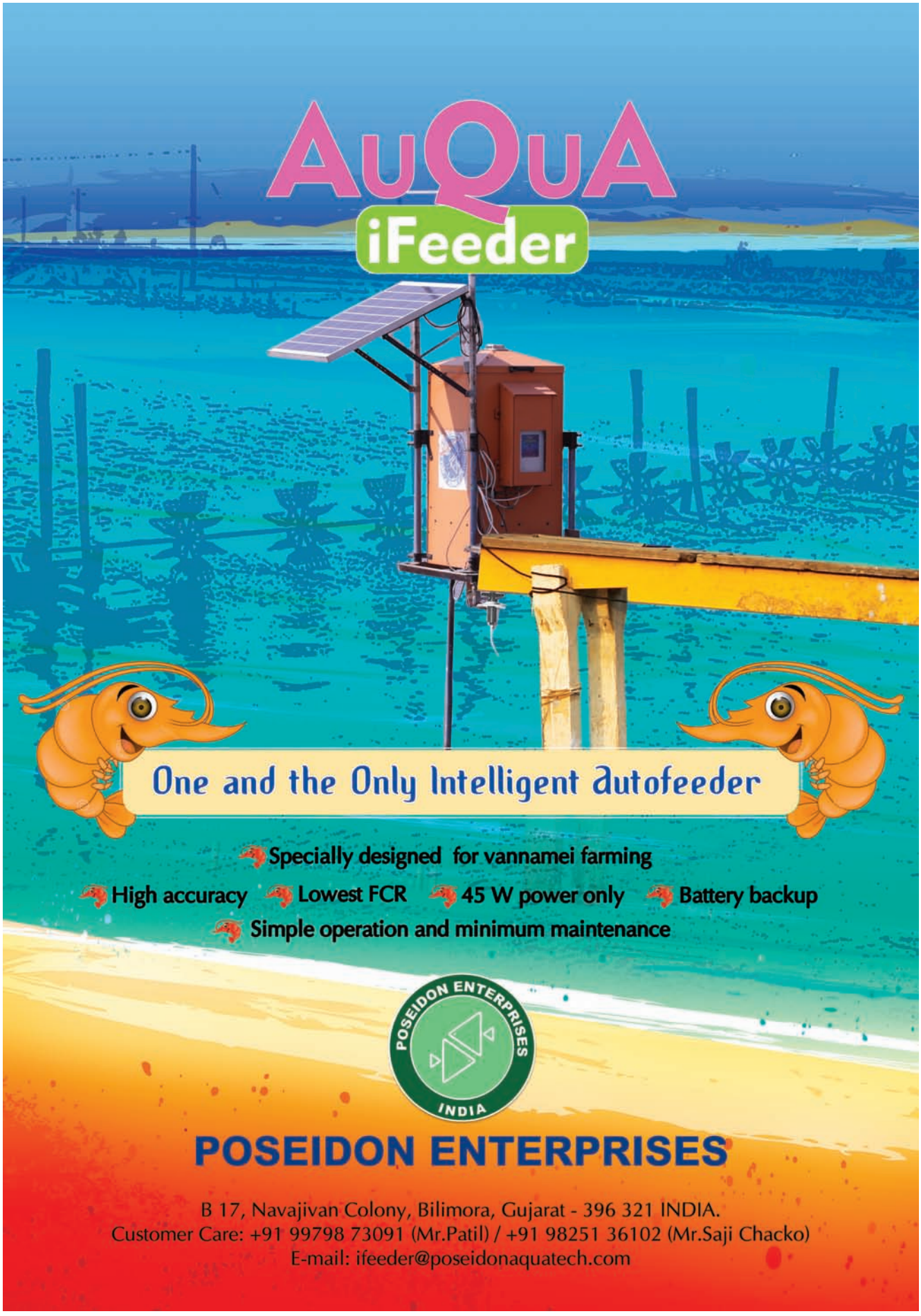
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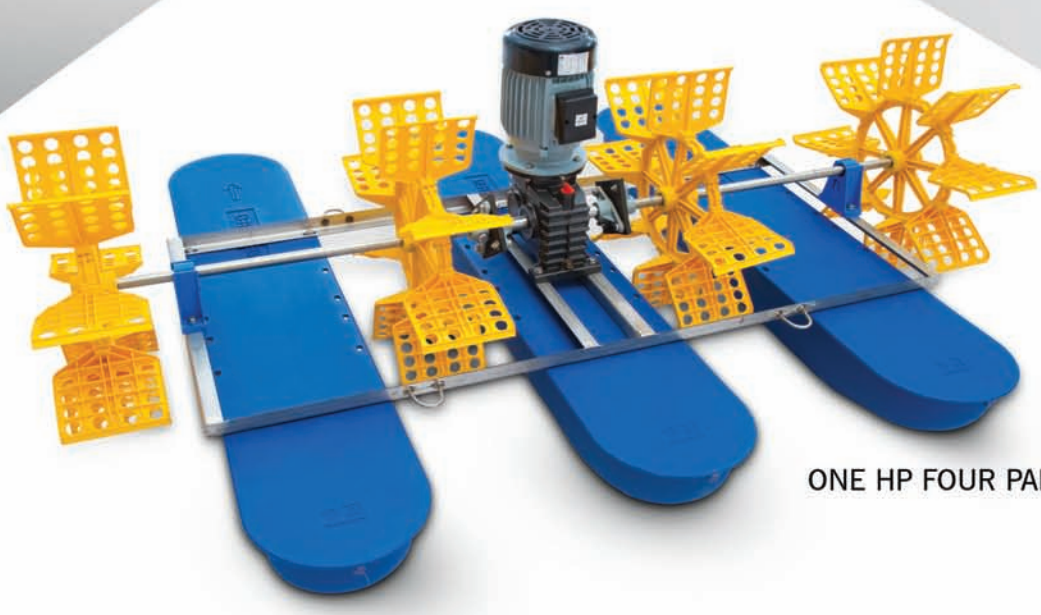
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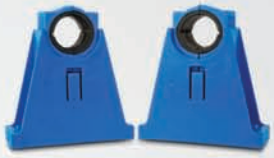

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COVID-19 changed the outlook of people and trade world over !

Let us be fair with ourself and with others !

COVID-19 has changed the outlook of the people and the trade world over and it has shaken the confidence and lives of the people. The unseen Corona virus made the people afraid of life and hide from it at home for months together. It is taking its toll on the world in about 184 countries causing deaths, illnesses and economic despair. It is estimated that about 45 - 55 million people are being pushed into extreme poverty.

Aquaculture sector in India was badly affected due to Corona virus and the industry lost hugely and future is going to be tough if the pandemic disease continues without its cure.

Shrimp and fish farmers had to face difficult times due to shortage and non-availability of feed, and credit system of feed supply was stopped for a few days in April month. Feed manufacturers also faced troubles owing to short supply of raw materials. Shrimp seed supply segment is going to be in crisis if import of broodstock is delayed due to global lockdown.

A positive thing happened due to lockdown is that Work from Home helped us all to streamline the things and get organised better, but if Lockdown continues longer period, sustainability will become difficult to smaller individuals and companies. Established companies with better funds and production may survive more.

Industry events have been postponed where people get an opportunity to update knowledge on various aspects of the industry and to promote business opportunities.

Some shrimp producers are trying new methods of farming such as moving to less-intensive shrimp-farming techniques, which require less antibiotic usage.

It was estimated that millions of shrimp seed and tens of thousands of broodstock may have been lost due to factors including the abrupt lockdown, farmers unwillingness to stock ponds due to low profitability and shortage of workers.

Looking at the shrimp production and its acceptance scenario world over, India has got opportunity to enhance its shrimp production, but this industry needs government support and stakeholders commitment to produce quality shrimp.

Let us be fair with ourself and with others

Some people responded on the editorial we published in March 2020 issue of this magazine titled "Stop hatredness, help people to live in peace". While some have appreciated the editorial content, a few expressed their displeasure, some people also mentioned religious matters.

The intention of writing the editorial was not to hurt any one's feelings. I express my regrets if any one felt hurt with my comments.

I gave my observations in the editorial on the happenings and how the actions of politicians and political parties are causing disturbance in the country. As I mentioned in the editorial, even after 70 years of Independence, still the rulers could not develop proper infrastructure facilities for the citizens in the country due to their attitude and insincerity.

There is a need of setting right economic situation of the country and solve unemployment issue, and increase production as well as productivity in agriculture and agri-based aquaculture – poultry and dairy sectors to give food to the people.

Whatever I mentioned is in the interest of all in the society and take it in a positive spirit. For me, peace and well being of the people of all religions and regions in India and globally is pertinent. I feel that I am only a citizen in the country and in the globe. As I was born in a Muslim family, people may call me a muslim, but I am a peace and welfare loving person for me and for all.

In my 27 years of experience as a journalist and as the editor in aquaculture sector, I tried to work with all sincerity and honesty in my profession. I hope we gave a quality magazine and promotional as well as awareness creating events to aquaculture. This industry and its stakeholders gave me fame and fortune and I express my gratitude to the industry and to the people.

Communal hatredness and violence is more dangerous than corruption and it will harm the growth and development of the country and its image in the world if we do not control it. People and the rulers should be faithful to our constitution.

I do not believe in religious organizations of any religion because initially their objective is fair, but later they start unhealthy practices of creating confusion and differences about each other religion leading to hatredness.

Whatever religion you belong to, please try to be moderate and reasonable. Religious extremism will not do good to any one. I always tell my family members, relatives, friends and others to be moderate in religious matters. For the mistakes of a few people, it is not appropriate to blame entire community.

Due to political reasons people are divided on the basis of caste, religion, region. This division might be useful to some people during election period, but it will not be helpful to bring all as united India. Great and successful people like Ratan Tata, Adi Godrej, Premji, Infosys Narayana Murthy and others during media interviews showed their great desire of seeing India as united country with equal opportunities. Instead of an Indian, people call as South Indian, North Indian or Punjabi, Gujarati, Tamilian, Andhra or Telangana etc. Country will be strong when we all become Indians first and inculcate positive thoughts in the minds of younger generations.

There are also good politicians who are working sincerely to make a mark in politics with good work.

I humbly suggest people to work hard and achieve excellence in whatever profession or trade you are in aquaculture or other sectors.

M.A.Nazeer
Editor & Publisher
Aqua International

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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.

Global Aquaculture Additives Market: Overview

Aquaculture Additives Market Promising Growth Opportunities & Forecast 2018-2028

Aquaculture is known as cultivating of mollusk, oceanic plants, fish, green growth, scavengers and other amphibian life forms. It includes development of seawater and freshwater oceanic life forms under conditions that are controlled to create high generation yield. Aquaculture additives are concoction mixes used to expand insusceptibility, shield oceanic creatures from contamination, support development, and give essential supplements to sea-going life forms. Such widespread uses have made a distinctive aquaculture additives market to exist from a global perspective.

Aquaculture has picked up an unmistakable pace in the worldwide creature agribusiness industry because of the extension in the worldwide economy and ascend in extra cash in creating economies, for example, China and India. This, thus, is driving the aquaculture additives market over the globe.

Global Aquaculture Additives Market: Notable Developments

- Enormous organizations are expanding their land nearness to increase by and large aquaculture additives market shares. They additionally participate in business extensions to make their items accessible to a bigger purchaser base over the globe.
- For example, in January 2018, Cargill, Inc. opened a feed plant committed to culture fish species in India. The office, with a complete limit of more than 90,000 tons yearly, is foreseen to empower the organization to expand its fish feed limit triple in the nation.

Some of the most prominent competitors operating in the competitive landscape of global aquaculture additives market include –

- Archer Daniels Midland Company
- Biomin Holding GmbH
- DSM
- NEOVIA
- De Heus Animal Nutrition B.V.
- Bentoli, Inc.

Global Aquaculture Additives Market: Key Drivers & Restraints

Rising mindfulness in regards to the advantages of additives to advance sound improvement of fish is foreseen to be a key driver for aquafeed aquaculture additives market. Significance of specific mollusks, for example, shellfishes and clams as a wellspring of nourishment for people combined with their medical advantages is relied upon to help their interest in not so distant future. Interest for mollusks to improve nature of the encompassing condition has likewise been pervasive in polyculture frameworks. Because of their numerous applications for customers and the agribusiness business, interest for this species is probably going to increment essentially amid the conjecture time frame boosting the interest for aquafeed.

The worldwide aquaculture additives market is relied upon to observe a not too bad development by virtue of the flood popular for fish nourishment, which is required to develop by virtue of an ascent in inclination for high protein, calcium, nutrient D, and iodine rich sustenance.

The worldwide aquaculture additives market is seeing innovative progressions. Organizations are continually endeavoring to grow new and better approaches to fabricate these additives. Improvement of new assembling procedures of aquaculture added substance and applications is evaluated to drive the aquaculture additives market. In any case, unpredictability in costs of crude materials is anticipated to hamper the aquaculture additives market.

Global Aquaculture Additives Market: Geographical Outlook

Asia Pacific significantly adds to aquaculture and aquafeed creation inferable from ideal climatic conditions. The district is evaluated to lead the market over the gauge years. Extending aquaculture industry in India and China because of the elements, for example, simplicity of asset accessibility, actuated conditions for aquaculture, and shoddy work is foreseen to look good for territorial development. Expanding utilization of fish in Southeast Asian nations including Vietnam and Thailand, is anticipated to advance aquaculture generation in the district and along these lines is anticipated to help the interest for feed in the up and coming years.

Furthermore, great climatic conditions in these nations help the general aquaculture creation, accordingly driving the market development. Elements testing development of the provincial aquaculture industry incorporate the confinements on emanating release and access to freshwater. Be that as it may, accentuation on the creation in concentrated recycling frameworks and seaward water bodies can conquer this test.

About TMR Research:

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Impact of Coronavirus on Aquaculture Healthcare Market 2020 - Global Industry Share, Growth, Demand, Size, Revenue, Cost Structure and 2020–2027 Forecast

Aquaculture Healthcare Market 2020

This report focuses on Global Aquaculture Healthcare Market status, future forecast, growth opportunity, key market, and key players. The study objectives are to present the Aquaculture Healthcare Market development in the United States, Europe, and China.

The report also summarizes the various types of Aquaculture Healthcare Market. Factors that influence the market growth of particular product category type and market status for it. A detailed study of the Aquaculture Healthcare Market has been done to understand the various applications of the usage and features of the product. Readers looking for scope of growth with respect to product categories can get all the desired information over here, along with supporting figures and facts

Our new sample is updated which correspond in new report showing impact of COVID-19 on Industry

Development policies and plans are discussed as well as manufacturing processes and cost structures are also analyzed. This report also states import/export consumption, supply and demand Figures, cost, price, revenue and gross margins.

The manufacturers responsible for increasing the sales in the market have been presented. These manufacturers have been examined in terms of their manufacturing base, basic information, and competitors. In addition, the technology and product type introduced by each of these manufacturers also form a key part of this section of the report. The recent developments that took place in the global Aquaculture Healthcare market and their impact on the future growth of the market have also been presented through this study.

This unique market intelligence report from the author provides information not available from any other published source. The report includes diagnostics sales and market share estimates by product as well as a profile of the company's diagnostics business.

Analysis tools such as SWOT analysis and Porter's five force model have been inculcated in order to present a perfect in-depth knowledge about Aquaculture Healthcare market. Ample graphs, tables, charts are added to help have an accurate understanding of this market. The Aquaculture Healthcare market is also been analyzed in terms of value chain analysis and regulatory analysis.

Covid-19 inflicts a daily loss of ₹224 crore to India's fishery sector

The Covid-19 lockdown has put the country's marine fishery sector in deep sea, inflicting a daily loss of ₹224 crore, a report prepared by the Central Institute of Fisheries Technology (CIFT) said.

The monthly loss for the sector is estimated to be about ₹6,838 crore; the Kochi-based institute has put ₹6,008 crore loss to mechanised sector and ₹830 crore for non-mechanised sector. However, the loss incurred in fish processing, exports and other nodes of the value chain are not considered.

The fisheries sector contributed about ₹1.75 lakh crore to Gross Value Added in 2017-18. Marine products are the most important agricultural commodity exported, accounting for close to $6.7 billion, growing more than 10 per cent per year, CN Ravishankar, Director, CIFT, said.

However, because of the lockdown, several fishing activities have been non-operational. Those fishermen, who were in the sea before imposing the lockdown, could not monetise their catch and had to abandon it. The distributional impacts of this could be felt more by coastal communities, women, children, and families who are wage earners, migrant labourers, and regular fish consumers, he said.

Exports suffer

Besides, the fish processing and export activities are affected in the maritime States. The economic slowdown due to the pandemic in major export destinations including the US, EU, UK and China could dampen India's export performance in the days to come. This could affect Indian aquaculture in the back-end, the report said.

The fishing and related activities in Gujarat — the No.1 State with 7.8 lakh tonnes marine seafood production in 2018 — have been hit severely. China is the major export market for Gujarat and the trade was affected by January when the Covid -19 virus infection affected China. It is estimated that there will be a 40 per cent reduction in the catch during this year.

Many of the importing countries, hit by the pandemic, have cancelled orders and this has resulted in an uncertain export market. Traders are anticipating a 20-40 per cent drop in price.

The report suggested setting up of a committee including all the stakeholders of the fishing industry to study the issues faced by the sector industry and come out with remedial measures. The government should also consider a comprehensive economic package considering the financial need of the fisheries sector. This could include a relief package for fishermen and processing factory owners comprising an economic component like loan waiver, deferring of loan instalments, subsidy to fishermen, etc.

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Vietnam Set to Make Aquaculture Farming Sustainable with Solar Energy

Two German institutes together with other companies signed an agreement to implement the project in Mekong Delta

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and the German research institute, Fraunhofer Institute for Solar Energy Systems (ISE), have signed an agreement together with other partners from the private and public sector to implement a new project of combining aquaculture farming with solar photovoltaics in Vietnam's Mekong Delta.

Within the 'Solar-Aquaculture Habitats as Resource-Efficient and Integrated Multilayer Production Systems' (SHRIMPS) project, solar modules will be installed on the roofs of shrimp greenhouses under a pilot project in Bac Lieu province.

In a press statement issued by MOIT/GIZ Energy Support Program, it was added that the project would effectively make use of the farming land, reduce freshwater consumption, wastewater and carbon emissions while keeping an optimal water temperature for shrimp growth as well as improve working conditions for the employees at the facilities.

Tobias Cossen, project director on behalf of GIZ, said, "The project offers a practical solution to double the use of land to produce both food and energy in Vietnam, and helps to achieve greater resilience of local farms to climate change impacts."

He also stated that the team would monitor the installation of the pilot project. The next step will be the transferring of the technology to small and medium-sized aquaculture businesses in other provinces. The team also plans to start similar projects in other Southeast Asian nations.

