TNJFU'S TECHNOLOGIES FOR DISSEMINATION

Date: 21.02.2020

Venue: IFPGS, OMR Campus, Chennai

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Contents

1.Nursery Technology for *Vannamei* in Raceways and Lined Ponds under Biofloc Culture

1.	Background of innovation	In recent years major catastrophic losses in shrimp culture was mainly tracked in the early rearing stages of *vannamei*. To overcome this challenge nursery phase intervention is recommended as it improves inventory, predatory and competition control of the culture species. The adoption of nursery phase helps to achieve low FCR and shorter DOC. This practice would permit more crops per year and it provides an opportunity for acclimation in the inland saline areas.
2.	Scientific Intervention	The standardization of nursery technique for raceways stocked 6000PL/m^3 was achieved.
3.	Commercial Potential	As *Penaeus vannamei* is the top most producer in Indian shrimp culture particularly many shrimp hatcheries are located in the northern and southern part of India. This technique would provide generous profit with high survival at commercial level.
4.	Economic benefits	Adoption of the nursery technique would increase production by 20-30% thereby it decreases DOC by 20-30 days. The benefit cost ratio of nursery rearing of *P. vannamei* in raceways and lined ponds was high which proves its economic feasibility.

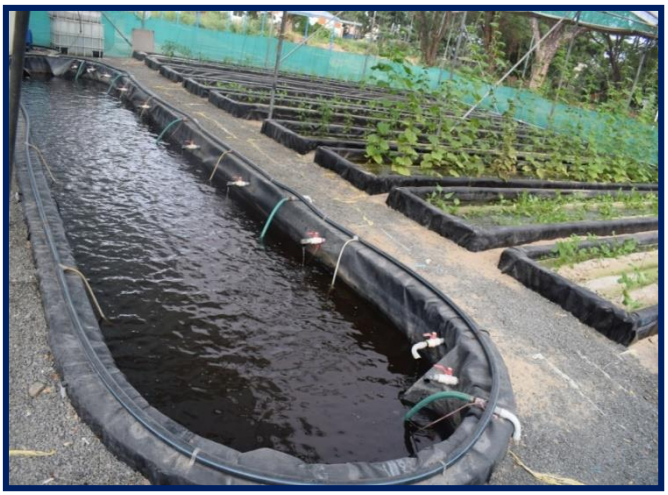
Scheme Title	:	Biosecured AMF driven Farming of Vannamei and Milk fish (Part II, Govt. of TN: 2014-15)
P.I	:	Prof. S. Felix
Names of the Scientists involved	:	Prof. S. Felix Dr.A.Gopalakannan Dr.M.Menaga

Biofloc Trails in Raceways & Lined ponds

2. Aquaponics Integrated culture of GIFT Tilapia & Plants

1.	Background of innovation	Arising climate change impacts in aquaculture along with heavy nutrient discharge from aquaculture ponds pose serious environmental problems such as eutrophication and shift of ecological niches. A huge nutrient discharge from aquaculture ponds also negatively impacts the financial returns of the aquapreneurs. Aquaponics system is an emerging technology is the agriculture and aquaculture sector. Therefore, this ecofriendly technology is promoting green farming technique with a motive of reducing carbon emission in aquaculture is necessary.
2.	Scientific Intervention	An aquaponics system of 60 ton capacity of around 500m^2 was developed to produce 4-5 tons of tilapia and 20-30 tonnes of vegetable per annum.
3.	Commercial Potential	The system is equipped with RAS and organic produce plants can be sold at a higher price in a commercial market. The nutrients from fish culture also will be utilized for the plant culture.
4.	Economic benefits	From fish production at Rs 120 wholesale rate, Rs 5.4laks per annum will be generated. From vegetables flower production at Rs.30, Rs.7.5 lakhs per annum can be earned.

Scheme Title	:	Farmed Pearl Spot (*Etroplus suratensis*) Production as an Alternative Livelihood to Promote Brackish Water Aquaculture Entrepreneurship for Fishers of Pulicat Lake (NADP – New Delhi:2016-17)
P.I	:	Prof. S. Felix
Thesis work	:	M.F.Sc., (S.Prabhu)
Names of the Scientists involved	:	S.Prabhu T.L.S.Samuel Moses Prof. S. Felix



Demo Aquaponics Unit at ARFF, Madhavaram

3. Biofloc driven intensive nursery rearing technology for GIFT tilapia (*Oreochromis niloticus*)

1.	Background of innovation	The ability of the tilapia industry to maintain competitive prices will depend upon improvements in production efficiency. Off flavor issues and purging are critical issues in successful marketing of tilapia. The dress out yield of tilapia is low. Inspite of these challenges, the tilapia industry is forecast to grow and will likely continue to evolve new technologies as it grows. As a means overcoming these challenges, biofloc technology or zero water technology is being applied to improve the production and productivity of GIFT Tilapia Culture.
2.	Scientific Intervention	An increased weight gain in the Tilapia culture was achieved by adopting biofloc technology at a stocking density of 100 fries/m^3 in raceways.
3.	Commercial Potential	Increased fish body weight within shorter duration can be achieved by the adoption of biofloc technology. Maximum body weight with improved FCR will find its commercial importance undoubtedly.
4.	Economic benefits	A continuous production of tilapia especially with the improved strains such as GIFT, Chitralada and Red tilapia can be achieved with reduced days of culture and improved weight gains.

Scheme Title	:	Healthy Shrimp and 'GIFT' Tilapia Production Through Bio-Floc Based Farming System: Development of Technology and Standard Operating Procedure (DBT, New Delhi:2016-19)
P.I	:	Prof. S. Felix
Thesis work	:	Ph.D., (M. Menaga)
Names of the Scientists involved	:	Prof. S. Felix Dr.A.Gopalakannan Dr.M.Menaga

Nursery Biofloc Technology for GIFT

4. Cost effective 'Raceway Ponds' for commercial Biofloc Production

1.	Background of innovation	The expansion of aquaculture is restricted due to high cost of land, its strong dependence on fish meal and fish oil for feed preparation. These ingredients are one of the prime constituents of feeds for commercial aquaculture. Microbial floc produced through microbial intervention using biofloc technology has met the nutritional requirement of commercially important finfishes and shellfishes saving about 30% of the feed cost.
2.	Scientific Intervention	The liner based raceway ponds were constructed in a customized pattern of 17 tonnes capacity for the production of biofloc. A continuous aeration for the suspension and production of biofloc is also provided. Nylon mesh based harvest chamber are used for the biofloc harvest at regular intervals.
3.	Commercial Potential	With the standardized biofloc based production system and established protocol for biofloc production. The utilization of biofloc as feed ingredient with low cost technology of productivity enhancement for shrimp would increase nutrient utilization in aquaculture.
4.	Economic benefits	The cost of constructing a single unit of raceway pond could to be around Rs.1.2-1.5lakhs. The cost of producing 1 kg dry biofloc would cost around Rs.27 farmed on the source of water used for the biofloc production and the flocs nutrient profile can be enriched through the use of different carbon sources. Farmers can produce biofloc in an economically feasible manner.

Scheme Title	:	Upscaling of Biofloc production Technology for developing Eco-Feed for *Vannamei* shrimp culture (NFDB, Hyderabad: 2018-2020)
P.I	:	Prof. S. Felix
Names of the Scientists involved	:	Dr. S. Felix Dr. B. Ahilan T.L.S. Samuel Moses Dr. M. Menaga M. Nethaji

Innovative out-door Biofloc Production Raceways at ARFF, Madhavaram

5. Photo Bioreactor for indoor Biofloc production

1.	Background of innovation	Bioreactors are guiding technology for sustainable future by producing microorganism in an artificial environment. The prefix "photo" particularly describes the bio-reactor's property to cultivate phototrophic micro-organism or organisms which grow by utilizing light energy. Photo bioreactor is the controlled supply of specific environmental condition for certain species. It provides higher growth rates and purity levels than anywhere in natural or habitat similar to nature. Photo-bioreactor can be defined as the culturing systems where the light passes through the reactor walls to the culture cells. Photo-bioreactor lowers the risk of contamination and water loss it also provides greater control of variables that affect culture growth, photo-bioreactors are used to achieve a maximum biomass production at minimum operating costs.
2.	Scientific Intervention	A customized design for the biofloc production equipped with acrylic tubes to the capacity of 25 liters/unit was designed to produce biofloc under controlled environment. The reactor is designed in a way to run the biofloc culture at a flow rate of 40-70l/LPM. Ambient culture conditions are maintained with the help of pH, DO and Temperature sensors for the mass production of biofloc.
3.	Commercial Potential	Fish meal is the first choice as a raw material in aqua feed production for its high-quality protein with a well-balanced amino acid profile. However due to the shrinkage of fish meal availability, bioflocs can be used as a cheaper protein source. The bioflocs produced using photo bioreactor holds high nutrient profile including chlorophylls, vitamins C and trace minerals and it can be added as dietary feed ingredients in fish and shrimp feed.
4.	Economic benefits	The cost of production of biofloc meal using this photo bioreactor would come around Rs.32 per kg dry biofloc with 32% crude protein content. The production of biofloc using this photo bioreactor would be economically viable compared to the use of fishmeal in the shrimp and fish diets.

