English Monthly from Hyderabad, India

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Aqua International

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Health • Nutrition • Management • Processing

June 2021

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Inside...

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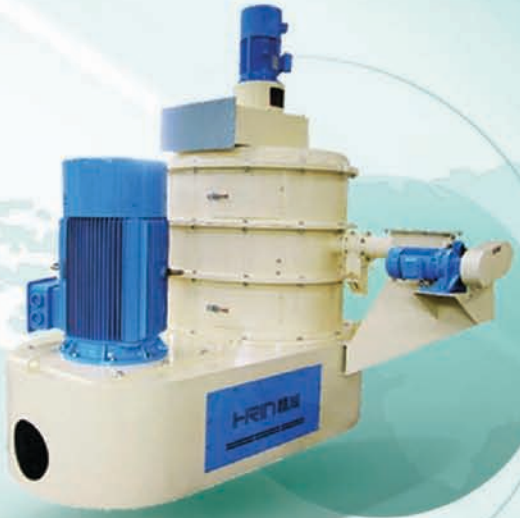

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Aqua International

English Monthly Magazine
(Established in May 1993)

Volume 29 Number 02 June 2021

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M. A. Nazeer

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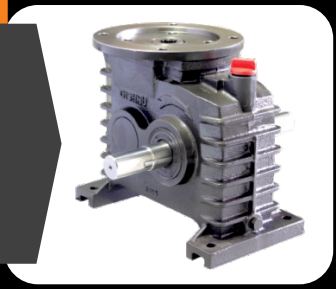

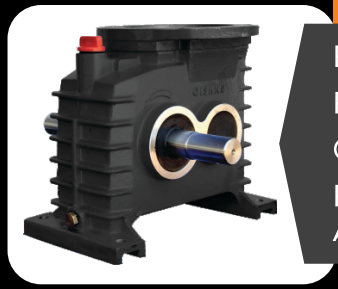

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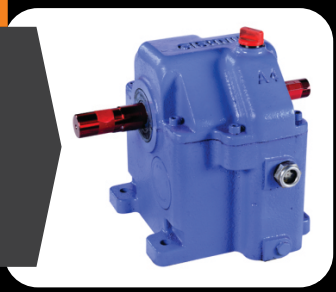

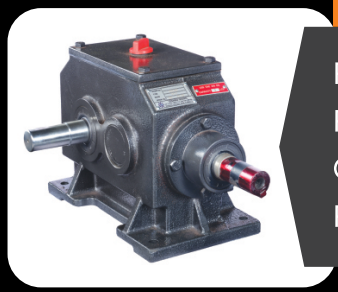

Type : GBH

Range : 3 hp & 5 hp
Pedals : 8+8 & 20+20
O/p RPM : 105 & 120
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India exports 11,49,341 MT of marine products worth Rs 43,717 crore during FY 2020 – 21

Dear Readers,

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

In the News section, you may find news about – **the COVID pandemic and sluggish overseas markets** cast their shadow over India's resurgent seafood sector as the country exported 11,49,341 MT of marine products worth Rs 43,717.26 crore (US$ 5.96 billion) during FY 2020 - 21, registering a contraction of 10.88 per cent in volume as compared to a year earlier. USA, China and the European Union (EU) were the leading importers, while frozen shrimp retained its position as the major export item followed by frozen fish. COVID, sluggish markets, logistical issues cause 10.88% decline, but revival in last quarter, says MPEDA Chairman Mr K. S. Srinivas. Aquaculture sector performs better; uptick in Tilapia and Ornamental fish exports.

Srinivas said besides the pandemic impact, several other factors negatively impacted seafood exports during 2020-21. 'On the production side, there were reduced fish landings due to less number of fishing days, slow logistic movements and market uncertainties'. Scarcity of workers in fishing and processing plants, paucity of containers at seaports, increased air freight charges and limited flight availability affected exports, especially of high-value chilled and live products, the official said.

Yaas-hit aquaculture biz to lose Rs 1k cr. Aquaculture industry in West Bengal estimated to have lost over Rs 1,000 crore following 26 May 2021 cyclone Yaas, which wreaked havoc and inundated a large area of agricultural fields and water bodies across some districts. The state accounts for almost 15 - 20 % of India's export of Aquaculture products, which, along with Odisha, have been hit badly by the flood-like situation following Yaas. Aquaculture export from the state is worth over Rs 8,000 crore.

Main areas of damage to shrimp farms include those facing sea at Mandarmani belt; Kanthi coastal belt-Bakipur area; farms along Haldi River and Rasulpur River-Kalinagar Belt; Norghat belt. According to Rajarshi Banerji, President, the Seafood Exporters Association of India, West Bengal region Farms in Nayachar Belt were severely damaged. Part of Nandigram belt was badly hit, too says.

MPEDA's Mud Crab Hatchery Technology gets patent right for 20 years. In an impressive milestone in India's aquaculture sector, MPEDA-RGCA's mud crab hatchery technology, the only one of its kind in the country, has been granted patent by the Controller General of Patent, Design and Trade Marks, Government of India, for 20 years from 2011 to 2030. Dr Emilia T. Quinitio, an eminent scientist from Aquaculture Division of International Institute known as Southeast Asian Fisheries Development Centre (SEAFDEC), Philippines, had extended the consultancy service till 2013 to RGCA. Since then, the technology has been standardized by the RGCA's scientists within a short span of period. RGCA has been set up to give a fillip to commercialization of diversified aquaculture species such as Sea bass, Mud crab, Genetically Improved Farmed Tilapia (GIFT), Cobia, Pompano and Artemia. It focuses on increasing India's marine products export by producing and supplying good quality seeds, which is a prime input for aquaculture. So far, 7.28 million seeds have been produced and supplied to 659 farmers across the country.

Hike in Freight costs, Retaliatory tariff, Seafood industry fears further setback. US trade authorities are planning retaliatory tariffs against the imposition of two per cent tax by India on revenue generated by digital services offered in India. Freight rates have been progressively raised for reefer containers to the US from $ 3,500 in March 2020 to around $ 6,500 now. The note said the seafood industry has now been informed by Maersk lines that effective May 1, the rate will be $ 12,500. Following Maersk, the largest shipping liner in the world, other shipping companies may follow suit. Marine product exports sector, which had been regularly registering annual growth over the past decade (from a level of ₽ 8,000 crore in 2009 - 10 to ₽ 47,000 crore in 2019 - 20), has gone through its worst year in 2020 - 21 with a drop of 20 per cent in turnover as well as volumes, said Alex K. Ninan, President of Seafood Exporters Association of India-Kerala Region.

Contd on next page

NRS GROUP

Aqua International

Our Mission

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

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

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

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

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

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India backs IMTA initiative. A pilot integrated multi-trophic aquaculture (IMTA) programme in Kerala, that combined the production of green mussels, seaweed and finfish has proved to be a great success. The project was undertaken by India's Central Marine Fisheries Research Institute (CMFRI), working with fish farmers in Moothakunnam, Ernakulam.

The Vizag belonged industrialist Devi Sea Foods Ltd Managing Director Mr P. Brahmanandam and the Kovur based Avanti Feeds Ltd Chairman and Managing Director Mr A. Indra Kumar have donated each of Rs one crore to the Andhra Pradesh CM Relief fund.

Andhra Pradesh state government is supplying electricity to aquaculture farmers in the state at Rs 1.50 per unit. The government for this purpose extended Rs 1500 cores. The state has about 40,000 shrimp farmers and a larger number of fish farmers using the power. It is also educating farmers about the best practices in farming.

How this Delhi seafood startup became the vendor of choice for the HORECA and B2B sectors. He travelled all the way from Delhi to Nellore and Bhimavaram, in Andhra Pradesh, to understand how prawns were grown and retailed. He also visited local markets, which supplied fish that was at least seven days old.

Prof Donald V. Lightner passed away on May 4, 2021 in Tuscon, Arizona. He will be missed by his family and friends, and by academic and industry colleagues around the world. The world of aquaculture especially aquatic animal disease specialist lost an icon.

In the Articles section -- Article titled ***Biopesticide: An Ecofriendly approach to the Aquaculture Practice,*** written by Mr Suman Karmakar and other authors highlighted that In this article discussed about the use of bio-pesticides in aquaculture practice.

Another article titled ***Crab Culture: A potential species for mariculture***, written by Shyam Kumar and other authors highlighted that the Commercial crab culture is one of lucrative and profitable aquaculture business for small-scale fisherman across the globe.

Article titled ***Fish paste: A viable option for Indian Seafood export industries***, written by Dr C. O. Mohan and other authors highlighted that Fish paste is very rich in highly digestible protein with well-balanced essential amino acids. Fish paste has promising market potential in domestic as well as international market.

Another article titled ***Rainbow Trout: Harnessing the Potential in India*** written by Salim Sultan and other authors highlighted that the cold water / hill fishery resources of the country are spread from north-western to north-eastern Himalayan region and some parts of Western Ghats, encompassing about ten States.

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

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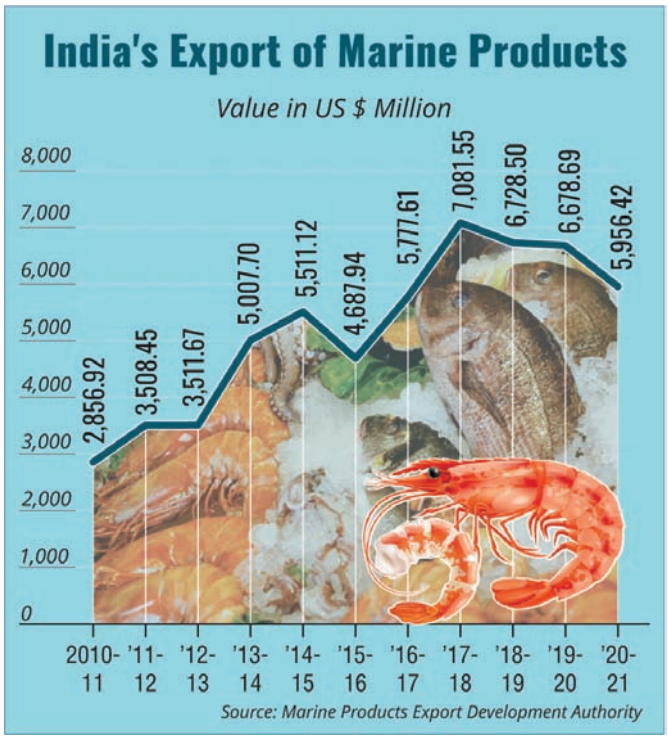
India exports 11,49,341 MT of seafood during 2020 - 21

- *COVID, sluggish markets, logistical issues cause 10.88% decline, but revival in last quarter.*
- *Aquaculture sector performs better; uptick in Tilapia and Ornamental fish exports.*



Kochi, 2 June 2021: The COVID pandemic and sluggish overseas markets cast their shadow over India's resurgent seafood sector as the country exported 11,49,341 MT of marine products worth Rs 43,717.26 crore (US$ 5.96 billion) during FY 2020 - 21, registering a contraction of 10.88 per cent in volume as compared to a year earlier.

USA, China and the European Union (EU) were the leading importers, while frozen shrimp retained its position as the major export item followed by frozen fish.

In 2019 - 20, India exported 12,89,651 MT of seafood worth Rs 46,662.85 crore (US $ 6.68 billion), marking a decline of 6.31 per cent in rupee terms and 10.81 per cent in dollar value in 2020 - 21.

"The pandemic drastically affected seafood exports during the first half of the year, but it revived well in the last quarter of 2020 - 21. Also, the aquaculture sector performed better during this fiscal by contributing 67.99 per cent of exported items in dollar terms and 46.45 per cent in quantity, which is 4.41 per cent and 2.48 per cent higher, respectively when compared to 2019 - 20," said Mr K. S. Srinivas, Chairman of the Marine Products Export Development Authority (MPEDA).

