



# ClimFish

NICRA Newsletter, ICAR-CMFRI, Kochi



## Inside this issue:

- ◆ Phenology & Trophodynamics
- ◆ Life Cycle Analysis
- ◆ Climate Change Modeling
- ◆ Climate Resilient Technologies
- ◆ Climate Smart Villages
- ◆ Climate Resilient Products



MOU signed between ICAR-CMFRI and Space Application Centre- ISRO



5 Acre Restored wetland of Edakochi, Kerala

## NICRA Project Second Phase Resumes till 2020

Owing to the successful completion of Phase 1, the ICAR sponsored National Innovations in Climate Resilient Agriculture (NICRA) project was approved for continuation till 2020.

Major work components for the second phase includes

- ◆ Phenology & Trophodynamics
- ◆ Spatio-temporal resource mapping
- ◆ Climate change modeling
- ◆ Catch & Vulnerability Forecast
- ◆ Blue Carbon Potential
- ◆ Habitat Management
- ◆ Climate Resilient Products
- ◆ Climate Resilient Technologies
- ◆ Climate Resilient Village Development

National Resilience Framework for Fisheries and Wetlands (NRFW) has been developed through the project. This is the first national instance that

a centralized portal and associated mobile application for regional small wetland profile monitoring is being developed in collaboration with Space Application Centre (ISRO), Ahmedabad.

Field demonstration of monoline seaweed culture method done at Tuticorin, Tamilnadu resulted in five fold increase in seaweed yield from a single plot over a culture period of 30-35 days with net revenue of Rs. 35,000-40,000 per plot.

Assessment of implications of climate change on phenology, trophodynamics and abundance were carried out on selected marine species at Mangalore, Mumbai, Vizag and Mandapam centers of ICAR-CMFRI.

Comparison of distribution of threadfin bream during 1993-95 and 2013-15 reveals reduction in abundance by half in the same ground.

Blue carbon potential for representative mangrove biomass and seaweeds from Gulf of Mannar reveals C sequestration potential of 635 Gigagram carbon per year.

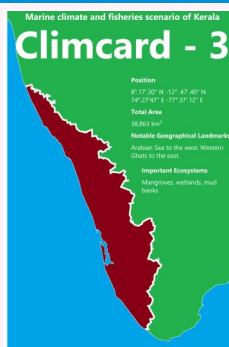


## Principal Investigator's Desk

Dr. P.U. Zacharia, Principal Scientist & Head, Demersal Fisheries Division

I am extremely glad to inform that NICRA project is successfully being carried out with novel interventions and technologies towards enhancement of socio-economic and ecological climatic resilience.

Catch and vulnerability forecast of key commercial marine fish species



using climatic projection data is of high national significance.

The mounting climatic pressures such as Ockhi and Gaja, emphatically point out the need for Development of Cli-

mate Resilient Fishing Villages and Technologies.

I profoundly hope that the project outcome could significantly contribute towards strengthening of climatic resilience of Indian marine fisheries sector.

# Research Highlights

## Phenology & Trophodynamics

### Climate change impacts on marine species

Zone-wise studies to unravel the effect of climate change on selected marine species are being carried out at Mangalore, Mumbai, Vizag, Mandapam, Chennai and Cochin by analysing parameters such as mean size, mode, fecundity, hepato-somatic, gastro-somatic and gonado-somatic indices, diet composition, sex ratio, spawning season and abundance in relation to SST, SSS, BST, SSH and DO.

### Impact of rainfall on the phenology of Indian oil sardine

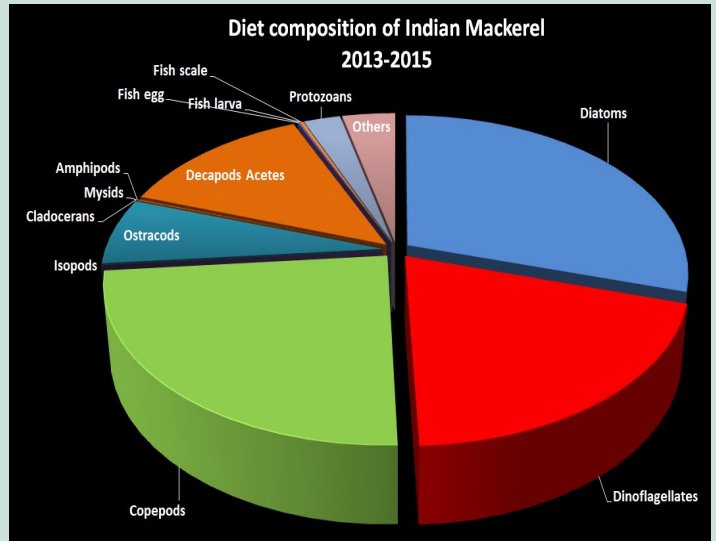
Analysis was performed along Kerala coast and the Lm was found to be +vely correlated (0.28) with SST and rainfall (0.20) anomalies. The correlation value for SST and rainfall is observed as with a moderate significance. Hence the direct or indirect effect of increased SST is reflected in the increase in Lm leading to late maturation.

The positive effect of SST on increase in Lm can be inferred as an outcome of increased stress by other secondary climatic factors which might have an inhibitory effect on reproduction as reported in earlier studies.

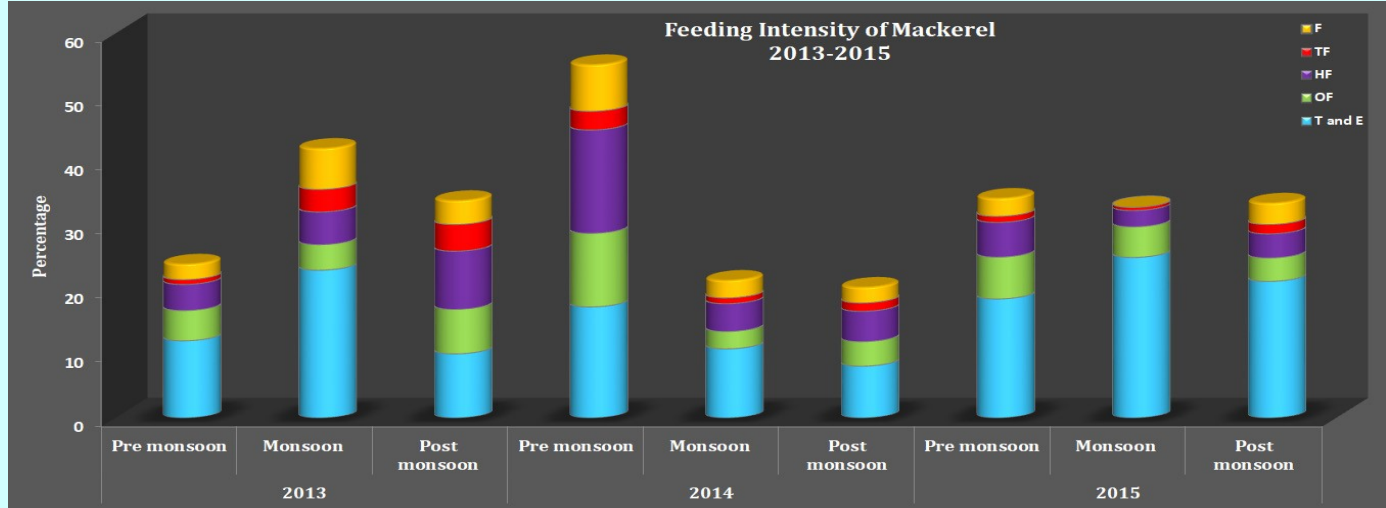
Spawning period of oil sardine *Sardinella longiceps* is observed to start during the onset of rainfall. A shift in peak spawning season of *S. longiceps* towards July-August-September rather than June-July-August was observed.

### Feeding habits of mackerel and climate change

Diet composition analysis of Indian mackerel showed the prey items as Diatoms, Dinoflagellates, Copepods, Decapods and Protozoans. It was observed that the monsoon season exhibited lower feeding intensity than the pre monsoon and post monsoon seasons in all the study period (2013-2015). Diet composition of mackerel also showed



significant relation with environmental variables such as SST, rainfall, Chl  $\alpha$ , CUI and salinity. Diatoms fitted the most with SST, Precipitation, Salinity and CUI influencing their presence in the gut of mackerel. Salinity was identified as the major environmental variable that was related to the relative importance of copepod in the gut of Indian mackerel.