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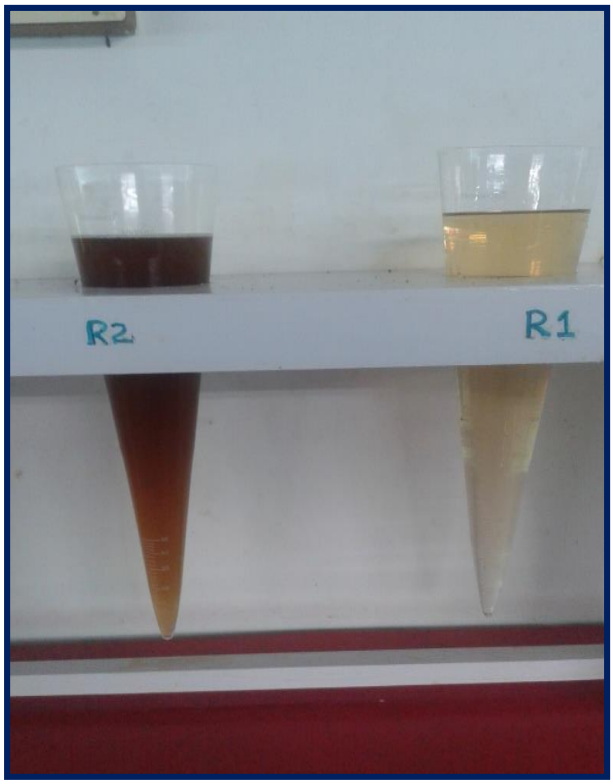
Photo bioreactor for indoor Biofloc production

6.Distillery Effluent in Biofloc Production and its Bioremediation in Aquaculture

1.	Background of innovation	With growing population, industrialization and energy consumption coupled with an increasing reliance on fossil fuels, the energy security needs of the world continue to escalate. One of such growing industries is distilleries and in India major distilleries are agro based which produce ethanol by fermenting agricultural products such as molasses, sucrose containing juices from sugarcane, potatoes, fruits and grains. However, these distilleries become most polluting industries as they consume raw water. Thus bioremediation of distillery effluent from distilleries is felt necessary.
2.	Scientific Intervention	Biofloc technology which is considered as zero water or minimal exchange technology was developed in aquaculture. This can be achieved through the maintenance of optimum carbon: nitrogen ratio i.e. >10%. This requires organic carbon supplementation to convert ammonia to bacterial flocs. Standardization of biofloc technology using distillery spent wash as well as the bioremediation of the distillery spent wash was achieved using this method.
3.	Commercial Potential	The total installed capacity of distilleries in India is 7140 million L alcohol per annum and therefore discharge of distillery effluent can be effectively treated through this technology. The microbial flocs produced by this technology serve as a nutritional food for fish and shrimp and reduced the food conversion ratio from 1.2 to 1.0.
4.	Economic benefits	The cost effective way of treating distillery effluent through biofloc technology does not incur any additional equipment's cost. The microbial fermentation of distillery spentwash and its application in aquaculture would reduce the feed cost by 20% in shrimp and fish culture.

Scheme Title	:	Biosecured AMF driven Farming of Vannamei and Milk fish (Part II, Govt. of Tamil Nadu: 2014-15)
P.I	:	Prof. S. Felix
Thesis work	:	Ph.D., (M.Menaga)
Names of the Scientists involved	:	Prof. S. Felix Dr. A. Gopalakannan Dr. M. Menaga

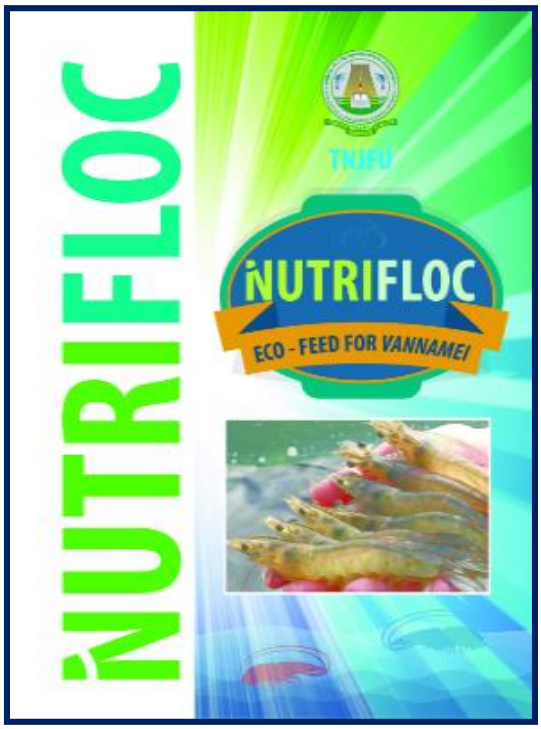


Distillery Effluent in Biofloc Production Trail

7.'Nutrifloc' – Biofloc Based Eco-Feed for *Vannamei* Nursery Culture

1.	Background of innovation	The biofloc systems has multiple advantage interms of feed, possess characteristics of immune modulants in shrimp diets and also effectively recycles the effluents to reduce the pressure on coastal water bodies. Exploration of cheap and fermented byproducts and manipulation of microbial community through probiotic consortium can also provide better quality bioflocs. Thus the use of biofloc as a feed ingredient in the nursery culture of *vannamei* has been developed.
2.	Scientific Intervention	A complete replacement of fish meal by using biofloc meal as a feed ingredient found to improve the growth performance of penaid shrimps. The digestibility of the feed along with improved survival has shown positive results for the growth of *vannamei*.
3.	Commercial Potential	Nutrifloc is a novel ecofriendly shrimp feed prepared from biofloc by replacing fish meal completely. Nutritional compositions of biofloc confirm its nutritional suitability as dietary ingredients for shrimp feed. This alternative feed offer the shrimp industry a viable option to replace costly fish meal and traditional plant protein by biofloc meal.
4.	Economic benefits	'Nutrifloc' feed can be produced at Rs, 65 per kg whereas commercially available shrimp nursery feed costs around Rs.86 per kg. This feed was found to be cost effective, ecofriendly and can bring more return to the farmers in subsidizing their actual feed cost.

Scheme Title	:	Healthy Shrimp and 'GIFT' Tilapia Production Through Bio-Floc Based Farming System: Development of Technology and Standard Operating Procedure (DBT, New Delhi: 2015-16)
P.I	:	Prof. S. Felix
Thesis work	:	M.F.Sc., (S. Ezhilmathi)
Names of the Scientists involved	:	Prof. S. Felix S. Ezhilmathi Dr. A. Gopalakannan Dr. M. Menaga



Biofloc Production in Raceways to formulate shrimp feed

8. 'BIOSAC'- A Polymeric Substance Extracted from Biofloc Culture Systems

1.	Background of innovation	Biofloc possess several immune modulatory compounds such as carotenoids, polysaccharides, phytosterols, taurine. An adequate level of PHB in biofloc to prevent the cultured animals from pathogenic infections has been reported widely. Therefore evidence on the efficiency of various PHB producing bacteria and its PHB production has been attempted.
2.	Scientific Intervention	A group of 40 bacterial isolates segregated from biofloc systems were grown in specific media for PHB production. The application of PHB in shrimp and GIFT Tilapia were found to improve the immune performance and particularly its disease resistance to *Vibrio* and *Aeromonas hydrophila* were also proved.
3.	Commercial Potential	'Biosac' is a biodegradable and bio compatible mixture which contains extra polysaccharides and polymers produced by beneficial bacterial species. It may find its uses in finfish and shellfish rearing for both nursery and growout culture in any culture systems.
4.	Economic benefits	As 'Biosac' is a biodegradable and biocompatible polymer produced by several bacterial species, the cost of production is Rs 2000 for 5g whereas other similar products that are commercially available would cost around Rs 10,000 for 10 g. Also this product has low restorability and tunable properties may find its uses in a variety of applications such as tissue engineering, controlled release systems, etc.