In 2018, Fraunhofer ISE, on behalf of GIZ, had conducted a pre-feasibility study on the potential for combining shrimp farming with photovoltaics. It also tested the technical and commercial feasibility of dual land use for solar power generation and commercial aquaculture on a specific shrimp farm.

According to the release, the project is a part of Germany's research cooperation efforts in Vietnam. The German Federal Ministry of Education and Research (BMBF) is funding the project within the framework program "Research for Sustainable Development" (FONA3) by supporting the research and development activities of the partners Fraunhofer ISE, the German Thünen Institute of Fisheries Ecology, SMA Sunbelt Energy GmbH and Suntrace GmbH.

Participating from the Vietnamese side was Ho Chi Minh City's Nong Lam University, the Vietnamese Institute of Energy, a major Vietnamese shrimp production company, and Bac Lieu's Department of Agriculture and Rural Development.

With an increase in annual electricity demand of around 10%, Vietnam cannot achieve a reduction in greenhouse gas emissions of between 8% and 25% by 2030 in compliance with the Paris Climate Agreement (COP 21) if it does not promote the growing use of renewable energy simultaneously. Meanwhile, groundwater is increasingly used for aquaculture farms in the Mekong region due to more surface water pollution, together with water abstraction for domestic and agricultural purposes.

"Therefore, using renewable energy can help the aquaculture sector in Vietnam alleviate the pressure on land and sustainably develop and protect the environment," states the company statement.

Recently, the International Finance Corporation (IFC), a member of the World Bank Group, announced that it would provide a loan to the Vietnam Prosperity Joint Stock Commercial Bank (VP Bank) to help expand its lending capacity to small and medium enterprises (SME) for climate-friendly projects.

In March 2020, Vietnam's SkyXSolar announced that it signed a joint venture agreement with SAIGONTEL to build and operate rooftop solar projects for industrial facilities within the industrial parks affiliated with the latter in Vietnam. The IFC said this was its first green loan to a bank in Vietnam, where most of the near-term multimillion-dollar climate investment potential was in renewables and infrastructure.

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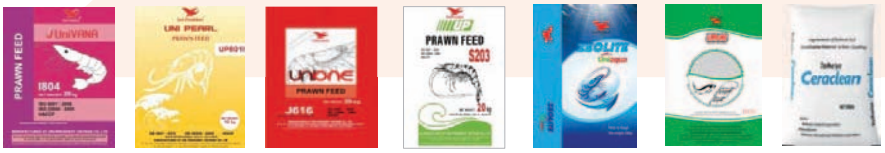

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Fish and Aquatic Food Systems COVID-19 Updates: India

On March 25th, India initiated a strict 21-day lockdown, later extended until May 3rd, May 17th and May 29th. Lockdown measures included school closures, border closure, travel bans, bans on gatherings, and bans on all transportation services except for essential goods. This initial lockdown was assessed as one of the most stringent in the world. It is estimated that around 80% of India's workforce is informal or semi-formal with minimal social nets or savings to depend on. By the beginning of May, India had registered 33,336 confirmed cases and 1,223 deaths.

Impacts on fisheries and aquaculture: During the 21-day lockdown, fishing was halted due to the closure of storage facilities, markets, and processing plants. On April 9th, India's Ministry of Home Affairs allowed fishing and aquaculture businesses to pursue their activities under conditions of adequate social distancing. Productivity levels at some shrimp processing plants were said to have been reduced to a third or fifth of their usual capacity. Processing plant operation was already hampered because they relied on migrant workers who make up 50% of the workforce in Andhra Pradesh. Many workers returned to their home states when the lockdown was announced, and are now unable to return to work due to continued restrictions on movement. In the Ernakulam district, Kerala, a fisher representative, stated 95% of factory workers are women.

A wide variety of actors in fisheries and aquaculture have experienced dire economic consequences. The COVID-19 crisis came at a particularly pivotal time for small-scale fishers as diverse spring catches were said to usually be sufficient to guarantee enough income to endure the following monsoon and annual fishing ban period. Thousands of seasonal fishing laborers were reportedly left stranded, unable to go home, and said to be living in terrible conditions. One fisher who was allowed by the government to go back at sea in his traditional non-motorized vehicle with a maximum of five people stated he did not feel safe doing so due to health concerns.

International exports were also severely affected. Frozen shrimp, which makes up 70% of India's seafood export earnings have seen a sharp slump in demand from the United States and Europe following their own lockdowns. To make matters worse, when China opened for imports again in March, a shortage of workers in processing plants made it impossible to process the shrimps. The cycle of shrimp hatchery operations also appears to have been disrupted. Import of Vannamei shrimp broodstock from the United States has been halted, delaying the breeding cycle, with a potential 20-30% fall in shrimp production as a consequence. Besides, it was estimated millions of shrimp seed and tens of thousands of broodstock may have been lost due to factors including the abrupt lockdown, farmers' unwillingness to stock farms due to low profitability, and a shortage of workers.

Lack of labor, transportation, or ice to preserve catch, and curfews leading to hundreds of boats being prevented from landing catch due to harbor closures, or forced to queue to sell their catch, were some of the many bottlenecks further handicapping the fishery sector. Dumping seafood was reported in Goa due to the inability to land fish, and Chennai where fish storage facilities are already at full capacity. One report states that in Raigad district of Maharashtra state, one hundred thousand tonnes of wild-caught seafood was thrown back at sea at the end of March. When fishers managed to sell their catch, it was said they had to sometimes settle for as little as half or one-fourth of the usual market price.

Women, who account for about half of all small scale fish workers in India, are believed to be amongst the most vulnerable in this crisis. Fish vendors, the majority being women, are unable to continue with their usual door to door selling activities. Reports surfaced of unfair treatment by the police in Kerala, who allegedly prevented them from selling their fish at the market due to doubts surrounding their status as essential food workers. These women are often the main income earners for their households and do not have other sources of income depend on.

Responses and adaptations: Fish workers were not mentioned in a national $22 billion crore relief package for the poor. The National Fish Workers Forum wrote a letter to the government at the end of March requesting a special package for fishers. India's situation is particular as the annual 61 day monsoon fishing ban period is coming up, meaning fishers' financial losses due to COVID-19 may be further compounded. The government is considering including the 21 lockdowns in the ban period, meaning that fishers could return to sea early. The government provides around $65 per fishing family during the 61-day ban, but a total compensation fund of $31.5 million is now in consideration. When this money would become available to fishers remains to be determined.

The state government of Andhra Pradesh has attempted to set the price of shrimp at INR 180 ($2.4) per kilogram. Still, traders and factories have refused to purchase at this rate, marking a discrepancy between policy and practice. Some fish workers in Kerala were said to be surviving on free rations and INR 2,000 ($26) provided by the state government. The state government in Odisha has facilitated the continuation of fish sales while enforcing social distancing measures by drawing circles on the ground at markets, indicating where people should stand. Online sales and home deliveries have surged, whereas the demand for farmed tilapia is reported to have grown as supplies of marine fish have been constrained. Some fishers have also reported they dry their fish and store them until the lockdown is over.

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Coronavirus Outbreak: Commerce ministry lists steps to support exporters as industry expresses fears of huge job losses

New Delhi: The commerce ministry recently said it has taken several measures to address hardships faced by exporters due to COVID-19 pandemic, a day after an apex exporters body warned of 15 million job losses unless an immediate incentive package is announced by the government.

The commerce ministry said that it has provided several relaxations/extensions of various compliance deadlines to address Corona pandemic related hardships of exporters.

The steps enlisted by the ministry included extensions of foreign trade policy by one year, export obligation under advance authorisation and export promotion capital goods scheme, the validity of registration cum membership certificate, lasts date for filing claims under services and goods export from India schemes, for filing RoSCTL (rebate of state and central taxes and levies) claims, valid period of all status holder certificates, and replenishment scheme for gems and jewellery.

It also said that steps have been taken to facilitate units in special economic zones. For these zones, extensions have been given filing quarterly progress report, annual performance reports, and permission to take desktop/laptop outside SEZs by IT and non IT units.

"In order to give relief to businesses and affected individuals amidst the stress caused by the novel coronavirus pandemic, the department of commerce has introduced several relaxations and extensions in deadlines etc. with regard to compliances mandated under its schemes and activities," the statement said.

Further, the Export Credit Guarantee Corporation (ECGC) too has extended the time for filing declarations, report of default, filing claims/replies, reduction in policy proposal processing fee, discretion to decide about shipments and claim eligibility period.

For agri exporters, it said that certification bodies have been advised to extend the validity of organic certificates, and registration of packhouses.

The Tobacco Board has extended the last date for submission of monthly returns by traders, and it has planned to start auctioning off the commodity with effect from April 15 to prevent loss of the crop.

Similarly, it said the Tea Board and the marine products export development authority have taken steps to help exporters.

MPEDA has started issuing most of the certificates for exports online like the DS 2301 certificates for the USA market from this month.

It also said that exporters who want to avail benefits under the EU Generalised System of Preferences (GSP) Scheme, wherein they get a registered exporter number, steps have been taken in this regard.

In view of the closure of the offices of these agencies, the ministry has prescribed the acceptance of scanned documents for getting that number so that the exporter has no physical interface with the agencies.

"This would ensure that exporters to EU under the EU GSP who have not got the REX number can apply electronically to the agencies," it added.

The FIEO on Friday said that 15 million people may face job losses in the export sector following cancellation of orders amidst global lockdown due to COVID-19 pandemic and has sought immediate announcement of an incentive package.

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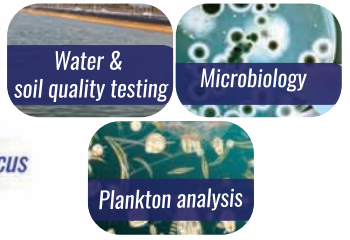

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Aquaculture Authority soon to Monitor Hatchery Activity

It will also ensure Minimum Support Price to farmers, says A.P Fisheries Minister

Vijayawada: The Andhra Pradesh State government will soon set up an aquaculture authority to monitor the hatcheries activity from seed level to marketing and will ensure Minimum Support Price (MSP) to farmers.

Addressing a press conference here recently, Animal Husbandry and Fisheries Minister Mr Mopidevi Venkata Ramana said the authority would monitor the activity from brooding to shipment.

The imported prawn seeds would be kept in the quarantine facility for five days. The seeds would be brought to the State only after ensuring that there was no virus. As part of it, the seeds would be distributed to farmers

Fisheries Minister, A.P, Mopidevi Venkata Ramana Rao

only after the seed was kept at Rajiv Gandhi Aqua Quarantine Centre for five days, he said, adding out of 550 prawn hatcheries in the country 420 were located in the State.

According to him, the State has the largest number of hatcheries in the country, and with the lockdown, brooding seed has become a Herculean task. As 80 % of the broader prawns are to be imported from the US, with the lack of proper cargo facilities, there arises a gap in the production activity. In this regard, the State government has already written to the Union Ministry of Commerce and Fisheries to permit the cargo for aqua production and sale.

The farmers were requested not to sell their aqua products in distress as the ports have opened up and exports would pick up once there was movement of the cargo ships, he said, adding, " As of now, exports of the aqua produce have begun in various ports across the State, soon the cargo services will be made fully functional."

Referring to the stranded fishermen in Gujarat, the Minister said that Chief Minister Y.S. Jagan Mohan Reddy has already spoken to Union Minister Nirmala Seetharaman regarding the issue and he was constantly pursuing the matter.

Reacting to BJP State president Kanna Lakshminarayana's comment that the State government was purchasing the rapid test kits at higher cost, the Minister said that the government had already clarified in this regard. The lowest price offered to other States would be taken into account while making the payments.

Serious charge against TDP

On the spread of coronavirus, the Minister levelled serious allegations against the Opposition Telugu Desam Party (TDP). The TDP might have sent 'sleeper cells' to the rural areas to spread the virus with a view to defaming the government, he alleged.

Covid-19 lockdown: Gujarat lifts restrictions for fishing and marine industry

Decision comes a day after Centre's addendum exempting aquaculture from lockdown

April 11, 2020: A day after the Union Home Ministry issued an addendum giving exemption to marine fishing activities from the lockdown restrictions, Gujarat government recently lifted the restrictions for the fishing community and allowed them to venture into the sea for the catch.

Making an announcement, Secretary to the Chief Minister, Mr Ashwini Kumar stated that Gujarat government has lifted the restrictions for fishing and allied activities amid nation-wide lockdown due to coronavirus outbreak.

"Fishermen in Gujarat can now venture into the sea for their regular business activities. We are starting to issue them tokens for the purpose," he said.

This also opens up the businesses connected with fisheries including processing, packaging, cold chain maintenance and transportation.

The Union Ministry of Home Affairs had issued an addendum to the consolidated guidelines regarding the nationwide lockdown to fight Covid-19 virus.

"The 5th addendum exempts from lockdown restrictions the operations of the Fishing (Marine) / Aquaculture Industry, including feeding and maintenance, harvesting, processing, packaging, cold chain, sale and marketing; hatcheries, feed plants, commercial aquaria, movement of fish/ shrimp and fish products, fish seed/feed and workers for all these activities," it had stated.

Gujarat, which covers about 1/5th of country's coastline with its 1,600 kmsof coastline, contributes about 20% of the country's total marine production. The state has about 8.42 lakhtonnes of fish production annually worth about ₹7,005 crore (2018-19).

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Lockdown hits aquaculture sector in Andhra Pradesh; ready-to-harvest shrimp worth over Rs 1,200 cr lying in ponds

Amaravati: The ongoing lockdown on account of COVID-19 could not have come at a worse time for the aquaculture sector that earns million of dollars through export of shrimp.

At the peak of the season, the lockdown has pushed the sector into jeopardy, with farmers, industrialists and exporters each facing their set of problems and an uncertain future as shrimp is seen as a luxury product.

Ready-to-harvest shrimp worth over Rs 1,200 crore is now lying in the ponds predominantly in East and West Godavari districts of Andhra Pradesh.

The shrimp processing units in the state are not functioning to their capacity due to acute shortage of manpower even as the Marine Products Export Development Authority said it would invoke Clause 43 of the MPEDA Rules, 1972, and de-register the licences if processing of the produce was not done.

Exporters are advised to remain supportive to the farmers in these difficult times so that they continue to engage in shrimp farming, which is the principal commodity of marine products exported from the country in terms of value, MPEDA secretary B Sreekumar told the processors and exporters.

In the absence of export orders and little scope for processing, farmers fear their produce would only perish.

Though China, one of the major markets for Indian shrimp, relaxed the restrictions for import, the exporters are unable to take full advantage of it as the processing is not happening adequately.

In the last one week, close to 3,000 tonne of shrimp was shipped to China. Andhra Pradesh has a 50.41 per cent share in the country in shrimp production and earns close to 53 per cent of the overall revenue.

In 2019-20, shrimp production in Andhra Pradesh was around four lakh tonnes and about 2.55 lakh tonnes of it was exported between April and December 2019, according to the state government data.

That fetched a revenue of Rs 13,960 crore to the aquaculture sector.

Exports had stalled since the outbreak of COVID--19 in China and the lockdown in various countries only aggravated the crisis, at a time when the Indian exporters were readying to ship the produce at the end of January- February slack period.

Shrimp from Andhra is exported mainly to EU countries and the US, apart from China.

The aquaculture sector, which is linked to the international market, is now at a standstill. Exports to China and the US have just re-started and our government is able to sort the problems out by taking up the issue with the Centre, state animal husbandry and fisheries minister MopideviVenkataRamana said.

The state has 72 units processing seafood but they are not functioning even to one-third of their installed capacity.

Essentially, a lot of manual labour is involved after the shrimp is harvested and before it is processed. Over 50 percent of the workers are migrants and because of the lockdown they went away to their respective states, P RamachandraRaju, an exporter, said.

The local workers were not coming to work because of the restrictions imposed by their respective village heads to check the spread of the pandemic.

In East Godavari district, for instance, of the total 11,000 workers only about 2,000 were attending duty, that too after persuasion by the government authorities, according to Agriculture Minister K KannaBabu.

The state government has taken a pro-farmer stand and been focusing on getting the aqua produce harvested and purchased by the industry.

The processors and exporters, however, are in a predicament.

Most of the containers that set sail with shrimp in early March, days before the lockdown, were stranded either at sea or in the port of arrival.

At the same time, the shrimp market overseas has also shrunk because of the lockdown, leaving little scope for further export.

Farmers want us to buy the stock even through deferred payment but the uncertainty in the export market will only be detrimental to the entire sector in the prevailing scenario, an exporter said.

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Brackishwater Farmers Conclave held in Surat

ICAR-CIBA organized "National Brackishwater Aquaculture Farmers' Conclave (BAFAC) - 2020" on 19 - 20 February, 2020, Surat, Gujarat

The ICAR-Central Institute of Brackishwater Aquaculture, Chennai in collaboration with the Society of Coastal Aquaculture and Fisheries (SCAFi) and Navsari Agricultural University (NAU), Gujarat organized the "*Brackishwater Aquaculture Farmers' Conclave - 2020 (BAFAC-2020)*" at Surat, Gujarat from 19th to 20th February, 2020.

The Chief Guest, Shri Anup Kumar, I.A.S., Secretary, Fisheries, Animal Husbandry and Agricultural Marketing, Government of Maharashtra lauded the ICAR-CIBA's efforts to organize the Farmer's Conclave in the West Coast.

In his address, Shri N.F. Patel, Department of Fisheries, Government of Gujarat recalled the decision of the Gujarat Fisheries Minister for allocating 7.5 ha of farm land at Matwad, Navsari to the NGRC of ICAR-CIBA to conduct the research and trials for the development of technologies suitable for the West Coast.

Dr. Joykrushna Jena, Deputy Director General (Fisheries Science), ICAR highlighted the brackishwater aquaculture's potential in the country and benefits the farmers can reap in on a sustainable mode. He outlined the sector's remarkable growth, where the farmers' income in brackishwater sector has been multiplied over 3 times since 2010. Dr. Jena also stressed on the need of a sustainable approach to keep the growth trajectory.

A view of the conference

Earlier, in his welcome address, Dr. K.K. Vijayan, Director, ICAR-CIBA and President, SCAFi & Convener, BAFAC-2020 articulated the significance of BAFAC-2020 and its main purpose. He also outlined the development of brackishwater aquaculture sector with special reference to the shrimp farming and the way forward for its sustainability. Dr. Vijayan also assured the stakeholders about the extending of the technological and capacity building support on "partnership mode" by the Institute to the programmes initiated on the west coast by the respective state governments for developing the brackishwater aquaculture.

The various farmer-friendly publications by ICAR-CIBA in the vernacular languages were released during the occasion.

Around 70 farmers of the region were distributed the Soil and Water Health Cards based on respective farm samples. Dr. Jena also handed-over a cheque for Rs. 5,00,000; an income generated by the Om Sai Women Self Help Group, Matwad, Navsari, Gujarat by taking up the Nursery rearing of finfishes with the facilitation of Navsari Gujarat Research Center of ICAR-CIBA.