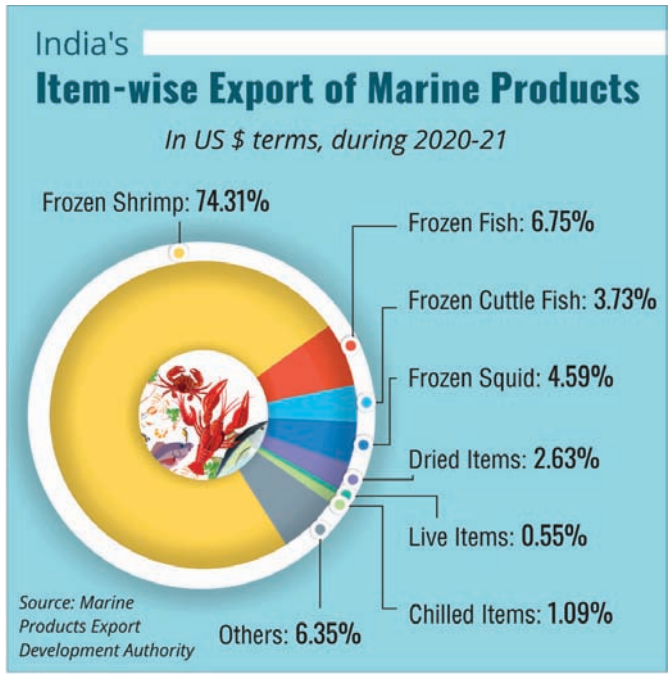
Frozen shrimp contributed 51.36 per cent in quantity and 74.31 per cent of the total dollar earnings. USA remained its largest importer (2,72,041 MT), followed by China (1,01,846 MT), EU (70,133 MT), Japan (40,502 MT), South East Asia (38,389 MT), and the Middle East (29,108 MT).

However, shrimp exports declined by 9.47 per cent in dollar value and 9.50 per cent in quantity. The overall shrimps export was 5,90,275 MT worth 4,426.19 million dollars. The export of Vannamei (white leg) shrimp decreased from 5,12,204 MT to 4,92,271 MT in 2020-21. Of the total Vannamei shrimp exports in dollar value, 56.37 per cent was exported to USA, followed by China (15.13 per cent), EU (7.83 per cent), South East Asia (5.76 per cent), Japan (4.96 per cent) and the Middle East (3.59 per cent).

Japan, the major market for Black Tiger (Penaeus monodon) shrimp, had a share of 39.68 per cent in dollar terms, followed by USA (26.03 per cent), South East Asia (9.32 per cent), EU (8.95%), the Middle East (6.04 per cent) and China (3.76 per cent).

Frozen fish, with a share of 16.37 per cent in quantity and 6.75 per cent in dollar earnings, retained the second position in exports basket though its shipments plummeted by 15.76 per cent in quantity and 21.67 per cent in dollar terms.

'Other Items', the third largest category that largely comprised Surimi (fish paste) and Surimi analogue (imitation) products, showed a marginal growth of 0.12 per cent and 0.26 per cent by quantity and rupee value, respectively, but declined in dollar terms by 5.02 per cent.



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1. WATER QUALITY CONDITIONING

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

2. HIGH ACTIVITY OF SPORES

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

3. DECREASE AMMONIA CONTENT

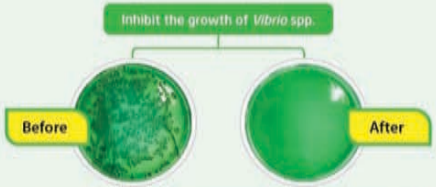
Prevent the accumulation of toxic substances such as NH_3, NO_2, etc.

4. IMPROVE WATER COLOR

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

5. ESTABLISH BALANCED POND BACTERIA SYSTEM

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



6. INCREASE AQUACULTURE PRODUCTION

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

* COMPOSITION:

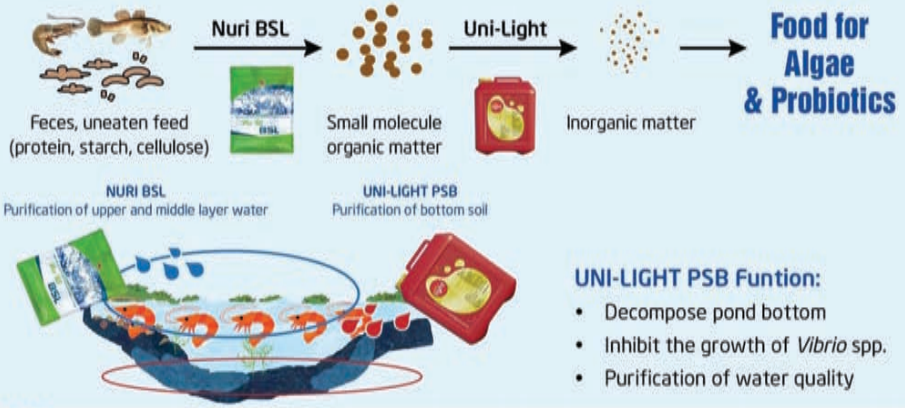
Bacillus spp. > 1x 10^{11} cfu/kg	15%
(Bacillus subtilis, Bacillus amyloliquefaciens, Bacillus licheniformis)	
Carrier (rice bran, corn gluten)	75%
Moisture	10%

* STORAGE:

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

* DIRECTION OF USE:

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



UNI-LIGHT PSB Funtion:

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

BSL Dosage:

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

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

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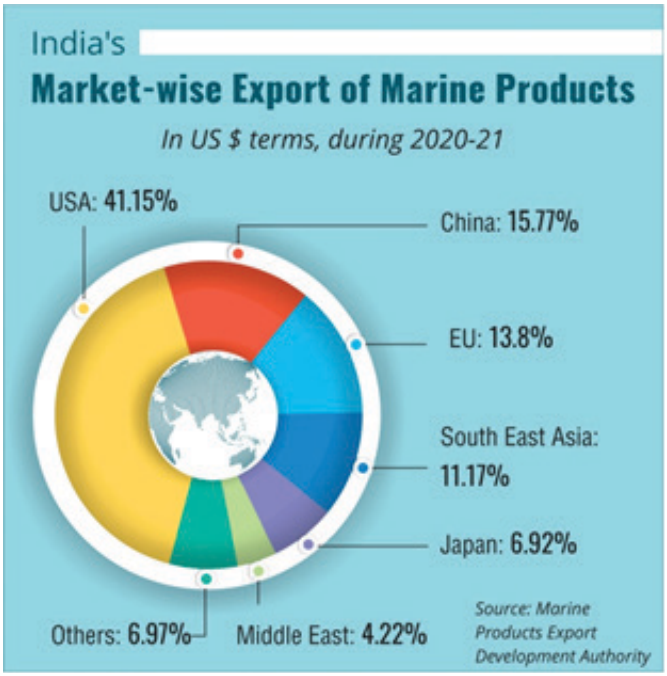


Frozen squid and frozen cuttlefish exports declined in volume by 30.19 per cent and 16.38 per cent, respectively. However, dried items showed an increase of 1.47 per cent and 17 per cent in quantity and rupee value, respectively.

Shipments of chilled items and live items, which were negatively affected due to the reduced air cargo connectivity in the pandemic situation, fell by 16.89 per cent and 39.91 per cent in volume, respectively.

Capture fisheries contribution reduced from 56.03 per cent to 53.55 per cent in quantity and from 36.42 per cent to 32.01 per cent in dollar value. However, tilapia and ornamental fish performed well with 55.83 per cent and 66.55 per cent increase in quantity and an uptick of 38.07 per cent and 14.63 per cent in dollar earnings, respectively. Tuna showed 14.6 per cent increase in quantity, but its dollar earnings downed by 7.39 per cent. Crab and scampi exports reduced both in quantity and value.

USA, with imports of 2,91,948 MT, continued to be the major importer of Indian seafood with a share of 41.15 per cent in dollar terms. Exports to that country grew by 0.48 % in rupee value but declined by 4.34 per cent and 4.35 per cent in quantity and dollar terms, respectively. Frozen shrimp remained the principal item exported to USA while exports of Vannamei shrimp showed an uptick of 6.75 per cent in quantity. However, its import of Black Tiger shrimps decreased by 70.96 per cent and 65.24 per cent in quantity and dollar terms, respectively.

China, with an import of 2,18,343 MT of seafood worth 939.17 million dollars, remained the second largest market with a share of 15.77 per cent in dollar earnings and 19 per cent in quantity terms. However, exports to this country declined by 33.73 per cent and 31.68 per cent in quantity and dollar terms, respectively. Frozen shrimp was the major item of exports to China, accounting for a share of 46.64 per cent in quantity and 61.87 per cent in dollar earnings.

EU, the third largest destination with a share of 13.80 per cent in dollar value, imported frozen shrimp as the major item. However, export of frozen shrimp to EU countries decreased by 5.27 per cent and 6.48 per cent in quantity and dollar value, respectively.

Exports to South East Asia had a share of 11.17 per cent in dollar value. However, it declined by 2.56 per cent in quantity and 5.73 per cent in dollar earnings. Shipments to Japan, the fifth largest importer with a share of 6.92 per cent in dollar terms, grew by 10.52 per cent in quantity but declined by 2.42 per cent in dollar value.

The Middle East, the sixth largest destination with a share of 4.22 per cent in dollar value, declined by 15.30 per cent and 15.51 per cent in quantity and dollar terms, respectively. Frozen shrimp was the major item of exports, having a share of 72.23 per cent in dollar terms.

Mr Srinivas said besides the pandemic impact, several other factors negatively impacted seafood exports during 2020-21. On the production side, there were reduced fish landings due to less number of fishing days, slow logistic movements and market uncertainties. Scarcity of workers in fishing and processing plants, paucity of containers at seaports, increased air freight charges and limited flight availability affected exports, especially of high-value chilled and live products.

The situation in overseas market was another dampener. In China, container shortage, increased freight charges, and COVID testing on seafood consignments caused market uncertainties. In USA, scarcity of containers made it difficult for exporters to execute orders in time. Closure of HoReCa (hotel, restaurant and café) segment also affected the demand. In Japan and EU, COVID-induced lockdowns made the retail, restaurant, supermarkets and hotel consumption sluggish.

AP supplying power to aqua farmers at Rs 1.50 per unit, costing Rs 1500 core annually

Vijayawada: Andhra Pradesh state government is supplying electricity to aquaculture farmers in the state at Rs 1.50 per unit. The government for this purpose extended Rs 1500 cores.

The state has about 40,000 shrimp farmers and a larger number of fish farmers using the power. It is also educating farmers about the best practices in forming.

Yaas-hit aquaculture biz to lose Rs 1k cr

Kolkata, 28 May 2021: Aquaculture industry in West Bengal is staring at a loss of over Rs 1,000 crore following 26 May 2021 cyclone Yaas, which wreaked havoc and inundated a large area of agricultural fields and water bodies across some districts. The state accounts for almost 15 - 20 % of India's export of Aquaculture products, which, along with Odisha, have been hit badly by the flood-like situation following Yaas. Aquaculture export from the state is worth over Rs 8,000 crore.

The overall marine product exports from India would take a hit following this cyclone, which has already suffered a setback due to Covid 19 pandemic. Marine product exports sector has been registering record growth for the last 10 years from a level of Rs 8,000 crore in 2009 - 10 to Rs 47,000 crore in 2019 – 20. But, it has hit its worst year in 2020 - 21. Following Yaas, the plight is taking a turn for the worse, feel industry players.

Rajarshi Banerji, president, the Seafood Exporters Association of India, West Bengal region, pointed out that embankments breached at 130 places in East Midnapur alone, apart from several other in South 24 Parganas such as Namkhana, Kakdwip and Hingalganj. According to him, main areas of damage to shrimp farms include those facing sea at Mandarmani belt; Kanthi coastal belt-Bakipur area; farms along Haldi River and Rasulpur River-Kalinagar Belt; Norghat belt. Farms in Nayachar Belt were severely damaged. Part of Nandigram belt was badly hit, too.