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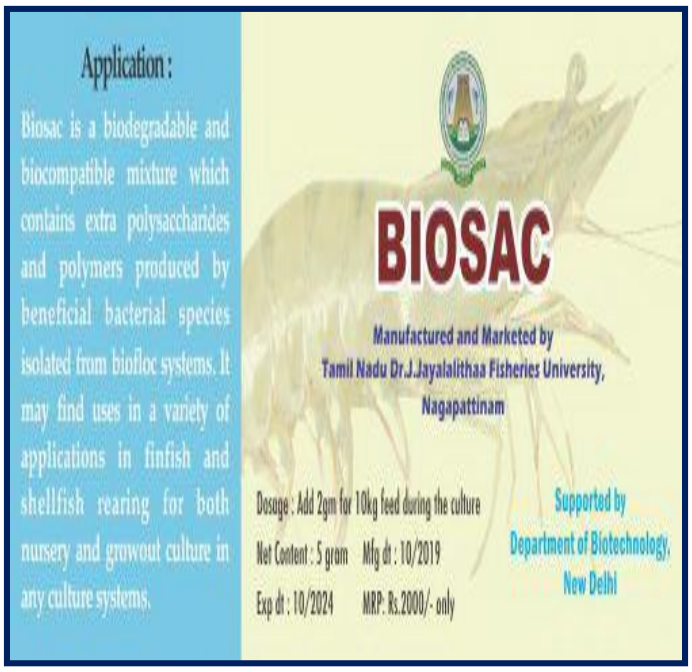

'BIOSAC' – a feed additive extract from Biofloc

9. 'BIOINO' - An Inoculum for rapid development of Biofloc

1.	Background of innovation	The intensification of the aquaculture can be driven by many advanced technologies and one among them is the biofloc technology. This technology allows aquaculture animals to grow at higher stocking densities with minimal water exchange. Therefore, different strategies are adopted worldwide to develop the biofloc using different carbon sources. A microbial consortium isolated from biofloc systems were used for the biofloc development and its effect on qualitative and quantitative characteristics of flocs were attempted.
2.	Scientific Intervention	Among 40 bacterial groups, five species of bioflocculant producing bacteria were identified and tested for its potential in rapid biofloc formation in both freshwater and seawater. The supplementation of 'BIOINO' at 25-30ml/ ton of water for alternative days during pond preparation improved the floc development.
3.	Commercial Potential	The use of flocculant producing bacteria in biofloc formation would enhance the floc characteristics interms of floc volume as well as floc settling velocity, floc density index, floc volume index, and porosity, TSS, TDS and VSS.
4.	Economic benefits	The production cost of BIOINO would cost around Rs. 750 whereas other similar products that are commercially available are costing around Rs.1500-2000 for 500ml. The application of 'BIOINO' also reduce the days of pond preparation for stocking the seeds due to the rapid development of floc in biofloc driven ponds.

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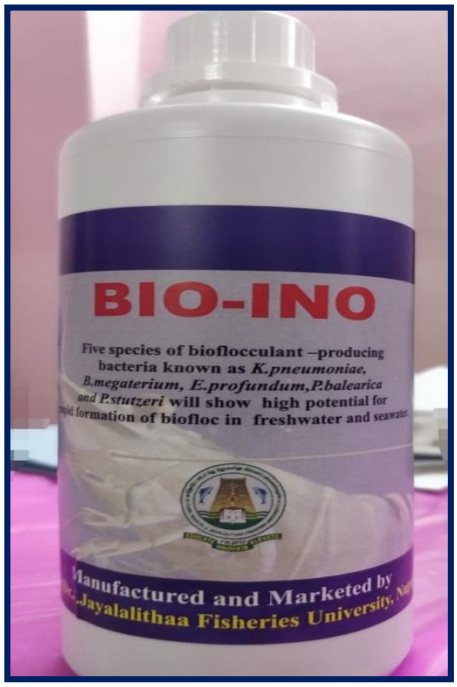
P.I	:	Prof. S. Felix
Thesis work	:	Ph.D., (M.Menaga)
Names of the Scientists involved	:	Prof.S.Felix Dr.A.Gopalakannan Dr.M.Menaga



'Bio-Ino': an inoculum for Biofloc production

10. Biofloc culture of Koi Carp (*Cyprinus carpio* var. *koi*) in Biosecured Raceways and Lined Ponds.

1.	Background of innovation	Ornamental fish culture has a huge potential in India and its commercial marketing is being flourished with several native and exotic ornamental fishes. Among which, the Koi carp, *Cyprinus carpio* var. *koi* belonging to the family Cyprinidae is an attractive ornamental fish that has high domestic and export value in ornamental fish trade. Use of biofloc technology in rearing this fish and enhancement of carotenoid pigmentation was studied for its commercial viability.
2.	Scientific Intervention	The culture of koi carp in bio secured raceways and lined ponds under biofloc technology increased the total carotenoid concentration along with survival.
3.	Commercial Potential	Koi carp is the second largest cultured ornamental fish in the India. This has the commercial potential in Indian market and production of koi carp using biofloc technology would increase the market value by 20% with high survival.
4.	Economic benefits	The ornamental fishes grown under biofloc conditions have enhanced carotenoid content resulting better coloration. It is technically feasible, economically viable and it is also ecofriendly for adoption

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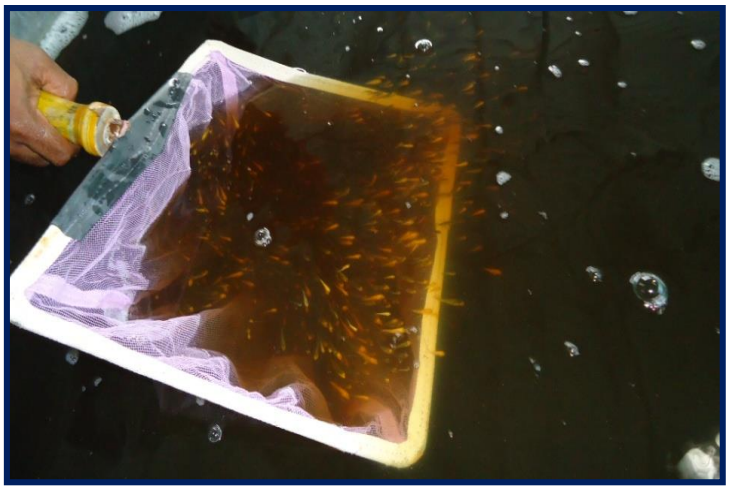
P.I	:	Prof. S. Felix
Names of the Scientists involved	:	Prof. S. Felix Antony Raj



Koi culture in Raceways (ARFF, Madhavaram)

11. Mass production of Pearl Spot – KARIMEEN (*Etroplus suratensis)* using Hormones

1.	Background of innovation	• *Etroplus suratensis* is native to southern Asia including India and Sri Lanka. It is an economically important food fish. In India it is widely distributed and traditionally cultured in estuaries and inland waters • Because of their omnivorous feeding habit, wide salinity tolerance, and high market price in Kerala, Pearl Spot is considered ideal for commercial culture in brackish and freshwaters • Cage culture of pearl spot is popular in Kerala. Lack of required quantity of fish seed has been the most serious constraint for expansion of its culture and there is a huge demand for supply of pearl spot seeds • The major constraint in the aquaculture of pearl spot is the lack of induced breeding techniques due to its inherent low fecundity, complex breeding behavior and parental care The present technology was developed with WOVA-FH and HCG hormones for the induced breeding and mass production of *E. suratensis* in polythene lined pond
2.	Scientific Intervention	In this technology, scientific intervention has been made to induce the breeding of pearl spot by synthetic hormones. • Pearl spot brooders length and weight 15 -18 cm and 110-180g were selected. WOVA-FH or HCG hormone is to be injected @0.5ml/kg and @1500IU/kg of body weight in the intramuscular region of the fish • After that injected fish were transferred to HDPE lined ponds. The fishes were stocked 1 fish /2m^3. After stocking of brooders, substrate material such as clay pot need to introduced into the pond 1-2 pot/ 10 m^3

		• The female fish lays the egg on the substratum and subsequently fertilized by male. Fertilized eggs are diligently guarded and aerator by both the parents and especially by female. The incubation period for eggs of pearl spot is between 82-100hrs • After the incubation period the larvae are hatched out. Newly hatched larvae will be free swimming in 7 days and in 20-25 days from 100 m^3 pond 1500-2000 Nos. of fry can be harvested • The optimum range of salinity induced breeding of breeding in brackish water for pearl spot is between 20-25ppt
3.	Commercial Potential	The technology can be transferred commercially to the interested aquaculture farmers to induced breeding of Pearl spot by synthetic hormones to increase themass seed production of pearl spot and to ensure the year round availability of seeds for cage culture of pearl spot in open water bodies. The Pearl spot is having good market value especially in Tamil Nadu and Kerala states.
4.	Economic benefits	It is commonly believed that the long term sustainability of fisheries and aquaculture of a brackish water fish species can be accomplished only through the development of captive seed production technologies. Standardization of breeding protocol for large scale seed production of brackish water fish species is critical in this expansion. Hence extensive farming of this fish species is very important, but is not being done mainly due to the non-availability of sufficient seed. Seed is the most important input in aquaculture. However, the induced breeding techniques to achieve economically viable results in commercial aquaculture operations by timely supply of seeds.