About 900 brackishwater farmers representing all the coastal states covering both East and West coasts of India from West Bengal to Gujarat and Inland states like Haryana Punjab and Rajasthan attended the programme.

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CIFT develops smart paper based freshness indicator

Narendra Singh Tomar, Union Minister of Agriculture & Farmers' Welfare, Govt of india releases the product

Freshness indicator Release

Smart paper based Freshness Indicator which shows the freshness of packed fish and shellfish was released by Honourable Minister Shri Narendra Singh Tomar Union Minister of Agriculture & Farmers' Welfare, Govt. of India in presence of Honourable Minister Shri Piyush Goyal, Union minister of Railways and Commerce& Industry, Honourable Minister Shri Parshottam Rupala, Union Minister of State for Agriculture and Farmers Welfare, Hon'ble Minister Shri Kailash Choudhary, Union Minister of State for Agriculture and Farmer Welfare, Honourable Minister Shri Pratap Chandra Sarangi, Union Minister of State for Animal Husbandry, Dairying and Fisheries, Hon'ble Minister Shri Rao Inderjit Singh, Union Minister of State for Statistics and Programme Implementation, Shri Surya Pratap Shahi, Minister of Agriculture, Government of Uttar Pradesh andDr. Trilochan Mohapatra, Secretary (DARE) & Director General (ICAR), New Delhi,

Shri Sanjay Kumar Singh, I.A.S., Additional Secretary (DARE) & Secretary (ICAR) at 91st Annual General Meeting of the ICAR held at NASC Complex, on 27 February 2020 at New Delhi. Shri. B. Pradhan, I.A.S. Additional Secretary (DARE) and Financial Advisor (ICAR) and Dr. Joy Krushna Jena, Deputy Director General, Fisheries, ICAR, New Delhi were also present among other dignitaries.

Fish production as well as fish consumption is on rise both in domestic and international market. Understanding the ever increasing demand for fish, retail marketing and online marketing is flourishing across India and the price of fish is also increasing. Consumers are always at doubt regarding the freshness / quality of fish and shellfish while purchasing. Fish being highly perishable, undergoes spoilage leading to formation of various chemicals (oxidation products and amines) which may affect the health of the consumers. The fish quality is either ensured by sensory attributes or by analytical methods. However, the analytical methods are time consuming, costly and are not real time in nature. This has resulted in relying on sensory quality assessment to judge the quality of fish being marketed. However, sensory quality analysis is qualitative and it can be biased and hence, quality control requires rapid methods for measuring fish freshness in real time. Smart packaging technology will be beneficial for this purpose. Under Honourable Prime Minister's prestigious 100 days programme, ICAR-CIFT has developed simple dye based paper disc to indicate the freshness of packed fish and shell fishes.

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- Better management control to reduce Post-harvest loss

Financial Implications:

Freshness indicator strips / discs are developed using locally available indigenous materials like filter paper and dyes and cost will be approximately 40 paise per pack. Considering the advantages for both the consumer and manufacturers, the financial implications will be very negligible.

Further contact: Dr Ravishankar, C. N., Director, ICAR-Central Institute of Fisheries Technology, Willingdon Island, Kochi

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NBFGR organises Awareness Programme on Biodiversity Conservation at Western Ghats

The ICAR-National Bureau of Fish Genetic Resources (NBFGR), Lucknow, in collaboration with the Department of Zoology, Bharathiar University has organized a one day programme on 'Awareness about Biodiversity Conservation at Western Ghats' which was held at the Bharathiar University, Coimbatore on 28 February, 2020.

The ICAR - NBFGR is the organization working for the conservation of Aquatic genetic resources, particularly fish genetic resources of the country. They have conducted the event under the Tribal Sub-Plan (TSP) programme of the institute. This programme was inaugurated by Dr. Gopal Krishna, Vice-Chancellor, ICAR-Central Institute of Fisheries Education, Mumbai. Followed the presidential address was delivered by Dr. A. G. Ponniah, Former Director, ICAR - NBFGR & CIBA. The Chief Guest of the programme was Mr. I. Anwardeen, I.F.S, Addl. P.C.C.F and Director, Tamil Nadu Forest Academy. Dr. Kandan, Director, Rajev Gandhi Centre of Aquaculture and Dr. K. Murugan, Registrar, Bharathiar University has facilitated the event and the programme was chaired by Dr. Kuldeep K Lal, Director, ICAR - NBFGR.

The aim of the training programme is to create awareness about the biodiversity of the Western Ghats and its conservation measures to the local people residing in the region, besides introducing new livelihood programe about indigenous fish culture. Dr. T.T. Ajith Kumar, Principal Scientist of NBFGR, Kochi Centre of the NBFGR has welcomed the gathering and briefed about the importance of the programme. Dr. Kuldeep Kumar Lal, Director, ICAR-NBFGR has explained the role of his institute in conservation of aquatic genetic resources of our country and livelihood promotion. He also assured NBFGR, Kochi centre will extend technical support to the tribal people of Western Ghats for improving their livelihood through indigenous fish culture.

Tribal participant expressing her views

Dr. A.G. Ponniah stressed upon the need to conserve the natural resources for the welfare of our future generation. Mr. I. Anwardeen, I.F.S., has explained the endemic diversity of Western Ghats bio-resources and also focused the need for its special attention. He also addressed about the understanding and role of ecosystem services to maintain the ecological integrity. Dr. Gopal Krishna emphasized the role of women in conservation and management.

In this programme, over 100 beneficiaries including Self Help Group members attached with Krishi Vigaya Kendra (KVK) and tribal community residing at various hamlets of Western Ghats region were participated. Resource Person from different organizations has explained the need for biodiversity conservation and also briefed about the alternate livelihood options suited for Western Ghats region, mainly with indigenous food and ornamental fish culture. Different case studies / successes stories about fish culture, conservation and sustainable utilization, livelihood promotion and breeding techniques of indigenous fresh and ornamental fish has briefed with audio video visuals by the NBFGR Scientists. Dr. L.K. Tyagi, Principal Scientist and TSP Coordinator and Mr. Kantharajan, Scientist, NBFGR were coordinated the events.

The participants, particularly the tribal community actively involved in the discussions and they shown their interest in adopting the indigenous fish culture techniques developed by the ICAR-NBFGR for their livelihood and Director, NBFGR has given assurance for the same.

A view of particpants

CMFRI launches GIS based info ofvicinity of fish landing centres to Covid hotspots

Kochi: In a major development that would become crucial in monitoring the activities at various fishing centres in the State, the Central Marine Fisheries Research Institute (CMFRI) has launched anonline GIS based databasedepicting the vicinity of fish landing centres to the Covid-19 hotspots of Kerala. Thedatabase offers visualisation of the entire 156 fish landing centres in Kerala in various colour groups in accordance with their geographical proximity with the Covid-19 hotspots identified by the government. The landing centres have been categorised in different groups according to their distance with the hotspots.

The first category, which requires priority in taking precautionary measures, includes fish landing centreslocated within 3 km of the hotspot. The landing centres at a distance of 3 to 5 km with the hotspots fall in second category, whereas the third category includes landing centres at a distance of 5 to 10 km from the hotspots. The data which is available at the Department of Health, Government of Kerala has been used by a team of CMFRI scientists to develop the online infographics. The team comprises of Dr J Jayasankar, Dr Shelton Padua, Dr C Ramachandran and Dr MA Pradeep.

As per the current status of Covid hotspots in Kerala, 17 fish landing centres fall in the first category. These landing centres are located in Thiruvananthapuram (2), Ernakulum (3), Kozhikode (2), Kannur (4) and Kasaragod (6) districts.

The GIS database, which is available in CMFRI website (www.cmfri.org.in) and will be updated in tune with the changes in the Covid hotspots, would become helpful to anybody to identify the category of a particular fish landing centre by a click, said Dr A Gopalakrishnan, Director of CMFRI.

"The initiative will greatly help authorities and policy makers to monitor the daily activities and take steps for regulatory or safety measures in marine fisheries sector in the backdrop of the Covid-19. The database will become a useful tool to implement safety measures for each landing centres according to their category.

The works are in progress to incorporate details of the fish landing centres in other maritime states too with the GIS database", he added.

Aqua International

Statement about ownership and other particulars about newspaper / Journal, Aqua International, to be published every year in March.

Form – IV
(See Rule 8)

1. Place of publication	:	Hyderabad
2. Periodicity of its publication	:	Monthly
3. Printer's and Publisher's Name	:	Meer Abdul Nazeer
Whether citizen of India?	:	Yes
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4. Editor's Name	:	M.A. Nazeer
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5. Name and address of individual, who owns the newspaper Apts. and partners or shareholders holding more than one percent of total capital.	:	M.A. Nazeer, BG-4, Venkataramana Apts, 11-4-634, A.C. Guards, Near IT Towers, Hyderabad – 500 004, Telangana, India

I, Meer Abdul Nazeer, hereby declare that the particulars given above are true to the best of my knowledge and belief.

Date: 1 March 2020

M.A. NAZEER
Publisher

KEMIN AQUASCIENCE

Indian Shrimp Industry Overview

C Sugumar
Regional Director – South Asia | Kemin AquaScience

Indian Shrimp Industry - 2019

- India produced >800,000 MT of Shrimp and exported 667,140 MT
- >350 approved shrimp export companies and 60 cold storage facilities
- >360 Hatcheries operating and produced 71 Billion seeds
- More than 30 feed companies making shrimp feed (1.2m MT)
- Farm culture area of >176,000 Ha (91% Vannamei, 8% Tiger, 1% Scampi)
-

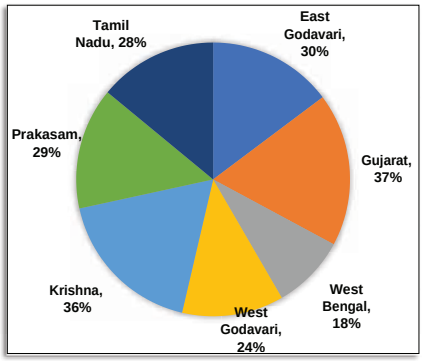
Indian Shrimp Industry - 2020

Hatcheries

- Approx. 63,430 brood stocks were imported from Jan to Mar 2020
- No new brood stocks were imported after COVID lockdown
- 16 billion Post Larvae (PL) produced until Mar 2020
- 4 billion PL produced in April during lockdown
  - Estimated current running culture : 30%
  - Ponds available for new stocking : 70%
  - If 35% ponds opt for new stocking, additionally 6 Billion seeds may required
- Short supply of PLs may be expected after the month of May
- Prices of PLs are increasing (From INR 0.35 to 0.45 / piece) further

Shrimp Farming

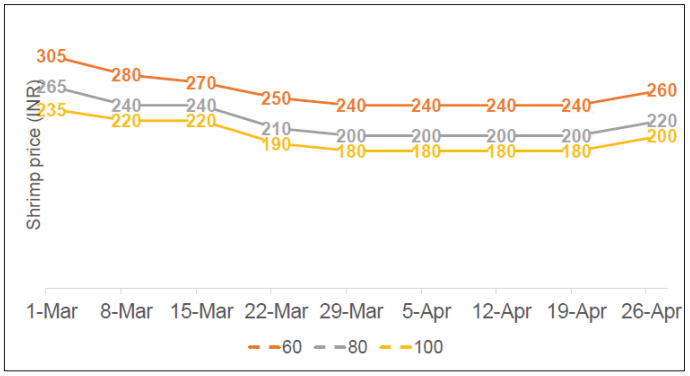
Prevalence of active culture in India as of April 2020



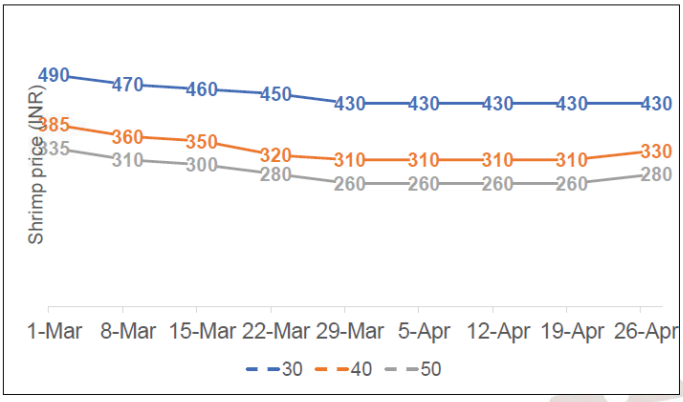
- In February and March 2020, farmers were preparing to stock their ponds with normal PL supply situation.
- COVID lockdown at end of March impacted PL supply and subsequent stocking.
- Drop in shrimp prices were observed in early April.
- MPEDA and SEAI are ensuring fixed minimum prices for a certain period of time.

Shrimp Prices INR

Weekly prices INR : 60 to 100 counts



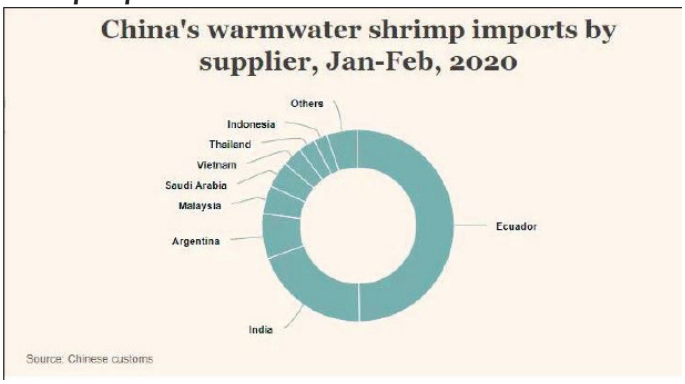
Weekly prices INR : 30 to 50 counts



Shrimp Feed

- Approx. 350,000 MT feed produced from Jan to March 2020 and Approx. 80,000 MT feed produced in April 2020
- 40% deficit in feed out put in April is estimated compared to prior year same period
- Supply chain is gradually reviving with the support of Government
- Feed demand may fluctuate based on the stocking
- Certain state borders were closed due to COVID regulations impacting RM logistics.

Shrimp Exports

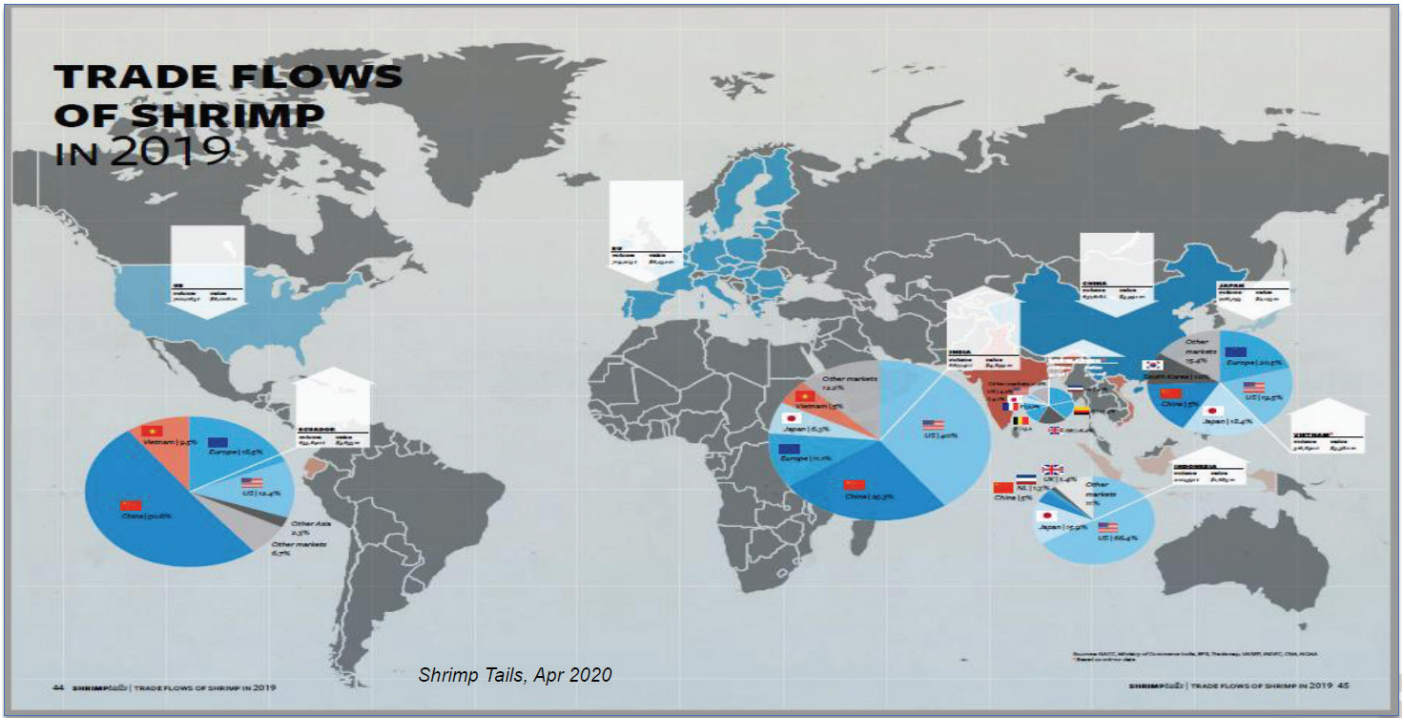


- Approx. 230,000 MT shrimp were produced until March 2020 and approx. 180,500 MT were exported to various markets
- Export volumes (Jan to Mar 2020)*
  - To USA : 73,970 MT
  - To China : 24,808 MT
- Approx. 25,000 MT Shrimps were stored in cold storage for future orders
- After lockdown, govt supported industry by opening major ports (Vizag, Kakinada and Krishnapatnam) in A.P to resume exports
- Some proportion of shrimps were sold in domestic market
- Japan has reduced import inspection sampling frequency for Indian black tiger shrimp.