"Seeding was complete up to 80 – 90 %. Most of the shrimp crop had grown and was ready for harvest; 25 – 30 % of that matured crop has been lost. Value of only crop loss in Midnapur is reliably estimated at around Rs 900 -1,000 crore. This does not include damage to farms, embankment, infrastructure, tools are separate," he added.

Banerjee feels that a rescue package will be definitely necessary for the farmers.

He pointed out that tidal water has gone down. But water entered through breach of embankments is still there in the farms. Which can't be used for prawn culture for the rest of this year. "West Bengal was expecting its all-time highest prawn crop of 1 lakh tonne this year. That prospect is damaged severely," he added.

An official of the association added that as per reports pouring in from the districts about 3,000 hectares of shrimp farms along the coasts of Odisha and Bengal become submerged. The severity of Cyclone Yaas on shrimp farmers of both the states seems to be significant, according to preliminary reports, according to a report in Times of India.

India backs IMTA initiative

Kerala, 24 May 2021: A pilot integrated multi-trophic aquaculture (IMTA) programme in Kerala, that combined the production of green mussels, seaweed and finfish, has proved to be a great success.

The project was undertaken by India's Central Marine Fisheries Research Institute (CMFRI), working with fish farmers in Moothakunnam, Ernakulam.

CMFRI started the venture in December last year as part of its research initiative for developing a sustainable cage fish farming model suitable to Kerala's ecosystem. In the first harvest among the three crops of the integrated farming, around one tonne of green mussel was produced from 150 strings hung around four fish cages.

The individual mussels grew to 72 g, which is a successful growth rate in mussel farming, according to CMFRI. Despite the harvest taking place during the Covid lockdown, the entire produce sold out quickly.

According to experts from the CMFRI, a good harvest with better growth rate of green mussel showed that IMTA is economically feasible and well suited to Kerala's conditions. A scientific team led by Dr Shoji Joseph, principal scientist of CMFRI, also observed that the fish inside the cage attained

Harvest of green mussel from a pilot IMTA project in Kerala, started by CMFRI

better growth and seaweed being cultured around the cage showed healthy status, with a fast growth rate. The fish are due to be harvested by the end of June.

IMTA also helps to maintain environmental sustainability. "Excess nutrients and carbon dioxide from the cage farm are directly or indirectly utilised by green mussel and seaweeds," said Dr Joseph.

CMFRI director Dr A. Gopalakrishnan said that the institute would take steps to popularise IMTA around the coast.

"CMFRI has successfully developed a model of IMTA practice on open sea waters of Tamil Nadu which helps coastal people fetch increased income. The popularisation of this innovative technology, in line with the increasing trend of adoption of cage farming technology, will help transform the lives of coastal communities," he said.

Courtesy: ***The Fish Site***

HIKE IN FREIGHT COSTS, RETALIATORY TARIFF

Seafood industry fears further setback

Kochi, 3 May 2021: Already beset with problems on the production and export fronts, the Indian seafood sector fears further setback due to the proposed retaliatory tariff by the US and impending freight rate hike.

US trade authorities are planning retaliatory tariffs against the imposition of two per cent tax by India on revenue generated by digital services offered in India.

One of the items mentioned is frozen shrimps. India's largest market of aquaculture shrimps is the US, accounting for about 50 per cent of the country's total production of $ 2.5 billion annually. The shrimp export sector, which employs nearly 10 million people, will get seriously affected, and requires an urgent consideration from the government, a note prepared by Seafood Exporters Association of India said.

Higher shipping charges

Freight rates have been progressively raised for reefer containers to the US from $ 3,500 in March 2020 to around $ 6,500 now. The note said the seafood industry has now been informed by Maersk lines that effective May 1, the rate will be $ 12,500. Following Maersk, the largest shipping liner in the world, other shipping companies may follow suit.

Marine product exports sector, which had been regularly registering annual growth over the past decade (from a level of ₹8,000 crore in 2009 - 10 to ₹47,000 crore in 2019 - 20), has gone through its worst year in 2020 - 21 with a drop of 20 per cent in turnover as well as volumes, said Alex K. Ninan, President of Seafood Exporters Association of India-Kerala Region.

Financial woes

The marine product export sector, which was the most healthy at the beginning of last year, had ambitious plans of ₹1,00,000 crore by 2025. This now looks bleak and a tad distant now. The sector is facing problems on all fronts, starting from fiscal support, disturbance or blockage of various major markets, serious issues relating to primary production source both in capture and culture fisheries, hike in freight and other costs, to erosion of net worth of many companies and the related finance support not coming from the banking sector, he said.

Business with China, which constitutes about 25 per cent of the total marine product exports from India, has been totally disturbed. The border issues have had an effect on normal flow of business.

The association has urged the Prime Minister Narendra Modi to include the issues on stringent measures on antibiotic residues in shrimp consignments which have been lower in the last few years than several other countries, in his trade talks at the India-EU Summit shortly.

The problem of the delay in release of MEIS from April to August 2020 amounting to ₹1,000 crore has been compounded by the fixation of a cap of ₹2 crore per exporter on the MEIS accruals at 5 per cent of FOB, for September to December 2020. The sector appealed for immediate introduction of Remission of Duties and Taxes on Exported Products (RODTEP) Scheme in the place of MEIS, says a report in The Hindu Business Line on May 4.

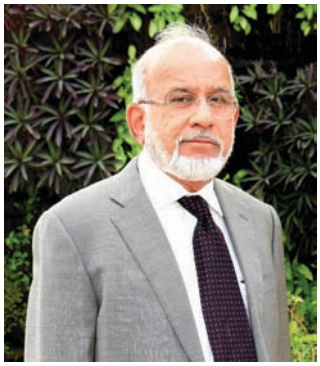
Avanti Feeds, Devi Sea Foods donate Rs one Crore each for corona prevention measure

P. Brahmanandam, MD, Devi Sea Foods Ltd

A. Indra Kumar, Chairman & MD, Avanti Feeds Ltd

Amaravathi: For Covid prevention measures, Vizag belonged industrialist Devi Sea Foods Ltd Managing Director Mr P. Brahmanandam and Avanti Feeds Ltd Chairman and Managing Director Mr A. Indra Kumar have donated each of Rs one Crore to the Chief Minister Relief fund.

Biostadt India Supports Employees with a Special Covid Care Program



Juzar Khorakiwala, Chairman and Managing Director, Biostadt India Ltd

Mumbai, 26 May 2021: Biostadt India Limited, a leading company in the agriculture, aquaculture and biostimulants sector, has rolled out special COVID care compensations for its employees across India. During these trying times, human lives have seen more hardship to last a lifetime. As a company with a mission to serve the farming community and with people at the heart of its business culture, Biostadt has announced these important initiatives for the benefit of the employees and their families.

- *Compensation of 1-year's salary to the spouse of COVID victims.*
- *Insurance policy of Rs. 10 lakhs against COVID fatalities for families of employees.*
- *Uninterrupted education upto graduation level for children, due to death of employees including COVID victims.*
- *A special COVID bonus of 3% for the year ended 31 March 2021.*

Biostadt believes it has a duty to stand by its employees especially during times of hardship. This could be physical, mental or even emotional challenges, at which time, the support of family and loved ones is paramount. Enabling close to 800 employees across the country, Biostadt offers the spouse of a COVID victim a full one year's salary to assist in whatever emergencies they may have. Additionally, the company has also taken out a COVID Insurance policy to the extent of Rs. 10 lakhs, for all employees resulting in COVID related fatalities. Due to the loss of a parent or sole earning member of the family, children should not lose out on any educational opportunities. Keeping this in mind, Biostadt will also be taking care of direct educational expenses of all the children of the deceased upto their graduation levels. As a gesture of good faith, the company also gave a COVID special bonus of 3% for the year ended 31 March 2021 to all employees. Very soon, the company is gearing up to offer yoga sessions to all employees which will be sponsored by the company.

In keeping with the brand ethos of servicing the community at large, Biostadt India also made contributions to multiple NGOs to the tune of INR 1 crore at the beginning of the pandemic in 2020, which was highly appreciated and put to much needed use.

Mr Juzar Khorakiwala – Chairman and Managing Director said, *"Uncertainties are life's constant and we are in unprecedented times. This pandemic has made life unpredictable, placing unknown challenges in our midst. At Biostadt, our people are our strength and it is a privilege and commitment to be there for our employees in their toughest hours. The sudden and untimely loss of a family member is undoubtedly the most difficult to bear and we mourn their loss as an organization and as a family. As a humble gesture, we are offering these compensations to help them in a small way during this time."*

Established in 2003, Biostadt India Limited is a diversified agrochemical organization which has been empowering the agricultural sector in India and across the globe. The company reached a turnover of INR 1000 crores in 2021. As market leaders and with a ground presence in biologicals, crop protection chemicals, aquaculture inputs, hybrid seeds, custom manufacturing, and international operations, Biostadt provides the farming community with superlative and research based products that enhance and ensure good quality yield.

How this Delhi seafood startup became the vendor of choice for the HORECA and B2B sectors

11 May 2021: In late 2007, Sanket Gupta had just graduated from Galgotia College of Engineering in Greater Noida. Like many aspiring entrepreneurs, he was brimming with ideas. He could be a retailer, a chocolatier and a tech entrepreneur.

Four years later, after trying his hand at many things, a discussion on how seafood retail was a 95 percent disorganised industry led him to change tack. It led him to helm seafood startup United Industries.

"I travelled all the way from Delhi to Nellore and Bhimavaram, in Andhra Pradesh, to understand how prawns were grown and retailed. I also visited local markets, which supplied fish that was at least seven days old. I wanted to understand if individual quick freezing could be a method to get fresh prawn and fish to market," Sanket says.

Launched in 2016, the Delhi-based seafood startup harvests 45 tons of prawns and fish every month, and sells to the HORECA and B2B sectors. In 2019, it started its own B2C brand, Aquastar, and began to supply fish directly to consumers.

In Andhra Pradesh, Sanket began talking to farmers and supply chain solutions providers. Both sides stated that seafood was borderline stale when it entered big cities because it would be "on ice, and not frozen".

Clear that frozen was the way forward when seafood was being transported, Sanket began trading in seafood like any ordinary trader arranging deals across the country. He did this for six years and learnt the tricks of the trade. He soon realised that he was ready to move up the value chain - from being a trader to manufacturer - and create a brand in the process. He set up a food processing unit in Bhimavaram and worked with over 20 farmers in 30 acres of land to source prawns and fish. And that's when the brand United Industries was born in 2016.

Today, the company farms and harvests 45 tons of prawns and fish on a monthly basis. After harvest, the seafood is cleaned and individually quickly frozen to maintain freshness for a week.

"This means the fish stays fresh till it reaches the plate within five to 15 days. We have more than 30 customers buying directly from us, including meat ecommerce companies," Sanket says.

The brand

In 2016, Sanket roped in his sister, **Shipra Gupta**, to take over the marketing and operations of the business. "I was a techie and was working in a couple of IT companies when my brother began expanding business pan-India. From being a trader, he had gone on to set up a factory, integrate farms, and B2B clients. I came in to help him with branding and expanding the operations," says Shipra.

Both of them began to meet large hotel chains like the Taj Group of Hotels and the Oberois to get them to try and taste their produce. As the quality standards were high - in harvesting, cleaning, and supply chain - United Industries became the go-to vendor for these chains. The company works with **27 HORECA clients**.

In 2019, the company started its own B2C brand called Aquastar and began to supply fish directly to consumers. In 2020, just when the pandemic hit, the brand turned to WhatsApp to ensure that operations were not affected. It began to create communities in cities where it operated, including Bangalore, Mumbai, and Delhi, to supply seafood to direct orders on WhatsApp.

"The pandemic hit the supply chain hard for two months. It affected our B2C and B2B businesses. But with seafood being an essential product, we found our way in to retail stores and markets. WhatsApp helped us clear stocks and we were able to work with our farmers in Andhra Pradesh," Sanket says.