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P.I	:	Prof. S. Felix
Names of the Scientists involved	:	Prof. S. Felix Dr. B. Ahilan T. L. S. Samuel Moses Dr. Selvaraj

Mass production of Pearl Spot - KARIMEEN (*Etroplus suratensis)* using Hormones

12. Cage culture of Pearl Spot (KARIMEEN) (*Etroplus suratensis)*

1.	Background of innovation	• Cage culture is receiving more attention by both researchers and commercial producers. Factors such as increasing consumption of fish, declining stocks of wild fishes and poor farm economy has increased interest in fish production in cages • Cage culture also offers the farmer a chance to utilize existing water resources in which most cases have only limited use for other purposes. Cage aquaculture involves the growing of fishes in existing water resources while being enclosed in a net cage which allows free flow of water • It is an aquaculture production system made of a floating frame, net materials and mooring system (with rope, buoy, anchor etc.) with a round floating net to hold and culture large number of fishes and can be installed in reservoir, river, lake or sea • Cage culture of Pearl spot were carried out in estuaries and inland waters. For the successful cage culture, selection the proper site is very an important factor
2.	Scientific Intervention	In this technology, scientific intervention has been made to culture of pearl spot in cages to increase the fish production especially to standardize the stocking density and to study the economic viability of the technology
	• Individual square shape cages (3×3×1m) made up of HDPE can be used • Four anchors each minimum having a weight of 10 KG are to be used • For every cubic meter 20-25 Nos. of fingerlings having minimum size of 15g of weight were stocked • Every day, the fishes are fed twice with 32% protein floating feed at the rate of 5 % based on their body weight • Feeding rate was revised by sampling once in 15 days based on increase in body weight • The nets in the cages should be cleaned properly on regular basis • At the end of culture period 5-6 months 4-6 kg/m^3pearl spot can be harvested	

3.	Commercial Potential	The technology can be transferred commercially to the interested aquaculture farmers to culture of pearl spot in cages to increase the fish production
4.	Economic benefits	The high productivity per unit area in cage farming and remunerative prices for the cultured species offer tremendous scope for raising the income of fish farmers in the state through cage farming. Currently cage farmed fishes find a better market in the local areas itself owing to the huge demand for quality fishes.

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P.I	:	Prof. S. Felix
Thesis work	:	Ph.D., (Javed Amiri)
Names of the Scientists involved	:	Prof. S. Felix Dr. B. Ahilan Dr.Javed Amiri Mr. T. L. S. Samuel Moses

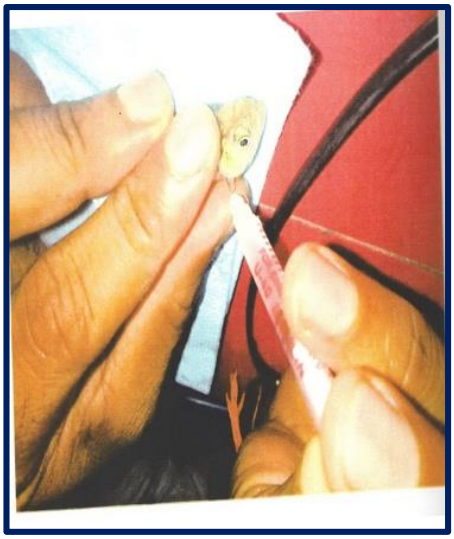
HDPE Cages for Pearl Spot Culturing

13. Induced Breeding and Mass Production of Black spot Barb *Dawkinsia filamentosa* (an indigenous ornamental fish)

1.	Background of innovation	• Induced breeding of endemic ornamental fishes of high value is necessary to improve the revenue of the fisher folk • Induced breeding of endemic ornamental fishes will help to conserve the wild variety • Development of larval rearing technology is also needed to improve the survival and mass production of the species. • Hence development of induced breeding and advanced rearing technology is needed. • Development of suitable feed for improved growth and mass culture is also needed
2.	Scientific Intervention	The breeding technique of two North-East region based ornamental fish *Dwakinsia filamentosa* provided insight into embryonic development stages. For initial feeding of fish larvae, mass production techniques of freshwater live food organism, rotifer (*Branchionus calyciflorus*), was standardized in both outdoor and RAS based indoor culture systems. Further, probiotic incorporated encapsulated feed was produced for enhancing larval health. For larval rearing, the study demonstrated maximum production in RAS based nursery raceways with highest possible stocking density and with minimum water usage. The results of this investigation shall be useful for fish breeders and ornamental fish farmers for expanding aquariculture, species restoration and conservation.
3.	Commercial Potential	The present study will help to introduce advanced sustainable farming technologies for ornamental farmers, breeders and entrepreneurs to enhance their production using cost-effective technologies in a small area with less use of valuable water resources. The present study also helps to introduce hatchery-bred seeds of valuable indigenous *Dawkinsia filamentosa* into the ornamental fish trade, reduce the exploitation pressure on natural resources to a considerable level and contributes in the conservation of the natural resources.

4.	Economic benefits	Development of this breeding technology will help the farmers in Captive production of wild variety of ornamental fish and improve their revenue through mass production.

Scheme Title	:	Establishment of Aquatic Rainbow Technology Park at Madhavaram for developing 'Rural Aquaculture Entrepreneurship' (TANII: 2015-18)
P.I	:	Prof. S. Felix
Thesis work	:	Ph.D., (Mahadevi)
Names of the Scientists involved	:	Prof. S. Felix Dr. Mahadevi



Induced breeding of *Dawkinsia filamentosa*

14. Induced Breeding and Mass Production of (Moustached Danio) *Danio dangila* (an indigenous ornamental fish)

1.	Background of innovation	• Induced breeding of endemic ornamental fishes of high value is necessary to improve the revenue of the fisher folk • Induced breeding of endemic ornamental fishes will help to conserve the variety • Development of larval rearing technology is also needed to improve the survival and mass production of the species. • Development of suitable feed for improved growth and mass culture is also needed • Hence development of induces breeding and advanced rearing technology is needed
2.	Scientific Intervention	The present study demonstrated the breeding technique of North-East region based ornamental fishes (*Danio dangila*) provided insight into embryonic development stages. For initial feeding of fish larvae, mass production techniques of freshwater live food organism, rotifer (*Branchionus calyciflorus*), was standardized in both outdoor and RAS based indoor culture systems under a continuous culture mode. Further, probiotic incorporated encapsulated feed was produced for enhancing larval health. For larval rearing, the study demonstrated maximum production in RAS water usage. The results of this investigation shall be useful for fish breeders and ornamental fish farmers for expanding aquariculture, species restoration and conservation.
3.	Commercial Potential	The present study will help to introduce advanced sustainable farming technologies for ornamental farmers, breeders and entrepreneurs to enhance their production using cost-effective technologies in a small area with less use of valuable water resources. The present study also helps to introduce hatchery-bred seeds of valuable indigenous (*Danio dangila)* into the ornamental fish trade, reduce the exploitation pressure on natural resources to a

		considerable level and contributes in the conservation of the natural resources.
4.	Economic benefits	Development of this breeding technology will help the farmers in production of new variety of ornamental fish and improve their revenue through mass production.

Scheme Title	:	Establishment of Aquatic Rainbow Technology Park at Madhavaram for developing 'Rural Aquaculture Entrepreneurship' (TANII: 2015-18)
P.I	:	Prof. S. Felix
Thesis work	:	Ph.D., (Bhosale Managesh Madhukkaro)
Names of the Scientists involved	:	Prof. S. Felix Dr. Bhosale Managesh Madhukkaro

Induced breeding of *Danio dangila*

15. Induced Breeding and Mass Production of Spot Fin Swamp Barb *Puntius sophore* (an indigenous ornamental fish)

1.	Background of innovation	• Induced breeding of endemic ornamental fishes of high value is necessary to improve the revenue of the fisher folk • Induced breeding of endemic ornamental fishes will help to conserve the variety • Development of larval rearing technology is also needed to improve the survival and mass production of the species. • Development of suitable feed for improved growth and mass culture is also needed • Hence development of induces breeding and advanced rearing technology is needed.
2.	Scientific Intervention	The present study demonstrated the breeding technique of North-East region based ornamental fishes *Puntius sophore* provided insight into embryonic development stages. For initial feeding of fish larvae, mass production techniques of freshwater live food organism, Rotifer (*Branchionus calyciflorus*), was standardized in both outdoor and RAS based indoor culture systems under continuous culture mode. Further, probiotic incorporated encapsulated feed was produced for enhancing larval health. For larval rearing, the study demonstrated maximum production in RAS water usage. The results of this investigation shall be useful for fish breeders and ornamental fish farmers for expanding aquariculture, species restoration and conservation.
3.	Commercial Potential	The present study will help to introduce advanced sustainable farming technologies for ornamental farmers, breeders and entrepreneurs to enhance their production using cost-effective technologies in a small area with less use of valuable water resources. The present study also helps to introduce hatchery-bred seeds of valuable indigenous *Puntius sophore* into the ornamental fish trade, reduce the exploitation pressure on natural resources to a

		considerable level and contributes in the conservation of the natural resources.
4.	Economic benefits	Development of this breeding technology will help the farmers in production of new variety of ornamental fish and improve their revenue through mass production.