Looking ahead

- Stabilizing the situation:
  - Availability of labor & logistics for proper functioning of the industry
  - Government support in finance and security to help farming community
- Targeting exports:
  - Low stocking would be a promising move
- Targeting domestic market:
  - Helps to ease the current demand situation – Small counts
  - Innovative marketing approach (NECC and Hass Avocado model)
- Profitable practices:
  - Judicious pond and feed management practices for a successful crop

sugumar.c@kemin.com



Shrimp Tails, Apr 2020

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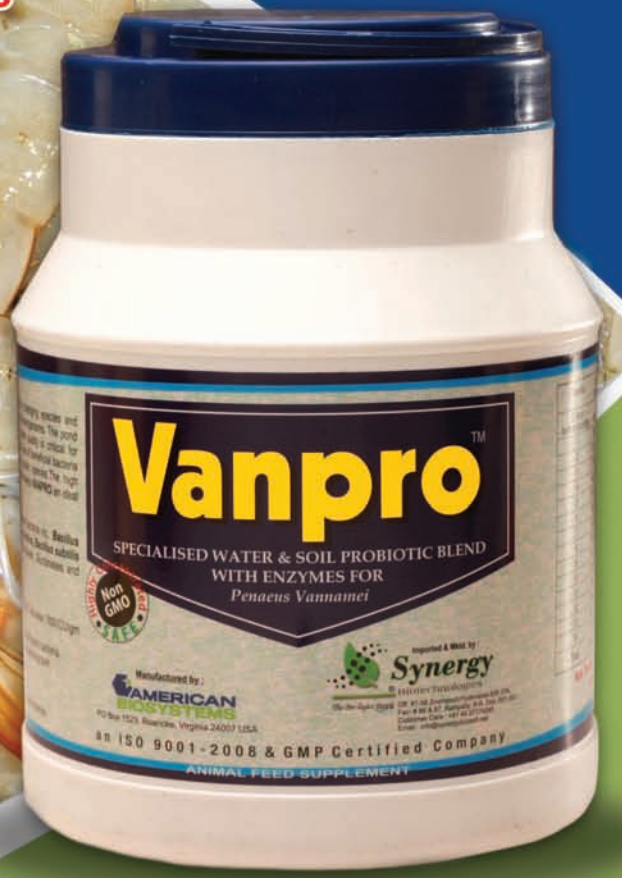

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COVID-19 - Mitigation Measures to keep Aquaculture in Action

Prof S. Felix & D M.Menaga
Tamil Nadu Dr J.Jayalalithaa Fisheries University, Nagapattinam

As India moves to a total lockdown with strict regulations and controls, the impact of the COVID-19 pandemic hardly hit the Indian economy. The current sharp turndown economic scenario will further leap down in the coming months due to the poor growth rate of various sectors caused by this pandemic. COVID 19 represents an unprecedented emergency and grave societal threat and no sector has escaped from its impact. Its impact on aquaculture is complex and varied across diverse segments that form the aquaculture value chain. Even among the different segments, its impact varies widely among different regions and among producers and aquaculture wage labourers causing reduced access to animal feeds, reduced access to inputs and services, reduced access to markets, reduced processing capacity, compromised storage and conservation, constrained informal businesses, constrained national transport, constrained international transport, modified retailing and product demand, reduced consumer purchasing power and reduced demand and public procurement. This impact will reverberate across the larger economy and will linger longer than a few months.Therefore, aquaculture sector needs to be patient and prepared to face the future under this inevitable background!

Impact of COVID-19 in Aquaculture sector

a. Issues related to Harvesting and Marketing:

Firstly, there are certain crises across the country within Harvesting and Marketing fishes at the farm level due to which:

a) The purchase of fish/shrimp seeds by the farmers is highly disrupted.

b) The disruption in the collection of harvests from the farms by fish processing plants & exporters;

c) Inadequate manpower in the farms to carry out the farm works

d) Transportation of the farm produce to the processing plants is affected heavily by the lack of drivers.

e) Major obstructions are seen inthe transport of aquaculture commodities across the major highways;

f) Limited operations of cold storage facilities ; and

g) Shutdowns of the retail aquaculture markets

The above problems of fish and fishery products lead to rise and fall of the fish price. The less movement of the fish and fishery products has increased the demand for middle class as well as urban and rural consumers, which causes the major loss in the supply chain.

a) Inevitable price fluctuation :

Secondly, due to these bottlenecks the price of fishes in the retail markets fluctuate highly, however farm gate price of the fishes/shrimps remain the same. Shrimp farmers in Nagapattinam are reported to be receiving not even the invested money in the shrimp crop and facing an average loss of Rs 100 per kg due to the existing problem.

In Tamil Nadu, the egg prices are reported to have fallen from Rs 4/egg to Rs 1.95/egg during this pandemic period and due to this the price of fishes in the domestic market has tend to rise. This is one of the influencing factorin determining the fish price in the current situation.

Besides these, as the fish landings are reduced due to this lock down, the cost of farmed fishes is getting increased.

b) Restricted Manpower Resources:

Thirdly, labour shortages are also being experienced in most fish processing plants, cold storage units, and feed manufacturing companies. According to the seafood processing plant owners and exporters most fish processing plants are currently operating with half of the labour force. Many workers are not reporting for work or have returned home also because of the fear of police patrol.

The Union Home Ministry, in a very significant move, has instructed to restrict the movement of farmers, farm laborers and harvesting and agriculture & allied sector-related machines due to the lockdown. But this doesn't come to correct way the farmers faced losses and there were put into critical position. While local people can be used for harvest, lockdown regulations disrupt their free movement. Further, in some places, a shortage of drivers/supervisors for these harvesters has also been reported. As machine repairing workshops are closed and mechanics become unavailable for work, spare parts are not easily available, leading to many machines being left unused.

c) Supply Chain Disruption :

Fourthly, supply chains have been interrupted across the country for a range of aquaculture commodities. The first official notification on lockdowns appears to have been ill-thought out, leading to the exclusion of a number of activities from the list of essential items. A second notification has corrected this, at least partially. Yet, major highways and entry points to States are seeing a pile up of trucks unable to move forward. Lorry transport is in major shortage at many places, leading to the extremely slow movement of goods particularly aquaculture feed ingredients produced across the country.

d) Shortage & Steep hike in Feed cost :

Fifthly, the less availability of fish/shrimp feed has increased the production cost in many fish producing regions. Despite the fact that Fish and fishery commodities has been declared as an essential item , the farmers and industry people were not allowed to transport the raw materials in time. The bulk purchase of the feeds by the small and marginal farmers was drastically reduced during this lock down period. This leads to the death of fishes in which farmers were forced to sell their fishes at low prices.

Way out for the Aquaculture sector ?

The poor sections of society are always the hardest hit in any disaster or pandemic situation. With about 85 percent of Indian farm households being small and marginal farmers, and a significant part of the population being landless farm laborers, welfare measures to contain any damage from COVID are definitely going to help them with sincere implementation. The focus of the Government to safeguard the farmer lives, mostly those losing their income from informal employment at this lockdown period, have to be provided with alternative avenues (cash transfers) till the economy bounces back (when this health crisis is successfully overcome).

1) Investment in key logistics has to be focused to sustain the demand for aquaculture commodities. Execution of e-commerce applications to enable door delivery of the farm inputs and farm produce through start-up companies will be the best futile effort in the current situation. The start-up companies should be encouraged with necessary incentives and policies. As lockdown measures have increased, demand has risen for home delivery of food items and E-commerce. This trend should be encouraged and promoted.
2) The small and medium enterprises, running with raw materials from the aquaculture otherwise, also need special attention so that the rural economy doesn't collapse.
3) To obviate the immediate concerns of scarcity of farm labor, policies must facilitate easy availability of machinery through state entities, FFDA's (Fish Farmers Development Agency),BFDA's (Brackish water Fish farmers Development Agency) or through Aqua one Centres (NFDB) and Co-operative societies of state custom with suitable incentives. It is also suggested to explore leveraging NREGS funds to pay part of the farm labour (with farmers paying the balance wage amount) to lessen the monetary burden on the farmer, while ensuring wage employment to the landless laborers and workers.
4) To answer queries relating to the announced measures of Government and addressing grievances of farmers, besides providing advisories on farm operations; availability of aquaculture-inputs, dedicated toll-free helplines/call centres (in local/vernacular languages) must be established by the Government.
5) Although government issued a notification for the transport of agriculture and its allied sector farm inputs, police dept is forcing farm input shops - seeds, fertilisers, etc. to remain shut in many parts of the country. Respective fisheries department officials have to be diverted to ensure the smooth flow of transportation of the farm inputs in all the districts. Also, the help line number issued by the government has to reach all the farmers out there for its effective use.
6) Railways have a big role to play in this crisis situation. Active transportation of farm inputs - including seeds, feed, etc. from hatcheries and feed mills to all over the country needs to be ensured. The passenger coaches - AC and non-AC can be used to transport smaller quantities of such produces and possibly even perishables. This will bring additional revenue for the railways and also help tackle food security concerns.
7) The aqua-input ecosystem is collapsed right now, so government should allow all sub-trades and manufacturing units associated with aqua-inputs to function. For example, fish /shrimp seed industry is also dependent on packaging and paper units, they should be allowed to function.
8) The government needs to roll out a special stimulus package for the seed industry with special focus for the S&M hatchery owners. This can include low-interest or interest free loans for the industry.
9) Waiver of farm loans, evidences suggest, have not fully benefitted the majority of small and marginal farmers. Rather, it affects the future credit behaviour of the borrowers and thus negatively impacts the aquaculture credit culture altogether. Aqua-inputs – seeds, fertilizers, feeds, etc. have to be pre-positioned for easy availability. Private sector must play a significant role with necessary policy support.
10) State Governments must gear up their machineries for smooth procurement operations of farmers' marketable surpluses at MSP (minimum support price) or through other price support schemes.
11) Manufacturing and services sectors may be severely hit in the short run till the time the economy bounces back. It will be thus very appropriate to focus attention on the aquaculture sector as a growth engine and also to bring resilience in food (and nutrition) security. At this critical stage, where climate change is already adversely impacting the aquaculture sector, productive investments, including for research and innovation, would be very purposeful.
12) Structural reforms such as land leasing, contract farming and private aquaculture markets, etc. have long been advocated to bring enhanced investments into the aquaculture sector and to push its growth. However, there has not been uniform implementation of these legislations by State Governments and so the full potential of the sector is unrealized. These reforms need significant political will. Concerns of a slowdown in the zeal of States, post-COVID scenario, could be tackled with suitable incentive mechanisms by the Federal Government to the States.

13) With a burgeoning population, there is a corresponding rise in food demand in India. However, the negative externalities of the blue Revolution, particularly the environmental trade-offs and staple carp farming fundamentalism, have since been realized. It is thus desirable to switch over to a suitable model with a far stronger nutrition focus where diets are more diverse. A post-COVID situation offers that unique opportunity to repurpose the existing food and aquaculture policies for a healthier population.

14) There have been global concerns, rather speculations, on restriction of exports of aquaculture commodities by a few global players. India, being trade-surplus on commodities like shrimp & other fishery products, etc. may seize the opportunities by exporting such products with a stable aqua-exports policy. Development of export-supportive infrastructure and logistics would need investments and support of the private sector, that will be in the long term interests of farmers in boosting their income. The government should promote trade by avoiding export bans and import restrictions.

15) Many climate models predict a favorable monsoon in the 2020 season (the India Meteorological Department has also since officially announced) as the El-Nino weather phenomenon, that disrupts rainfall in India, is not evident. This is indeed a good news in the COVID scenario, assuming aquaculture can practice largely unscathed.

16) Farmers' health is utmost crucial thing to be taken care and as they are relatively older population, an health package particularly for COVID 19 can be issued meaning that preventive and protective recommendations from the state (and local) public health experts are critical for our farming population.

The intervention of the Government of India will have to be considerably enhanced in the following ways. These are immediate measures to be considered for adoption. As and if the crisis grows, these measures will have to be updated.

1) Provide short-term stimulus packages that support sales, cash flow and working capital. Such measures help to maintain or increase cash flows and provide tax credits, cuts, deferrals and refunds.

2) Enhance access to finance by incentivizing the creation or extension of guarantee schemes for loans to smallholder producers, direct public lending and setting targets for financial institutions for lending to smallholder producers.

3) Providing grants, subsidized loans and tax incentives. Promoting inclusive investments on aquaculture is also important. Lessons in this regard can be gleaned from the Global Agriculture and Food Security Program (GAFSP), which was launched in 2010 to respond to the food price crisis with better and targeted investments in agriculture and its allied sectors.

4) Women in low paid jobs with insecure employment conditions in the seafood industry are at greater risk of losing their income. When women lose their income, they severely cut budgets supporting the well being of their children, households and communities.

Case studies of the other countries :

In **China**, the Ministry of Agriculture and Rural Affairs : i) created special travel permits, platformsfor public procurement and e-commerce to allow the supply of fresh agricultural products andraw materials (including imported products); ii) supported animal feed, slaughtering and meat processing enterprises to resume operations; iii) incentivized fish and poultry farming (i.e. the sub sectors most hard hit by the crisis); iv) strengthened prevention and control measures against animal diseases v) promoted insurance and financial services in rural areas through cooperation agreements.

In **Italy**, public and private sector collaboration led to the: i) promotion of seasonal and local products (e.g. #Mangial taliano, the "Eat food made in Italy" campaign by Italy's main farmer organization); and ii) allocation of 6 million euros by the Italian Ministry of Agricultural, Food and Forestry Policies to purchase ultra-high-temperature (UHT) to support dairy farmers, avoid loss and distribute milk to vulnerable families.

In the **Philippines**, the Department of Fisheries is issuing "Certificates of Food lane Accreditation" and "Food Passes", which provide privileges to suppliers and transporters of certain food commodities to ease passage at checkpoints and assist with delivery.

In **Egypt, Tunisia, and Morocco**, national authorities have planned one-off payments for, informal workers, including sellers at local markets. In addition, Morocco: i) established alogistics and e-marketing platform for local products affected by the cancellation of this year's International Aquaculture Fair; and ii) enabled mobile cash transfers to informal workers. These examples were selected to illustrate the different areas of response at the time of writing. Up to date and exhaustive lists of responses can be found in other information resources.

Conclusion

These are frightful times, where we need courage and truth as the lodestar. We need to make informed decisions so COVID-19 doesn't evolve to threaten our aquaculture and food supply. The sector which involves over 15 million stakeholders need to safe guard themselves following all the COVID -19 's self and societal security measures scrupulously. Good news is that Government of India has now increased its focus on nutrition (besides food)- security and raising farmers' income (rather than enhancingonly farm productivity). Changing the consumer behaviour with suitable programs and incentives is already in the agenda. For all these to happen, the existing landscape of policy incentives that favour the two big staples of fish and shrimp has to change. Designing aquaculture policies, post-COVID19 scenario, must include these imperatives for a food systems transformation in India. COVID-19 is an unprecedented challenge for India; its large population and the economy's dependence on informal labour make lockdowns and other social distancing measures hugely disruptive. The central and state governments have recognized the challenge and responded aggressively—but this response should be just the beginning. India must be prepared to scale it up as events unfold, easing the economic impacts through even greater public program support and policies that keep markets functioning. Post COVID-19 global scenario will be a boost to the Indian economy and more precisely to the fisheries and aquaculture sectors to reemphasis their importance to the world to ensure food supply and nutritional security.

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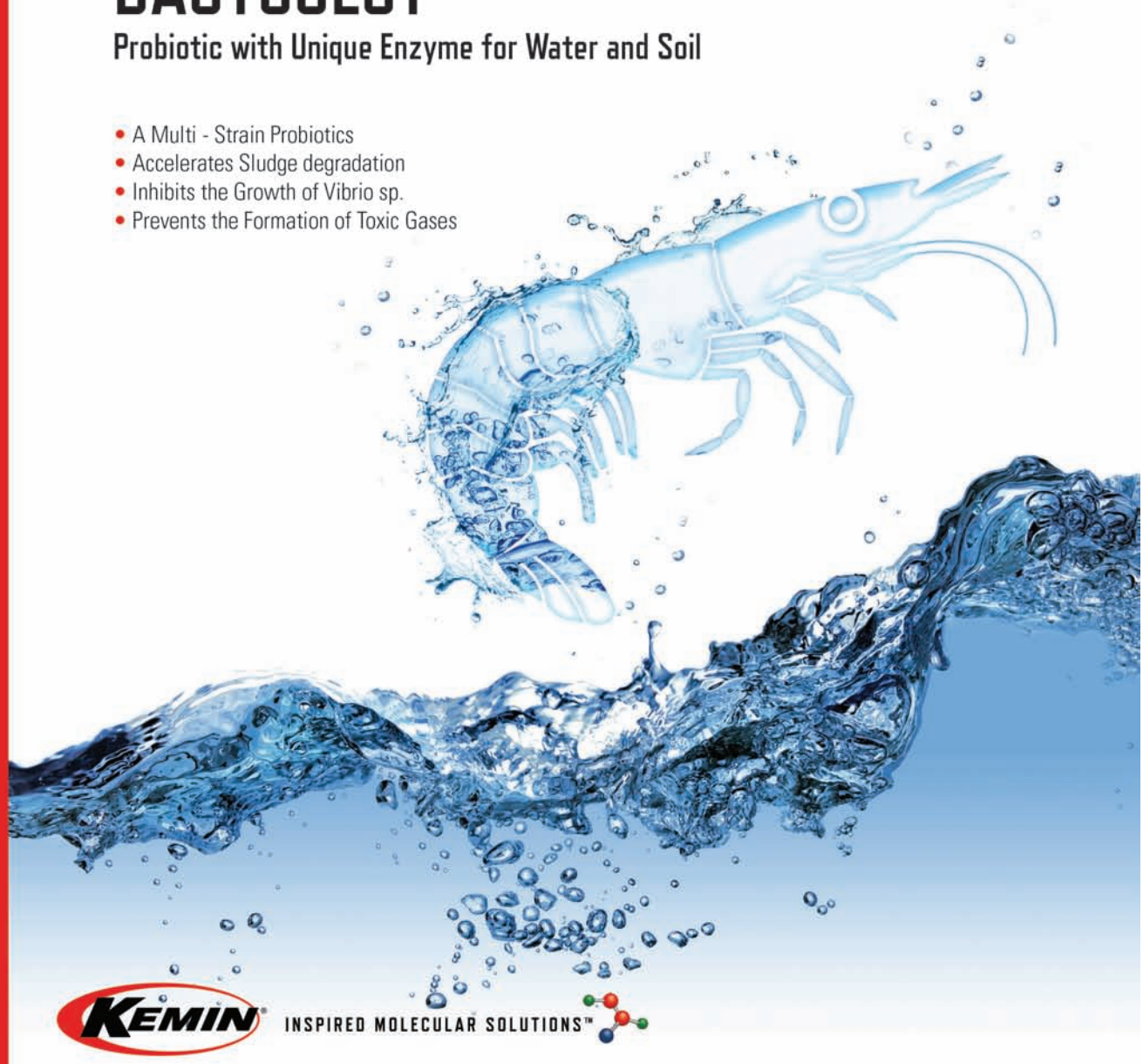

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Bon Ammonia and obnoxious Gasses

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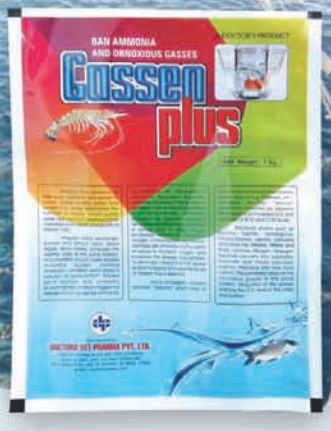
Irregular water exchange, excess and leftout feed, dead algae, fecal matter, increases the organic load at the pond bottom. Accumulation of such waste absorbs available oxygen, creating anaerobic condition which leads to pollution of pond bottom. Polluted pond bottom and unhealthy environmental conditions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

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

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

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

PRESENTATION: 500 gms &1 kg



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Inositol - 10 mg.
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Biotin - 15 mcg.
Vitamin-B12 - 6.25 mcg.
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DL-Methionine - 150 mg.
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- *Bacillus mesentericus*
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- *Thiobacillus thiooxidans*
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- *Lactobacillus brevis*
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Growth Hormone Genes in Fishes and their Applicatons

Highlight Points

▶The Growth hormone genes Incorporated fishes show increased production with high disease resistance. ▶GH genes transfered fishes are seen with high quality strains .▶It is an efficient method to avoid the use of antibiotics and various growth enhancers.