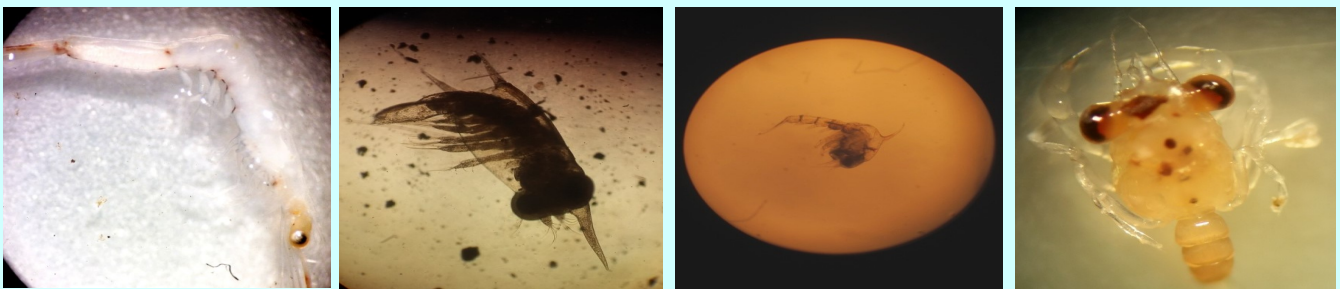
# Research Highlights

## Phenology & Trophodynamics

### Larval distribution and recruitment studies off Vizag

A preliminary analysis of the presence of crustacean and fish larvae with oceanographic variables were done. The results of crustacean larval studies indicated a significant positive correlation with SST and Chl  $\alpha$  and a negative correlation with current velocity.

Fish larval studies showed positive correlation with Chl  $\alpha$  and negative correlation with SST and current velocity. The major composition of larvae observed were that of Mysis and post larval stages of the shrimps, alima stages of stomatopods and crab Zoea and Megalopa stages.



Mysis stage of shrimp, Alima stage of stomatopods, Zoea stage of crab and Megalopa stage of crab

## Spatio-temporal mapping of resources

### Decadal analysis of threadfin bream distribution

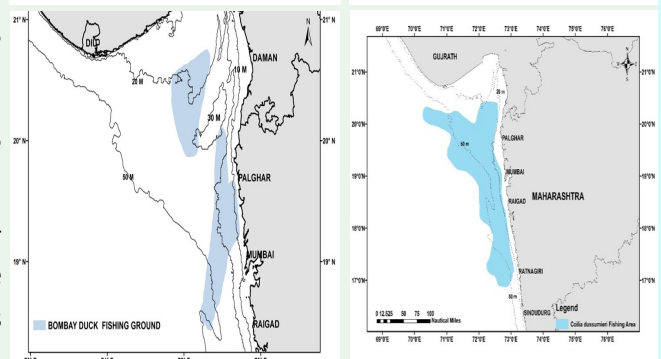
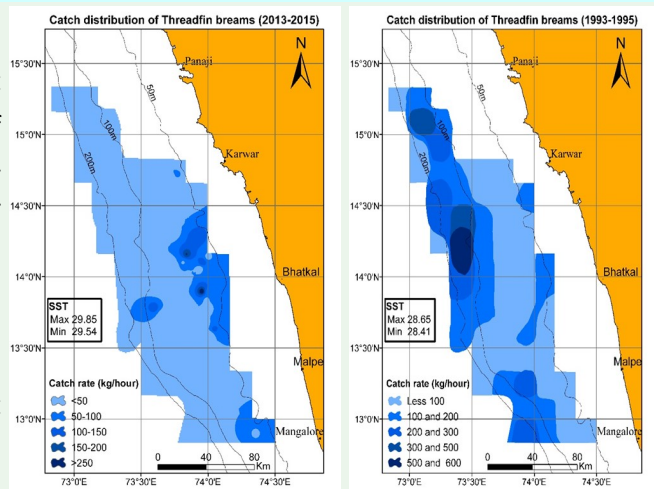
Distribution of threadfin breams along Mangalore coast during 1993-95 was compared with the distribution of the species in the same ground after 20 years (2013-2015). Slight reduction in catch rate and increase in SST was observed.

### Mapping of resource, catch composition in relation to upwelling

Geo-coordinated unsorted catch analysis from trawl net and dol net operating off Mumbai waters was conducted. *Harpadon nehereus* and *Coilia dussumieri*, were analysed thoroughly and the mapping of these resource was done with the help of Arc10.1 software

### Effect of environmental parameters on the abundance of jelly fish and occurrence of bloom

Six species of jelly fishes were identified from Maharashtra coastal waters. Initial analysis on abundance reveals correlation with environmental variables (Salinity, SST, BST, current speed). GAM model indicates high abundance of bloom when the salinity is below 35.5 ppt and the bottom sea temperature (BST) below 20.5°C. The research gains significance as extensive blooms are reported in Arabian sea and Maharashtra coastal waters recently.



Mapping of Bombay duck, and Golden anchovy

## Research Highlights

### Phenology & Trophodynamics



#### Extremities in the seasonalized fish landings: Mixed response of stakeholders

Remya, L., Johnson, B. and Sudhan, C., Mandapam Research Centre

Fish catches brought by trawlers operating in and around Mandapam coastal waters has shown a noticeable irregularity in seasonal landings during 2017-18.

- ◆ Gastropod mollusc landings at Mandapam region of Palk Bay was found extremely high prior to the onset of northeast monsoon in Tamilnadu. Accordingly, associated shell craft industry in the area flourished to some extent.
- ◆ Huge quantum of white-spotted spinefoot juveniles, *Siganus canaliculatus* (Park, 1797) was landed (3-4tonne/day) at Gulf of Manan side of Mandapam waters after the onset of monsoon.
- ◆ Unlike usual landings prior to summer, the noteworthy bumper catch of long barrel squid, *Uroteuthis singhalensis* (Ortmann, 1891) in October and November, 2017 surprised the fishers.

- ◆ Low catch of lean-bodied Indian oil sardine, *Sardinella longiceps* (Valenciennes, 1847) was recorded at the Rameswaram Verkode Fish landing centre (FLC) during the regular season from November to March, 2017.
- ◆ Fishers have mixed feelings and concern over the changing scenario on the unexpected seasonal catch at Mandapam.



Bumper catch of white-spotted spinefoot



Bumper catch of Long barrel squid



#### Record size of Black Pomfret, *Parastromateus niger* (Bloch, 1795) from Pamban (Light House) Fish Landing Centre, Gulf of Mannar, Tamilnadu

Sudhan, C., Remya, L. and Johnson, B., Mandapam Research Centre

- ◆ One specimen of black pomfret, *Parastromateus niger* (Bloch, 1795) was collected at Pamban (Light House) fish landing centre from the commercial catch of single day mechanized craft, Vallam operated at 15 m depth on January 19th, 2018.
- ◆ Occurrence of record size black pomfret (Actinopterygii > Perciformes > Carangidae > Caranginae) is reported for the first time from Mandapam Coast of Gulf of Mannar coast, Tamilnadu.
- ◆ The specimen is an adult male with weight of 2.25kg and length of 54cm. Specimen was collected during the regular phenological collection trips made to Pampan as part of NICRA studies.



