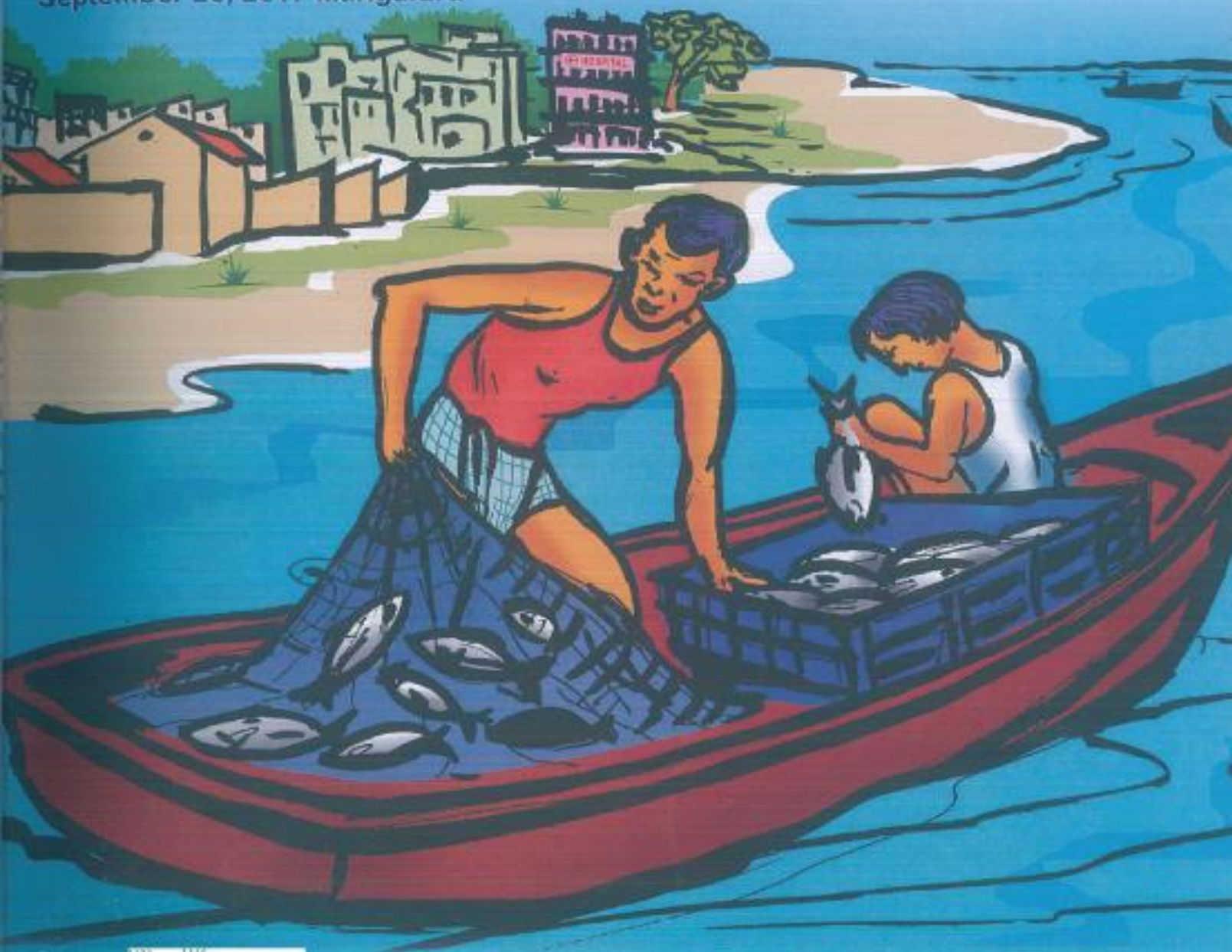


# Sāmarasya...

National Workshop  
Harmonizing Coastal  
Industrialisation with  
Marine Ecosystem Health  
(HCIMEH, 2017)

September 25, 2017 Mangaluru



ICAR-Central Marine Fisheries Research Institute  
Mangalore Research Centre

*Sāmarasya*



National workshop  
Harmonizing Coastal Industrialization with  
Marine Ecosystem Health