Scheme Title	:	Establishment of Aquatic Rainbow Technology Park at Madhavaram for developing 'Rural Aquaculture Entrepreneurship' (TANII: 2015-18)
P.I	:	Prof. S. Felix
Thesis work	:	Ph.D., (Bhosale Managesh Madhukkaro)
Names of the Scientists involved	:	Prof. S. Felix Dr. Bhosale Managesh Madhukkaro

Induced breeding of *Puntius sophore*

16. Induced Breeding and Mass Production of Red Line Torpedo Barb (Miss Kerala) *Sahyadria denisonii* (an indigenous ornamental fish)

1.	Background of innovation	• Induced breeding of endemic ornamental fishes of high value is necessary to improve the revenue of the fisher folk • Induced breeding of endemic ornamental fishes will help to conserve the wild variety • Development of larval rearing technology is also needed to improve the survival and mass production of the species. • Hence development of induced breeding and advanced rearing technology is needed. • Development of suitable feed for improved growth and mass culture is also needed
2.	Scientific Intervention	The breeding technique of two North-East region based ornamental fish *Sahyadria denisonii* provided insight into embryonic development stages. For initial feeding of fish larvae, mass production techniques of freshwater live food organism, Rotifer (*Branchionus calyciflorus*), was standardized in both outdoor and RAS based indoor culture systems. Further, probiotic incorporated encapsulated feed was produced for enhancing larval health. For larval rearing, the study demonstrated maximum production in RAS based nursery raceways with highest possible stocking density and with minimum water usage. The results of this investigation shall be useful for fish breeders and ornamental fish farmers for expanding aquariculture, species restoration and conservation.
3.	Commercial Potential	The present study will help to introduce advanced sustainable farming technologies for ornamental farmers, breeders and entrepreneurs to enhance their production using cost-effective technologies in a small area with less use of valuable water resources. The present study also helps to introduce hatchery-bred seeds of valuable indigenous *Sahyadria denisonii* into the ornamental fish

		trade, reduce the exploitation pressure on natural resources to a considerable level and contributes in the conservation of the natural resources.
4.	Economic benefits	Development of this breeding technology will help the farmers in Captive production of wild variety of ornamental fish and improve their revenue through mass production.

Scheme Title	:	Establishment of Aquatic Rainbow Technology Park at Madhavaram for developing 'Rural Aquaculture Entrepreneurship' (TANII: 2015-18)
P.I	:	Prof. S. Felix
Thesis work	:	Ph.D., (Mahadevi)
Names of the Scientists involved	:	Prof. S. Felix Dr. Mahadevi

Induced breeding of *Sahyadria denisonii*

17. Pangas Catfish (*Pangasianodon hypophthalmus)* culture in Lined ponds

1.	Background of innovation	Pangas *(Pangasianodon hypophthalmus*) is one of the commercially important candidate species for aquaculture in India and other tropical countries. The characteristics of this species such as fast growth, good meat quality, less bones, hardy and feeding habit makes it suitable fish in Indian context. Therefore production of *Pangasius* in lined ponds at a high stocking density would further improve the productivity of this fish culture.
2.	Scientific Intervention	*Pangasius* fishes are stocked at rate of 4-10/sq.m to attain production of 50 tonnes/ha/annum in lined ponds.
3.	Commercial Potential	The production of *Pangasius* fishes can be tripled in one hectare lined pond with a production of 50 tonnes per annum and profitable returns of Rs.12 lakhs can be achieved.
4.	Economic benefits	The production of *Pangasius* fishes using the advanced culture system such as lined ponds would pave way for environmentally sustainable production. Adoption of this culture technique on improving flesh quality would improve the water quality of the pond water at commercial scale.

Budget	:	College's General budget allotted to ARFF
P.I	:	Prof. S. Felix
Names of the Scientists involved	:	Prof. S. Felix T.L.S.Samuel Moses

Pangas catfish in HDPE Lined ponds at ARFF, Madhavaram

18. Cost effective *Azolla* production and its usage as feed supplement to GIFT Tilapia

1.	Background of innovation	Due to the decline in the capture fisheries, the availability of fish meal reduced in recent years and hence research on use of other conventional and non-conventional ingredients protein sources is attempted worldwide. The nutrient profile of Azolla is found to be almost similar to that of commercial poultry feed, except that the protein content is high and calcium content is slightly low. The use of *Azolla* as a feed ingredient in the aquatic feeds was explored by standardizing *Azolla* on culture.
2.	Scientific Intervention	Cultured *Azolla* was dried and added as a feed ingredient by partially replacing a fish meal at a ratio 2:1 and through this the production cost of feed was reduced by Rs. 13.
3.	Commercial Potential	*Azolla* culture can be easily adopted and production of azolla feed ingredient is been taken up commercially in animal husbandary sector. Therefore use of *Azolla* as feed for Tilapia has been proved in commercial Tilapia culture.
4.	Economics benefits	*Azolla* can be fed directly to GIFT Tilapia and it also can be powdered and mixed along with other ingredients such as rice bran and ground nut oil cake. One kg of *Azolla* can be sold at Rs.200 per kg. The cost of one kg of fish feed available in the market is Rs. 48 whereas the cost of *Azolla* incorporated fish feed is Rs.35/-.

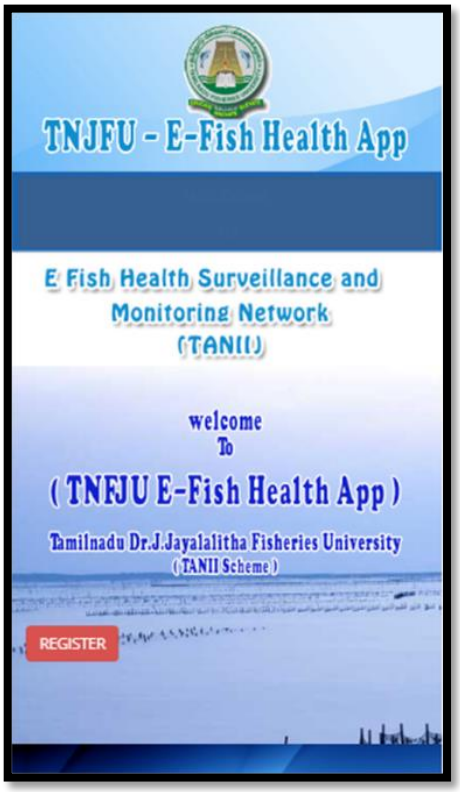
Scheme Title	:	Establishment of Demonstration Units of Azolla as Feed Supplement of GIFT Tilapia (NFDB, Hyderabad:2018-2020)
P.I	:	Prof. S. Felix
Thesis work	:	Ph.D., (Sebastian Mosha)
Names of the Scientists involved	:	Prof. S. Felix Dr. B. Ahilan Dr. Sebastian Mosha T.L.S Samuel Moses

Azolla Culture Units at ARFF, Madhavaram

19. TNJFU E-Fish Health App

1.	Background of innovation	• Health management in aquaculture is an important aspect as incidences results in economic and product losses in commercial aquaculture operations. • Knowledge among the farmers on the common diseases affecting the cultured fishes will help them to identify the diseases to adopt appropriate management measures. Educating the farmers on health management strategies by providing the information on diseases and their management is essential. • Timely decisions are needed in the event of disease outbreak in the aquaculture farms. As the farms are often located in remote locations with lesser accessibility, suitable tools like Mobile applications (App) is needed to undertake quick management measures. Hence, development of an App that could be used in smart phones with the important information on the common diseases and with the facility to contact our referral laboratory to seek the help to make quicker decisions to save their crop will be helpful for the farmers to increase the productivity in aquaculture.
2.	Scientific Intervention	In this technology, scientific intervention has been made in identifying the disease and getting information on their management using the App which is an Information and Communication technology (ICT) tool.
3.	Commercial Potential	As mobile App would extend the health management service to the aquafarmers, the technology can be transferred commercially to the interested aquaculture industries.
4.	Economics benefits	Development of this mobile phone App would help the farmers in early identification of diseases in their culture operations and to take quick health management decisions like treatment or emergency harvest so that their crops are saved and the production and economic losses are avoided

Scheme Title	:	E-Fish Health Surveillance and Monitoring Network to improve Fisheries Production in Tamil Nadu (TANII: 2017-20)
P.I	:	Dr. A. Uma
Names of the Scientists involved	:	Dr. A. Uma Prof. S. Felix Dr. N. V. Sujathkumar