## Research Highlights

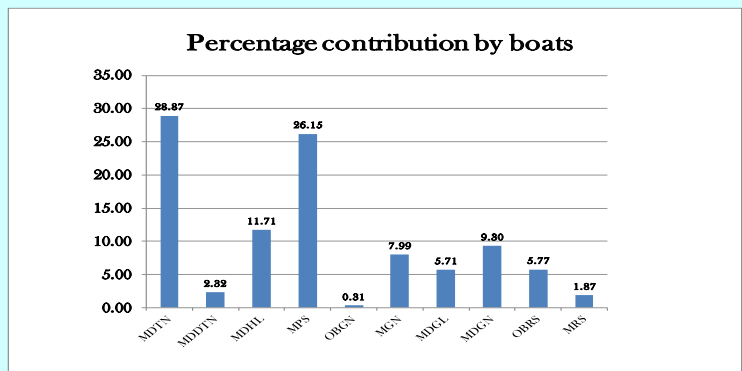
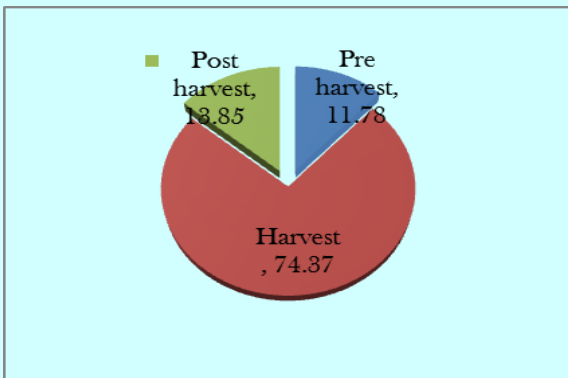
### Life Cycle Analysis

Main inferences of LCA analysis along Kerala coast are

- ⇒ Of the three phases of fisheries (pre-harvest, harvest and post-harvest), the harvest phase was responsible for the most emissions due to greater fuel consumption.
- ⇒ Fuel consumption was found to be the single biggest contributor to the overall carbon foot-

print during the fishing operations which constituted more than 90% of the total CO<sub>2</sub> emission from fishing vessels.

- ⇒ Among the various mechanised fishing units, multiday trawlers gives the highest carbon footprint per day of operation (829 kg CO<sub>2</sub>/day of operation), while ring seine fishing has the lowest footprint.



### Carbon Stock Assessment of Mangrove and Seaweed Ecosystems

- ⇒ Assessed carbon sequestration potential of mangroves of Dharmadam estuary, Kerala.
- ⇒ The above ground C-stock was highest (42.24%), followed by sediment carbon stock (39.82%) and the carbon stock of root biomass (17.94%).
- ⇒ The carbon sequestration potential of commercial seaweed biomass from Gulf of Mannar was estimated.
- ⇒ Available seaweed biomass (8,445 tonnes) can absorb 450.3 CO<sub>2</sub> tonnes per day of which 14.5 tonnes of CO<sub>2</sub> were emitted per day.
- ⇒ Carbon sequestration index could be beneficial towards eco-management efforts.



Species	Biomass (tons)	Efficiency to absorb CO <sub>2</sub> (mg/g/h)	CO <sub>2</sub> absorbed (t/day)	Efficiency to emit CO <sub>2</sub> (mg/g/h)	CO <sub>2</sub> emitted (t/day)
<i>Sargassum sp.</i>	6736	2.35	379.9	0	0
<i>Turbinaria sp.</i>	224	2.35	12.6	0	0
<i>Cystoseira sp.</i>	40	2.35	2.3	0	0
<i>Hypnea sp.</i>	965	1.6	37.1	1	9.7
<i>Gracilaria edulis</i>	225	1.6	8.6	1	2.3
<i>Gelidiella acerosa</i>	42	1.6	1.6	1	0.4
<i>Gracilaria sp.</i>	213	1.6	8.2	1	2.1

# Research Highlights

## Climate Change Modeling

### Time series analysis of CMIP5 model and observed SST anomaly along Indian coastal zones

The yearly and decadal seasonal variations of SST anomaly over the four coastal zones of India were analysed for a time frame of 1960 – 2014.

The analysis revealed that the SST anomaly was highest in northwest region of India in 2010 during the pre-monsoon season (March-May), whereas lowest value was observed in northeast region during the winter season (January-February) in the year of 1962.

Decadal analysis reveals that in NE zone, the warming

trend started since 1960 onwards, whereas in other three zones the warming trend began around 1970.

Comparison of CMIP5 model value with observed values reveals that, the model and observed SST anomaly follows almost similar trend, but with noticeable differences in values among the both.

Owing to the differences in the model and observed values, it could be emphasized that error corrections needs to be applied in futuristic SST projections and related studies of Indian fisheries.

### Effect of climatic variability on the fishery of Indian oil sardine along Kerala coast

The weighted CPUE of Indian oil sardine was correlated with the climatic variables (Sea Surface Temperature, Precipitation, Chlorophyll a and Salinity) and relationship was explored by Generalized Addictive Model (GAM).

The best fit model was attained by lowest AIC value and

Root Mean Squared Error (RMSE) value criteria.

The SST and salinity showed a negative relation whereas precipitation was found to be positively related to the catch of Indian oil sardine.

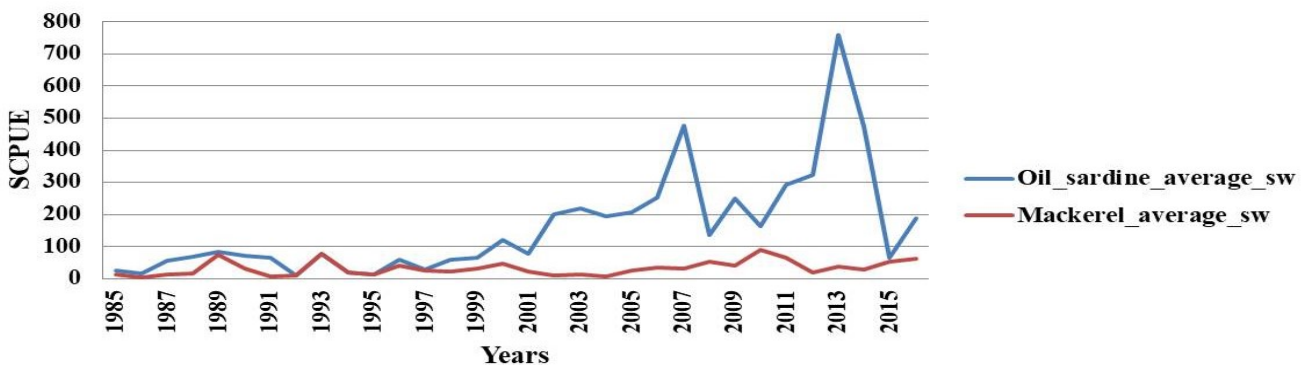
The results of the study strongly indicate the effect of changing climate on the distribution of *Sardinella longiceps* along the Kerala coast.

### Inter-annual variability analysis of oceanographic variables on oil sardine and mackerel fishery

Analysis of the inter-annual variability of oceanographic parameters, extreme oceanographic events and trend in Standardized Catch per Unit Effort (SCPUE) hints the im-

along the southwest coast of India. Afterwards a hike in oil sardine fishery happened from 2000 to 2007 and during this period increased upwelling was noticed and enrichment of chlorophyll-a concentration was observed along the southwest coast of India.

SCPUE of Oil sardine and Mackerel



pacts of coastal ocean dynamics and extreme oceanographic events on Indian oil sardine and mackerel fishery along the southwest coast of India.

In early 90's, due to more number of co-occurred ENSO and IOD events, the oil sardine fishery was at its lowest

The result indicated that oil sardine fishery is dependent on mackerel fishery. Successful oil sardine fishery hints the collapse of mackerel fishery owing to the prey-predatory relationship between them.

# Research Highlights



## Scientist's/Investigator's Desk

Dr. Grinson George, Senior Scientist, Headquarters Kochi

### Climatic projections of Indian Ocean (2030–2100)

There is lot of scientific interest among climate change researchers to forecast the future of climatic variables.