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Dr M.G.R. Fisheries College and Research Institute, Ponneri - 601 204
Tamil Nadu, Dr J.Jayalalithaa Fisheries University.

INTRODUCTION:

Fish culture is one of the earliest activities of man. The first record of pond culture can be dated back 2500 years to the Handbook of Fish Culture, in which the author Fan Li described the domestication and cultivation of common carp in ponds in China. Advancement in the techniques of fish culture has increased but has always fallen short of the demands of the expanding human population and their increasing needs. To develop high technology has been a pressing matter for the aquaculture industry and gene transfer could be of great potential to fulfil this purpose. Growth hormone (GH) is a single chain polypeptide of about 22K dalton which is synthesized in and secreted from the anterior lobe of the pituitary gland in vertebrates. In mammals, the GH gene is required for the pre-adult growth and development by triggering target cells to synthesize somatomedin (IGF) which stimulates the growth of muscle, bone and connective tissues. In lower vertebrates like fish, the mechanism by which fish GH gene works has not been clearly elucidated. However, several early studies showed that the administration of mammalian GH gene, enhanced fish growth rate (Pickford and Thompson, 1948; Komourdjian et al., 1976). In the early 80s, a few mammalian GH genes were isolated and the DNAs sequenced, serving as models for the study of gene regulation and evolution (Barta et at., 1981).

GROWTH HORMONE:

Growth hormone (GH) or somatotropin, is a peptide hormone that stimulates growth, cell reproduction, and cell regeneration in fishes. It is important as it raises the concentration of glucose and free fatty acids levels in the fishes. It is a type of mitogen which is specific only to the receptors on certain types of cells. GH is a 191-amino acid, single-chain polypeptide that is synthesized, stored and secreted by somatotropic cells of the pituitary gland. Growth hormone 1, also known as pituitary growth hormone or simply as growth hormone (GH) or somatotropin, is a protein that is encoded by the GH1 gene. Thus the growth hormone genes are responsible for the production of growth hormones and their release into the blood for carrying out various functions.

FUNCTIONS OF GROWTH HORMONES IN FISHES:

The biological actions of growth hormone (GH) are pleiotropic, including growth promotion, energy mobilization, gonadal development, appetite, and social behaviour. Accordingly, the regulatory network for GH is complex and includes many endocrine and environmental factors. In fish, the neuroendocrine control of GH is multifactorial with multiple inhibitors and stimulators of pituitary GH secretion. In fish, GH release is under a tonic negative control exerted mainly by somatostatin. Sex steroid hormones and nutritional status influence the level of brain expression and effectiveness of some of these GH neuroendocrine regulatory factors, suggesting that their relative importance differs under different physiological conditions. At the pituitary level, some, if not all, somatotropes can respond to multiple regulators. Therefore, ligand and function-specificity, as well as the integrative responses to multiple signals must be achieved at the level of signal transduction mechanisms. Results from investigations on a limited number of stimulatory and inhibitory GH-release regulators indicate that activation of different but convergent intracellular pathways and the utilization of specific intracellular Ca(2+) stores are some of the strategies utilized. However, more work remains to be done to better understand the integrative mechanisms of signal transduction at the somatotrope level and the relevance of various GH regulators in different physiological circumstances.

GROWTH HORMONE GENE:

The protein encoded by the growth hormone gene is a member of the somatotropin / prolactin family of hormones that play an important role in growth control. The gene, along with four other related genes, is located at the growth hormone locus present on the chromosomes where they are interspersed in the same transcriptional orientation, an arrangement thought to have evolved by a series of gene duplications. The five genes share a remarkably high degree of sequence identity. Alternative splicing generates additional isoforms of each of the five growth hormones, leading to further diversity and potential for specialization. This particular family member is expressed in the pituitary but not in

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placental tissue as is the case for the other four genes in the growth hormone locus. Mutations in or deletions of the gene lead to growth hormone deficiency and short stature related problems.

GENE TRANSFER TECHNOLOGY FOR GH GENES:

Gene transfer technology has produced a great impact on modern biology and biotechnology (Powers et al. 1998). Several fish species are in focus for gene transfer experiments with the transfer of GH genes and can be divided into two main groups: animals used in aquaculture (Fletcher and Davies, 1991; and model fish used in basic research (Chen and Lu, 1998). Zebrafish is an already well-established model organism (Kimmel, 1989; Westerfield, 1995). This fish offers the possibility of combining rapid early development, which is amenable to direct observation and manipulation, large numbers of progeny from a single mating, and relatively short generation time (2 to 3 months). Transgenic technology through DNA microinjection into zebrafish embryos has made a great gain in the last decade. Stuart et al. (1990) first showed that the DNA injected into the cytoplasm of fertilized zebrafish eggs could integrate into the fish genome and be inherited in the germline Culp et al. (1991) demonstrated that the frequency of germline transmission of a microinjected DNA could be as a high as 20% in zebrafish. This technology, however, still has as the major constrains the low-efficiency generation of transgenics.

GH GENES INCORPORATED FISHES:

The GH genes have been incorporated in the following fishes through gene transfer methods and thus produced the species with successful results showing increased growth and with enhanced phenotypic behavior.

Among the major food fish species the following are incorporated with GH gens,

- **carp** (*Cyprinus sp.*), **tilapia** (*Oreochromis sp.*),
- **salmon** (*Salmo sp.*, Oncorhynchus sp.)
- **channel** catfish (*Ictaluruspunctatus*) , **zebrafish** (*Danio rerio*)
- **medaka** (*Oryziaslatipes*) , **goldfish** (*Carassiusauratus*).

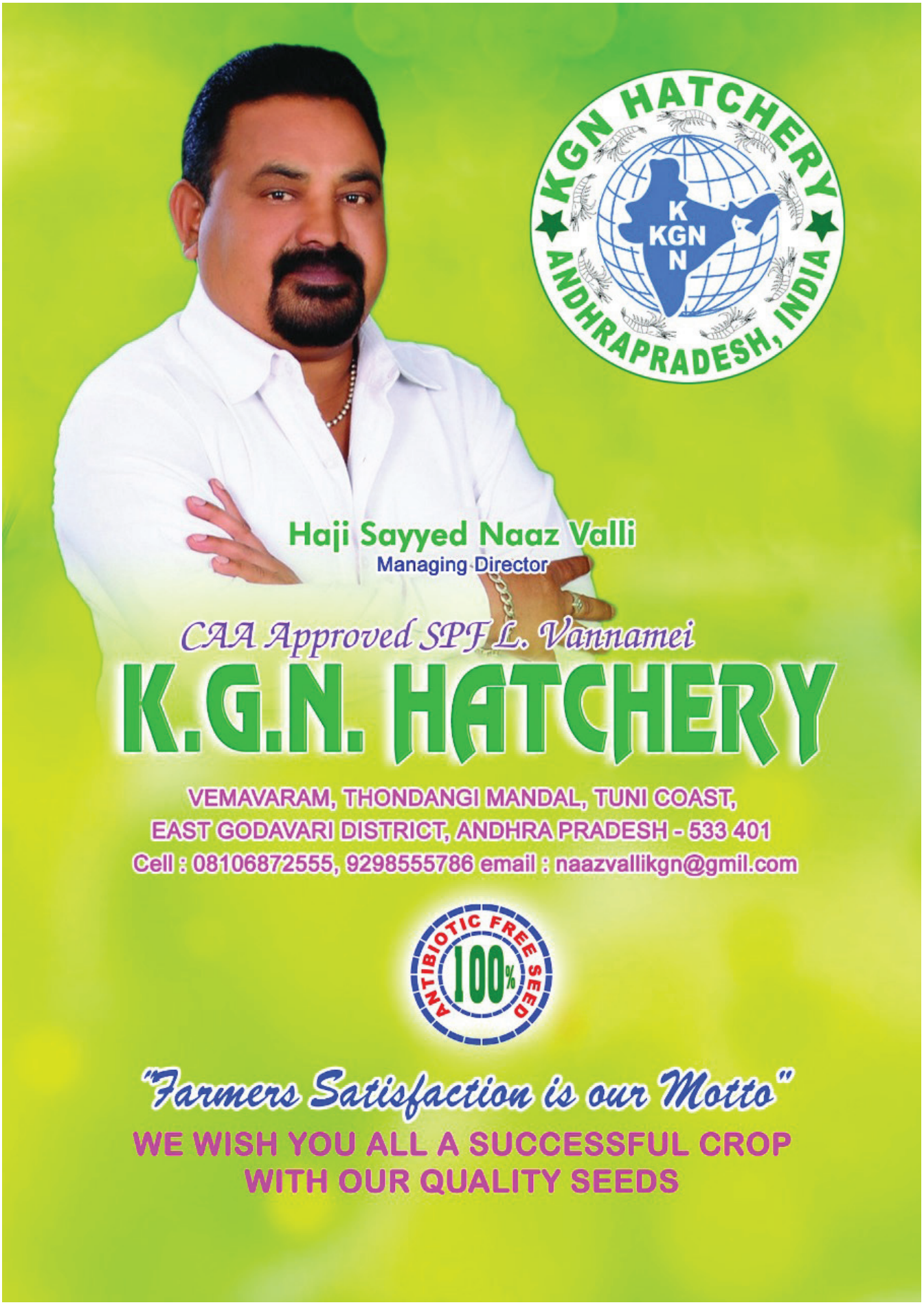
ACTUAL AND THE POTENTIAL BENEFITS OF GROWTH HORMONE GENE INHERITED IN THE FISHES:

Fish species	Gene	Potential benefit	Actual benefit	Reference
Atlantic salmon	Gh gene	To enhance growth and increase cold tolerance	Enhanced growth and increased tolerance to cold observed	Melamed et al ., 2002
Carp	GH gene	To enhance growth	Higher growth rates than the non trangenics control	Hinits and Moav, 1999
Tilapia	GH gene	To enhance growth	Up to 30 times more than non trangenics	Martinez et al., 1999
Seabass	GH gene Along with dna vaccine	To manage viral diseases in farmed fish	Foreign gene transferred by injection in to the muscles	Sulaiman, 1998
Rainbow trout	GH gene	To enhance growth	Significant growth enhancement observed	Chen et al., 1996
Coho solmon	GH gene	To enhance growth	>10 fold increase in size of transgenic fish	Devlin et al., 1995a
Channel catfish	GH gene	To enhance growth	20% larger than non-transgenic siblings observed	Chen et al., 1992

GROWTH HORMONE GENE FOR PRODUCING TRANSGENIC FISHES:

Domestication has been extensively used in the fishes to modify phenotypes such as growth rate. More recently, transgenesis of the growth factor genes [primarily growth hormone (GH)] has also been explored as a rapid approach to accelerating the performance of both culturable and ornamental fish species. By incorporating the growth hormone gene into the fishes, results in the production of the strains with increased growth and phenotypic behaviours. Thus the GH genes are mostly used to produce the genetically modified organisms. Growth rates of many fishes respond dramatically to GH gene transgenesis, whereas genetic engineering of domestic mammalian livestock has resulted in relatively modest gains.

The most dramatic effects of GH transgenesis in fish have been seen in relatively with the wild strains that have undergone little or no selection for enhanced growth, whereas genetic modification of fish stocks necessarily has been performed in highly domesticated strains that already possess very rapid growth. Such fast-growing domesticates may be refractory to further stimulation if the same regulatory pathways are being exploited by both genetic approaches. By directly comparing gene expression in wild-type, domestic, and GH transgenic strains of coho salmon, it have been found that domestication and GH transgenesis are modifying similar genetic pathways. Genes in many different physiological pathways show modified expression in domestic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and GH transgenic strains relative to wild-type, but effects are strongly correlated. Genes specifically involved in growth regulation (IGF1, GHR, IGF-II, THR) are also concordantly regulated in domestic and transgenic fish, and both strains show elevated levels of circulating IGF1. Muscle expression of GH in nontransgenic strains was found to be elevated in domesticated fish relative to wild type, providing a possible mechanism for growth enhancement. These data have implications for genetic improvement of existing domesticated species and risk assessment and regulation of emerging transgenic strains.

Many fish species used in aquaculture have been found to strongly respond to GH gene transgenesis (e.g., body sizes increasing up to 35- to 37-fold for mud loach and coho salmon, carps etc., whereas domesticated agricultural mammals engineered with growth factor transgenes have shown only small enhancements of growth rate and some abnormalities. suggested this modest response in domesticated animals may be due to their long prior selection for a maximum growth rate that limits further responses to GH. Testing this hypothesis in mammals is difficult as representative wild-type progenitor strains are in most cases no longer accessible.

EFFECTS OF GH GENESINCORPORATION IN FISHES:

Major effects of GH gene transfer and domestication on energy metabolism of carbohydrates, lipids, and protein have been observed, as were effects on protein synthesis, stress and immune function, and cellular structure. Complex effects on metabolism and GH receptor expression have also been observed in liver and muscle in rainbow trout treated with GH protein

Further, genes specifically associated with the growth-regulation pathway (GH receptor, IGF1, and IGF1 receptor, thyroid hormone receptor, IGF-II) analyzed by QPCR also showed parallel effects between strains in all cases. Such concordant regulation in genes arising from these 2 distinct genetic processes implies that they share modification of regulatory pathways controlling the expression of genes involved in growth. Gene expression effects in GH transgenic animals arise from elevated extra pituitary expression of GH and its consequent effects on downstream GH-responsive genes and physiologies. Parallel effects on gene expression in domesticated fish strongly suggest that the same downstream pathways are also being affected.

Domestication and directed selection can have very strong effects transforming phenotype from wild type. For example, in rainbow trout, selection underway for over a century has generated domesticated strains with growth rates similar to very fast-growing GH transgenic strains both of which are very growth enhanced relative to wild type. The GH pathway has been implicated in mediating enhanced growth rate in the domesticated strain because treatment of wild and domesticated strains with GH (by transgenesis and by GH protein injection) revealed that the slow-growing wild strain showed much greater growth stimulation than the fast-growing domesticated strain. Further, GH-induced abnormalities (e.g., analogous to acromegaly) were induced in domesticated but not wild-type fish, suggesting that the former already possessed elevated levels of, or sensitivity to, GH. GH treatments have also been found to be more pronounced in slow-growing than fast-growing strains of channel catfish and Atlantic salmon.

The present studies also implicate common downstream regulation of cellular and physiological pathways between GH transgenic and domesticated strains by transgenesis may not yield further beneficial phenotypic change. In this case, modification or creation of alternative pathways, and/or targeting other points in the pathways.

FUNCTIONS OF GROWTH HORMONE AND GH GENES:

Effects of growth hormone on the tissues of the body can generally be described as anabolic (building up). Like most other protein hormones, GH acts by interacting with a specific receptor on the surface of cells.

Thus the incorporation of GH genes results in the following functions in the fish body,

- Increases calcium retention and strengthens and increases the mineralization of bone
- Promotes lipolysis
- Increases protein synthesis
- Stimulates the growth of all internal organs excluding the brain
- Plays a role in homeostasis
- Reduces liver uptake of glucose
- Contributes to the maintenance and function of pancreatic islets
- Stimulates the immune system

CONCLUSION:

The growth hormone genes have a wide function in the fishes. They enhance the role of the growth hormones and regulate various metabolic activities. The transfer of growth hormone genes into the fishes through various gene transfer method showed better results than transferring directly the growth hormones into the fishes as the hormones are difficult to collect and separate. The GH genes show a wide range of functions in the fishes, thus their use in aquaculture industry will enhance the increased production of good strain fishes.

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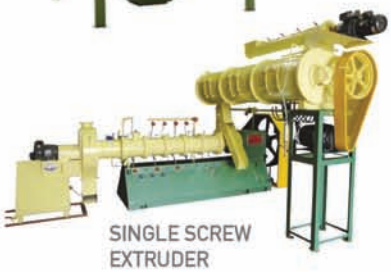
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Global warming mitigation through algal biomass- way forward towards green technology

Highlight Points

► Microalgae can utilise CO_2 emissions from power plants and other industrial sources for their growth in a CO_2 biosequestration process. Typically, 1 kg of microalgal biomass synthesis requires about 1.8 kg of CO_2. ► Microalgae are more photo synthetically efficient and are able to mitigate CO_2 from 10 to 50 times higher than terrestrial plants. ►Microalgae-based sequestration systems have minimal negative impacts on environment, and are eco-friendlier as compared to chemical and physical sequestration. • Micro algal carbon sequestration is believed to be more versatile and high energy efficient with respect to economic perspective and time consuming. ► Microbial carbon capture cells (MCCs) used in the production of algae were proved to be an effective technology for CO_2 emission reduction with simultaneous voltage output without aeration.

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Division of Aquatic Environment and Health Management, ICAR-CIFE, Mumbai

Introduction:

Rise in temperature and acidification, change in pH of various aquatic bodies led to drastic changes, like melting ice bergs, rising sea level, volcanic eruptions and disruption of ecosystem. Since the beginning of the industrial revolution in the mid-eighteenth century, the release of greenhouse gases (GHGs) from anthropogenic activities has resulted in an increase in atmospheric carbon dioxide (CO_2) concentrations from approximately 280 parts per million (ppm) in 1750 to 390 ppm in 2010, with as much as 50 % of the increase occurring in the last three decades, leading to global warming. Carbon dioxide (CO_2) is contributing maximum in the warming potential of all greenhouse gases (GHG), due to the over usage of world economies on fossil fuels. While CO_2 levels and global temperatures were higher in the geological past, it is the current rate of change that will pose a problem for biota. Keeling curve from Mauna Lao observatory clearly showed that average concentrations of atmospheric CO_2 have risen from about 316 ppm in 1959 to approximately 370 ppm in 2000 and 390 ppm in 2010. The biggest concern is that after 1970, the curve showed increase by roughly 2 ppm per year with global CO_2 emission already reached 48 Gigatons (Gt) in 2010. It is high time to reduce the global CO_2 emission to 44 Gt if we have to limit global warming to 2°C. This concern led to United Nations Framework Convention on Climate Change Kyoto Protocol (UNFCCC Kyoto Protocol) promotion with the objective of reducing GHGs by 5.2 % based on the emissions in 1990. Therefore, compatible mitigation strategies are required to neutralize the excess CO_2. Several methods have been proposed to reduce the load of atmospheric CO_2 concentration, such as oceanic sequestration through oceanic injection, terrestrial sequestration, establishing fast growing vegetation and chemical methods such as cryogenic fractionation, absorption, adsorption, and membrane separation but they are less energy efficient with respect to economic perspective, time consuming and laborious. Of the several methods proposed for the carbon sequestration, micro algal carbon sequestration is believed to be more versatile.