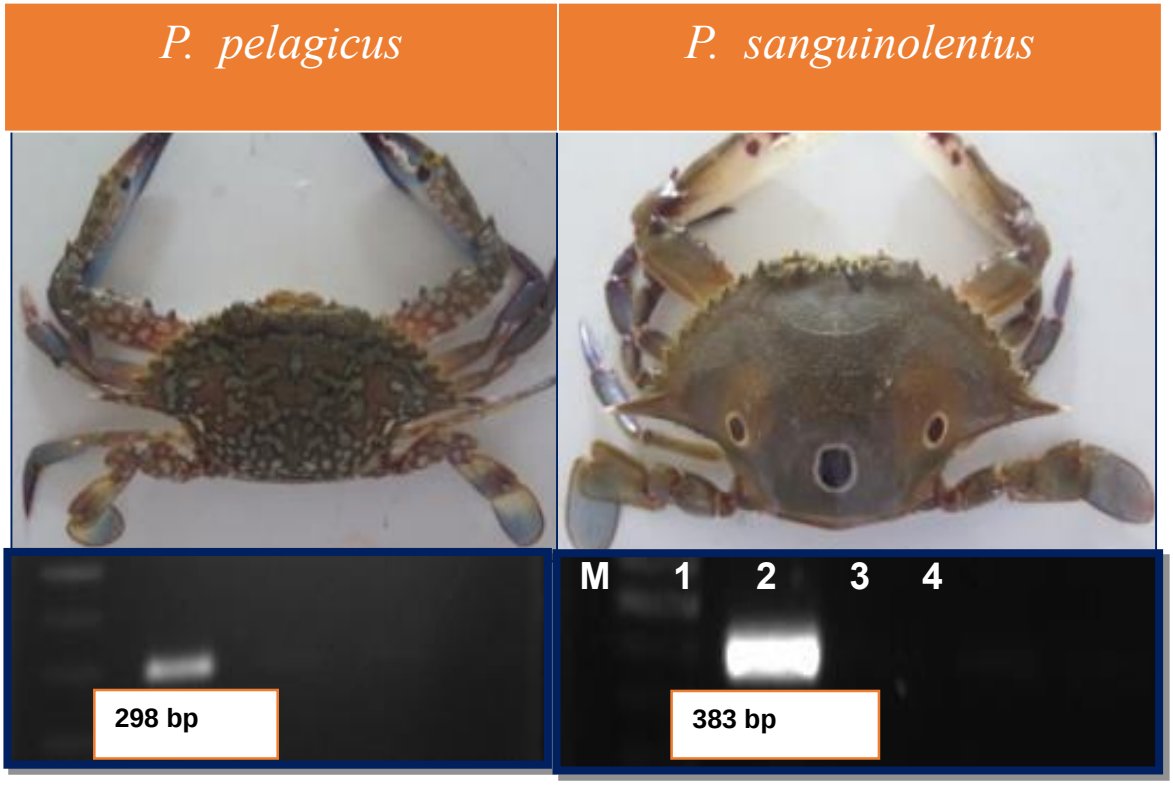


TNJFU E-Fish Health App

20. Molecular Markers for the Identification of Three Spotted Crab Meat in Pasteurized Blue Swimming Crabmeat

1.	Background of innovation	➢ Blue swimming crab (*Portunus pelagicus*) is an economically important species fetching high demand in export market in India. ➢ An ongoing problem is the possible substitution of a similar species of crabs, especially three spotted crab, i.e. *Portunus sanguinolentus* of low commercial value. ➢ Molecular markers are valuable tools for authentication of seafood products. ➢ Species specific molecular markers for the identification of *Portunus pelagicus* and *Portunus sangiunolentus* by PCR method are not available and hence, this technology is developed.
2.	Scientific Intervention	Designing of species specific 16sRNA primers for the identifying the adulteration of three spotted crabmeat in pasteurized blue swimming crab meat by PCR analysis
3.	Commercial Potential	This assay shall be used by regulatory authorities to identify fraudulence in pasteurized blue swimming crabs; and to the crab processors to ensure authentication of their products.
4.	Economic benefits	Cost per sample analysis - Rs. 200/-

Scheme Title	:	ICAR – Niche Area of Excellence in Fish Safety and Quality Assurance
P.I	:	Dr. G. Jeyasekaran
Names of the Scientists involved	:	Dr. G. Jeyasekaran Dr. R. Jeya Shakila B. Sivaraman Dinesh Kumar Dr. V. Alamelu

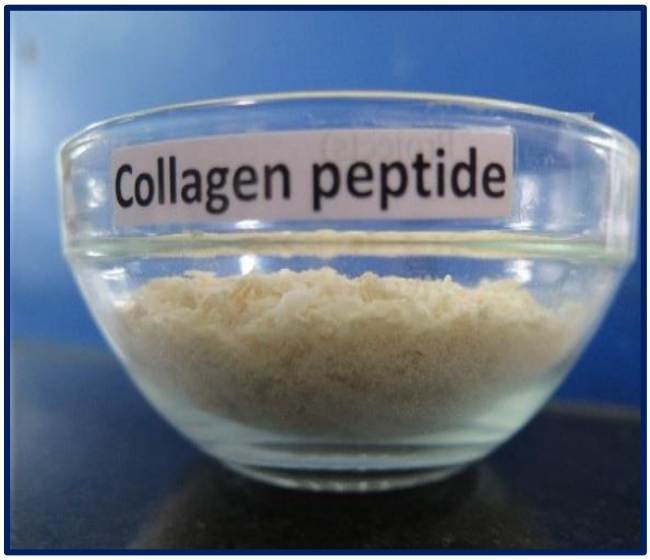


Molecular Markers for the Identification of Three Spotted Crab Meat in Pasteurized Blue Swimming Crabmeat

21. Protocol for the Extraction of Collagen Peptides Directly from Fish Bones by Enzymatic Hydrolysis

1.	Background of innovation	➢ Fish collagen peptides are gaining popularity as bioactive materials for tissue engineering and regenerative medicine, due to their biocompatibility, stability and bioactivity. ➢ Collagen peptides have shown positive effect on bone to counteract several bone related diseases. ➢ Currently, collagen peptides are derived from collagen, which is extracted from fish bones involving lengthy laborious procedures. ➢ Therefore, a technology was developed to prepare collagen peptides directly from fish bones by enzymatic hydrolysis
2.	Scientific Intervention	Pre-extraction steps introduced to remove non-collagenous protein, lipid, and minerals from fish bones prior to enzymatic hydrolysis of fish bones.
3.	Commercial Potential	This protocol shall be used by the nutraceutical industries preparing bioactive molecules from marine sources, either as dietary supplements or functional foods.
4.	Economic benefits	Direct extraction of collagen peptides from fish bones helps to reduce the duration and cost of production. Production cost Rs. 400/ per kg fish bone

Scheme Title	:	DBT Scheme on Bioprospecting of Antiosteoporetic Properties of Collagen Peptides Derived from Fish Bone
P.I	:	Dr. R. Jeya Shakila
Names of the Scientists involved	:	Dr. R. Jeya Shakila Dr. G. Jeyasekaran Surya B. Sivaraman L. Vinoth Kumar

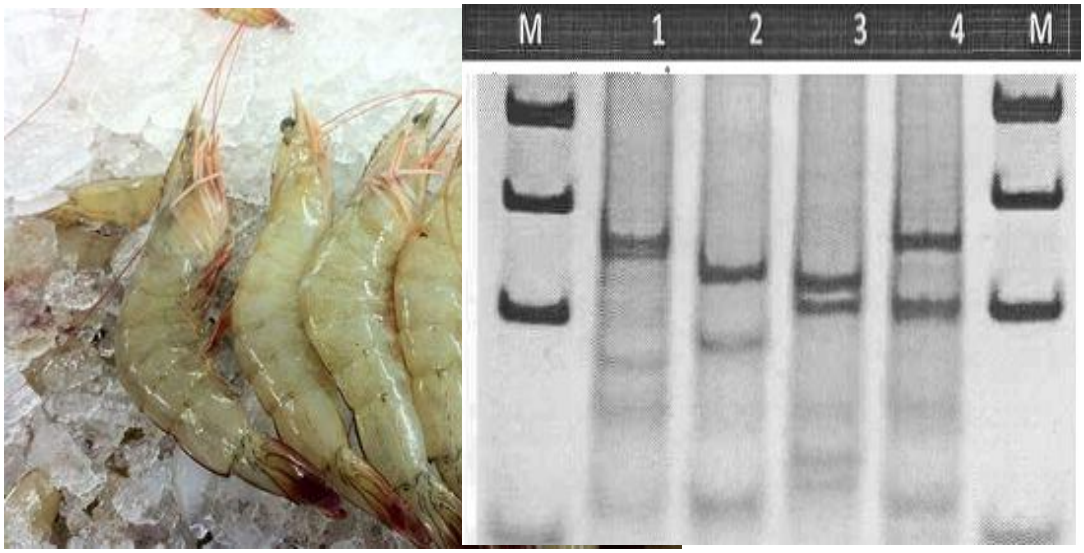


Extracted of Collagen Peptides Directly from Fish Bones

22. Molecular Marker for Authentication of Four Species of Processed Shrimps using Restriction Analysis by Single Enzyme

1.	Background of innovation	➢ Shrimps are highly preferred seafood among consumers due to their delicacy, and served in the restaurants, hotels and fast foods in processed forms by removing their external features and preventing the consumers to identify the species. ➢ Replacement of high value species with low valued ones, wild species with farmed ones, less allergenic with allergenic species are quite common in the trade. ➢ A molecular marker region that can distinguish the five commercially important shrimp species following restriction digestion using a single enzyme is challenging.
2.	Scientific Intervention	A mitochondrial region, 16S rRNA/tRNA identified as molecular marker to authenticate four species of shrimps using single enzyme in this technology.
3.	Commercial Potential	This protocol shall be used by the regulatory authorities to authenticate the processed shrimp products sold in domestic markets or for export to check the fraudulence.
4.	Economic benefits	➢ Consumers can check the economic fraudulence as cheap value farmed shrimps is sold at high cost in restaurants, hotels and fast foods as marine shrimps. ➢ Beneficial for the regulatory authorities to perform the test within 12h to identify fraudulence ➢ Cost per test: Rs. 300/-