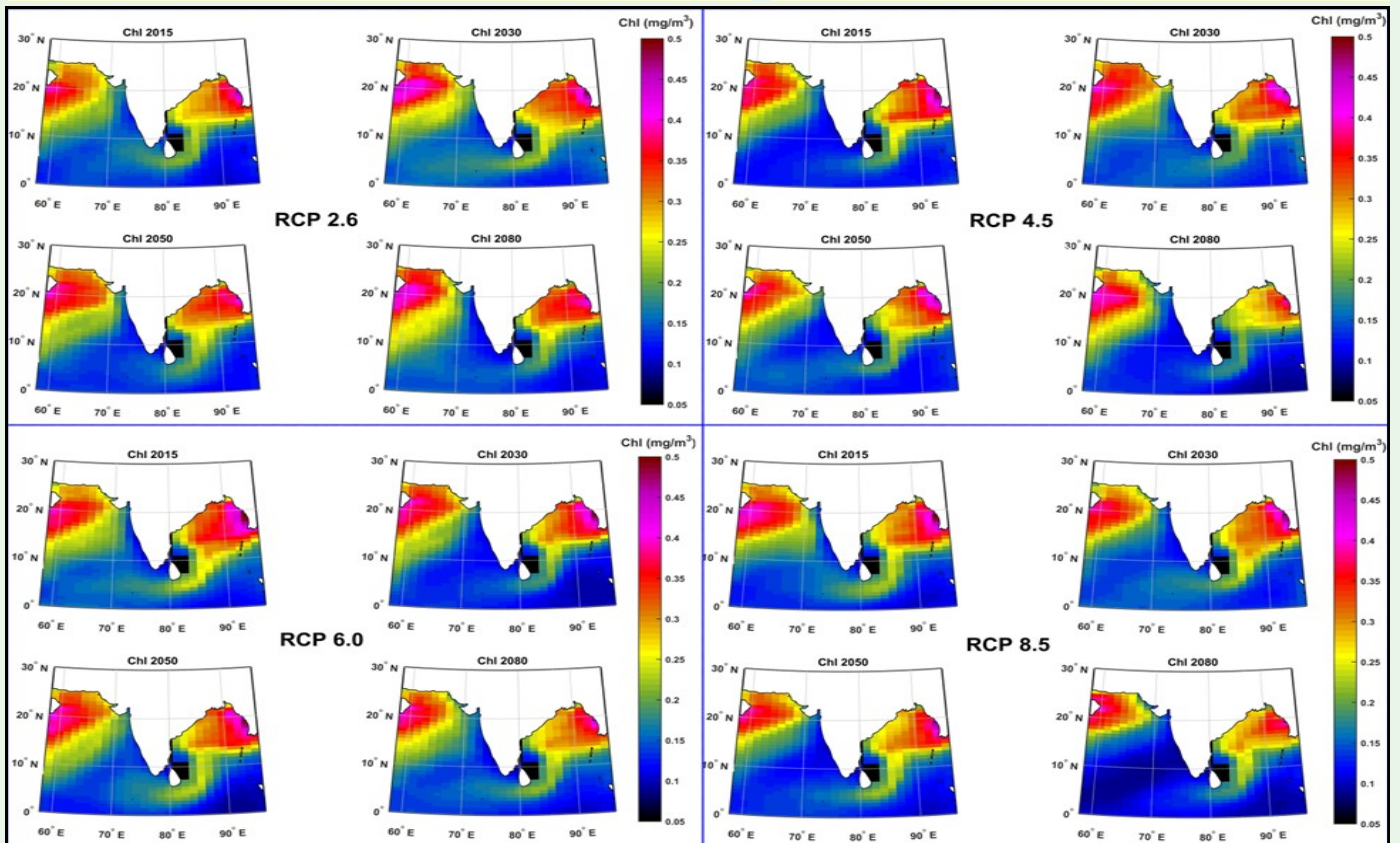
As part of the research program in NICRA we initiated a working group to analyze various existing forecasting of models to derive some important environmental variables.

Climate projections were obtained for oceanographic variables such as sea surface temperature (SST), pH,

Salinity, Chlorophyll concentration, Rainfall, Sea level rise (SLR) in the Indian ocean during 2020-2100.

Projections were obtained using CMIP5 model output in all four RCP scenarios (RCP 2.6, RCP 4.5, RCP 6.0, RCP 8.5).

Decadal catch trend analyses of commercially important marine species of 4 zones are being carried out and the output shall be utilized for the catch forecast of marine species.



RCP Scenarios	Description
RCP 2.6	Radiative forcing reaches 3.1 W/m <sup>2</sup> before it returns to 2.6 W/m <sup>2</sup> by 2100. To reach such forcing levels, ambitious greenhouse gas emissions reductions would be required over time.
RCP 4.5	Radiative forcing is stabilized shortly after year 2100, consistent with a future with relatively ambitious emissions reductions.
RCP 6.0	Radiative forcing is stabilized shortly after year 2100, which is consistent with the application of a range of technologies and strategies for reducing greenhouse gas emissions.
RCP 8.5	This RCP is consistent with a future with no policy changes to reduce emissions. Characterized by increasing greenhouse gas emissions that lead to high greenhouse gas concentrations over time.

## Climate Resilient Technologies

### Ecological Resilience

#### ICAR-CMFRI –NICRA signs MoU with Space Applications Centre - ISRO to develop a centralized wetland portal and mobile application

The ICAR-Central Marine Fisheries Research Institute (CMFRI), Kochi has signed a Memorandum of Understanding (MoU) with the Space Applications Centre (SAC) of the Indian Space Research Organisation

Dr. A.P Dineshababu (Pr.Scientist), Dr. Grinson George (Sr.Scientist) and Dr. Rojith Girindran (Research Associate) are other scientific persons of ICAR-CMFRI team who participated in the event and further technical discussions.



Dr. P.U Zacharia and Shri. Nilesh Desai

(ISRO) through NICRA project on 8th April 2019 at SAC Main Campus in Ahmedabad. MoU was signed between Shri Nilesh Desai, Associated Director of Space Application Centre, Ahmedabad and Dr. P.U Zacharia, Principal Scientist, Head DFD and Principal Investigator, NICRA project of ICAR-CMFRI.

In line with the MoU a mobile app and a centralised portal will be developed with focus on field level data collection of wetlands and integration into a common digital platform.

ISRO has geospatial database of regional wetlands across the nation, which shall be further strengthened by ICAR-CMFRI and collaborating institutions with ground level data on physico-chemical, microbiological and other parameters of wetlands.

The dataset thus generated shall be integrated into a common repository with access to scientific communities, so as to provide real time analysis and advisories for the management of regional aquatic bodies.

**This is the first national instance that a fisheries institute is collaborating with ISRO to implement a comprehensive climate resilient framework for fisheries and wetlands.**



Team NICRA with Team SAC-ISRO

#### GIS Mapping Project to be Partnered

MoU signing was followed by a technical session. Dr. Grinson George made the technical presentation from CMFRI side and Shri. Rajendra N Gaikwad presented from SAC. ISRO scientists explained about an ongoing GIS Mapping project of wetlands, for which

they are looking for project partners in Andaman and Nicobar Island. Dr. Dineshababu, CMFRI agreed to undertake the project for the project location in line with further official modalities and sanction.