# *Sāmarasya*



September 25, 2017

Hotel Moti Mahal, Mangaluru, Karnataka



Mangalore Research Centre of  
ICAR-Central Marine Fisheries Research Institute  
Post Box 244, Hoige Bazar, Mangaluru, Karnataka



*Sāmarasya, the Souvenir released on the occasion of National Workshop, HCIMEH, 2017 at Mangaluru, commemorating the Platinum Jubilee of ICAR- Central Marine Fisheries Research Institute*

ISBN 978-93-82263-17-3

*National workshop on  
Harmonizing Coastal Industrialization with Marine Ecosystem Health*

**Organized by**

*Mangalore Research Centre of  
ICAR-Central Marine Fisheries Research Institute  
Post Box 244, Hoige Bazar, Mangaluru, Karnataka*

**Published by:**

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*The Mangalore Research Centre of ICAR-Central Marine Fisheries Research Institute, Mangaluru acknowledges the funding received from sponsors towards printing and publishing the Souvenir*

**Cover design & Illustration :**

*Abhilash P.R. and David K.M.*

**Printed at**

*School Book Company  
Carstreet, Mangaluru*

*The views expressed in the articles are that of the author/authors and the organizers are not responsible for the same*



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## Message

I have great pleasure to learn that the Mangalore Research Centre of the ICAR-Central Marine Fisheries Research Institute (CMFRI) is organizing a National Workshop on “*Harmonizing Coastal Industrialization with Marine Ecosystem Health*” (HCIMEH 2017), on 25<sup>th</sup> September, 2017 at Mangalore, Karnataka to commemorate the Platinum Jubilee year (2017-2018) of CMFRI.

The Institute through its research programmes has been contributing immensely to the development of the marine fisheries sector. Some of the important studies of the Institute include marine biodiversity, fisheries and environmental monitoring; climate change and anthropogenic activities; mariculture and allied R& D; nutraceuticals from marine organisms; economics of fishing operation; socio-economic status of fisherfolks and HRD.

The coastal resources and habitats in Karnataka are being monitored by Mangalore Research Centre of ICAR-CMFRI since 1947. Industrialization, exploration and utilization of available natural resources are integral parts of development activities. The proposed Workshop is expected to enable the coastal industries and monitoring institutions to put forth the measures taken up by them to sustain the coastal ecosystem health. The output of the Workshop could guide future research and development programmes to sustain the marine ecosystem, rejuvenate its living resources and improve the livelihood of the coastal populations.

I wish the programme a grand success.

  
(JK Jena)





सुभाषचंद्र बोस  
GOVT. OF  
MAHARASHTRA

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## Message

It is a pleasure to know that the Mangalore Research Centre of ICAR-Central Marine Fisheries Research Institute, is organizing a National Workshop on “Harmonizing Coastal Industrialization with Marine Ecosystem Health” (HCIMEH 2017) on the 25<sup>th</sup> September 2017 at Mangaluru, Karnataka to commemorate the Platinum Jubilee year of CMFRI.

A major challenge in any emerging economy is to promote economic development without erosion of its natural capital. The long coastline of our country and its living and nonliving resources can certainly act as a major engine of growth, but it should not be at the cost of the health of the coastal environment or its immense biodiversity. This delicate balance between development and conservation can only be brought about through a sustainable development strategy, the key elements of which should be clean technologies and optimum utilisation of natural resources.

I am sure the workshop would deliberate on the regulatory standards presently followed in coastal industrialization, the roles of institutions in coastal environmental monitoring, environmental safety measures and the importance of corporate social responsibility as a major source of funding for conserving the coastal ecosystems.

I wish to take this opportunity to congratulate the organizers and wish the programme a grand success.

**(N. Vasudevan, IFS)**

**Additional Principal Chief Conservator of Forests,  
Maharashtra Mangrove Cell**





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KRISHI ANUSANDHAN BHAVAN-II, PUSA, NEW DELHI - 110 012



## Message

It gives me immense pleasure to know that the ICAR-Central Marine Fisheries Research Institute (ICAR-CMFRI), Mangaluru Research Centre is organizing a National Workshop on “*Harmonizing Coastal Industrialization with Marine Ecosystem Health*” (HCIMEH 2017) on the 25<sup>th</sup> of September 2017 at Mangaluru, Karnataka to commemorate the Platinum Jubilee year of the Institute.