The product range in the Indian industry includes a range of seafood, including fresh such as Vannamie Prawns, Indian Basa, Pomfret, Surmai, Tilapia, Mahi, and Rohu, and frozen produce such as IQF Prawns, Vietnamese Basa, River Salmon, Bombay Duck, and more. It is in trading IQF Prawns that United Industries has made its mark.

The family-owned company's business model is simple – it buys from farmers at a farmgate price and sell it at Rs 570 and then sells them at a margin in the market.

The startup competes with distributors such as Amigo, Siam Canadian, and Angel Plus. These companies also supply to the HORECA market. According to E&Y HORECA is $55 billion to $65 billion food purchase market in India

Over the last year, United Industries has reached a revenue of Rs 25 crore. It has big plans for the future: it aims to be a Rs 100 crore business in five years. The company, which doubled its B2B clients in 2021, has plans to invest in its D2C business, and increase its market share in the Northern, Western and Southern markets.

According to Expert Markets Research, seafood is a $15 billion market in India, and poised to double in five years.

"It's a great market to go after in India. There is increased consumption of protein and seafood is a great way for people to increase their protein intake. United Industries will scale up very fast," Shipra says.

Prof Donald V. Lightner passes away

Tuscon, 4 May 2021: Prof. Donald V. Lightner passed away on May 4, 2021 in Tuscon, Arizona. He will be missed by his family and friends, and by academic and industry colleagues around the world. The world of aquaculture especially aquatic animal disease specialist lost an icon.

Dr Donald V. Lightner

In the 1970's, Dr Lightner put together a team of researchers at the university of Arizona that provided much of a the basic knowledge on shrimp disease and health which enabled shrimp aquaculture grow into a global industry that now supplies more than half of all the shrimp consumed around the world.

Virtually every shrimp disease expert in the world has had some connection with Dr Lightner and the Aquaculture Pathology Laboratory in the University of Arizona in Tucson, Arizona. Dons contributions were both applied on his visits to farms around the world and the academic with hundreds of scientific articles, industry reports, conference presentations, graduate students, and short courses.

The University of Arizona's role as the world Organization for Animal Health(OIE, Paris, France) Reference Lab for crustacean health and as a major service provider for industry are testimony to the role that Don personified as the go person for shrimp health globally, says Dr Arun K. Dhar, Ph.D, Associate Professor, Director, Aquaculture.

Gassen Plus

Bon Ammonia and obnoxious Gasses

Shrimp / Fish performs all their body functions and growth in water. Good quality water and proper D.O. levels determines the success or failure. Good quality water, optimum D.O. level is of prime importance for health and growth of Shrimp / Fish.

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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MPEDA's Mud Crab Hatchery Technology gets patent right for 20 years

Technology to boost diversified aquaculture and seafood exports: MPEDA Chairman

Kochi, 14 May 2021: In an impressive milestone in India's aquaculture sector, MPEDA-RGCA's mud crab hatchery technology, the only one of its kind in the country, has been granted patent by the Controller General of Patent, Design and Trade Marks, Government of India, for 20 years from 2011 to 2030.

The hatchery technology for mud crab (scientific name – Scylla serrata), a much in demand species in South East Asian countries where live crabs are highly preferred as a delectable seafood, has been developed by the Rajiv Gandhi Centre for Aquaculture (RGCA), the research and development arm of the Marine Products Export Development Authority (MPEDA).

MPEDA Chairman Mr K. S. Srinivas said it is a remarkable achievement in the history of Indian aquaculture as for the first time the Central Government has granted patent for this technology in the country.

"It will go a long way in meeting the seed requirement of farmers who intend to undertake diversified species for aquaculture instead of concentrating on shrimp farming alone. MPEDA is dedicating this achievement to the aquaculture farmers of the country for their support and to the young scientists of RGCA who have worked tirelessly to achieve this morale-boosting feat," added Mr Srinivas, who is also President of RGCA.

K. S. Srinivas, Chairman, MPEDA

Mud Crab Hatchery Rajiv Gandhi Centre for Aquaculture

Mud Crab Adult

Taking into account that there is no other hatchery for mud crab in India, RGCA had applied for patent right for the mud crab hatchery technology in 2011 with the Controller General of Patent, Design and Trade Marks.

However, the patent was granted after following a long arduous process. Various research institutions in the world discussed the matter with renowned experts, who referred various research references and held a string of meetings with RGCA's scientists with facts and figures. After ascertaining the various issues, it was finally decided to grant the patent right to the hatchery technology of MPEDA–RGCA for 20 years, which is unique in India.

Keeping in view the huge demand of mud crab, especially in South East Asian countries, MPEDA had initiated a pilot project for mud crab seed (known as crab-instar) production during 2004 and subsequently made the commercial hatchery for the first time in India during 2013 with the capacity of one million per annum. Due to its growing demand, the seed production capacity of RGCA's mud crab

Match Box Sized Crablets

hatchery has been increased to 1.4 million per annum.

Dr Emilia T. Quinitio, an eminent scientist from Aquaculture Division of International Institute known as Southeast Asian Fisheries Development Centre (SEAFDEC), Philippines, had extended the consultancy service till 2013 to RGCA. Since then, the technology has been standardized by the RGCA's scientists within a short span of period.

So far, 7.28 million seeds have been produced and supplied to 659 farmers across the country.

The MPEDA chairman said the major achievement lies in increasing the survival rate of crab in star from three per cent world record to seven per cent. Further, the hatchery unit is designed in such a manner that all sections are under one roof with complete bio-security measures. So far, 7.28 million seeds have been produced and supplied to 659 farmers across the country.

RGCA has been set up to give a fillip to commercialization of diversified aquaculture species such as Sea bass, Mud crab, Genetically Improved Farmed Tilapia (GIFT), Cobia, Pompano and Artemia. It focuses on increasing India's marine products export by producing and supplying good quality seeds, which is a prime input for aquaculture.

"We would like to thank the Department of Commerce and Department of Fisheries of the Central Government besides the Indian Council of Agricultural Research (ICAR) for their continued support to MPEDA-RGCA for implementation of projects for promotion of diversified aquaculture in India," Srinivas said.

Biopesticide: An Ecofriendly approach to the Aquaculture Practice

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Highlight Points

- In this article discussed about the use of bio-pesticides in aquaculture practice.
- Concept of bio-pesticide is an eco-friendly approach in agriculture as well as aquaculture practice because it is mainly made up of plant and animal materials.
- Farmers are benefited to use this pesticide because it increases the production silently and affordable cost.
- In future for sustainable production bio-pesticides are required in aquaculture sector.

Biopesticide is one type of eco-friendly pesticide which is mainly derived from natural material such as animals, plants and microbes. Nematodes, plants (e.g. Chrysanthemum, Azadiracthaindica), microbes (e.g. Bacillus thuringiensis, Tricoderma, Nucleopolyhedrosis virus) which are the parental material of biopesticides.

Three major classes of biopesticides

- Microbial Biopesticides
- Plant incorporated Biopesticides
- Biochemical Biopesticides

Table 1: summarized 3 types of biopesticides.

Microbial biopesticides	Plant incorporated biopesticides	Bio-chemical biopesticides
Products which consist of microorganisms as active ingredients. Mainly utilized fungi, bacteria and virus. Ex. Bacillus thurinngiensis	Here, genes inserted into the plant tissue and pesticides produce inside its own. Ex. Bt canola, Bt cotton, Bt potato etc.	Naturally occurring substance that control pests by non-toxic mechanisms. Ex. Azadiractin from Neem tree.

As a biopesticide extraction of Neemazadiractin is one of the most versatile and well known which contains at least 35 biologically active compounds such as antiviral, antibacterial, antifungal and insecticidal properties (Murussiet al., 2015).

Earlier to remove the predatory fish from aquaculture pond different types of synthetic piscicides were used. These piscicdes have long term persistency in the water and also contaminate the aquatic environment. Therefore in the present situation, biopesticides are replaced with

those harmful synthetic pesticides (Saravanaet al., 2010). Biopesticides are gained much more attention due to its non-persistency and low bioavailability in the environment.

Azadiractin has been successfully used in aquaculture to control the predator fish and different pest (Saravanaet al., 2010). Sometimes, it also prevents bacterial and viral infections in aquaculture farms. The dose of these biopesticides is most important because a high dose of biopesticides is slightly toxic towards the non-targeted organisms (Murussiet al., 2015 and Saravanaet al., 2010).

Significance

- Biopesticide is a systematic pesticide mainly acts upon target organism and closely related organisms(Saravanaet al., 2010).
- These are decomposed very quickly and bioavailability is very low.
- It is an integrated approach to ensure ecosystem and conserve biodiversity.
- It is replaced the synthetic pesticides and reduce the contamination in aquaculture farm and enhances

the ecosystem based aquaculture for sustainability (Murussiet al., 2015).

- Biopesticides are also prevented bacterial, fungal and parasitic infections in fish culture (Kumar et al., 2013).
- Inhibit the growth of weeds.
- More effective than chemical pesticides in the long term.

Hindrances

- High levels of these substances are slightly toxic to the non-targeted organisms (Saravanaet al., 2010).
- Sometimes the speed of action of these pesticides is very low.
- Biopesticides are highly specific, mainly act upon the targeted species.

Future prospect and Conclusion

Biopesticides are eco-friendly to the environment. In the present situation, acceptances of these substances are increased among the farmer due to its low marketable value and environmental safety. Due to the use of biopesticides revolution occurs in aquaculture practice. In the future, much more research is required to standardize the optimal dose of different biopesticides for non-targeted organisms.

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Crab Culture: A potential species for mariculture

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Highlight Points

1. The Commercial crab culture is one of lucrative and profitable aquaculture business for small-scale fisherman across the globe.
2. There are various species of mud crab which occur in mangrove swamps and nearby intertidal and subtidal muddy habitat.
3. The crabs are basically carnivorous and prefer to feed on slow-moving and bottom-dwelling animals such as bivalve molluscs, small crabs and dead and decayed animal materials.
4. The mud crabs are generally sold in live condition for both local consumption and live export trade.
5. There are four commercial viable species of mud crab-like Scylla serrata, S. *tranquebarica*, S. *paramamosain* and S. olivacea.

Abstract:

The crab culture has a large number of variations as compare to the other types of aquaculture like the use of wild seedstock and hatchery produced. The farming systems also exhibits variation from extensive to intensive, monoculture to polyculture; and mangrove farm to well-constructed ponds or fattening cages. There is no specific way to farm mud crabs, but techniques, technologies and principles have been developed a lot so that it can be adapted to meet the specific needs of farmers and governments wishing to develop mud crab aquaculture businesses.

Introduction:

The culture of the mud crab has been started 100 years ago in China and for the past 30 years throughout Asia. Majority of crab aquaculture production relies on wild-caught stock, as larval rearing has not yet reached a commercially viable level for stocking into aquaculture farms. The major limitation restricting the further expansion of mud crab culture is the inadequate supply of crab seed for stocking enclosures. Even at the present magnitude of the mud crab culture industry, quantities of crab seeds caught by fishermen are insufficient to meet demand. Apart from this, it is also causing the loss of mangrove forest, over exploitation of wild stocks. The seasonal nature of availability of seed crabs compounds the supply problem. There are various species

of mud crab which occur in mangrove swamps and nearby intertidal and subtidal muddy habitat throughout tropical to warm temperate zones where they form the basis of small but important in shore. The size, high meat yield and delicate flavour of crabs are sought after as a quality food item. As they are simply caught by means of simple traps or nets, they remain alive for considerable periods after capture (Gillespie and Burke 1992) and are of high value. The animal is an important source of income for small-scale fishers throughout the Asia-Pacific region. There are four commercial viable species of mud crab which are sold live in market like *Scylla serrata*, *S. tranquebarica*, *S. Paramamosain* and *S. Olivacea* that are the focus of both commercial fisheries and aquaculture production throughout their distribution.