Microalgae:

Algae are the large and diverse group of simple phototrophic unicellular to multicellular organisms that utilize CO_2 during photosynthesis using green coloured chlorophyll pigment to produce carbohydrates, proteins, lipids, vitamins, and several by-products. These occur in the variety of natural aquatic and moist terrestrial habitat exhibiting the great range of diversity among them. Algae have been broadly classified in to two types based on their size into micro algae (less than 2 mm in diameter) and macro algae (are macroscopic). All the algae differ with each other with respect to colour, pigmentation, biochemical composition, nature of by-products, photosynthetic efficiency, preferential growth medium, temperature, pH and light intensity etc. Different algal species so far been isolated from marine and fresh water

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It is necessary to protect the hepatopancreas during the Penaeus Vannamei breeding, because the hepatopancreas plays an important role in digestion, detoxification, immunity and energy storage. Hepatopancreas is the largest but also the weakest organ of vannamei. The damange of hepatopancreas will lead to malnutrition, slow growth, or even seriously cause failure of molting, intestinal inflammation, white feces, liver atrophy etc. All these will cause a large number of deaths.

Normal development of pancreas: from shrimp seedlings being put into the ponds, with shrimp growth and molting, the hepatopancreas grows and becomes mature.

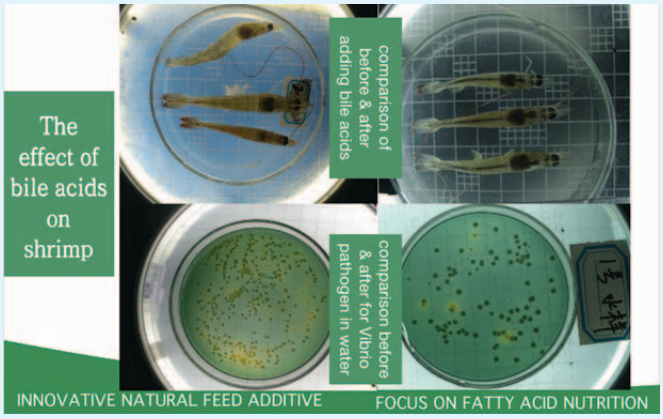
1-2cm shrimp seed: from seed farm to pond, the nutritional composition of the feed changes, from biological feed to artificial feed, so the color of liver (The shrimp's liver is called hepatopancreas. The abbreviation should be HP. In the following articles, liver is changed to HP.) changes. With bare eye vision, the shrimp seed HP in the seed farm is off-black, while the HP in the pond is yellowish brown, it means the HP is in the process of developing, so the structure incomplete, relatively clear contour, and no or not-clear membrane.

2-3 shrimp seed: HP develops relatively complete, and the color turns to brown, with complete structure, clear contour and liver markings and visible membrane.

3-5cm shrimp seed: HP is in the color of dark brown, full HP structure, clear contour and liver markings, membrane is clearly shown below the brown area.

Large market applications prove that adding bile acids on Penaeus Vannamei can significantly improve HP health conditions in 5-7 days, including repair damaged HP, strengthen the energy supply function, significantly improve the feeding, and make the stomach, HP tract clear and full;Long-term adding of bile acids can prevent the occurrence of diseases such as enteritis, white feces, liver atrophy and HP necrosis, reduce the mortality rate.

Different from traditional Chinese medicines, enzyme preparation, antibacterial preparation and other liver protection products, bile acids is the endogenous liver health protector. It is the main component of bile, which can protect liver, non-polluting, has no toxic side effects, and does not increase Pancreas' burden.



The functions of Runeon (bile acids) on shrimp

1. Promote the digestion and absorption of lipid nutrients, provide sufficient energy and nutrition for the development of hepatic lobule, promote the rapid development of hepatopancreas, promote the smooth transition of liver and pancreas, and make the liver and pancreas clear and full.

2. Provide energy for hepatocyte growth and metabolism, promote liver cell regeneration, and effectively cope with symptoms such as red liver, white liver and liver atrophy.

3. Promote HP detoxification. Bile acids can bind to heavy metals, algal toxins, bacterial endotoxins and other toxic substances, accelerate their elimination from the intestines, reduce the accumulation of toxins in the body, and restore the health of the liver and pancreas.

4. Promote the synthesis of ecdysone, promote the smooth molting of shrimp.

5. Improve the number of B.R cells in the HP, thereby improving the body's antioxidant capacity and improving the anti-stress ability of shrimps.

Therefore, adding bile acids in shrimp farming, protect shrimp hepatopancreas and improve shrimp growth performance.

viz., Anabaena cylindrical, *Ankistrodesmus sp., Chaetoceros muelleri, Chaetoceros calcitrans, Chlamydomonas rheinhardii., Spirulina spp., Tetraselmis spp.* etc are known to sequester carbon from the environment.

Culturing the Microalgae:

Naturally microalgae grow in the places such as open ponds, pools, ditches, reservoirs, lakes, lagoons, moist and damp walls and soil etc. It grows by sequestering carbon dioxide but believed to be less productive than photo-bioreactor, due to limitations with respect flexibility of temperature, light, nutrients, pH etc. Microalgae also grows abundantly in the flooded water after the rainfall, flowing domestic water drainage channels and results in the green coloration of water. There are two methods which are most commonly used for the carbon dioxide sequestration using micro algae, 1) Open pond system and 2) Closed photo bioreactor. Other improved algal culture systems that provides large scale algal biomass includes, 1) High rate ponds and 2) Continuously stirred tank reactors.

Open Pond System

Open pond system is traditional method of the cultivation of algae (Schenk *et al.,* 2008). The most commonly used system includes shallow big ponds, tanks, circular ponds and raceway ponds. Among the types of open ponds, raceway ponds are very common and they have been used for the mass culture of algae since 1950s. They are easier to construct and operate, easy to clean after cultivation. However, major constraints include poor light utilization by the cells, high evaporation rate, diffusion of carbondioxide to the atmosphere,

Microalgae	CO2 %	NOx ppm	SOx ppm	Growth rate in linear phase g L^{-1} day^{-1}

requirement of large land areas and prone to contamination which result in low biomass productivity.

Closed System

To overawed the limitations of open culture systems, development of closed culture system has gain attention. Different types of closed system have been developed such as flat – plate photobioreactor, tubular, vertical column etc. The main advantage of open culture systems includes higher productivity and less contamination rate as compared to open system. Most photobioreactors are characterized by largely exposed illumination surfaces. Closed photobioreactors are good for the immobilization of algae and biomass productivities are very high compared to the open system of cultivation

Harvesting of Algae

Though there is no particular method for harvesting algae, the most commonly used harvesting method is flocculation, micro screening and centrifugation. Harvesting process also depends on the type of strain that is cultivated. For example, Spirulina sp. is easily harvested by microscreening method. Flocculation methods are mainly used for the harvesting of algae in raceway ponds (Schenk *et al.,* 2008).

Chlorococcum littorale	70	50	30	0.47
Chlorella HA-1	20	100	50	0.51
Synechocystis sp.	100	600*	100*	-
Cyanidium caldarium	15	-	-	-
Chlorella KR-1	30	100	100	0.78

Importance of microalgae as carbon sequester

Microalgae uses sunlight and carbon dioxide to form biofuel, food, feed and several high-value bioactive compounds. Microalgae can utilise CO_2 emissions from power plants and other industrial sources for their growth in a CO_2 biosequestration process. Typically, 1 kg of microalgal biomass synthesis requires about 1.8 kg of CO_2. Microalgae can convert more solar energy (at about 4–7.5%) during cellular metabolism compared to 0.5% for land-based crops. It has a great potential for biosequestration of CO_2 released from power plants and industrial processes which would otherwise go into the atmosphere. Microalgae also acts a pool of several by-products, such as methane produced by anaerobic decomposition of algae, biodiesel and several other products of an industrial importance, biodiesel is derived from microalgal cells and photobiologically produced biohydrogen and as a source of fuel. Production of fuel using micro algae has now gained much momentum due to increased fossils fuel prices and effect of global warming and climate change. Several researchers reported that macroalgae could sequester about 173 TgC yr^{-1} (with a range of 61–268 TgC yr^{-1}) globally. Approximately 90% of this sequestration occurs through export to the deep sea, and the rest through burial in coastal sediments (Jensen and Duarte, 2016).

Table1. Growth characteristics of microalgal candidates for biofixation of carbon dioxide

(Lee and Lee 2003)

***** NOx and SOx concentration in aqueous phase

Carbon reserve capacity of algae:

Cyanobacteria and algae are first organisms on earth and these photosynthetic organisms sucked the atmospheric CO_2 and started releasing extra oxygen. Due to this, the levels of CO_2 started reducing to such an extent that leads to evolution of life on earth. Once again, these smallest organisms are poised to save us from the threat of global warming. Most anthropogenic emissions of CO_2 resulted from fossil fuels combustion as two sectors, electricity and heat generation and transport, produced nearly two-thirds of these global emissions at present. It is well known that algae are more photosynthetically efficient and have higher productivity rates than terrestrial plants and as a consequence alga have greater capacity to generate and are more efficient CO_2 fixers. For example, microalgae are able to mitigate CO_2 from 10 to 50 times higher than terrestrial plants. Producing 1 t of algal biomass fixes 1.6–2.0 t of CO_2 because approximately half of the dry weight of algal biomass is carbon. Thus, algae have a huge potential to considerably contribute to GHG emission reductions right at the very first stage of the feedstock production. Microalgae present one of the few technologies for the capture and utilization of atmospheric carbon dioxide through the process of photosynthesis. The biomass produced contributes in reducing the carbon dioxide concentration in the atmosphere, and also provides a feedstock for biofuel production.

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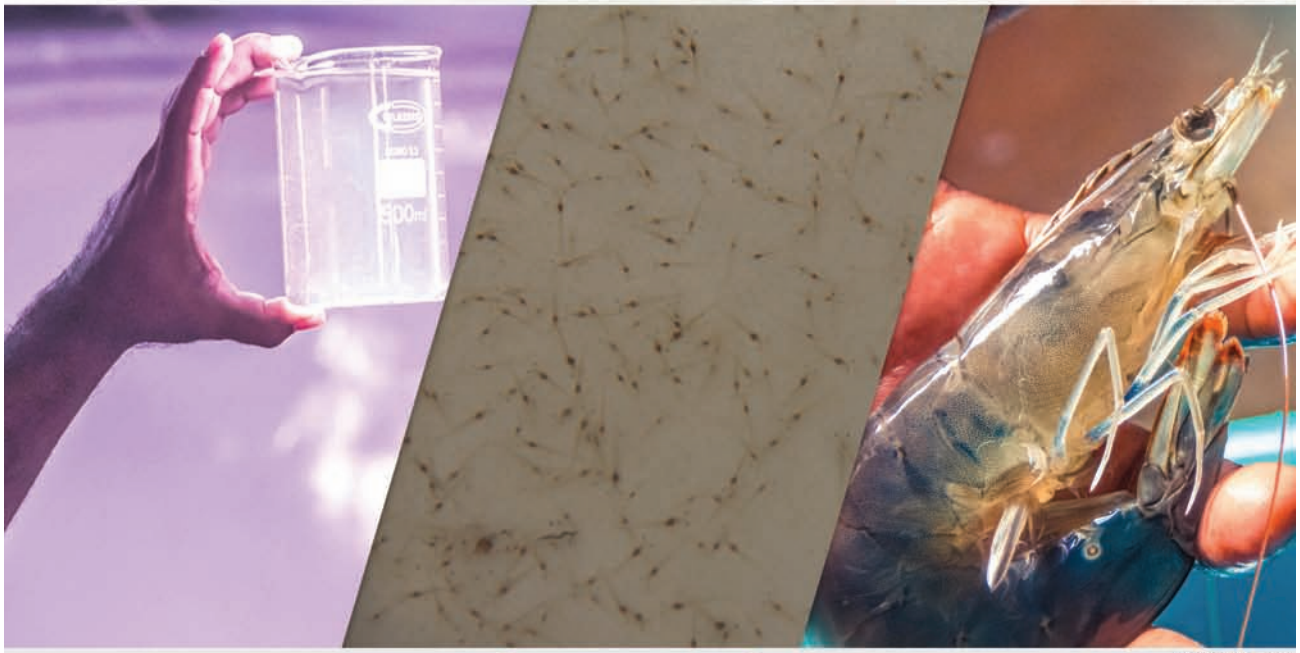

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Advantages of microalgae-based sequestration systems:

The main advantages of microalgae-based sequestration systems are as follows:

- Microalgae do not require traditional agricultural resources for cultivation, as they can be cultivated with or without land and in seawater or freshwater. Further, it requires e lesser volumes of water for cultivation compared to terrestrial crops.
- Algal culture does not require high purity CO_2 and flue gas containing a mixture of CO_2 and NO_2 can be fed directly to the algal ponds.
- The combustion products in flue gas such as NO_X and SO_X can be utilized as nutrients for microalgal culture which could reduce the cost of production of algae.
- These systems have minimal negative impacts on environment, and are eco-friendlier as compared to chemical and physical sequestration.
- These systems have higher growth rate within a short duration of time compared to land-based crops and are sustainable, and environment friendly biofuel that can meet the global energy demand.
- Transition to low carbon economy, namely from hydrocarbon to carbohydrate, protein and lipid resources.
- Huge and superior feedstock to displace terrestrial biomass for producing bioenergy.
- Enormous greenhouse gas uptake and especially superior CO_2 capture and sequestration with extra oxygen release while growing.

Recent advancement in production of algae for CO_2 mitigation

In recent times, CO_2 mitigating effect of a liquid fuel production process from microalgae using thermochemical liquefaction were studied (Raheem *et al.,* 2015). Thermochemical liquefaction has the advantage of treating wet materials compared with direct combustion, gasification and pyrolysis, as it does not require a drying process. Successful studies on thermochemical liquefaction of *Botryococcus braunii* and *D. tertiolecta* was conducted achieving 64% and 42% yield of bio oil at 300 ˚C with a higher heating value (HHV) of 45.8% MJ kg^{-1} and 34.9 MJ kg^{-1} (Raheem *et al.,* 2015). Gasification converts organic or fossil based carbonaceous materials into clean fuel gases or synthetic gases. This is achieved by reacting materials at high temperature (800–1000˚C) without combustion in partial oxidation of air, oxygen or steam. Biomass pyrolysis is a thermochemical process which occurs at 200–750 ˚C in the absence of oxygen to produce renewable bio oil, char and gases. Further, due to integration of anodic off gas into an algae grown cathode (*Chlorella vulgaris*), microbial carbon capture cells (MCCs) were proved to be an effective technology for CO_2 emission reduction with simultaneous voltage output without aeration (610 ± 50 mV, 1000 Ω) (Wang *et al.,* 2010). The mitigation of CO_2 can be augmented by combining other processes such as wastewater treatment as a medium for microalgae cultivation (Singh *et al.,* 2011).

Conclusion:

Micro algae are the diverse group of microscopic chlorophyllous creatures with the wide range of physiological and biochemical diversity capable of growing at a wide range of aquatic environment, accumulating carbohydrates in them by fixing CO_2 present in the atmosphere, growth medium and industrial exhaust flue gas. These micro algae are capable of producing large biomass in short time and yields several economically, ecologically and industrially important by-products compared to terrestrial vegetation. Micro algae thus act as a potential tool in combating global warming and climate change and could also alleviate economical distress of an individual, society and country in a sustainable way. The biomass production of algae can facilitate a dual benefit situation where atmospheric carbon dioxide sequestration and value-added products such as biofuels can be obtained by down-stream processing of the biomass. Though, currently projected costs of algal biomass production appear to be on higher side, however, the overall cost of production can be reduced by utilizing the waste resources and industrial emissions such as flue gases, hence a strategic significance to an environmentally sustainable society.

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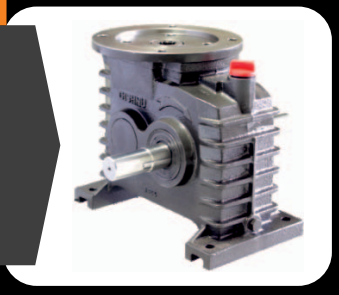

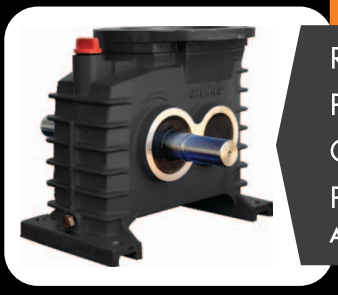

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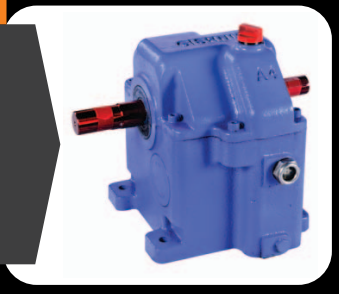

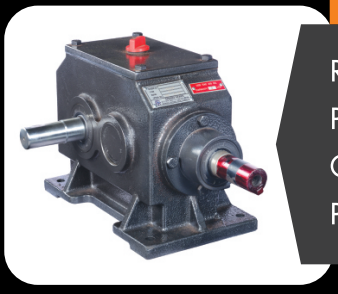

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Edible Oyster Culture: A Boon to Aquaculture Farmers

Highlight Points

▶ A profitable aquaculture practice. ▶ It is nutritious other than some kind of fishes. ▶ The processing and byproducts utilization of oyster is going to embark the food processing field as well as in other industries.

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ABSTRACT

Crassostrea madrasensis is the dominant species of edible oyster found in India. The rich source of nutrients makes this as a potential health food. Severe pollution in the waterbodies cause its degradation. Edible oyster culture for mass production is feasible and profitable for aquaculture farmers because of its increasing consumer demand.

INTRODUCTION

Oysters are the most widely cultivated marine animal and highly esteemed sea food, considered as delicacy throughout the globe. Yet the use of oysters is not at all optimal. According to Indian scenario till recently these were consumed mostly by people of coastal areas. With the growing awareness of nutritional composition of oysters, the demand of these also increased among all class of people. India has rich bivalve resources along the west and east coasts but the utilization of oysters for consumption is very negligible. Six different species of oysters are found in India in which Crassostrea madrasensis is the dominant species.

Crassostrea madrasensis, The Indian backwater oyster is an edible oyster comes under bivalvia molluscs. This sedentary animal attaches the substratum by a cupped lower valve and the upper valve acts as a lid which are widely distributed along the east and west coast of India. It is confined mostly to the southern region. The demand of growing backwater oysters increased substantially in India because of its highly nutritional composition. Succulent meat of backwater oysters is delicious as well as nutritious and it is the best oyster which human can eat. This oysters are fastly vanishing from their natural habitats due to the effects of severe pollution. Once estuaries and backwaters had plethora of oyster reef communities are now degraded and wants recolonization.