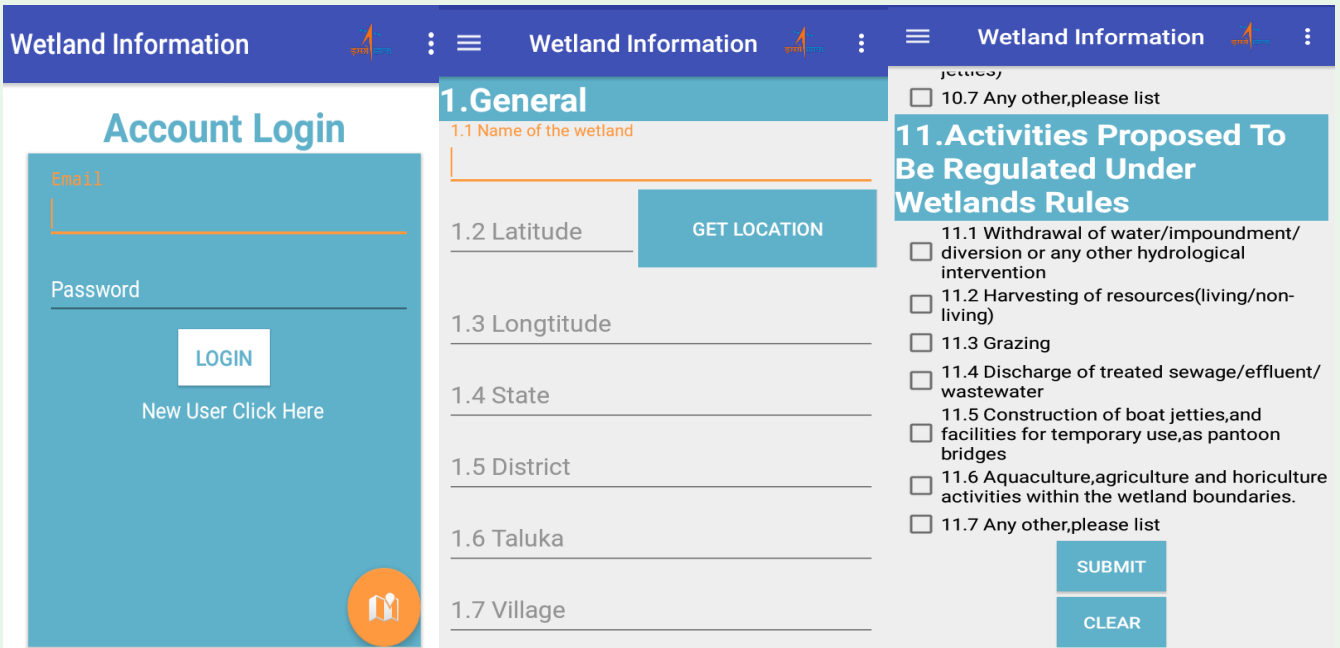


# Mobile App & Portal developed for National Wetland Management

The Mobile App and Portal developed in collaboration with ISRO is focused on generating and integrating field level regional wetland datasets with geo-spatial database. The comprehensive datasets could be used to monitor the GHGs profiles, water quality index, sediment quality index, species health, habitat health, biodiversity profiles and climatic stressors of the regional wetlands, which in turn facilitates national wetland management and real time advisories.

Three level of grading is maintained for ensuring data quality.

- Data Input by users such as Farmers, Researchers, Labs and Consultants.
- Data validation by Experts such as Scientists, Professors and Govt. Authorities.
- Data approval by Admin (ICAR – CMFRI, Kochi HQs).



Beta version of wetland mobile application

## Highlights

- The mobile Application could be a handy tool towards field level data acquisition in a uniform digital format
- The portal could emerge as a vital one-stop comprehensive qualitative and quantitative wetland data source with access to scientific communities for aqua farm advisories
- Integration of aquaculture in regional wetlands could generate periodic datasets along with enhancing village level food and nutrition security
- Fisheries institutes and professionals could take lead role in continuous monitoring of regional wetland eco systems
- Wetland monitoring shall be done in partnership with ICAR-CIBA and other stakeholder institutions.

## In Media



The Hindu Business Line | Hindustan Times | Business standard | The Economic Times | Indian Express | The New Indian Express | Outlook | ICAR Website & More

# Climate Resilient Technologies

## Socio-Economic Resilience



Hon. Direct General, ICAR Dr. Trilochan Mohapatra on 7th December 2018 at NAS, New Delhi launched and released the multivendor e-commerce website and associated mobile app developed through NICRA project of CMFRI

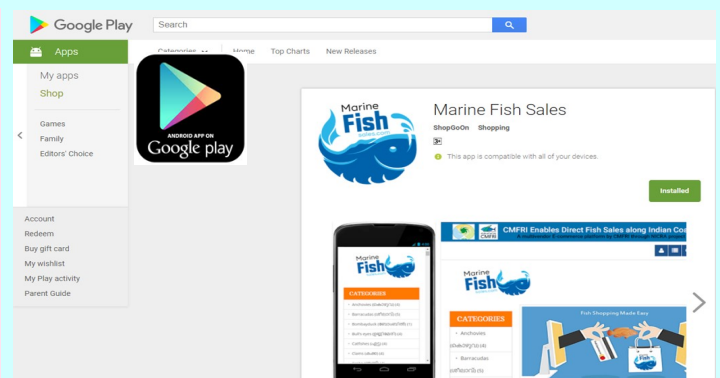
This is the first national instance that a Govt. institute is facilitating e-commerce solution in fisheries sector

## Multivendor E-Commerce Website and Mobile App for Fishermen Income Improvement

- ◆ Direct impacts of climate change on society are loss of fishing days, low catch followed by livelihood insecurities and income loss.
- ◆ In spite of high price for fishes in market, the fishermen are getting low returns
- ◆ Alternative livelihood practices away from the sector is unsustainable, as it leads towards the exit from fisheries sector.
- ◆ To address above challenges, NICRA-CMFRI intervened through development of a multi-vendor E-commerce website and associated mobile application so as to enable direct marketing and sales between fishermen self help group and customers.



- ◆ Trainings for familiarization with e-commerce were provided for fisher folks and Fish farmers. Training were also provided on fish processing and packing.
- ◆ Initial sales of around 1.5 lakh were done at Kochi through the developed e-platform.
- ◆ The e-platform envisions to engage more fishermen SHGs with service extension to other centers.



# Climate Resilient Technologies

## Features of E-Commerce Website and Mobile Application



### Components: Admin panel, Vendor panel, Store Front

- ◆ The platform is an interface with administrative control panel, vendor panels and user storefront with ICAR-CMFRI in administrative role.
- ◆ Various fishermen SHGs/ fishermen/ farmers can register as vendors and update their stock availability under pre-approved categories and products, which shall be displayed in the website.
- ◆ Customers through store front could view and select or search for products under various categories and further proceed to checkout > fill customer details > confirm order.

### Admin (CMFRI) Features

- ◆ Create & manage unlimited categories, products, filters, profiles.
- ◆ Approval & monitor of unlimited vendors, products, sales, orders, payment gateway integration.

### Vendor (Fisher SHGs) Features

- ◆ Vendor logins, dashboard for each, add & modify products, information, downloads & images, special prices, discounts
- ◆ Auto stock reduction, printable invoice, sales reports, Email & SMS alert on each order.

### Store Front (Customer) Features

- ◆ Search categories & products
- ◆ Options for Cleaned, Sliced and Whole
- ◆ Add to cart, Pay (Online & COD) for product delivery
- ◆ Review products

The research work 'Climate change and role of e-commerce as a socio-economic resilience strategy for fishermen communities' won Best Oral Presentation Award at International Conference on Aquatic Resources and Blue Economy (AQUABE 2019) organized by Kerala University of Fisheries and Ocean Studies (KUFOS) during 28<sup>th</sup> to 30<sup>th</sup> November 2019.

## In Media



Print Media: The Hindu | The New Indian Express | Times of India | The Financial Express | Deepika Hindu Business Line | India Today | Deepika | Kerala Kaumudi | Madhyamam | Mangalam | Mathrubhumi | Outlook |

Visual Media: Multiple news channels (Asianet, Asianet News, Reporter, Janam)

# NICRA E-Commerce Trainings

## Trainings at ICAR-CMFRI, Kochi HQs

### Familiarization of On Multivendor E-Commerce Website for Fish Farmers



- ◆ Training program was organized on 16.12.17 to familiarize the developed e-commerce website and mobile app among fish farmers.
- ◆ 28 participants (farmers, fishermen, SHGs and traders) underwent training.
- ◆ Farmer meet were arranged on 21.03.18 to fix minimum base price for farm products.

- ◆ Training on 'Fish processing and Packaging' was also arranged on 17.04.18 at KVK Njarakkal.
- ◆ Distributors have been engaged to facilitate distribution in case farmers do not have distribution facility.
- ◆ The website ([www.marinefishsales.com](http://www.marinefishsales.com)) is opened for public to order fresh fish of their choice from the vendors who registered their products in the website.

- ◆ Scale up of the e-commerce technology with adequate institutional support could enable vulnerable coastal self help group to advance through the supply chain and towards attaining income improvements and livelihood securities.
- ◆ However, lack of training and minimum assured order are to be resolved prior to scaling up.



Trainings on Ecommerce Website and Mobile App

## NICRA E-Commerce Trainings

### Training on fisheries E-Commerce implementation for the state of Himachal Pradesh

- ◆ Govt. of Himachal Pradesh expressed interest to implement the similar system at their state for inland fisheries and accordingly Himachal Pradesh Govt. made allocations in the state budget speech.
- ◆ Further Director cum Warden, Directorate of Fisheries, Bilaspur, Himachal Pradesh sought the technical guidance from resource persons of ICAR - CMFRI, which was agreed upon.
- ◆ Dr. P.U. Zacharia, Principal Investigator, NICRA project along with Dr. Rojith.G, Research Associate were deputed as resource persons.
- ◆ Training meeting was convened by the Director cum Warden at Directorate of Fisheries, Bilaspur along with other state fisheries officials, administrators and farmers on 5<sup>th</sup> February 2019.
- ◆ Technical information and implementation guidelines were provided by the resource persons.
- ◆ The training and interactive sessions were fruitful and concluded around evening.