Habit and habitat:

The crabs are generally found in the shallow coastal waters, lagoons, estuaries, backwaters, brackishwater lakes, the mangroves and inter-tidal swamps of east and west coast as well as in the creeks and bays of Andaman and Nicobar Islands. They select sandy or muddy slush bottom for their life cycle. Both the species prefer to remain buried under the substratum during the day and are active in the night. The larger species *(S. tranquebariea)* remains buried under the substratum, the smaller species (S. *serrata)* remains in the burrows made at the bottom most part of the embankments in a brackish water canals and fish farms. Both the species wander into brackish water area during their post-larval stage (megalopa stage). Early juveniles abound the inter-tidal region, while the adults occupy a deeper portion of the estuaries. After reaching maturity, adults migrate, especially the berried females to the sea for breeding. S *tranquebarica* is free-living and frequents open areas of estuaries, whereas *S.serrata* is more common in mangrove areas.

Life history:

The mud crab megalopais non-selective among estuarine habitats (seagrass, mud or sand) while crablets (juvenile mud crabs) strongly select for a seagrass habitat, indicating that living within seagrass beds likely increases their survival. This supports the theory that mud crabs settle out of the plankton in the near shore region of the coastal shelf and colonize in the estuaries. Crablets makes shelter in a variety of in shore habitats including reed beds, areas of aquatic macrophytes, under stones and within the mud and sandy sediments.

The maturation of mud crab is a step-wise process where they pass through an apparent physiological maturation before becoming functionally mature. In *S. serrata,* the 01 stage of maturation for a male occurs from carapace width (CW) 90–110 mm, while from CW 140–160 mm males develop their characteristic "large-claw" and mating scars on their sternum and front walking legs developed apparent. A sudden change in the chela height to CW ratio has also been linked to functional maturation of males in *S. paramamosain*. The absence of mating scars does not confirm that a male is immature, as these can be lost between moults. In immature *Scylla* spp., a chitinous protrusion from the sternite engages the abdomen, preventing it from opening, so that abdominal disengagement is required before either males or females can mate. In female mud crabs, the characteristic U shape of their abdominal flap, heavily pigmented abdomen and highly setose pleopods together with a well-developed fringe of setae is a more obvious sign of maturation. The Copulation typically follows the change of the abdomen from the more triangular immature female to the more rounded, broad form.

Typically, males guard mature females, cradling them prior to their moult. The male carries the female underneath him using three pairs of walking legs. The male can successfully mate and transfer spermatophores (packets of sperm) into the female's spermatheca once she has moulted and is soft-shelled. During copulation, which may last 7–18 hours, the male turns the female upside down.The female stays in the protection of the male until her shell is fully hardened, which may be several days. The subsequent development of the ovary can be seen by depressing and pushing forwards the first abdominal segment next to the carapace on female crabs. The color of ovaries change as they mature, progressing from transparent through to yellow and finally dark orange, although a more accurate description of the maturation process can be obtained through microscopic examination.

Sexual identity:

Sex can be identified in juveniles measuring 35 mm in carapace width (CW) by the shape of the abdominal flap. In a male, the abdominal flap is slender and triangular, while it is broad and triangular in immature and semi-circular in matured and berried females. In case of both sexes, the abdominal flap in live crabs is folded firmly against the ventral side of the body.

Food and feeding habits:

Both the species of mud crabs are carnivorous. They feed on slow-moving and bottom-dwelling animals such as bivalve molluscs, small crabs and dead and decayed animal materials. These crabs are often known as scavengers in spite of that they cannot catch alive stirring prey.

Moulting:

The growth in mud crabs is exhibitedby the shedding of the outer shell. Before moulting, a new exoskeleton is developed below the old, hard and dead shell. During the moulting process, the old shell is cast off. The formation of the new shell and casting of the old shell is energy taking process which is called moulting. The growth in the sizeof the crab after moulting occurs due to the endo-osmosis of water by the body tissueand thus the moulted crabs increase in their size. Since the moulted crabs utilizes the deposited energy for moulting, they comparatively weigh less and they contain more amount of water.The newly moulted crabs having watery meat and soft exoskeleton are known as 'water crabs'. Such water crab remains defenceless and becomesan easy prey to other animals, mainly by the other hard mud crabs. The new formed shell of the moulted crabs becomes hardens 3-4 days later moulting. The frequency of moulting generally more injuveniles and sub-adults, while it is less in adults. The hard-shelled crabs are known as "meat crabs", which fetch a higher price.

Growth:

In the field culture, the early juvenile crabs (15 to 60 mm in CWl3 to 20 g in TW) grow at a rate of 7 to 13 g per month, while juvenile crabs (60 to 80 mm / 25 to 70 g) shows a monthly growth of 10 to 12 mm and 45 to 95 g. In sub-adult and adult stages, the monthly growth works out to

9 to 10 mm and 100 to 130 g. The *S.tranquebarica* attains a maximum size of 220 mm and 2.5 kg and the *S.serrate* attains 160 mm and l *kg* in the wild.

Maturity:

The attainment of maturity in female crabs can be identified by change in the shape of the abdominal flap, from triangular to half-roundhorse-shoe shaped. For males, there is no external morphological character to identify the mature ones. The size at maturity for a female is about 120 mm for *S. Tranquebarica* and *83*mm for *S. serrata).* After the commencement of maturity, the development ofovary takes place internally. Initially, the colour of the ovary is bright orange which later changes to deep yellow before extrusion of eggs. The inner ovarian development is determined by pressing down between the carapace and abdominal flap. The mature egg is visible by its yellowish colour.

Mating:

The copulation occurs between a hard male and a freshly moulted soft female. Prior to copulation, a hard male climbs over the back of hard female crab, clasping her by his chelipeds and first two pairs of walking legs. This formation is known as "doubler" or "pre-mating embrace" which continues for around 2 - 3 days. The pair divorces when the female approach the moulting. The female moults which is called as "pre-copulatory moult". The male helps the female throughout the pre-copulatory moulting. After the moultingoccurs, the male embraces the soft female again for the real mating. The male gently turns the female over on her back by the help of his chelipeds, while the female discloses her abdominal flap and holds the male in position. The copulation continues for around 6-8 hours. During the copulation act, the male deposits spermatophores in the seminal receptacles of the female.

Breeding:

When the eggs become ripe, they are fertilised with the help of stored spermatophores. After that, they are extruded and remain as "mass" or 'sponge" and attached to the hair-like branches of 04 pairs of appendages of the abdominal flap. The egg mass as a whole, attached to the abdominal flap is called as *"berry".* The number of eggs in the beny varies from 2 to 3 million for *S. tranquebarica.* The eggs measure 0.2 to 0.3 mm in diameter. The incubation period is about 2 weeks, during which time, the colour of the eggs gradually changes fromorange to brown and then to black. The stored spermatophores are used for more than two spawning. The mud crabs are continuous breeders asevidenced by the occurrence of ovigerous and berried females throughout the year inthe coastal water.

Hatching:

As part of health management, the berried crabs obtained either from wild or from the culture pond or from the captive brood-stock facility should be treated with 10 ppm malachite green and methylene blue dipping for 5 minutes, which would ensure the eradication of harmful bacteria from the eggs. This treatment would enhance the hatching rates. The berried females should be kept individually in 500-litre capacity fibre glass / cement tanks covered with black cloth to cut the light. Before the liberation of larvae, the abdominal flap of the mother crab makes frequent jerking movements and the egg mass get loosened. Also, the jabbing of walking legs over the egg mass takes place, before hatching first zoea larvae from the eggs. Normally, the release of larvae occurs in the early morning hours, which is a continuous process, lasting for 3 - 5 hours. The liberated zoea larvae are photo-tactic, i.e. attracting towards the light.

Larval stages:

Before releasing the larvae, the colour of the eggs becomes black, which is due to the formation of eyes of the larva, The larva which emerges after piercing the egg membrane is called as "zoea'. There are 5 zoea and lmegalopastages (post-larval) before attaining the first crab stage. The interval between zoeal stagesis 3 - 4 days and the megalopa takes 11-12 days to become the first crab stage. The size of the first and fifth zoea is 1.2 mm and 3.5 mm in length respectively, while the megalopa measures 2.5 mm in carapace length. The first crab stage, which measures 3 7 mm in carapace width. The zoeal larvae are highly carnivorous and feed on larvae / adults of zooplankton including zoeal larvae of their own and other crabs, indicating the existence of cannibalism from larval stages onwards. The duration between the first zoea and first crab stage is about one month.

Culture practices:

The culture of mud crab started from the eighties of the nineteenth century. In the traditional shrimp and fish culture fields, young mud crabs generally migrate through the sluice gate and the grown-up crabs are fished out at the time of partial or final harvest. Initially, the young crabs collected from the wild were stocked in milk fish (*Chanoschanos*) or tiger shrimp *(Penaeusmonodon*) culture ponds as a secondary stock, since the mud crabs do not compete for food either with fish or with shrimp. Later, monoculture for mud crabshas emerged to meet the increased demand and practised in Bangladesh, China, India, Indonesia, Malaysia, Singapore, Sri Lanka, Taiwan and the Philippines on amoderate scale. In order to reduce the dependence on wild seed, efforts were made to raise the seed under the hatchery system and met with varying degree of success in China, India, Malaysia and the Philippines.

Types of culture:

Four types of culture are practised in South East Asian countries:

1. Mono-culture in grow-out ponds with proper fencing, where juvenile crabs are raised to marketable size over a period of 3 - 4 months.
2. Poly-culture with shrimp, milk fish and seaweed
3. Fattening process, in which, recently moulted crabs are raised to gain weight in 3 -4 weeks
4. Rearing of un-riped females till they develop full ovaries.

Pond preparation:

To prevent the escape of reared crabs from the pond, fencing with suitable materials such as casuarinas poles, bamboo split matting, G.I. chicken wire mesh, plastic-coated galvanised Iron wire mesh, nylon netting and asbestos sheet to a height of one meter are erected either in the inner edge of the pond or on the top of the earthen bund. The fencing is positioned at 45° towards the inner side of the pond to prevent the climbing and escape of small crabs. Since mud crabs are highly cannibalistic, earthen and PVC pipes and worn-out tyres are placed as hideouts / shelters

to reduce the fighting among the normal hard crabs and mortality of the soft "water crabs".

Stocking:

The crabs with a size range of 80 to 100grams are stocked at a rate of 1 - 5 / m^2. The stocking with uniform-sized crabs is preferred to avoid fighting and competence for food. The first zoea larvae are stocked at a rate of 30 – 100 / litre in 2 - ton fibre glass / cement larval rearing tanks with filtered seawater and aeration facility.

Grow-out pond culture:

The earthen ponds of 0.1 - 0.4 ha in size and rectangular in shape having a sandy or muddy or clay loamy bottom soil are preferred to suit the burrowing habits of the mud crab and provided with 4 meters wide and 0.8 meter deep ditches leading towards the sluice as shelters. The wider axis of the pond is arranged to face the backwater canal in order to have a greater tidal effect through the sluice. A row of earthen mounds is constructed in such a way that they remain submerged during the high tide and visible during low tide, in order to serve as natural habitat. The filtered sea water having a salinity range of 30 - 35 ppt and water temperature of 27 - 29 °C is used daily water exchange at the rate of 80 %. The reared crabs are examined periodically by sampling to record their growth and health condition. By employing a lift net with bait preferably in the evening hours, crabs can be obtained for sampling. The crabs should be handled with care and properly tied before measuring their carapace width and weight. At stacking density of 1 crab/m^2, it grows from an initial size of 50 g to the final weight of 500 g in 4 months. The containers used for export of live mud crabs %. The "water crabs" encountered in the final harvest are utilised for fattening purpose.