HABITAT AND DISTRIBUTION IN INDIA

The brackish water oyster can tolerate wide variations in salinity and are inhabited as a thick bed in backwaters, creeks, bays, estuaries, harbors, ports. It is widely distributed along Sonapur, Deltas of Godavari and Krishna, Gokulapalli, Pulicat, Ennore, Madras, Cudallore, Athankarai, Kanchanakudi, Kerala coast and Port Blair.These are found from the intertidal zone to a depth of 4-17meters predominantly in Orissa, Karnataka, Andhra Pradesh and Tamil Nadu. Pulicat lake, the second largest brackish water lagoon in India has covered with almost 10-hectare oyster beds with an estimated standing stock of 1320 Tonnes. Ennore creek has a treasure of 45-hectare oyster bed with support of standing stock 18600 Tonnes. The Kerala coast supports small oyster population. The population of back water oysters are also recorded in Ashtamudi and Vembanad lakes, cochin backwaters, Mahe estuary and the creeks of Dharmadam, Valapatinam, Nileshwaram and Chandragiri. The colonies of these oysters are not only stucked to rocky substances but also to hard muddy bottom in the waterbodies.

NUTRITIONAL COMPOSITION

The biochemical and nutritional composition of backwater oysters helps to access its edible value. The main constituent of the oyster meat is water of 82%. High amount of protein (10%) and lipids (3.25%) are found similar as in fishes. 3.2% of carbohydrate and some amount of glycogen are also reported in the flesh of oysters. The presence of macro minerals (Na, K, Ca, Mg) and trace elements (Mn, Cu, Zn, Fe, Cr, Se) are significantly high in this meat. Amino acids like aspartic acid, threonine, serine, glutamic acid, proline, glycine, alanine, cysteine, valine, methionine, isoleucine, leucine, tyrosine, phenylalanine, histidine, lysine, arginine, threonine are present in oyster meat in which lysine (14.3g/100g of crude protein) and threonine (12.3g/100g of crude protein) are dominant essential amino acids. The presence of essential amino acids makes back water oysters as a good source in complementing cereals for weaning food. Among non-essential amino acids aspartic acid (11.8g/100g of crude protein) content is more followed by histidine (7.7g/100g of crude protein). Biological value which describes the excellence of proteins in terms of essential amino acid was found to be 174 for this species.The energy due to protein in oyster meat can prevent protein-energy malnutrition in the consumers. The cholesterol and β- sulphonic amino acid (taurine) content in 100g of oyster meatwere found to be106mgand 243mg respectively.The high cholesterol content in the oyster is compensated by the high amount of taurine with its hypocholesterolemic effect. Eicosapentaenoic, docosahexaenoic and linolenic acids are the prominent poly unsaturated fatty acids present.

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Saturated fatty acids like stearic acid, palmitic acid and n-9, n-7 monounsaturated fatty acids are also present in the oyster abundantly.

CULTURING PRACTICES OF EDIBLE OYSTER FOR MASS PRODUCTION

The culture of edible oyster should be necessarily practiced as the oysters are continuously exploited from its natural habitat. In recent years, as a result of substantially increasing awareness in concomitant with rising demand of animal protein in context with malnutrition there is vast potentialities to embark upon programs to develop oyster culture in India and is an easy way to earn money for the aquaculture farmers. Some criteria should be followed for the mass production of oysters. The farming of oyster includes the rearing of spats and growing oysters for economic market.

1. SELECTION OF FARM SITE

Sheltered areas providing prevention from strong wave action are preferred to growing edible oysters. Some parameters should consider while selecting the site which are enlisted in Table 1

Insert Table 1 Parameters considered during site selection

2. SEED COLLECTION

The edible oyster seeds are procured from natural waterbodies by keeping suitable seed collectors called clutches for some period of time. Oyster shells also can use as seed collectors. A small hole can be made in empty shells and these can hang on nylon rope of 3mm diameter with a spacing of 10-20cm. During spawning this ren can be laid down on the bottom, or can suspended from racks. The right time to hang the seed collectors is after 7-10 days of peak spawning. After the attachment of seeds, this shells can be removed and restrung for growing at the rate of 5 shells per meter of rope. In tray method of culture, the seed collectors or lime coated tiles are placed on trays. Lime coated tiles shows better results than shells. On an average 120 larvae are known to settle in one lime coated tile. Reports shows that April-May month is more productive than August- September season for laying seed collectors. Nursery rearing of spats need calm an adequate water flow for bringing phytoplankton. Artificial nursery ponds also constructed in inter tidal region

3. FARMING METHODS

Farming methods are broadly classified into on bottom culture and off bottom culture. In on bottom culture, Oyster seeds attached to the collectors are planted at the bottom of water bodies and allowed to grow there. The main disadvantages of this method is more exposure of edible oysters to benthic predators, this cause low production. The off bottom culture is more beneficial than on bottom culture. Rapid growth and good meat yield are relatively high in off bottom culture in addition with the culture area can be utilized 3- dimensionally. Silting and predatory problems are found to be negligible in off bottom culture and also the biological function of oyster can have carried out independent of tidal flow. In rack and string method the racks are constructed in 1 to 2.5-meter depth. Several single beams are secured and supported with many posts. The string with shells are suspended from these racks. Almost 125 racks can be made in 1 hectare. At the end of farming about 7-7.5 kg of adult oysters can be harvested. The estimated production per hectare is 80 tons and the mortality rate of this method is 45%.In rack and tray method, Nursery reared spat with 25mm length are transferred to 40*40*10cm trays. The trays are made with 2mm synthetic twine with appropriate mesh hanged from racks. Oysters are segregated and transferred to rectangular trays of 90*60*15cm once they reached 50mm length. Each tray has the capacity to hold 150-200 oysters. Oysters with average length of 85mm can harvested after one year. The production is also very high compared to string method with 120 tons/ hectare in a year, but the cost of production is very high. These are the farming methods mainly used in India.

4. FARM MANAGEMENT

Farm should be inspected frequently for identifying the broken farm structure, so it is easy to suspending the loosened strings which touches the bottom of water bodies. Fallen strings cause high mortality rate of oysters. Predators like crabs, gastropods, starfishes, polychaetes also eat oysters. Mortality rates of oysters may increase due to diseases caused by some fungus and protozoans. Washing of oysters are preferably done by pumps to remove silt, newly attached fouling organisms and other dirt. Cleaning of oysters is depend upon the environmental condition. Monthly washing is needed when siltation is heavy. Overcrowded of oysters cause slow growth and death increases rapidly. So it should be thinned once it reached 3cm length. The sorting of oysters should be done to maintain same size in each trays until it reaches market. Sorting reduces labor at harvesting time and it is easy to select market size oysters during harvesting. Pest control and predator protection also should take while culturing oysters.

5. HARVESTING, TRANSPORTATION AND STORAGE

The harvesting of oyster culture is done manually when it reaches 9-12 months after stocking. Meat yield will be more during March –April and August –September month as per southern Indian condition. Under moist and cool conditions, it can be alive for several days. But it is desirable to reach consumer within 3 days of harvest. It can be safely transported for 25-30hrs without mortality packed in wet gunny bags. The harvested oysters should be brushed properly to remove fouling organisms and the bacterial load in oysters can bring down to a permissible limit by depuration process. Oysters collected in cleaning tanks are washed well with continuous flowing filtered saline water followed by pumping fresh water. This cycle should continue 2-3 times and then hold in 3ppm chlorinated saline water for an hour and again washed before marketing.

6. PROCESSING

The oysters can be eaten as fresh with half shell condition. But processing of oysters can be done in several ways. Removal of the succulent meat from the shell is called shucking. This can be done by a sharp knife. Freezing of oysters, immersing in hot water treating with weak hydrochloric acid and laser are the other methods to remove the flesh inside the shells in which first two techniques are commonly practiced. It takes 5-10 minutes to open the shells while immersing in hot water. Succulent meat can eat as such or can be processed. Oysters

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are processed in many ways. The whole oyster or the meat can be frozen after depuration with air blast freezer. It is having shelf-life of about 6 months at -25°C storage. Canned oyster is also available in which meat is blanched for 4-5 minutes and packed in cans. This cans are seamed, sterilized, chilled and stored. Smoked oysters, oyster stew, oyster pickle also can prepare for commercialization of this nutritious rich source of food in market. Byproduct utilization involves the Shell utilization for manufacturing of cement, calcium carbide, lime fertilizer also a way of earning money for the farmers. The broken shells can also use as poultry grits.

CONCLUSION

Back water oyster farming is one of the feasible and profitable farming which gifts a new aquaculture practices to the aquaculture farmers. The main advantages of this oyster culture are low cost of production and need of small. waterbodies. For all kind of aquaculture, around 60% of money is invested for buying feed. But for backwater oyster doesn't need feed and it eats phyto planktons present in the water. Almost 1-acre land is needed for producing 1 tonnes of fishes, but backwater oyster requires only 0.01-0.02 acre of land. The only condition is that salinity of water should be maintained. The meat inside the two shells are edible and these shells can be further used for collecting oyster spat or in the manufacture of calcium carbide, lime, fertilizer, cement. Oyster culture can be easily done because of less care is required. The demand and high price of oyster meat in the international market cause expansion of edible oyster culture in India. Reports shows that farmers are selling 1 oyster for 15 Rs and per kg it costs Rs 500

TABLE 1 PARAMETERS CONSIDERED DURING SITE SELECTION

Sl No	Parameters	Range
1	Salinity (ppt)	10-38
2	Depth (m)	1.5-4
3	Temperature °C	23-34
4	Dissolved Oxygen mg/l	3-5
5	pH	6.5-8.5
6	Turbulence due to wave (m)	<0.5 -1
7	Water current (m/s)	1-5
8	Environmental conditions	Free from fecal, agricultural, industrial wastes

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

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ICT in Improving Efficiency of Fresh Water Aquaculture Sector

Highlight Points

▶ Opportunities to enhance aquaculture contribution to National Development. ▶ Major challenges for Aquaculture Development. ▶ Multiple water Uses Opportunities for Enhancing Water Productivity. ▶ ICT Needs of the Aquaculture Sector, Production Aspects, Marketing Aspect.

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Aquaculture is a livestock-rearing business that has developed and grown considerably during the last decade. As a major supplier to the food trade, the Indian aquaculture sector has had to learn how to produce & integrate its products within markets that are increasingly more complicated to supply and to understand. A little background on the sector's history is without doubt, necessary and this communication will concentrate on the commercial fish farming sector of aquaculture besides ways of multiples use of water.

History

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and, historically, the freshwater major carps and trout sectors were the first professional elements of commercial fish farming. These developed slowly at the beginning using artisanal production technology where young fish stocks were reared in ponds or tanks. The development of transportation technology allowing movement of young fish from hatcheries to on-growing farms, combined with the industrial manufacture of polluted feeds made to the dietary requirements of different species & adoption of polyculture, led to a very rapid expansion of the sector's production in the 1990s. During this period, trout and carp farming developed very rapidly in different areas of India. In addition, growing market-size freshwater prawns and cat fishes also became a viable commercial activity. More recently, additional species have been added to the list of potential products notably L.bata, L.dyochelius, P.sarana, and P.sutchi et.

The application of information and communication technology has varying topics of interest in improving the aquaculture production. In addition, the fish farmer does not have the possibility of landing his catch at a market with the infrastructure for sales & distribution. It is these sectoral characteristics that make the modern Information Communication Technology ideally suitable and even essential for the sector's future.

Opportunities to enhance aquaculture contribution to National Development

Aquaculture as a potential contributor to the national development is presented with lots of opportunities and some which are:

i. Aquaculture can be easily integrated into conventional farming including small scale crop and animal production in rural areas and maximize resource use.

ii. Aquaculture management involves issues of conventional farmers e.g. stocking, feeding and harvesting etc.

iii. Aquaculture leads to equitable access to aquatic resource use.

iv. The government is harmonizing policies and regulation essential to aquaculture development.

v. The government has put in lots of effort for research and development and technology transfer which are pre-requisite for the industry.

vi. An appropriate trained force is essential to aquaculture development.

Major challenges for Aquaculture Development.

i. Uncoordinated promotion of aquaculture through many institutions.

ii. Lack of certified quality seed and commercial feed.

iii. Demand driven research programmes.

iv. Inadequate training programs for farmers and extension workers.

v. Inadequate record keeping by the farmers.

vi. Low investment by the private sector.

vii. Lack of credit.

Multiple water Uses Opportunities for Enhancing Water Productivity

In order to derive maximum benefit from the depleted or diverted water and maximize output to increase water productivity, the productive or beneficial interventions of multiple nature both non-consumptive and less water consumptive such as fisheries, aquatic crops, aquatic resources, livestock etc. may be integrated into the existing irrigation and water use systems/ water infrastructures. Such multiple use of water is aimed at:

- Enhancing water productivity
- Increasing farm productivity without any additional diversion of water
- Enabling diversification to high value outputs
- Reducing risk, better use of resources and increased resource use efficiency
- Ensuring increased income and better flow of income throughout the year
- Enabling better utilization of otherwise wasted/ depleted water resources, water
- Congested / waterlogged areas.

It is increasingly recognized that promoting multiple water use entails significant, but largely untapped opportunities to enhance water productivity. However, conventional irrigation systems, water harvesting schemes and water supply systems tend to ignore or lack multiple uses of water and have rarely considered this aspect in planning and design. Multiple water use systems distribute water from several sources such as canals, streams, rivulets and springs in hills, pumped ground water, water harvested from watersheds or roofs, and may also include unused or underutilized water bodies (small or big) and water congested areas and use of poor quality waters in peri-urban areas. Even though their qualities may be different, there is sufficient similarity to treat them in the first instance, as contributing to the same 'pool'.

In India and elsewhere in developing or under developed countries, a lot of interest has been generated and work on multiple water use has been undertaken at experimental farms, watersheds and farmers field. Evidences of multiple uses could be found in irrigated, rainfed, water logged, coastal and hilly areas/ watersheds.

ICT Needs of the Aquaculture Sector

Production Aspects

Commercial aquaculture requires good technical and financial management, where production monitoring and efficiency is a key element. For example, feeds represent one of the major cost items in the business and accurate data on stocks and other parameters are needed in order to manage efficiently and minimize the waste.

All farmers are looking for optimal growth at the lowest cost and a number of increasingly-sophisticated computer programmes are currently available for this purpose, allowing much improved operational planning to be achieved.

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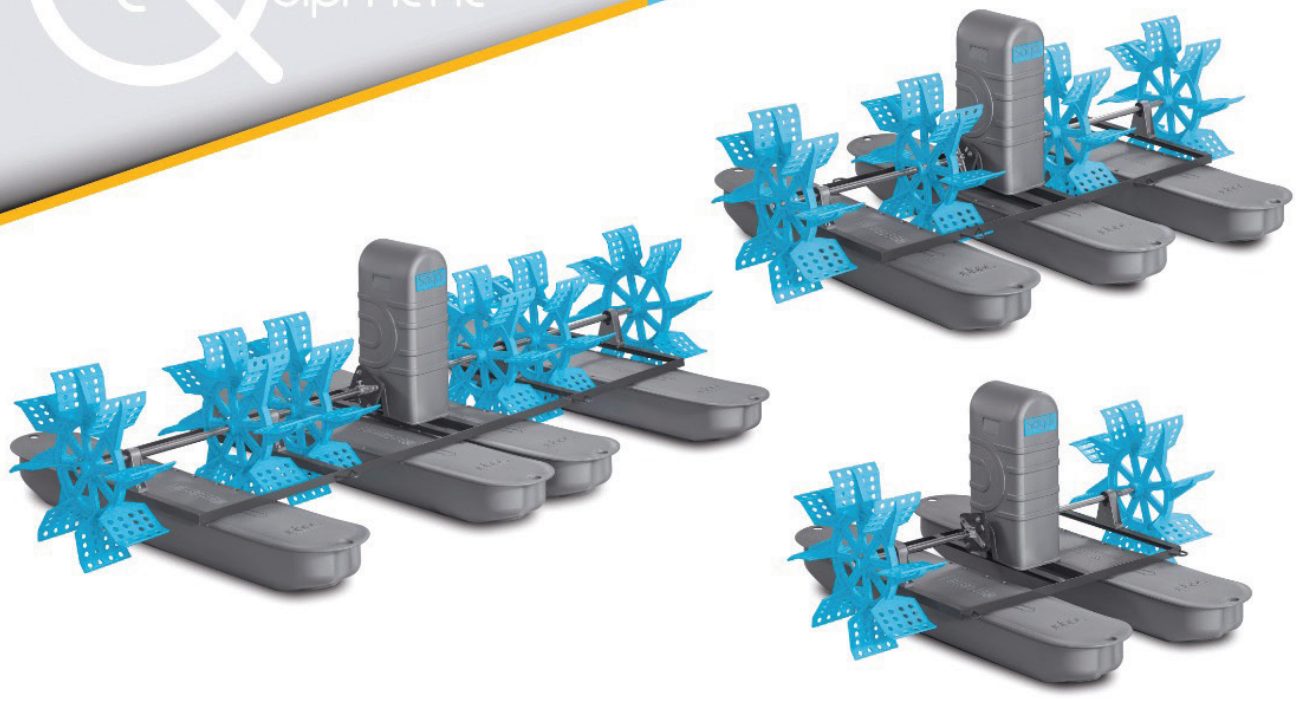

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Analyzing production data to provide accurate harvest forecasting is without doubt one of the keys to operating a successful modern farm. Seasonal demand and price fluctuations are common for many fisheries and aquaculture products but where aquaculture should have the significant advantage of being able to plan production and harvest rather than rely on the variant conditions encountered by capture fisheries.

Marketing Aspects

Increasingly sophisticated sales and marketing strategies are required. The absolute need to abide to the consumer safety laws and requirements for food processing has mirrored increased processing activity by many aquaculture companies. Although one often refers to 'added-value' products from processing, the absolute need to respond to the consumer's wishes and desires infers, that packaging and processing have become a means to sell rather than an option. Consequently, part of the production sector has moved towards processing in order to get 'closer' to the consumer by manufacturing a product that can be sold to a retailer, the chain of intermediaries has been reduced.

Companies investing in this part of the business no longer need to pass through the lines of

- Wholesale
- to Processing (optional)
- to Market

thus reducing the Distribution logistics and costs associated with these sectors.

This concept has not been possible for those in the sector who do not possess the capacity, in terms of production or finance, to make the jump towards processing, noting that ready-to-eat meals are one of the fastest growing sector in the food business in India. The further complications of small company size in addition to geographic and product dispersion have already been mentioned. Individual or co-operative investments in this sector are now responsible for a large part of the sales of aquaculture's products, adapting to and evolving with the modern market's requirements. Evidently, traditional IT products for business management are considered essential within such an environment.