Training session held at Directorate of Fisheries, Govt. of Himachal Pradesh, Bilaspur with Director cum warden of HP Fisheries

- ◆ The features of developed e-commerce website and android app were presented in detail with live online demonstrations through website. Assistant Director, Himachal Pradesh too explained the features to the farmers in regional language.
- ◆ A hand-on session was provided to farmers of the program and a representative farmer registered as vendor, updated his stock detail with image, which was visible on store front after approval by admin.
- ◆ Guidelines were further provided to implement the system for the state of HP viz., IT requirement, Self Help Groups, need for farmer training on e-commerce familiarization, distribution network development and im-

- ◆ Govt. level implementation of E-Commerce for inland fisheries shall pave way towards exploration of new market avenues and sales strategies for fish farmers than conventional supply chain dependence

## Research Highlights

### Space Applications Centre (SAC) - ISRO Transferred National Wetland Information Mobile Application and Website to NICRA project of ICAR-CMFRI



SAC - ISRO has developed the mobile application and centralized portal as per the MoU with NICRA project, ICAR-CMFRI, in the context of climate change and wetland resilience



Dr. A. Gopalakrishnan, Director, CMFRI and Dr. P.U. Zacharia, Principal Investigator, NICRA project receiving manual of e-platform from SAC-ISRO scientist

- ◆ The e-platform along with operational manuals were transferred and demonstrated by SAC-ISRO scientist to NICRA project of ICAR-CMFRI in an event organized on 30<sup>th</sup> September 2019
- ◆ Dr. P.U. Zacharia, Pr. Scientist, Head DFD delivered the welcome address, followed by an introductory talk by Dr. A.P. Dineshababu, Pr. Scientist, CMFRI, Mangalore.
- ◆ Dr. A. Gopalakrishnan, Director, CMFRI delivered the presidential address.
- ◆ SAC-ISRO scientist made technical presentation and demonstrated the features of mobile Application and portal.
- ◆ Event was attended by stakeholder institutions such as ICAR—CIBA, NCAAH, KUFOS, SWAK and CMFRI research centers
- ◆ Wetland visit was arranged at Puthuvype research centre, KUFOS for field demonstration of mobile application
- ◆ Dr. P. Kaladharan, Pr. Scientist, CMFRI made a brief talk on wetland sampling techniques and delivered vote of thanks.
- ◆ Dr. G. Rojith, RA, NICRA is the national coordinator and technical contact person for the e-platform



Field data acquisition using mobile application at a wetland in Puthuvype Research Centre of KUFOS

## Climate Smart Village Development

### Wetland Restoration at Edakochi Village, Kerala

- ◆ Initial field survey revealed the 5 acre wetland site at Edakochi, Ernakulam, Kerala as degraded and unfit for scientific fish farming as effluent influx from sewage to the aquatic water body was evident along with shallow water level.
- ◆ NICRA interventions include construction of side bunds to prevent the pollutant influx into water body and fortification of sluice gate to enable large scale aquaculture.
- ◆ Water quality tests were frequently carried out to conform the quality of water for aquaculture
- ◆ The restored wetland was further utilized for multi-species (Prawns, Pearl spot, Milk fish, Grey Mullet) fish farming.
- ◆ A partial harvest was done on April 2019 with good yield.
- ◆ Stakeholders stated that NICRA interventions helped in stabilizing the wetland towards aquaculture.
- ◆ Juvenile of initial farming were preserved within the wetlands as seed to continue aquaculture.



- ◆ It is remarkable that the restored wetland withstood the floods during 2018 and 2019



Partial harvest at restored wetland site

## Research Highlights

### Climate Smart Village Development

#### Trainings/Technology Demonstrations on Vulnerabilities, Capture Based Aquaculture, IMTA and Cage Culture

- ◆ About 52 fishermen from 15 coastal villages from Thoothukudi District were given training on vulnerability mapping and mitigation strategies. Representatives from different coastal villages presented the visible changes occurring due to climate change and its effect on fisheries.



Vulnerable resource mapping by fishermen and facilitators

- At Sippikulam farms in Tuticorin, Tamilnadu coastal fishermen were empowered to harness positive impact of climate change by capture based aquaculture, technologies of sea cage farming of high-value fishes like cobia, sea bass and pompano, lobsters and also low-cost cage construction as well as mooring of cages in the sea.
- Experiment on seaweed (*Gracilaria edulis* and *Kappaphycus alvarezii*) culture in Indoor FRP tank and outdoor cement tank systems using rope and raft, rope and net tube were successfully done.



Seeded coir rope deployed in Karapad lagoon

- ◆ Mandapam Regional Centre has successfully demonstrated the Integrated Multi Trophic Aquaculture system (IMTA), initiated by stocking 2,000 fingerlings of Silver pompano, *Trachinotus blochii* and 80 kg of seaweed per raft at Munaikadu village.
- In Chinnapalam village of Mandapam, fisherfolk were educated on the impact of plastic pollution, how it affects and enters marine ecosystems, plastics decay properties, how to reduce/avoid plastic usage.



Awareness program on the impacts of plastic pollution at Mandapam

- A mangrove nursery unit for species like *Rhizophora* spp., *Avicennia* spp etc. was set up and will be used in restoration/planting in selected locations.
- 40 fisherwomen from Chinnapalam village, Mandapam were trained on 'Marine Ornamental Culture' including a field visit to Thangachimadam.



*Kappaphycus alvarezii* using rope and net-tube method after 45 days



## Technology Demonstration



### Climate change adaptations and mitigation measures adopted in Ramanathapuram district, Tamilnadu.

Johnson, B., Sudhan, C. and Remya, L, Mandapam Research Centre

- Construction of Sea wall at Mundariyarchatiram near Dhanuskodi was done to protect sea or coastal erosion; Mangroves and casuarina vegetation is being done as a coastal defense structures in the coastal areas of Ramanathapuram district.



Casuarina vegetation



Mangroves vegetation

- Owing to the lack of sufficient number of cyclone shelters, actions has been taken to construct new cyclone shelters to accommodate the vulnerable coastal populations

- Pucca houses were constructed under Tsunami Rehabilitation scheme followed by the placements of Tsunami evacuation boards near the coastal residence at various places in Ramanathapuram district.



Cyclone shelter



Tsunami Evacuation Sign Board

- Seaweed farming of *Kappaphycus alvarezii* was carried out in five coastal districts (Ramanathapuram, Pudukottai, Thoothukudi, Thanjavur and Kanyakumari) of Tamilnadu.



Participants from Chinnapalam village receiving training at Mandapam RC

## Integrated Multi Trophic Aquaculture

- Sea cage farming of cobia *Rachycentron canadum* along with the rafts of seaweed *Kappaphycus alvarezii* was developed and demonstrated to the fishermen SHG's.
- At the end of the farming operation an additional production of cobia (12%) and seaweed (50%) were achieved.
- Integration of seaweed with cobia cages favourably generates additional revenue through in-

creased yields of both cobia and seaweed.

- Nearly 100 fishers in Ramanathapuram district, Tamilnadu are being benefited through this technology and they are continuously adopting this technology with their own investment.
- IMTA is also efficient in controlling both organic and inorganic pollution in the natural open waters and thereby ensuring ecological balances.

## Research Highlights

### Climate Smart Village Development

#### Vulnerable Village Adoption at Tamilnadu & Karnataka

##### Tamilnadu

- ◆ Among the six highly vulnerable villages of Ramana-thapuram district, Tamilnadu identified through PARS, two villages namely Vadakadu (Rameswaram) and Chinnapalam (Pamban) were adopted to develop as climate smart village.
- ◆ Village level meetings were organized and technologies on small-scale entrepreneurship for production of marine ornamental fishes were disseminated to the selected fishers.
- ◆ Hands on training was given to 40 fisherwomen from Chinnapalam village, on broodstock development, breeding, larval and juvenile rearing of clown fishes, grow-out techniques, livefeed culture, water quality and disease management.
- ◆ The Thematic Apperception Test (TAT) clearly shows that the majority of participants attained medium to high level of achievement.
- ◆ Training Effectiveness Index (TEI) revealed that most of the trainees perceived the marine ornamental fish culture training programme as highly effective.