Feeding:

The reared crabs are fed twice in a day, preferably in the forenoon and in the late evening either with trash fish or mollusc meat (bivalve/ gastropod) at a rate of 5 to10 % of stocked biomass, depending upon the observed feeding intensity and the size recorded at a regular and periodical sampling of the reared crabs. The daily rate of feeding for a 4 - month culture is expressed as:

Daily feed = No. of crabs x % of Average body weight x % of the feeding dose

Percentage composition of natural food of Scylla serrata of different on to genic stages

S.N.	Food item	Juve-niles	Sub-adults	Adults
1	Unidentified organic matter	42.09	46.30	41.09
2	Inorganic sand shell	9.46	15.04	17.18
3	Plant, algae and sea grass	13.05	12.88	16.0
4	Fish meat and hard parts	17.41	12.18	10.24
5	Molluscs	9.21	7.18	8.58
6	Crustacean	8.20	5.16	4.56
7	Unidentified organic matter	0.57	1.26	2.24

Water management

In tide-fed ponds, water having a salinity of 10 – 35 ppt is exchanged through the sluice. The water temperature is maintained within the range of 28 - 32 °C and the dissolved oxygen level 5 - 7 ppm. The pH of the water is retainedbetween 7.5 - 8.5. The depth of water is maintained in the culture pond should be 0.5 to 1.0 m.When the crabs tend to come out of the pond, it is an indication of deterioration of quality of pond water.

Transport of berried crabs:

For short-time transportation (1 - 6 hrs.), the berried crabs are kept submerged in sea water (salinity- 15-25 ppt) and placed individually in 10 - litre capacity containers such as plastic buckets and metal tins. For longer journeys of 7 - 24 hours, 50 - litre capacity containers with proper provision for aeration are used.

Packing:

The first pair of largest legs with pincers (chelate legs) of each live crab is firmly tied up with the body by jute or nylon thread to curb their movement and to avoid the fighting among them. The wet seaweeds are kept in between the packed layers of crabs to enhance their moist and cool condition during the transport from place to place for local consumption. The tied crabs are washed with fresh seawater and packed either in a bamboo basket or in perforated thermocol box for export purpose.

Marketing:

The mud crabs are generally sold in live condition for both local consumption and live export trade. For the marketing purpose, mud crabs are graded as 'extra-large" (1 kg and above), "large" (500 grams to 1 kg), "medium (300 to 500 grams) and "small" (200 to 300 grams). The matured and berried female crabs are usually sold at a higher price. The meaty crabs weighing above 300 grams are considered for live mud crab export, while the smaller-sized crabs (less than 300 grams) and the crabs which have lost their limbs are sold by number in local markets. They are marketed only in live condition, as there is an aversion among the consumers for dead mud crabs.

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FISH PASTE: A VIABLE OPTION FOR INDIAN SEAFOOD EXPORT INDUSTRIES

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Fish paste is a value added product prepared from deboned fish by mixing with condiments, salt and oil. Fish flesh with other choice of ingredients is mixed in a meat bowl chopper to get fine paste consistency and taste.

Fishes suitable for fish paste preparation

Both fatty and non-fatty fishes of marine origin and fresh water fishes of low value are preferable for fish paste production. Marine fatty fishes could serve as rich source of omega-3 fatty acids and impart characteristics taste of fatty fishes. Fish paste can be prepared from variety of fishes even from fishes with low economic value.

List of some of the suitable fishes and their approximate cost

Marine fish / prawns / fresh water price	*Cost in Rs (Average landing centre /farm gate price)
Sardines	47 - 98*
Mackerel	130 - 180*
Tuna	180 - 250
Pink Perch	125 - 150
Croaker	150 - 180
Ribbon fishes	140 - 271*
Squid	215 - 280
Non-Penaid prawns	220 - 330*
Tilapia	120 - 180
Indian major carps/exotic carps	160 - 220
Pangasius	90 - 160

*CMFRI annual report 2018-2019.

Highlight Points

- Fish paste is very rich in highly digestible protein with well-balanced essential amino acids.
- Fish paste has promising market potential in domestic as well as international market.
- Fish paste production, suitable ingredients and nutritional benefits are discussed in this article.
- Indian seafood export industry needs diversification and value addition.
- Information provided would help in new entrepreneurship development in seafood sector.

Note: The cost varies with location, season and demand supply. For the purpose of business, lower the cost of fish better the return and viability.

A wide variety of ingredients have been tried in the formulation of fish paste (Table 1). Commercial products in the market having customized ingredients in the recipe to meet the local consumer preferences. Normally preservatives like, nitrite (E 250), Sodium nitrate (E 251), potassium nitrate (E252) are used as curing agents in the formulations. Ammonium carbonates (E 503) and diacetyl tartaric acid esters of mono- and diglycerides (DATEM) (E472e) are used as raising and stabilizing agents, respectively. Also, derivatives of ascorbic acid like sodium ascorbate (E301) is used as antioxidant especially when fatty fishes are used in fish paste preparation like sardine, mackerel, tuna etc.

Table 1. Ingredients used in recipe formulations

Tomato paste	Soya Protein	Mustard Flour	Lemon Juice
Corn starch	Rapeseed Oil	Wheat Flour	Chicken Stock
Corn starch	Egg Yolk	Calcium Carbonate	Yeast extract
Potato starch	Vinegar	Minerals	Fibre extract
Vinegar	Sugar	Vitamins	Mushroom
Preservatives (E252, E251, E250)	Nutmeg extract	Mayonnaise	Skimmed milk powder
Raising agent (E503)	Onion powder	Herbs extract	Stabilizer (E472e)
Antioxidant (E301)	Ginger paste	Garlic paste	

Note: Ingredients inclusion could be customized based on the consumer targeted/needs

Fish paste is very rich in easily digestible protein compared to chicken and beef paste with the digestibility factor of 93 – 98%. A comparison of the nutritional information of fish paste with chicken and beef paste is represented in Table 2. The added advantage of fish paste when prepared from fatty fishes like sardine, mackerel etc supply therauputicΩ-3 fatty acids which are very limited in paste prepared from other meat varieties.

Table 2. Nutritional information (per 100g) of fish paste - a comparison with market products available commercially

Nutrients	Fish paste	Chicken paste	Beef paste
Protein	14 - 17 g	13 - 15g	13 - 15 g
Fat	9 - 10 g	11 - 13 g	15 - 17 g
Carbohy-drate	6 - 9 g	4 - 6 g	1 - 5 g
Salt	1.5 - 2.0 g	0.75 - 1.25 g	1.0 - 1.5 g
Omega-3	1 - 3 g	---	--

Salient features of fish paste:

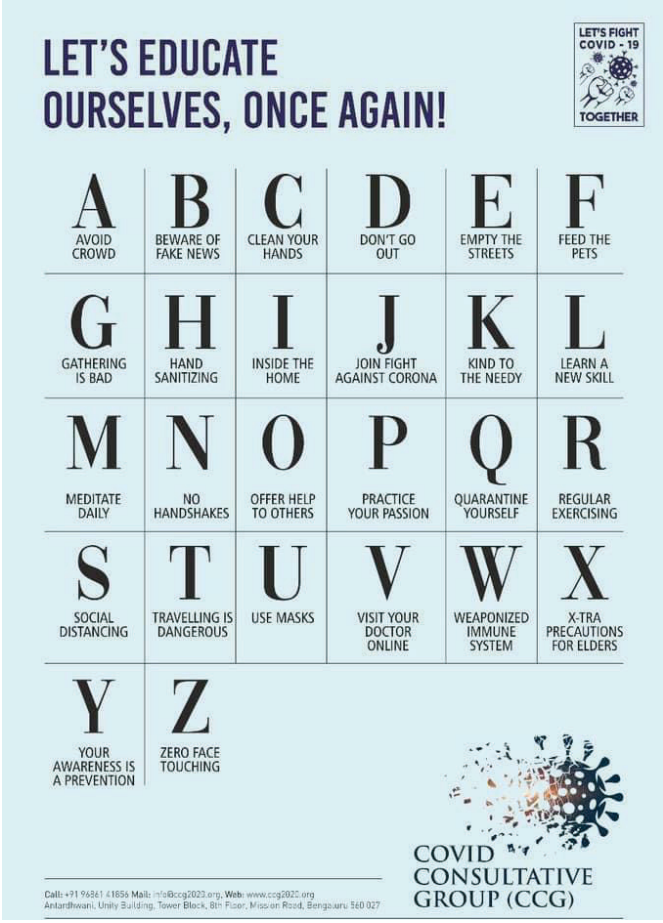
- Very rich in highly digestible protein with well-balanced essential amino acids.
- Can be customized to variety of taste .Helps in concealing the identity of the original fish from which it is made and consumers may not hesitate to accept this even though the original fish would have been unacceptable as whole fish.
- It finds application in processing several 'convenience foods' like salad dressings, spread (bread spread / spread on roti / chapatti), condiments etc.
- Suitable for all age groups including kids, lactating women and aged persons.

Storage:

- Can be stored under chilled condition (+0 to 2°C) with a shelf life of few days to few weeks
- Can be stored under frozen condition (-18°C) with a shelf life of 6 to 12 months
- Fish paste in Ready-to-eat (RTE) form can be stored at ambient temperature with a shelf life of minimum 1 year

Conclusion:

Considering the great nutritional advantage and convenience, fish paste can be a very good viable option for the Indian market, where the value addition is very limited. Although, fish paste has huge demand in International market, currently it is not being exported from India. To cope up with the growing competition for innovative fish products in the international market, Indian seafood Industry and other aspiring entrepreneurs can consider fish paste as a viable business option.



Rainbow Trout: Harnessing the Potential in India

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Highlight Points

- The cold water / hill fishery resources of the country are spread from north-western to north-eastern Himalayan region and some parts of Western Ghats, encompassing about ten States.
- Considering the diverse natural resource-base and wide climatic diversity, they are ideal for developing food, sport and ornamental fisheries of high value to provide avenues of livelihoods for the hill people, where other income earning opportunities are less and difficult to practice.
- There is huge opportunity for investors to develop industrial scale integrated Rainbow trout units exclusively for international markets also.
- Government of India has given special attention in terms of Policy, legislation, development and conservation under 'Blue Revolution' and now 'Prime Minister's Matsya Sampada Yojna' (PMMSY) to ensure adequate brood stock, import of germ plasm, seed, feed, grow-out and marketing infrastructure for large scale expansion of trout farming in potential areas.

Private Trout Farm, Kullu, HP

Profile

Dr Salim Sultan obtained his M.Sc., M.Phil., and Ph.D. degree in Fisheries from Aligarh Muslim University, Aligarh and advance trainings on various aspects of Fisheries, Aquaculture and Management from ICAR Institutes, National Productivity Council, Administrative Staff College, Hyderabad and IIM, Ahmadabad. He also served at Senior Positions in UP State Fisheries Department, NFDB, Hyderabad and Ministry of Fisheries GOI, New Delhi. He has worked as Senior Technical Officer, in INFOFISH, Kuala Lumpur and Consultant, World Bank, New Delhi. Additionally, he has worked for the implementation of several National and external funded projects in the field of Aquaculture and Fisheries in about 7 countries. Dr Sultan has contributed more than 80 publications on various aspects of fisheries development published in National and International Magazines / Journals of repute.

Abstract

Presence of bounteous pristine water resources in the form of rivers and rivulets, streams, springs and lakes supported with the institutional and basic infrastructure has steered significant advancement in high altitude fisheries of India. Recent endeavours to supplement fresh Genetically Improved Strain of Rainbow trout obtained from authentic sources of native European countries coupled with increased investment will provide a major impet us for Rainbow Trout farming and consequent economic growth and social development in Himalayan cold regions of India.

Key Words:

Rainbow trout, Farming, Breeding, Formulated feed, Supply-chain

Introduction

Trout, members of family Salmonidae, are native to North America, North Asia and Europe, were introduced in Indian waters during mid-eighteenth Century in the Himalayan and Peninsular regions which represent about 16.2% of geographical area and 4% total population of the country. The amenable coldwater available at the high altitude extremities of India have unique landmass covered with parallel mountains of different geological formations. Though these are difficult areas, the adversities found here also offer excellent aquatic habitats in the form of rivers and

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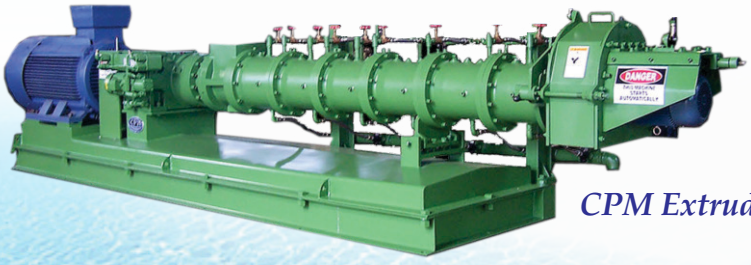

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rivulets, streams and lakes suitable for trout farming. This study critically analyses the range of issues to understand ongoing development and sustainable expansion of trout farming in India.