Scheme Title	:	ICAR – Niche Area of Excellence in Fish Safety and Quality Assurance
P.I	:	Dr. G. Jeyasekaran
Names of the Scientists involved	:	Dr. G. Jeyasekaran Dr. R. JeyaShakila Lidiya wilwet



M - Marker
Lane 1 – P*eneaus indicus*
Lane 2 – *Peneaus monodon*
Lane 3 – *Peneaus semisulcatus*
Lane 4 – *Peneaus vannamei*

Molecular Marker for Authentication of Four Species of Processed Shrimps

23. An Anti-Oxidative Edible Film from Fish Gelatin Derived from Rohu Swim Bladder and Fucoidan Derived from Brown Seaweed

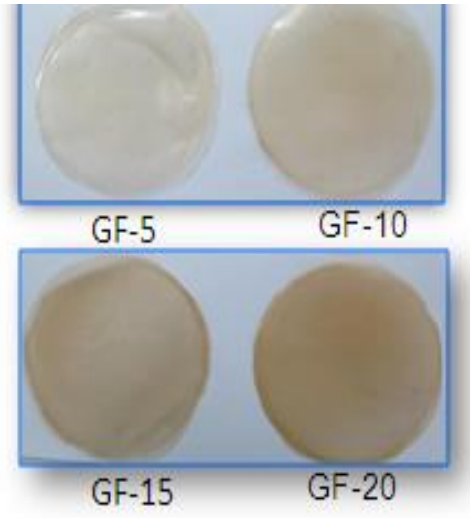
1.	Background of innovation	➢ Lipid oxidation affects the quality of foods, by altering their appearance, odour, flavor, shelf-life and nutritional value. ➢ Synthetic antioxidants are prone for possible toxicity, which has led way for the search for new natural antioxidants. ➢ Edible film and coatings are gaining importance as biodegradable food packaging materials. ➢ Active edible film incorporated with antioxidant or antimicrobial is a new concept for extending the shelf life of foods.
2.	Scientific Intervention	A natural antioxidant compound from seaweed is used as an anti-oxidant to develop an edible film using fish gelatin derived from the swim bladder of rohu fish in this technology
3.	Commercial Potential	The scope of this material is to wrap food products as edible films or coatings, which are now-a-days taken by food industries, as an alternative to synthetic packaging.
4.	Economic benefits	Gelatin-fucoidan films are bio-degradable, edible films with anti-oxidant property to prevent lipid oxidation in foods Production Cost :Rs. 15/- per film of dimension 200 x 200 mm

Scheme Title	:	Physico functional properties of collagen and gelatin film derived from fish processing waste (DBT, New Delhi)
P.I	:	Dr. R. Jeya Shakila
Names of the Scientists involved	:	Dr. R. Jeya Shakila Dr. G. Jeyasekaran G. Raghu

Fish Gelatin

Fucoidan

Gelatin-fucoidan film



Anti-Oxidative Edible Film

24. A Modified Purification Kit for the Extraction of Pesticides from the Green, Brown and Red Seaweeds Prior to Gc-Ms Analysis

1.	Background of innovation	➢ Seaweeds contain different photosynthetic pigments such as chlorophyll, carotenoids, and phycobiliproteins. ➢ Presence of pigments hinders the extraction of pesticides from the coloured matrix. ➢ Existing solvent extraction methods involve extensive instrumentation, toxic solvents, and longer time for analysis. ➢ QuEChERS kit is available for the extraction and clean-up of pesticides from food matrix in a single step.
2.	Scientific Intervention	The existing QuEChERS kit did not remove the pigments from the seaweed extract, during the clean-up process. Therefore, the concentrations of kit components were optimized to remove the interference of pigments, polyphenols and other polar compounds the extracts of green, red and brown seaweeds, prior to GC-MS analysis of pesticides.
3.	Commercial Potential	This technology shall be adopted for extraction of pesticides from the different seaweeds prior to GC-MS analysis by the scientists or environment monitoring laboratories
4.	Economic benefits	The purification kit does the extraction fast within 30 min. Cost of the purification kit - Rs. 250/ per sample.

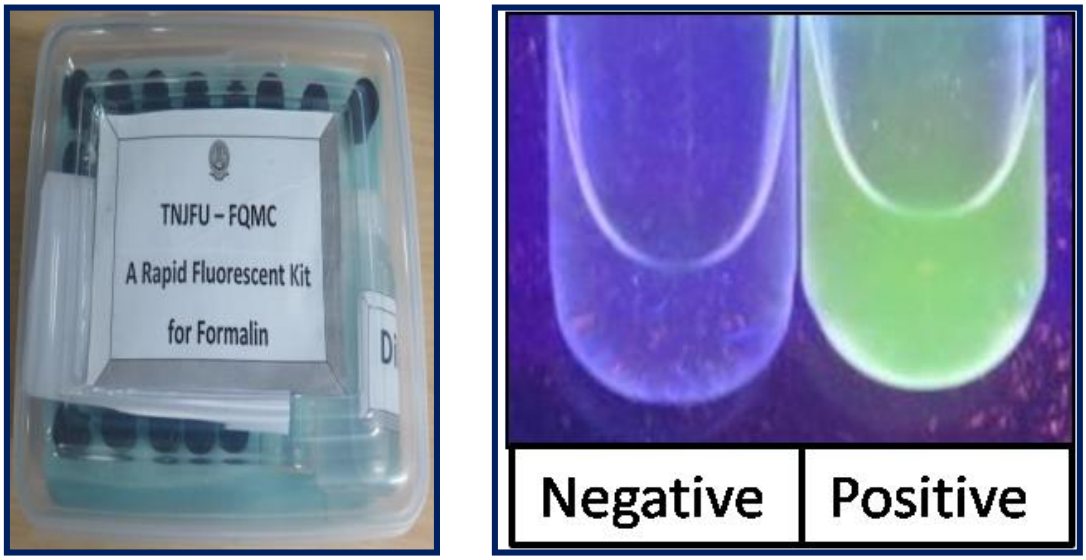
Scheme Title	:	ICAR – Niche Area of Excellence in Fish Safety and Quality Assurance
P.I	:	Dr. R. Jeya Shakila
Names of the Scientists involved	:	Dr. R. Jeya Shakila Dr. G. Jeyasekaran S. Sundhar Arisekar N. Asha Hema Malini

Modified Purification Kit for the Extraction of Pesticides

25. TNJFU – FQMC Rapid Fluorescent Formalin Kit for Fish

1.	Background of innovation	• Formalin (formaldehyde) is a chemical, which is used to preserve biological specimens in laboratories and corpses in mortuaries. • The International Agency for Research on Cancer (IARC) classifies formaldehyde as Group 1 carcinogenic compound to humans (IARC, 2004). • Few fish retailers in India use formalin to preserve fish to extend its shelf life mainly during transportation. Several tons of fish &shrimp were seized for formalin abuse in Kerala, Goa, Delhi, Assam, Orissa and even Tamil Nadu
2.	Scientific Intervention	A kit that is quick and hand held that gives visible results within 10 min to detect formalin in fish.
3.	Commercial Potential	This kit is suitable for food testing laboratories, regulatory authorities, state fisheries department, and food inspectors on site to check the level of formalin in fish.
4.	Economic benefits	Rs. 1000/- for 50 tests.

Scheme Title	:	ICAR – Niche Area of Excellence in Fish Safety and Quality Assurance
P.I	:	Dr. R. Jeya Shakila
Names of the Scientists involved	:	Dr. R. JeyaShakila Dr. G. Jeyasekaran R. Shalini Arisekar N. Asha Hema Malini



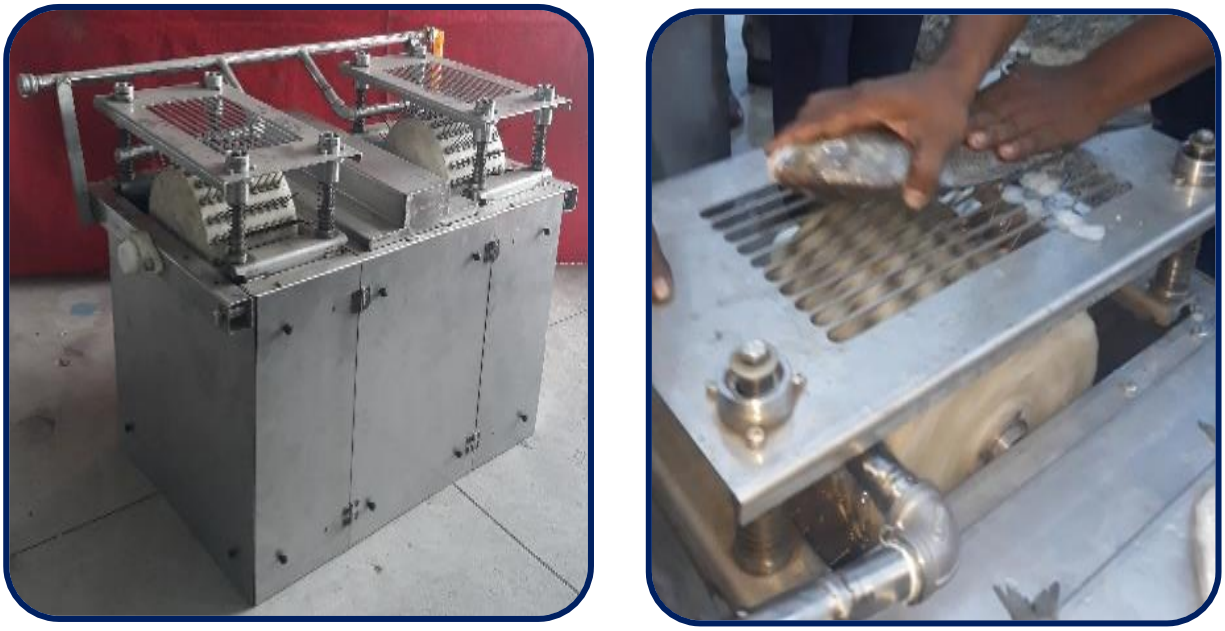
FQMC Rapid Fluorescent Formalin Kit for Fish