##### Karnataka

- ◆ The Integrated District Level Adaptation and Mitigation (IDLAM) study conducted along coastal Karnataka revealed that Udupi district has high climate related vulnerability index (0.460) compared to Dakshina Kannada (0.418) and Uttara Kannada districts (0.362).
- ◆ Udupi district is also vulnerable to accelerated sea level rise.
- ◆ A village named Alvaekodi, Paduvari Grama panchayat in Udupi district was adopted to upgrade as “Climate Smart Village (CSV)” through interventions that can facilitate sustainable increase in agricultural productivity and income.
- ◆ An interactive meeting on climate smart technologies were held with stakeholders.
- ◆ Hands-on training to alternate vocations (seaweed farming) were provided to 40 fishermen participants.
- ◆ Seaweed *Kappaphycus* was introduced from Tuticorin at Alvekodi (Udupi) and Chaliyam (Calicut) estuaries and the growth monitored.

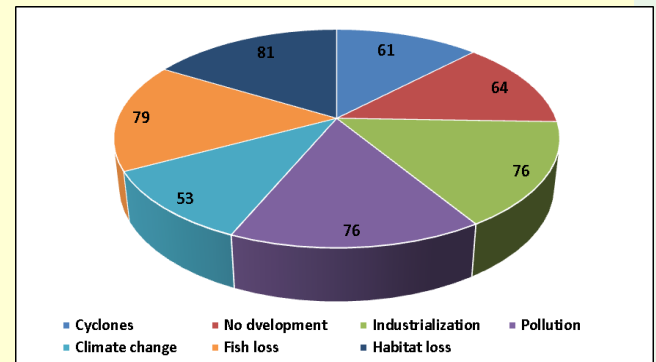
#### Climate resilient seaweed farming practices using improved monoline method at Mullakadu Coastal Village, Thoothukudi District, Tamilnadu

- Field demonstration carried out at Tuticorin, Tamilnadu revealed that on an average farmers got a yield of 10 tonnes of seaweeds (5 fold increase) from a single plot (consist of 100 numbers of monolines) within a culture period of 30-35 days with a net revenue gain of Rs. 35,000 to Rs.40, 000/- per plot.
- An individual group can manage four numbers of improvised monoline seaweed plots at a time and could perform the cultural activities for nearly six months from April to September.
- The farm gate price of harvested seaweed in wet basis fetches Rs 5/kg and Rs. 40 per kg for dried seaweed with 25-30 % of moisture level.
- Owing to success, State Fisheries Department of Tamilnadu, Tuticorin is planning to provide subsidies for improvised seaweed farming practice to the fishermen of Thoothukudi District, Tamilnadu.
- The estimated average cumulative carbon sinking potential was 424.6 CO<sub>2</sub> Kilogram/plot (1 Plot = 100 Monolines each of 15 m Length).
- The estimated average cumulative carbon sinking potential during the second, third and fourth week of culture period was 82.5, 141.7, 242.9, & 339.1 CO<sub>2</sub> Kilogram/plot respectively.

## Research Highlights

### Vulnerability Assessment of coastal villages of Tamilnadu

- ◆ Vulnerability mapping of coastal villages and taluks of Tuticorin, Tirunelveli and Kanyakumari of Tamilnadu were done.
- ◆ Vulnerability Index was high in Vilavankode taluk of Kanyakumari District whereas it was high in Thoothukudi Fishing Harbour (0.3076) followed by Therespuram (0.2243) fishing village for Thoothukudi district.
- ◆ As a part of IDLAM program, 21 villages of Tiruvallur district were surveyed and based on the response it was observed that the direct impact by loss of livelihood and sustenance sources were due to habitat destruction and dwindling of fishery resources.
- ◆ The indirect impact relates to low education and employment opportunities was due to lack of proper facilities and lack of marketing channels is a major drawback for fishing activities.
- ◆ Widespread damage caused by recurrent cyclones has also upset the economy of the fishing communities in these villages.
- ◆ All the fishermen interviewed opined that habitat loss and reduction in fishery resources are the major reasons for declining fishery.



- ◆ Assessment of the vulnerability index based on village-level survey revealed a high overall vulnerability index of 0.704 for the Tiruvallur district.
- ◆ Vulnerability Indices developed based on indicators and sub-indicators of climate change revealed that Karunkali village was most vulnerable, followed by Koraiuppam, Ernavurkuppam and Kattupallikuppam.
- ◆ Most of the youth respondents in all the villages have evinced keen interest in exploring alternate livelihood options such as cage culture of fishes, introduction of artificial reefs, initiating ecotourism etc.

### Co cultivation of red seaweed *Kappaphycus alvarezii* integrated with green mussels in Padanna backwaters, Kasaragod, Kerala

- ◆ The Carrageenan yielding red seaweed *Kappaphycus alvarezii* being cultivated in large scale at Palk Bay was brought to Padanna village, Kasaragod, Kerala and introduced in floating rafts (2 x 2 m) and kept afloat in mussel rens with active participation of local mussel farming self-help groups.
- ◆ Water quality and growth were monitored fortnightly and the rafts were cleaned to remove the adhering abiotic and biotic seston.
- ◆ The biomass after 60 days was harvested to find that the Padanna Estuary supports seaweed growth without affecting the mussel production.
- ◆ The water quality in the farming site recorded reduction in ammonia levels and increase in dissolved phosphate levels significantly.



Floating rafts brought to shore for cleaning

## Research Highlights



### A Novel Low Cost Sediment Corer for Studying Bluecarbon Stocks from Seagrass and Mangrove Ecosystems

P. Kaladharan, K. Vijayakumaran and V. Akhilbabu, ICAR - CMRI, Kochi

- ◆ A cost effective and easy to operate sediment corer was fabricated with locally available materials that can be handy to collect sediment cores from seagrass meadows and mangrove stands for studying the blue carbon stocks.
- ◆ The corer (1 m long) was made from a heavy duty PVC pipe of 6 cm diameter with a removable metal handle as shown in the figure. The outer surface of the corer is marked in cm to drive below the sediment at a required depth.
- ◆ The sediment core can be drawn easily without breaking the core through a sediment releaser made of metal rod fitted with a handle on one end and a circular disc to the distal end.

The advantages of the corer are:

**Light weight:** Easy to carry to the field

**Simple:** Easy to operate single handedly, core of sediment from desired depth can be sampled for bulk density determination

**Durable:** Can be used for multiple sampling as the corer is made of heavy duty pipe



**Cost effective:** Made with locally available materials and fabricated locally, not to exceed INR.100/ piece.



## Researcher's Desk

Liya V. Benjamin, Senior Research Fellow, NICRA, Headquarters Kochi

### Climate change adaptation strategy: Harmful algal blooms as Biofuel source

- ◆ Variations in climate change parameters such as sea surface temperature and precipitation alter the natural dynamics of fresh and marine waters, favoring the harmful algal blooms (HAB).
- ◆ In spite of the widespread documented detrimental effects of algal blooms, opportunities exist to harness them to develop climate resilient products such as biodiesel, bio-butanol, bio-ethanol, hydrocarbons, biogas and hydrogen. Microalgae have 30%–40% lipid contents by dry weight and have around 80% energy content to that contained by petroleum. Besides, microalgae are capable of producing 30 times the amount of oil per unit area of land, compared to oilseed crops. Large-scale algae cultivation can be done using open-pond reactors (OPR) and closed photo bioreactors (PBR).
- ◆ Major challenges facing commercial biofuel production from algal resources include development of efficient algae harvesting techniques, more cost-effective oil extraction and identification of suitable species with high growth and production rate. By conquering these challenges, cost effective fuel production from algae could be attained along with scalability.