Information Requirements

In summary, the aquaculture characteristics include:

- wide geographic dispersion
- production specialization (mono or very few species)
- production limitations (site licenses limiting production)
- distance from major markets

The traditional producer response to counter falling prices is increased production. In many cases, farms have exceeded the capacity of their local market and the economies of scale required for increasing efficiency have put particular pressure on both inter and intra-company communications. This phenomenon is changing and modernizing the way in which the aquaculture industry operates.

There is a recognized need for accurate, trustworthy and readily available market information since this is required for both short and medium term planning of production, harvesting, processing and sales. Consequently, the real and potential facilities accorded by information technology and electronic communication are being integrated into the sector, albeit slowly. Around 2% of aquaculture businesses use the Internet and that most of these are relatively large companies.

The evident cost benefits of using the Internet for information communication has moved on from being technically led, in the same way that aquaculture was, to being market-led and answering to consumer demand. Simpler user technology and immediate results are the most convincing argument to attract those involved in the production sector. Busy technical and sales staffs do not have the time to 'surf' the Internet; they want to find the information that they want or need, quickly & efficiently. If the service is good, they will use it. There is considerable hope for the application of electronic information and trading mechanisms that would help the smaller rural and/or coastal producer to be able to benefit from the concept of the shorter distribution chain described.

The challenge of using direct communication lines between the seller and the buyer, who is at the closest point to the consumer, probably represents the only way in which a producer will be able to make an adequate profit margin while selling at a real market value. This would be because the costs charged by intermediaries would not be passed down and added to his 'ex-farm' price. The reality of this situation, referring particularly to declining prices and increasing costs, is evident to those working within the sector.

The Internet now provides low-cost and efficient communication where developments in data encryption and electronic payment facilities, are providing an increasingly safe desktop environment for conducting business. When these factors are combined with adequate information services for technical and marketing data, the scene is being set for the most significant leap forward in efficiency that the sector could hope for.

Conclusion

There are many identifiable subjects that are appropriate for ICT and from which the aquaculture sector could benefit but if these projects are to succeed, the following criteria should be respected:

- Clear and focused services
- Simple and user-friendly
- Accurate information
- Well organized and easy to find

Closer co-operation between developers and industry operators has to be stimulated in order to encourage real progress. It is important to avoid dispersion and distancing from the wishes and desires of the end-user in this development phase.

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An Overview of the Status of Coastal Aquaculture

Highlight Points

► Global coastal aquaculture and mariculture production in 2016 is recorded as 28.7 million tonnes. ► Asia ranks first in coastal aquaculture and mariculture production with 23.8 million tonnes of different food fish organisms. ► In India production of *Penaeusmonodon* and *Litopenaeusvannamei* shrimp during 2017 – 18 is reported as 57 691 tonnes & 622 327 tonnes respectively. ► There is 24.14 % increase in the *L. vannamei* production in 2017-18 compared to 2016-17. ► India has exported 13.77 Lakh tonnes of seafood worth 45 106.89 Crores in 2017-18 ► Frozen shrimp is the major item of export in terms of quantity and value, accounting for a share of 41.10 % in quantity and 68.46% of the total USD earnings.

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1. Introduction

Marine aquaculture, also known as mariculture,is practiced in the sea, in a marine water environment, while coastal aquaculture is practiced in completely or partially human-made-structures in areas adjacent to the sea, such ascoastal ponds and gated lagoons. In coastal aquaculture with saline water, the salinity is less stable than in mariculture because of rainfall or evaporation, depending on the season and location. On the world level, it is hard to distinguish between mariculture and coastal aquaculture production, mainly because of the-aggregation of production data from several major producing countries in East and Southeast Asia, especially for finfish species that are farmed in marine cages as well as in coastal ponds (FAO, 2018).It is also the fastest growing sub-sector of aquaculture. A total of 575aquatic species and species groups grown in freshwater, seawater and brackish water have been registered in the FAO Global Aquaculture Production Statistics Database (FAO, 2018). At global level, mariculture produces many high value finfish,crustaceans, and mollusks viz. oysters, mussels, clams, cockles and scallops.

2. Global Status of Coastal Aquaculture & Mariculture

Global aquaculture production in 2016 included 80.0 million tonnes of food fish and 30.1 million tonnes of aquatic plants, as well as 37 900 tonnes of non-food products such as ornamental shells and pearls. Farmed food fish production included 54.1 million tonnes off in fish, 17.1 million tonnes of molluscs, 7.9million tonnes of crustaceans and 938 500 tonnes of other aquatic animals such as turtles, sea cucumbers, sea urchins, frogs and edible jelly fish. China, by far the major producer of farmed food fish in 2016, has produced more than the rest of the world combined every year since 1991. The other major producers in 2016 were India, Indonesia, Vietnam, Bangladesh, Egypt and Norway (FAO, 2018).

FAO (2018) recorded 28.7 million tonnes (USD 67.4 billion) of food fish production from mariculture and coastal aquaculture combined in 2016 **(Figure 1)**. Most of the finfish production report edunder marine and coastal aquaculture in Africa,the Americas, Europe and Oceania is produced through mariculture **(Table 1).**

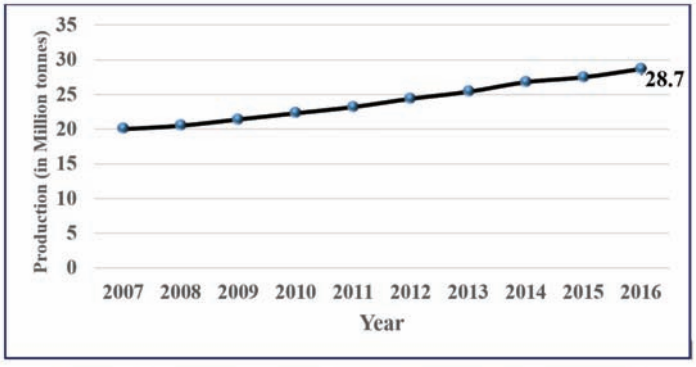

Figure 1. Year-wise Global Marine Aquaculture Production

Table 1. Marine & Coastal Aquaculture Production of main groups of food fish species by continent, 2016 (Thousand tonnes, live weight)

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Category	Africa	America	Asia	Europe	Oceania	World
Marine & Coastal Aquaculture						
Finfish	17	906	3 739	1 830	82	6 575
Crustacean	5	727	4 091	0	6	4 829
Mollusks	6	574	15 550	613	112	16 853
Other Aquatic animals	0	0	402	0	5	407
Subtotal	**28**	**2 207**	**23 781**	**2 443**	**205**	**28 664**

3. Indian Scenario

India has a long coastline of about 8 129 km. The potential coastal water area available in India includes about 8.9 million ha of inshore waters for open sea farming, and 1.7 million ha of estuaries, backwaters, brackish water lakes and swamps. A variety of high valued fishes, crustaceans, molluscs, seaweeds and other marine organisms, possessing high reproductive capacity, short larval development, fast rate of growth, and physiological features to adjust to wide changes in the environment are available in our coastal waters. There are also a large number of unemployed and under employed fishermen who could advantageously take up coastal aquaculture (Imelda, 2015). The dwindling catch rates in capture fisheries and rampant unemployment in the coastal region focus towards the development of mariculture and coastal aquaculture as a remunerative alternate occupation (Gopakumar, 2016).

At present, Indian mariculture is limited to a few species of shrimps, lobsters, molluscs (oysters and mussels), seaweeds and finfishes (cobia, pompano, sea bass and grouper) (Gopakumar 2016). In-spite of vast potential, the development of coastal aquaculture in India has been mainly confined to brackishwater shrimp culture. Earlier Giant tiger shrimp (*Penaeusmonodon*) is the single most important species used for culture. But recently, Pacific White shrimp (*Litopenaeusvannamei*) however, has attracted the farmer attention because of its fast growth, low incidence of native diseases, availability of SPF strains & culture feasibility in wide salinity range (Nair, 2017) Shrimps plays an important role in the export market, it is estimated that nearly 63% of the shrimp exported is sourced from the coastal aquaculture (Bhat & Vinod, 2008).Coastal Aquaculture Authority(CAA) has been authorized by the govt. of India to license the aqua farming in the coastal region. CAA also regulate the development of coastal aquaculture in an environmentally & sustainable manner. The Marine Products Export Development Authority (MPEDA) of Government of India has been playing a major and significant role for promoting coastal shrimp cultivation in the country.

4. Indian shrimp aquaculture production

According to MPEDA production 2017-18, a total of 59 099 ha area is under *Penaeusmonodon* culture in 9 maritime states producing 57 691 MT (Metric Tonnes) with an average productivity of 0.98 MT/ha/year. The state of Gujarat records maximum productivity of 2.97 MT/ha/year followed by Tamil Nadu and Orissa with productivity of 2.80 and 1.48 respectively **(Table 2)**. Also a total of 93 496 ha area is under *Litopenaeusvannamei* culture in 9 maritime states producing 622 327 MT with Andhra Pradesh leading in total area under culture and production. All India average productivity is 6.66 MT/ha/year. Thus nine farming states have produced 680 018 MT of these shrimp varieties with Andhra Pradesh topping the production **(Table 2)**. Year-wise total *Penaeusmonodon* and *Litopenaeusvannamei* shrimp production (in MT) is presented in **Figure 2**.

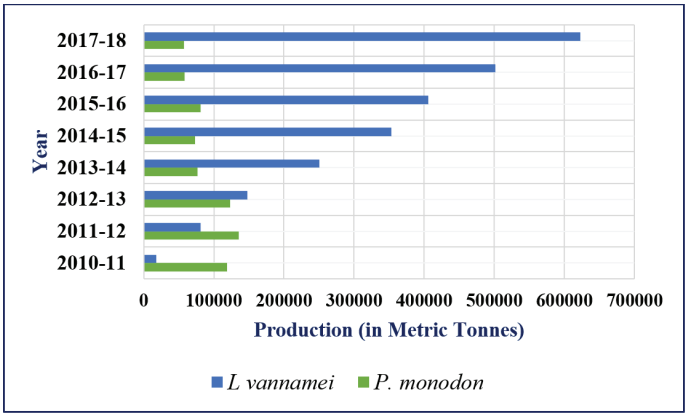

Figure 2. Year-wise Shrimp Aquaculture Production of India

Table 2. Area utilized and production of *Penaeusmonodon* and *Litopenaeusvannamei* shrimp during 2017 – 18

No.	State	Area utilized (ha)		Production (Metric Tonnes)		Productivity (MT/ha/Year)	
		P. monodon	*L. vannamei*	*P. monodon*	*L. vannamei*	*P. monodon*	*L. vannamei*
1.	West Bengal	51 084	4 127	49 319	22 191	0.97	5.38
2.	Orissa	2 624	8 862	3 887	37 229	1.48	4.20
3.	Andhra Pradesh	1 880	62 342	2 714	456 300	1.44	7.32
4.	Tamil Nadu	10	8 849	28	43 622	2.80	4.93
5.	Kerala	3 144	52	1 522	208	0.48	4.01
6.	Karnataka	302	399	59	1 465	0.19	3.67
7.	Goa	0	32	0	78	0.00	2.47
8.	Maharashtra	0	1 291	0	6 073	0.00	4.71
9.	Gujarat	55	7 542	162	55 161	2.97	7.31
	Total	**59 099**	**93 496**	**57 691**	**622 327**	**0.98**	**6.66**
	Subtotal	**152 595**		**680 018**		-	-

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During the financial year 2017-18, India has exported 13.77 Lakh tonnes of sea food worth 45 106.89 Crores (Anon., 2018). Frozen shrimp continued to be the major item of export in terms of quantity and value, accounting for a share of 41.10 % in quantity and 68.46% of the total USD earnings. The export of Vannamei shrimp has improved from 329 766 MT to 402 374 MT in 2017-18 with a growth of 22.02% in quantity and 24.74% in USD value (Anon., 2018).

Increased production of the Pacific White shrimp (*Litopenaeusvannamei*) continued to propel India's culturedshrimp. The *L. vannamei* production during the year was 622 327 MT, which was 121020 MT more than the previous year production of 501297 MT, thus registering an increase of about 24.14% **(Table 3)**. The increase in *L. vannamei* production has helped to increase the overall productivity of shrimp farming. Among the other shrimps which contributed to aquaculture production during the year, the aquaculture production of the native Tiger shrimp (*Penaeusmonodon*) showed a marginal decline of 0.81%.

Table 3. Variation in species-wise production in 2017-18 in comparison with 2016-17

No.	Species	Production (Quantity in MT)			% Variation
		2016-17	2017-18	Difference	
1.	*L. vannamei*	501 297	622 327	121 030	24.14
2.	*P. monodon*	58 163	57 691	-472	-0.81

5. Production of other exportable varieties of fish and shellfish

A production of 13615 MT of other diversified species, such as Crab, Sea bass, and Tilapia (GIFT) besides Pangassius production of about 26300 MT has been reported (Anon., 2018). The production of diversified species of fish and shellfish for export is still in the early stages. Large scale development can be possible with the involvement of corporate bodies who can invest in setting up integrated units of exportable varieties of fish and shellfish including hatcheries, farms and processing plants. Details of state-wise culture production of diversified species during 2017-18 are given in the **Table 4** (Anon., 2018).

Table 4. State-wise culture production of new exportable species during 2017-18

State	Crab		Seabass	
	Area (ha)	Production (MT)	Area (ha)	Production (MT)
West Bengal	4 324	270	15 046	2 214
Orissa	804	503	148	116
Andhra Pradesh	2 181	1 052	379	585
Tamil Nadu	48	24	26	24
Kerala	47	11	6	3
Karnataka	90	46	0	11
Goa	0	0	0	0
Maharashtra	0	220	0	1 287
Gujarat	0	0	0	0
Total	7 494	2 126	15 605	4 240

The other coastal aquaculture activities are green mussel farming which is confined to Malabar Coast in Kerala producing more than 15 000 tonnes and seaweed farming along the coast of Tamil Nadu producing about 17000 tonnes (wet weight) annually. Many mariculture technologies are very simple, eco-friendly and use only locally available infrastructure facilities for construction of farm, feed and seed and hence the entire farming can be practiced by traditional fishermen. Another advantage is that most of our brackish and coastal areas are free from pollution and suited for aquaculture. In recent years, the demand for mussels, clams, edible oysters, crabs, lobsters, sea weeds and marine finfishes is continuously increasing and brings premium price in the national and international markets.

6. Major Constraints

- Unavailability & uncertainty of healthy seeds.
- Lack of skilled persons.
- Lack of contact between farmers & scientists.
- No awareness about the mariculture & natural resources available in common man.
- Lack of training facilities.
- No education i.e. no literacy.
- Religious point of view have no acceptance.
- Human Nature.
- No policy for poor people.
- Environmental impacts

7. Future prospects in Coastal Aquaculture & Mariculture

- The increasing demand for fishwill require more production, and the supply from capture fisheries is static.
- Emergence of the sector: Aquaculture has become recognized as a growth sector of economic importance inmany countries and has attracted the attention of the private and public sectors.
- Culture-based fisheries: Stocking of reservoirs and enhancement/rehabilitation of fisheries will gain importance with time, particularly as cost/benefit problems are resolved
- Growing awareness of sustainability needs: There is a rapidly growing awareness of the need to ensure the sustainability of the sector in the long term. Public debate involving all stakeholders, national and international efforts to arrive at practical guidelines for sustainable practices. Technical efforts to improve the sustainability of some aquaculture systems, are positive responses to challenges and will yield constructive results in the medium and long term.

8. Conclusion

India has bright scope in marine aquaculture sectors, scope lies in trade of various seeds throughout globe, developing efforts in policies pertaining to seeds in India. As there is a growing demand for marine finfish, and offshore fish farming can offer new vistas for Indian aquaculture to achieve the set target, advance national economic development and ensure the livelihoods of many more people. Thus in today's era of developments in marine aquaculture has proved to be a boon for Indian aqua culturist because it increases the productivity. But still there is need for expansion of aquaculture in India because it is restricted to a few states and few species only, so there is great scope for the other fisheries based industries to enter into this sector.

***References can be provided on request**

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A Tribute to Kary Mullis: Nobel Laureate Who Invented the PCR

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Kary Mullis (December 28, 1944 – August 7, 2019) was a Nobel Prize-winning American biochemist. In recognition of his invention of the polymerase chain reaction (PCR) technique, he shared the 1993 Nobel Prize in Chemistry with Michael Smith. His invention became a central technique in many biochemistry and molecular biology.

Mullis was born in rural North Carolina in the US. During high school, he developed an interest in science, and went on to study chemistry at the Georgia Institute of Technology, later completing a PhD in biochemistry at the University of California, Berkeley in 1973. In 1985, Kary Mullis invented the process known as polymerase chain reaction (PCR), in which a small amount of DNA can be copied in large quantities over a short period of time. PCR uses an enzyme a heat stable DNA polymerase that is cycled through sequences of heating and cooling to amplify DNA, creating millions of copies of a chosen sequence, which can then be used for analysis or experimentation.

Kary Mullis is generally credited with inventing PCR in 1985 while working for Cetus Corporation in Emeryville, California. Mullis' role at Cetus was to synthesise oligonucleotides for groups working on, amongst other things, methods to detect point mutations in human genes. Mullis was hatching an idea to detect the point mutations using Sanger-type DNA sequencing, employing DNA polymerase in the presence of an oligonucleotide primer and ddNTPs. The problem was that sequencing a single copy gene within the expanses of the human genome was impossible; the primer would bind in too many places. What he needed was a way to increase the concentration of the specific gene of interest.

While driving his Honda Civic on Highway, Mullis made an intellectual leap. He reasoned that by using two opposed primers, one complementary to the upper strand and the other to the lower, then performing multiple cycles of denaturation, annealing and polymerization he could exponentially amplify the piece of DNA between the primers.

The idea of PCR was born, but the technique was still very much in its infancy. The *E. coli* DNA polymerase used in the early days was destroyed during the denaturation step so had to be replenished after every cycle. Cetus workers quickly developed the first thermal cycler named "Mr Cycle", which automatically added new polymerase after each heating step.

In 1985, Mullis came up with the idea of using polymerase isolated from the extremophilic bacterium *Thermophilus aquaticus*. The polymerase, known as Taq polymerase, has optimal activity at 72°C and can withstand the 94°C required for denaturation of the DNA, meaning that many reaction cycles could be performed without being replenishing the enzyme. However, both *Science* and *Nature* rejected the resulting manuscript, which was ultimately published in *Methods in Enzymology* in 1987.

This breakthrough, together with advances in oligonucleotide synthesis made PCR both cost effective and convenient and it quickly entered mainstream research. It was hailed as one of the most important scientific inventions of the 20th century as it was a discovery that enabled scientists to make innovative applications and research.

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