The marine fisheries sector has grown into a major industry, contributing significantly to the agricultural GDP of the country; providing employment opportunities and meeting the food and nutritional security of the people. The Mangaluru Research Centre of ICAR-CMFRI has been identifying major issues in the marine fisheries sector of Karnataka and providing management advisories for sustaining its marine fisheries. It is imperative that judicious management of the limited natural fisheries resources is the key for sustained development of the sector. I am sure that the Research Centre will continue to strive towards fisheries development of the state through its scientific research and will contribute towards blue revolution in the country.

This workshop will be a meeting point for the coastal industries and monitoring institutions to identify sustainable eco-friendly technologies that would lead to overall development of the coastal regions for and coastal population along with maintaining the coastal ecosystem health.

I extend my heartiest congratulations to the Director, ICAR-CMFRI and the Scientist-in-charge and staff members of Mangaluru Research Centre of ICAR-CMFRI on the occasion to commemorate the Platinum Jubilee Celebrations of the Institute and wish the programme a grand success.



(P. Pravin)





**H.S. VEERAPPA GOWDA**  
DIRECTOR OF FISHERIES



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## *Message*

It is heartening to know that ICAR-Central Marine Fisheries Research Institute, Mangalore is organizing a National Workshop on “Harmonizing Coastal Industrialization with Marine Ecosystem Health” (HCIMEH 2017), on September 25, 2017 at Mangalore, Karnataka to commemorate the Platinum Jubilee year of the Institute.

The marine fisheries sector in Karnataka over the year has grown into a major industry contributing significantly to the agricultural GDP of the country; providing employment opportunities and meeting food security. Overall development leading to self-sufficiency is the benchmark of developed and developing countries. Harmonization of industrialization with marine ecosystem is the key to a holistic development of the region.

This workshop will be a meeting point for the decision makers, researchers, coastal industries and regulatory bodies to discuss and work towards a common goal of sustainable utilization of the available natural resources.

Best wishes to the organizers of this programme.

**H.S.Veerappa Gowda**  
Director of Fisheries  
Bangalore



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# Green Mussel extract (GMe)

CMFRI has developed Cadalmin™ Green Mussel extract (GMe), which contains 100% natural, marine, bioactive anti-inflammatory principles extracted from the green mussel *Perna viridis*. The product is effective for chronic joint pain & arthritis and improves cardiovascular functioning and is complete nutritional supplement.

Cadalmin™ GMe is a blend of nutraceutical and nutritional elements including concentrated *n*-3 polyunsaturated fatty acids, essential amino acids, vitamins, naturally chelated minerals, antioxidants, enriched substituted polysaccharides and phospholipid derivatives. It is free from deleterious *trans*-fatty acids, free radical adducts and low molecular weight carbonyl compounds. Each capsule contains: GMe active principle 500 mg supplemented with 100% natural ingredients.



Recommend dosage: Two capsule per day along with food or as suggested by the physician

Contraindications: Individuals with seafood allergies and hyperuricemia should avoid taking GMe.

CMFRI has commercialised the technology with Accelerated Freeze Drying Company Ltd, Kochi. Cadalmin™ GMe is marketed under the trade name Musseltone, which is available from:

#### The Chairman

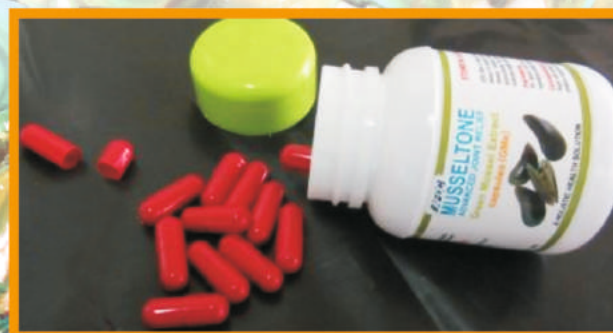
Accelerated Freeze Drying Company Pvt. Ltd.  
Amalgam House, Bristow Road  
Willingdon Island, Kochi- 682003  
Fax: 0484-2668130  
Email: [amalgam@amalgamfoods.in](mailto:amalgam@amalgamfoods.in)  
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An ICAR