26. Fish De-Scaling Machine

1.	Background of innovation	Manual scaling of larger fishes requires around 50% of the total time necessary to produce beheaded and gutted fish without fins
2.	Scientific Interventions	Morphology of the fish scales were tackled mechanically (Profile & speed)
3.	Commercial Potential	All Fishing vessels, Landing centers and Fish retail shop can have each one machine
4.	Economic Benefits	Shelf life increases due to hygienic process

Scheme Title : Development and Demonstration of Innovative Fisheries Engineering Interventions for the Product Maximization in Fisheries Industry. (TANII: 2017-20)

P.I : Dr. M.Sivakumar



Fish De-Scaling Machine

27. Fish Deboning Machine

1.	Background of innovation	Manual filleting of larger fishes requires around 50% of the total time necessary to produce beheaded and gutted fish without fins
2.	Scientific Interventions	Morphology of the fish was tackled using profile plate and adjuster.
3.	Commercial Potential	All Fishing vessels, Landing centers and Fish retail shop can have each one machine
4.	Economic Benefits	Shelf life increases due to hygienic process

Scheme Title : Development and Demonstration of Innovative Fisheries Engineering Interventions for the Product Maximization in Fisheries Industry. (TANII: 2017-20)

P.I : Dr. M.Sivakumar

Fish Deboning Machine

28. Fish De-Capitation Machine

1.	Background of innovation	Manual processing of larger fishes requires around 50% of the total time necessary to produce beheaded and gutted fish without fins
2.	Scientific Interventions	Semi-automated hand held operations successfully processes the fish
3.	Commercial Potential	All Fishing vessels, Landing centers and Fish retail shop can have each one machine
4.	Economic Benefits	Shelf life increases due to hygienic process

Scheme Title : Development and Demonstration of Innovative Fisheries Engineering Interventions for the Product Maximization in Fisheries Industry. (TANII: 2017-20)

P.I : Dr. M.Sivakumar

Fish De-Capitation Machine

29. Fish Slicing Machine

1.	Background of innovation	Hygienic Slicing of fish
2.	Scientific Interventions	Morphology of the fish was tackled mechanically by height adjuster & Profile carrier.
3.	Commercial Potential	All Fishing vessels, Landing centers and Fish retail shop can have each one machine
4.	Economic Benefits	Shelf life increases due to hygienic process

Scheme Title : Development and Demonstration of Innovative Fisheries Engineering Interventions for the Product Maximization in Fisheries Industry. (TANII: 2017-20)

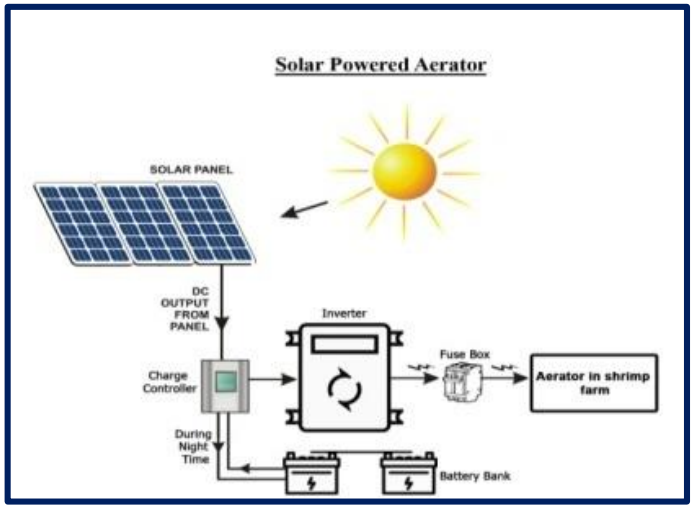
P.I : Dr. M.Sivakumar

Fish Slicing Machine

30. Solar Powered Aerators in Shrimp Farms

1.	Background of Innovation	• Aquaculture sector is spending huge amount of money towards the use of non-renewable energy. Thus, helping the farms during solar energy to operate the aerators. • Solar energy can be used where there is a insufficient in power • To decrease the pollution the solar energy can be used.
2.	Scientific Intervention	• The initial investment and installation of solar panels are high. • The solar panel requires more space for installation. Also, the change in climatic change and weather condition there is insufficient sun rays received to earth. • Therefore, the panels can be installed in roof tops to get sufficient power and it can be used where there is a less minimal of space for installation.
3.	Commercial potential	• The solar powered aerators are used to reduce the money spent on fossil fuels (i.e.) diesel/petrol cost. • The conventional energy source is depleting and creates pollution to the atmosphere. • The solar aerators can be used when there is power shut down.
4.	Economic benefits	When 1kW solar panels are installed in aquaculture farm, 5kW of power can be generated. Therefore, when 10kW solar panel are installed, 18250 Units of Power and Rs.1,50,000 can be saved in a year.

Scheme Title	:	ICAR – Extramural; Development, Demonstration and Dissemination of Solar Energy Operated Aerators in Shrimp Farms
P.I	:	Er. D. Babiyola



Solar powered Aerator

31. Real Time Monitoring System in Aquaculture (Temperature, pH, DO, Ammonia)

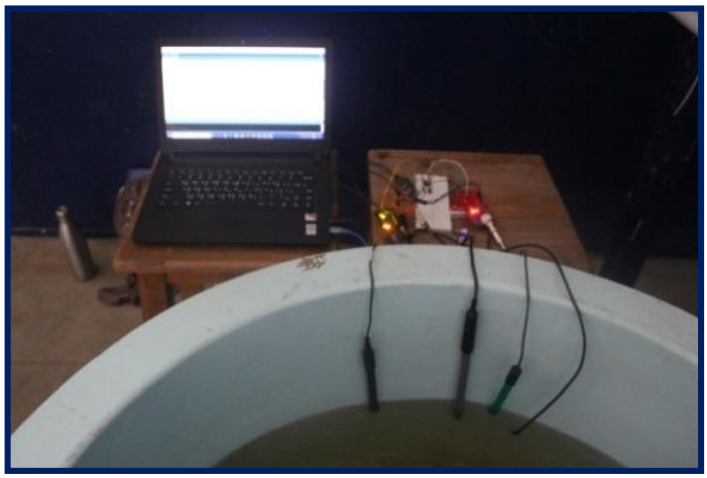
1.	Background of innovation	• Manual Water Quality Monitoring needs much of time and attention. The samples of water are collected from the hatchery and send to the water quality testing laboratory for analysis. • It involves man power to visit the farm and test the water quality parameters. Manual methods are time consuming and less accurate. • Therefore to overcome the drawbacks of manual methods the Design and Implementation of IOT Based Real time Hatchery Monitoring System is developed to monitor the essential water quality parameters for accurate and onboard results.
2.	Scientific intervention	Compared to the manual methods IOT Based Real time monitoring system consists of sensors for temperature, pH, Dissolved oxygen and Ammonia monitoring. The data's are sensed and it is transferred to Microcontroller chip and converted to digital data and stored in the database. The data's are monitored through online in mobile application. The developed mobile application helps in remote monitoring of IOT sensors. This method is accurate, less time consuming and less man power.
3.	Commercial potential	The developed system can be commercialized in the following areas: • Hatcheries • Farms • Ornamental Aquariums
4.	Economic benefits	• In laboratory method, available thermometer and pH meters are of cost Rs.4000 approximately and it can measure about 2000 sample with 2 years warranty. • The Ammonia water quality testing kit costs Rs.3000 approximately and measure 200 samples with 2 years warranty.

		• The Dissolved Oxygen water quality testing kit costs about Rs.2000 and the measure 200 samples with 2 years warranty. • The laboratory method has limitations with the samples and it involves replacement cost and less accurate. The developed IOT based Real time Monitoring system in Aquaculture is one time investment with accurate onboard results with less man power.

Budget : Junior Teacher Research Fellowship (2019-2020)

P.I : Er. C. Mercy Amrita

Onboard Water Quality Monitoring in Thirumurthy Fish Farm



Onboard Water Quality Monitoring in hatchery tank at CoFE