2. Resource Distribution

The cold water fishery resources comprise waters located in high and mid altitudes zones. Trout contributes about 1063 metric ton annually which is insignificant to the total fish production of the country (about 9.58 million metric ton in 2018). However, it carries larger consequence in the context of resource utilization, unique bio-diversity and germ plasm. Several fish species are widely distributed both in Himalayan and peninsular India forming an entirely different eco-geographical entity.

Areas with Trout Potential

2.1, Major Areas

The Himalayan Ranges of India spreads between 21°57' - 37°5'N latitudes and 72°40 - 97°25'E longitudes with about 250-300 km width. It stretches across 2500 km from Kashmir in the west to Arunachal Pradesh in the east where the geo-climatic and hydrological properties are congenial for trout farming. This area is endowed with natural lakes, rivers, manmade reservoirs and fish diversity. The temperature of this region vary between -15°C to 32°C and receives both south-west and north-east monsoon with an average annual rainfall of 192 cm.

Table 1. Fishery resource distribution in in different states

S.N.	State	Lakes (ha)	Reser-voirs (ha)	Rivers (km)	No. of Fish Species
1	Kashmir Region	137275	4087	10894	26
2	Himachal Pradesh	27	31320	10464	62
3	Uttarakhand	212	16864	10658	63
4	Sikkim	1005	--	1772	47
5	Arunachal Pradesh	2793	--	12351	167

2.2. *Minor Areas* In the Western Ghats region of Peninsular India (Temp Range: 6°C - 20°C, Lat: 11°6- 11°38N, Long: 75°10'-77° 8›E) amenable climatic conditions spread over 2549 km² provide scope for trout farming. Besides streams and rivulets 11 manmade reservoirs (422 ha) is suitable for trout. The eastern part of India such as North Bengal (Temp Range: 1.5-19.1°C,Lat: 27°2'9.62"N, Long: 88°15'45.61"E) Nagaland (Temp Range: 16-31°C, Lat: 25°54'22.56"N, Long: 93°43'39.33"E), Meghalaya (Temp Range: 4.9-24.1°C, Lat: 25°29'-14.60"N, Long: 90°24'-45.84"E) and Manipur (Temp Range: 0-32°C, Lat:24.66° N, Long: 93.90° E) potential is available to a certain extent for farming in raceways.

3. Progress Over the Time

In the Indian Sub-continent two species of trout *viz.* Brown trout (*S. fario*) and Rainbow trout (*O. mykiss*) were transplanted from Europe primarily to develop recreational angling during late 19th and early 20th Century.Separate set of efforts in north-western and peninsular regions of the country were made to establish these exotic species.

Rainbow Trout

3.1. Kashmir Valley

Trout was introduced in 1899 by F.J. Mitchell who brought a consignment of eyed-eggs of Brown trout from England (Mitchell, 1918) which perished during transport. Another consignment of Brown trout eyed-eggs were procured from Scotland in the year 1900 which successfully attained sexual majority and the first spawning was done in December, 1905 at Harwan near Srinagar (Kashmir). Subsequently, Mitchell established trout hatchery at Harwan having a capacity of 100,000 green eggs. Later he succeeded in hatching and rearing Rainbow trout eggs received from Bristol Water Works, England in the year 1912.The state started promotion of Rainbow trout commercial farming in 1984 with the establishment of 'Trout Fish Farming Project, Kokernag' assisted by the EEC (EU). In the 1st phase, 0.1 million eyed-ova were imported from 'Isle of Man' (England) in December 1984 followed by two more consignments in the next two years. Another batch of improved variety which consisted of all female stocks was imported from Denmark. Recently, a consignment of 0.225 million eyed-ova of Rainbow trout imported from Billund (Denmark) were successfully put in for production of brood stock at Beerwah, Budgam (Kashmir) in 2019. This Genetically Improved Rainbow trout strain from Denmark is expected to boost production and arrest inbreeding depression. At present, the state is equipped with 14 hatcheries meant for trout breeding and seed production.

3.2. Himachal Pradesh

The eyed-ova of Brown trout were brought to Kullu, Kangra and Chamba from Kashmir where they hatched successfully at Katrain in the Mahili hatchery; district Kullu in 1909 - 10. Subsequently, from Katrain Brown and Rainbow trout were transferred to Chamba, Barot, Chirgaon and Sangla trout hatcheries. Later a Norwegian Government assisted project

was implemented for Rainbow trout farming in 1988.The transfer of technology envisaged construction of modern trout farm with a capacity to produce 10 metric ton of trout annually, import of fast growing disease-resistant eggs, production of pelletized feed and training. Now 6 trout hatcheries are operational in different parts of the state and catering the needs of farmers for stocking in grow-out raceways.

3.3. Sikkim

Initially, trout fishery development program was confined to production and stocking of brown trout fish seed for promoting angling. Later the farming activity was promoted by government agencies in private sector by distributing the trout seeds to farmers for rearing in the private and public water bodies. There are six trout hatcheries set up in the state for Brown and Rainbow trout seed production. Rainbow trout seedlings so produced are for distribution to the beneficiaries for culture in their private raceways whereas brown trout seedlings produced from Menmoitso and Lachung trout hatcheries are stocked in natural water system for the promotion of angling and to increase trout production. During the year 2015-16, 1.23 lakhs of Brown trout green ova and 1.34 lakhs Rainbow trout green ova was stripped in the government farms. So far 249 beneficiaries have been given financial support under the scheme of trout culture in raceways (2018). The State Fisheries Department has collaborated with ICAR- Directorate of Cold water Fisheries Research, Bheem Tal for research and development program for trout farm management raising of brooders at Uttarey and Yoksom farms. Field officers from State fisheries department were trained at Kokernag trout farm in Jammu and Kashmir.

3.4. Arunachal Pradesh

The landscape of this eastern most state of India is characterized by mountains with snow-clad peaks, dense forests, turbulent streams, rivers, gorges and rich diversity of flora and fauna. The climate varies from sub-tropical in South to temperate and Alpine in the North. Two trout hatcheries have been established in West Kameng (27.133 N, 92.277 E) and Tawang (27.535 N, 92.050 E) districts.

3.5. Peninsular India

The very first attempt to implant trout from New Zealand was made in 1863by Sir Francis Day in Nilgiri Hills and later efforts were followed from 1866 to 1906that were aimed at Brown trout but with little success. Mr. H.C. Wilson, Consultant, Pisciculture, Madras Presidency, constructed a hatchery at Avalanche (Tamil Nadu) in 1909-1910 (Sultan 2012). However, due to failure in the case of Brown trout, the focus shifted towards Rainbow trout.

3.6. *International Collaborations*

Although the attempts for trout culture in upland regions were began in the year 1863; but its expansion did not pick up mainly due to lack of infrastructure and husbandry management. Later on various international agencies helped to overcome the gaps through modernization of infrastructure, disease management and culture practices. The important ones are:

i) Former EEC (now EU) assisted a project in Jammu and Kashmir in association with Fish Farms Development Internationals (FFDI) Scotland and Rambell and Hanneman, Denmark. Equipment and machinery were procured from Ottevanger, Holland in 1984. This project is still a landmark milestone in the development of feed based trout culture in India. The machinery for a new feed mill of 1 ton / hr capacity was imported from Ottevenger, Holland in 2012 with the financial assistance from National Fisheries Development Board to enhance to further enhance feed production capacity in the State.

ii) Norwegian government assisted a project for transfer of technology and production of trout in Himachal Pradesh during 1988 at Patli Kuhl district Kullu which inter alia facilitated trout farming in that area. The Project was split up into two phase's viz. (1) transfer of technology, and (ii) production phase. The transfer of technology (first phase) envisaged construction of modern trout farm on Norwegian model with capacity of produce 10 tonnes of trout per year. Import of quick growing disease-resistant eggs, development of economical and viable pelletized feed with locally available ingredients, training of local staff and farmers & production of economically viable fingerlings with the aim to enable the local farmers to adopt trout farming were the other aspects included under this bilateral project. 'Fish Health Studies' for Rainbow trout farming was done in association with National Veterinary Institute, Oslo, Norway. This part of project covered the areas of fish disease management and skill development for trout farming.

4. **Inherent Constraints**

Though the efforts were initiated, a century ago, for the development of trout farming but the results are not so wide spread, especially quantum of production, due to following complexities.

4.1. Fingerlings

Three different genetic stocks were introduced in the country *viz*. Himachal Pradesh stock, Kashmir stock and Munnar Hill stock (Southern India) (Barat *et al.* 2015). Besides the available capacities in existing 30 hatcheries, estimates project that about additional 22 hatcheries are needed to cater all potential waters. The Stocking material supplied to farmers from government owned hatcheries lacks competitiveness. The supply of under aged or under sized finger ling along with timings directly hampers grow - out results at the end of culture period. Being of paramount importance, this issue is well flagged and due attention has been paid in the prospective plans. The recent endeavor to expand hatchery and seed production activity in private sector will take few years to resolve these issues.

4.2. Feed

A diet of about 35% crude proteins @ 3% of bodyweight per day is recommended during grow-out period of rainbow trout. The requirement for Arginine including n-3 or w-3 PUFA is comparatively higher for this species. Feed formulations use fish meal and its cost always disturbs the final price of feed, pampering for the compromise in

quality and quantity. Some farmers use local substitutes without any standardization which causes growth, health and hygiene related problems. The increasingly scarce supply of fish meal and its high market price had made it necessary to seek a cost effective replacement of fish meal to supply dietary protein in trout feed. This is a significant area for research to reduce the feed cost by developing a formulation consisting of locally available ingredient (Singh *et al*. 2017).

4.3. Post-Harvest Issues

Timely disposal of harvest at remunerative price is another limitation in the spread of rainbow trout farming. Since farms are located in remote areas in the hills with poor transportation facilities, access to market is a real challenge. Being a premium commodity, rural domestic consumption cannot be the target of the Rainbow trout industry. In the absence of post-harvest, especially, cold-chain facilities and reliable market linkages, expansion of trout farming in far flung areas on a commercial scale is stuck up. The sporadic nature of resource coupled with lesser investment discourages indigenous innovations.The longer travel time from harvest to market necessitates proper dressing, preserving and packaging techniques. Ice, cold storage and fish dryers are required to maintain the high quality of the trout meat. The smoked trout and other value added products have been attempted with the technical support of Indian Council of Agriculture Research (ICAR)–Central Institute of Fisheries Technology (CIFT), Cochin in Himachal Pradesh. Value addition of the final produce will be needed to ensure increase in sales, consumption and returns to farmers.

4.4. Health Management

Indian Council of Agriculture Research (ICAR)-Directorate of Cold water Fisheries Research (DCFR), Bheemtal reported presence ofbacteria namely *Citrobacterfreundii, Pantoeaagglomerans, Aeromonashydrophila, Aeromonasveronii, Hafniaalvei, Pseudomonas fluorescens, Plantibactersp, Morganellasp, Staphylococcus sp, Plegiomonassp, Carnobacteriummaltaromaticum & Corynebacterium sp.* Surveillance of Rainbow trout farms at different locationsobserved the presence of bacterial diseases like tail rot, gill rot, fin rot and exophthalmia. However, no epidemic like situation is reported so far in any region of the country. Disease surveillance of trout farms is regularly done under National Surveillance Program on Aquatic Animal Diseases (NSPAAD) by ICAR-National Bureau Fish Genetic Resources (NBFGR) Lucknow.