## Climate Resilient Products

### Biofuel production from Seaweeds and Water Hyacinth

- ◆ Water hyacinth (*Eichhornia crassipes*) and Seaweeds (*Kappaphycus alvarezii* and *Gracillaria corticata*) were the substrates for experiment.
- ◆ Compositional analyses such as carbohydrate, cellulose, and lignin content of substrates reveals the suitability of the substrates for biofuel.
- ◆ Pretreatment with hydrogen peroxide, followed by acid hydrolysis and subsequent fermentation using yeast *Saccharomyces cerevisiae* yielded bioethanol, which was detected by High Performance Liquid Chromatography.
- ◆ Optimization of process parameters could yield higher ethanol.



Fermentation of hydrolysate using yeast *Saccharomyces cerevisiae*

The research work *Conversion of Aquatic Weed Eichhornia crassipes into Climate Resilient Products 'Biofuel' and 'Biochar' and its Implications on Climatic Resilience* won **Best Poster Presentation award** during International conference BRAQCON 2019 organized by ICAR-CIBA.

### Biochar production from Water Hyacinth and its Application in Representative Integrated Fish - Paddy Culture Systems

- ◆ Aquatic weed, The water hyacinth (*Eichhornia crassipes*) was converted into 'biochar' and further applied in representative integrated paddy-fish culture systems
- ◆ Biochar was incorporated into the feed of tilapia, *Oreochromis mossambicus* in selected ratio and was fed to the fishes grown in tanks for 4 weeks
- ◆ Weight and length of the fish were found to be enhanced significantly in biochar mixed feed
- ◆ Biochar amendment to soil in the culture system enhanced the specific growth rate of *O. mossambicus*
- ◆ The optimal ratio of biochar – soil mixture in comparison to control were inferred as per the observed highest growth performance of pokkali in the biochar amended soil system



Biochar amended feed experimental setup



Control 5% 4% 3% 2% 1%  
Paddy growth enhancement in biochar amended system

The research work *Characterisation of biochar from water hyacinth Eichhornia crassipes and the effects of biochar on the growth of fish and paddy in integrated culture systems* won **Best Oral Presentation award** during International conference BRAQCON 2019 organized by ICAR-CIBA.

## HRD Programs Conducted

SI No.	Name of the Program	No. of participants	Date
1	E- commerce training organized by CMFRI-Cochin.	28	16 <sup>th</sup> December 2017
2	Farmers meeting to fix minimum base price for multivendor e-commerce organized by CMFRI-Cochin.	30	21 <sup>st</sup> March,2018
3	Fish processing and packaging for E-Marketing organized by CMFRI-KVK-Cochin.	10	17 <sup>th</sup> April 2018
4	Village level meetings to develop them in to Climate Smart Village organized by Mandapam Regional Centre.	50	8 <sup>th</sup> February 2018
5	Marine Ornamental Fish Culture organized by Mandapam Regional Centre.	40	16 <sup>th</sup> February 2018
6	Field demonstration on Integrated Multi-Trophic Aquaculture organized by Mandapam Regional Centre.	52	15 <sup>th</sup> - 17 <sup>th</sup> February 2018
8	Training cum workshop on application of ARC GIS and QGIS in wetland mapping and analysis organized by Mangalore Research Centre.	2	5 <sup>th</sup> - 9 <sup>th</sup> February 2018
9	Awareness on climate change preparedness and alternate livelihood options organized by Mangalore Research Centre.	50	17 <sup>th</sup> September 2018
10	Training on Integrated Multi-Trophic aquaculture & marine ornamental fish culture organized by Mangalore Research Centre.	100	27 <sup>th</sup> - 28 <sup>th</sup> September 2018
11	Initiation of seaweed culture - A climate resilient farming practice at Mullakadu coast of Thoothukudi District organized by Tuticorin Research Centre on the occasion of National Fish Farmer's Day.	25	10 <sup>th</sup> July 2018
12	One day training program on "Seaweed farming: A Climate-Smart Farming Practice at Mullakadu village of Thoothukudi district, organized by Tuticorin Research Centre.	15	11 <sup>th</sup> December 2018
13	Demonstration on seaweed farming: A climate resilient farming practice at Tsunami Nagar of Thoothukudi coast organized by Tuticorin Research Centre.	15	14 <sup>th</sup> August 2018
14	Interactive meet with seaweed and sea cage farmers of Sippikulam, Mullakadu coastal villages of Thoothukudi.	30	31st August 2018

## HRD Programs Conducted

SI No.	Name of the Program	No. of participants	Date
15	Training on fisheries E-Commerce implementation for the state of Himachal Pradesh hosted at Directorate of Fisheries, Bilaspur, HP.	25	8 <sup>th</sup> April 2019
16	Awareness on the model mangrove farm: building resilience to climate change organized by Tuticorin Research Centre.	50	5 <sup>th</sup> February 2019

## NICRA Publications

SI No.	Category	Published
1	Book Chapters	8
2	Journal Paper	15 Accepted : 2
3	Conferences/ Seminars : Proceedings / Abstracts	15
4	Technical (Popular) Articles	1
5	Leaflets	2
6	Brochures/Pamphlets	1
7	Handbook	2
8	Visual Media	5

## Major Conferences Presentations

SI No.	Name	Date	No of Abstracts
1	World Brackishwater Aquaculture Conference BRACON 2019 organized by ICAR - CIBA, Chennai.	23 <sup>th</sup> - 25 <sup>th</sup> January 2019	12
2	International Conference on Aquatic Resources and Blue Economy orga-	28 <sup>th</sup> - 30 <sup>th</sup> November 2019	2
3	Sixth Biennial Conference OSICON - 19 organized by Ocean Society of India	12 <sup>th</sup> - 14 <sup>th</sup> December 2019	2
4	International Conference on Frontiers in Marine science Challenges and Prospects, MARICON-2019 organized by CUSAT, Kochi (Upcoming).	16 <sup>th</sup> - 20 <sup>th</sup> December 2019	3

## Success Story

### Trained fishers undertake ornamental fish culture

Through marine ornamental fish culture a fisher family in Ramanathapuram district is earning an average monthly income of Rs.12,000/- to Rs.15,000/- (only grow-out of marine ornamental fishes; buying half-inch size clown fishes and grow them up to 1 ½ inch size, which is ready for marketing in 45 days).



### Recognitions / Awards

- ◆ **Best paper in Oral Presentation:** Rojith. G, Zacharia P.U, Sharon Benny\*, Sajna V.H, Liya V Benjamin, Roshen G.N, Dhanya Joseph, Akash. S and Grinson George, for the research paper 'Climate change and role of e-commerce as a socio-economic resilience strategy for fishermen communities' at International Conference on Aquatic Resources and Blue Economy (AQUABE 2019) organized by Kerala University of Fisheries and Ocean Studies (KUFOS) held on 28<sup>th</sup> to 30<sup>th</sup> November **2019**.
- ◆ **Best paper in Oral Presentation:** Najmudeen T.M\*, Mary Febna A.A, Rojith. G and Zacharia P.U, for the research paper 'Characterisation of biochar from water hyacinth *Eichhornia crassipes* and its effects on the growth of fish and paddy in integrated culture systems', during World Brackishwater Aquaculture Conference (BRAQCON) held during 22–25 January **2019** at ICAR-Central Institute of Brackishwater Aquaculture, Chennai.
- ◆ **Best paper in Poster Presentation:** Shamiya Hasan, Haritha. J, Rojith. G\*, Ros Kooren, Rinu Madhu Sayooj. P, Grinson George and Zacharia P.U. for the research paper 'Conversion of aquatic weed *Eichhornia crassipes* into climate resilient products and its implications on climate resilience' during World Brackishwater Aquaculture Conference (BRAQCON) held during 22 – 25 January **2019** at ICAR-Central Institute of Brackishwater Aquaculture, Chennai.
- ◆ **Best paper in Poster Presentation:** Bhendekar S.N\*, Mohamed K.S, Shenoy Latha, Dineshababu A.P, Jayasankar.J, Jaiswar A.K, Singh V.V and Anulekshmi Chellappan for the paper titled 'Spatial Variability and unusual abundance of Indian Squid Off Maharashtra coast, India' at International Conference on Challenges and Opportunities for Sustainable Fisheries and Aquaculture Development (COSFAD2019) during 17-20 January **2019** at College of Fisheries Ratnagiri, Maharashtra.

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