4.5. *Over Dominance of Government Sector*

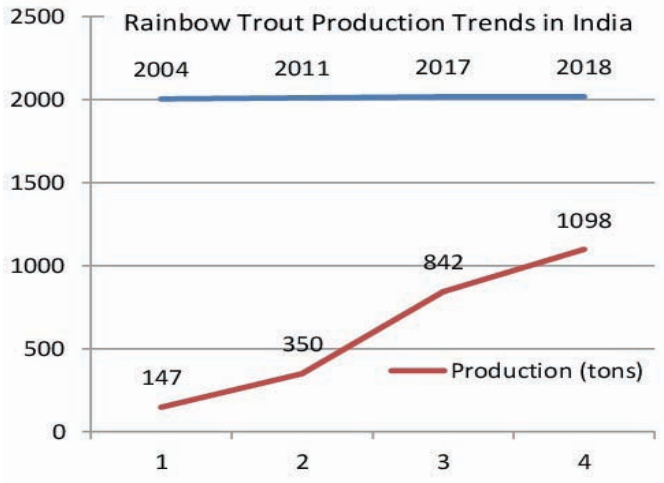
For many reasons government agencies assist development process as it is essential in early phase but the over control suppresses the purpose. Having an early strong role in establishing fisheries in these un-accessible areas in the past, government has extended their involvement by imposing their own ideas and manners. Government agencies presumed to be necessary for designing and implementing policies, but the availability to benefit from resources can be secure by a variety of mechanism, including technology, capital, skills and laws. Efficiencies in these fields have been emerged through differential access to financial capital and infrastructure, government policies, social connections and perhaps entrepreneur behaviour.

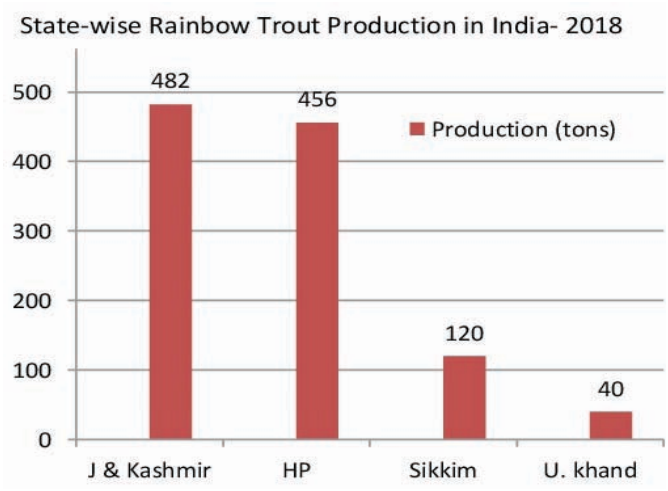
5. *Global* Production Trends

The poor survival of Brown trout due to unique feed requirements dampened the ambition of trout farming. It paved the way for Rainbow trout which eventually became the viable trout fish in the cold waters of India by the end of 20th century. Globally production of trout is increasing and attained 814 MMT level in 2016(FAO). This increase is being possible as a result of pellet feed technology, disease management and improved culture practices. The leading countries are Iran, China, Turkey, Peru, Norway *etc.* Indian production of 1063 ton is negligible in the global perspective.

5.1. *Commercial Farming in India*

Trout farming has progressed steadily in last 4 decades in India and the production has increased from 147 tons during 2004-05 to 1098tons annually in the year 2018. Trout ova production also increased from 1.85 million during 2004-05 to 10.75 million in 2018. Over the years two north-western Himalayan regions namely Himachal Pradesh and Kashmir remained the main contributor to the rainbow trout production (81.2%), however, Sikkim, a north-eastern state has shown significant increase in trout production in recent years while other states such as Uttarakhand, Arunachal Pradesh and states of southern India contributes meagerly.





5.2. *Natural Waters*

Most of the States stock trout fingerlings every year in their respective open waters. The natural stock flourished in the rivers and streams is the main stay of capture fishery and angling. These states regulate angler's activities under relevant rules and regulations to maintain healthy stocks.

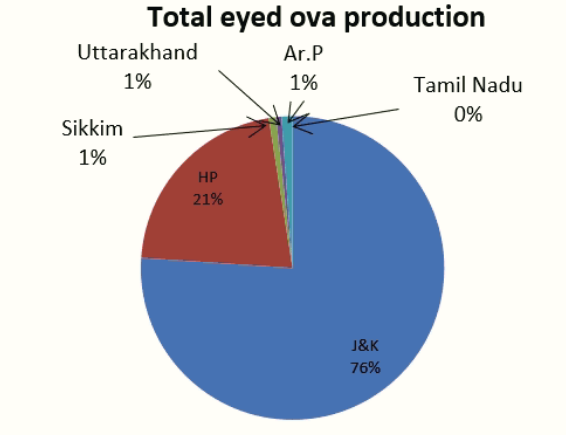
6. Infrastructure

Fish Husbandry related facilities are developed in government and private sector while breeding and seed rearing capacities are mainly in the government owned farms. The grow- out facilities are more in private sector as government intends to push culture activity in private raceways.

State	Govt. Hatcheries (No.)	Eyed Ova Production (Million)	Govt. Farms (No.)	Pvt. Farms (No.)	Feed mills (No.)
Kashmir Region	14	132.00	44	513	3
Himachal Pradesh	5	37.19	5	572	2
Sikkim	5	1.34	5	249	2
Uttara-khand	3	1	4	15	0
Arunachal Pradesh	3	2	3	10	1
Tamil Nadu	1	0.009	1	0	0
Total	31	173.54	62	1359	8

6.1. *Seed Production*

The trout production infrastructure has increased steadily in the country preceding decades. The State-wise infrastructure spread over seven states in the western, north-eastern and peninsular regions of the country. These hatcheries or seed production units cater the need of farmers, private entrepreneurs and also supply for ranching in natural waters to build their stocks. It is estimated that 1356 numbers of trout units exist in the private sector mostly located in the Himachal Pradesh, Kashmir and Sikkim.



6.2. *Formulated Feed Production*

The ingredients and contents of trout feed are different from other fishes due to high protein requirement. The increasingly scarce supply of fish meal and its high market price had made it necessary to seek a cost effective replacement of fish meal to supply dietary protein in trout feed. One of the promising alternate to fish meal seems to be locally available soybean which is rich in protein and generally low in phosphorus. Trout feed is in short supply in all areas except Kashmir. The feed mills of smaller capacity with limited production are logistically more suitable in hilly areas but difficult to operate under various compelling factors. There is a plan to establish about 25 small feed mills serving the grow-out clusters.

7. Technology Dissemination

7.1. *Research*

ICAR-DCFR has undertaken some research and development initiatives for vertical and horizontal expansion of rainbow trout production in the country. These are improved feed having low FCR, farm design with greater efficiency, optimization of stocking density, brood stock maintenance and hatchery practices (Pandey and Ali, 2015).

7.2. *Extension Support*

Government extension agenises take care of capacity building of farmers. Hatcheries operate successfully as the core team is trained by foreign experts. Farmers are encouraged to adhere to the principles of Good Aquaculture Practices as trout farming is highly sensitive for pathogens and nutritional deficiencies.

7.3. *Culture Practice*

The DCFR undertook R&D activities to evaluate the comparative growth performance of the rainbow trout *O. mykiss*from different Himalayan states. The information suggests that higher temperature in midaltitudes of Himalayas can help in yield optimization of trout. Generally, it takes 12 - 14 months to attain marketable size (250 – 260 g) in Kashmir, Himachal Pradesh and Garhwali region of Uttarakhand. However, comparatively better growth of about 500 g is observed in 12 months in west Sikkim due to favorable thermal range of water (14-18°C for 8 months in a year). In general, the production level of rainbow trout in Indian conditions ranges300 - 500 kg per raceway of the size of 15 m x 5 m x 1 m (45 m^2) in 12 months. However, productivity of 1 metric ton /raceway or more has been achieved at different farms in experimental conditions. With regard to stocking density, a flow rate of 4 LPS can support up to 20 kg/m^3, though higher volume and higher quality may allow stocking densities as high as 35 kg/m^3. Of late, with growing intensification of farming practices in raceways, discharge effluents are receiving attention of environmentalists.

7.4. *Maintaining Genetic Stocks of Rainbow Trout in India*

It is important to retain the variability and purity of exotic germ plasm through scientific management of brood stock to check the dilution traits in case of prolonged inbreeding. Regular supplement of improved strain and establishment of exclusive brood bank is the policy to address this issue.

This is also on priority and work is in progress in consultation with the ICAR-DCFR for authentication of source, genetic makeup and post supply tie ups.

8. Market and Trade

Trout is a coveted product and fetches a premium price in Indian consumer's perspective. Most of trout farms are distantly located in difficult terrain and have poor accessibility to the market where quick transportation of fish is difficult, hence the sale of fish is confined to local markets. Himachal Pradesh supply to visiting tourists, Chandigarh and New Delhi, the two nearby metros. Produce from the Government farms is mostly disposed through a chain of outlets in Kashmir, however, the private growers' sale through unorganised trade channels in local markets. Being highly perishable commodity, promotion of proper dressing, preservation and packing techniques along with ice, cold storage, fish dryer will ensure high quality of trout meat. The sale of fish is confined to local markets. New trade channels are expected to come up soon, once production blooms with upcoming infrastructure.

9. Prospective Plan

Government of India has envisaged anambitious five year action plan (2018-22) with the investment of about Rs. 1155 million to upscale trout fishery in all areas above 1500 MSL having congenial temperature range of Rainbow trout. Although there are opportunities in the shape of pristine resources, technologies and substantial gap in demand-supply, some inherent constraints like investment, extension machinery, absence of cold-chain, processing, value addition and marketing channels needs to be taken care. It is planned to overcome these deficiencies by adopting cluster based approachtocover all the segments like culture raceways, fingerling rearing, feed production and marketing through large scale operations at significant locations. Respective agencies may develop suitable spots as 'Trout Village' for bulk production and employment using the commerce to involve private sector, especially in feed, marketing and value-addition to bring resiliency. The thrust areas identified for long term impact: 1.Creation of Infrastructure such as cemented raceways (2200 no.), feed mills (12 no.), hatcheries (22 no.), brood bank (5 no.), and cages (500 no.) *etc*. This will ease the supply of inputs such as finger ling up to 24 million within few years, similarly feed availability will also improve at competitive price.2. Enhancing productivity to achieve targeted production of 5000 tonnes annually.3. Creation of Post-Harvest units that will include cold-chain (14), markets (9), value addition, processing units (9) *etc*.4.The possible employment is about 1800 direct and 600-700 persons indirect. 5. And capacity building to manage farming operations along with conservation and development.

Development of Trout Fisheries under PMMSY

The North-eastern and Himalayan States/UTs will be assisted on specific projects along with all other sub-components/ activities envisaged under PMMSY, as common to all States/ UTs. While fixing unit costs for the remoteness and terrain of these areas has been factored in to facilitate these activities. Some of the activities worth to mention are: (For detailed description please see PMMSY guidelines)

- Disease Monitoring and Surveillance Network: Department of Fisheries (DoF) has initiated a National Surveillance Programme for Aquatic Animal Diseases (NSPAAD) in 2013. Currently, this programme is being implemented in 15 states of aquaculture importance and Union Territory of Andaman and Nicobar Islands, through 24 National/State Fisheries Institutes. The 2nd phase of National Surveillance Programme on Aquatic Animal Diseases (NSPAAD) will be supported under PMMSY with active involvement of States/UTs.
- Establishment of Brood Banks.
- Establishment of Trout Fish Hatcheries.
- Construction of Raceways of minimum of 50 meter^3 including inputs for trout Rearing Units.
- Establishment of medium RAS for Coldwater Fisheries. (with 4 tank of minimum 50m3/tank capacity and fish production capacity of 4 ton/crop).
- Establishment of large RAS for cold water fisheries (with10 tanks of minimum 50 m3/tank capacity and fish production capacity of 10 ton/crop).
- Establishment of Cages in coldwater regions.
- Aquatic Referral Labs for Quality Testing and Disease Diagnostics.

Acknowledgement

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