Health Product



ICAR-Central Marine Fisheries Research Institute's

# Cadalmin™ Antihypercholesterolemic extract (Cadalmin™ ACe)

A green remedy to dyslipidemia and obesity from the seaweeds



For further information please contact:

**The Director**

ICAR- Central Marine Fisheries Research Institute  
Ernakulam North PO  
PB No 1603  
Cochin-682018  
Kerala



An ICAR  
Health Product

ICAR-Central Marine Fisheries Research Institute's  
**Cadalmin™ Antihypercholesterolemic extract  
(Cadalmin™ ACe)**

A green remedy to dyslipidemia and obesity from the seaweeds

Cadalmin™ Antihypercholesterolemic extract (Cadalmin™ ACe) is a nutraceutical product, which provides a unique blend of 100% natural bioactive ingredients extracted from seaweeds with an ecofriendly "green" technology.

Cadalmin™ ACe is a natural remedy of dyslipidemia and obesity from marine source.

Bioactive pharmacophore leads from seaweeds were used to develop Cadalmin™ ACe, which can be administered to regulate clinical indicators leading to obesity and dyslipidemia. The bioactive principles in the nutraceutical inhibit hydroxymethyl glutaryl coenzyme A reductase, various target receptors and other rate limiting enzymes, which are responsible to cause obesity and dyslipidemia.

The preclinical trial showed no test substance-related general organ or systemic toxicity following long term oral administration of Cadalmin™ ACe.

#### Ingredients (60 capsules)

Cadalmin™ ACe (per capsule) active principle 400 mg enriched with 100% natural bioactive ingredients. The active ingredients have been encapsulated in low moisture content 100% vegetarian based hydroxypropyl methylcellulose capsules.

#### Recommended dosage

Two capsules twice daily for 3 months. Two capsules once daily, thereafter.

#### Contraindications

People with seafood allergies should consult physician. If pregnant, nursing or under medication, consult your physician before using the product.



For further information please contact:

**The Director**  
ICAR- Central Marine Fisheries Research Institute  
Ernakulam North PO  
PB No 1603  
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Kerala

## GLORIOUS 70 YEARS IN INDIAN MARINE FISHERIES RESEARCH AND ACHIEVEMENTS OF ICAR-CMFRI

**A. Gopalakrishnan, Bobby Ignatius, Grinson George**

ICAR-Central Marine Fisheries Research Institute, Kochi

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The Central Marine Fisheries Research Institute (CMFRI), premier research establishment to undertake marine fisheries research in the country was established as a Marine Fisheries Research Station on February 3<sup>rd</sup> in 1947 in Madras, and the institute later joined Indian Council Agricultural Research, (ICAR) family in 1967. The year-long Platinum Jubilee celebrations of the Institute began on February 18, 2017 marking the eventful 70 years of research activities by the Institute in the area of marine fisheries of the country. Apart from the Headquarters, the ICAR-CMFRI, country's national R&D body in marine fisheries, has 11 Regional Research, 15 field centres throughout the coastal belts of the country and one KVK at Njarakkal, Ernakulam.



In order to accomplish its mandate, the CMFRI presently conducts research on characteristics of exploited marine fish stocks, carries out exploratory surveys, assesses the under and unexploited resources, undertakes research in fishery environmental characteristics and ocean-dynamics besides hosting several human resource development and consultancy programmes. Realizing the limited potential of the oceanic resources to meet the growing demand from fish-eating population of the country, CMFRI has allocated significant part of its research resources to develop mariculture technologies.



## CMFRI's Major Contributions to the Nation

The Institute collects Marine Fisheries Statistics and makes estimation of species-wise landings and monitors the landings on a continual basis from all along the country's coast. Spatial mapping of fishing grounds is carried out on a continuous basis, which will help in identifying the seasons of high abundance of spawners/juveniles and in identification of critical fishing grounds where seasonal and spatial closure of trawl fishery can be implemented.

CMFRI undertakes annual estimation of the marine fishery resources for more than 1200 species covering 1511 fish landing centres on a GIS platform for marine fish stock assessment. The institute maintains a National Marine Fishery Resources Database which is generated based on continuous and perpetual field data collection on marine fishery resources over decades. The Fisheries Resource Assessment Division of CMFRI undertakes the Marine Fisheries Census across the maritime states of the country every 5 years to assess the human, capital and infrastructural resources associated with marine fisheries in the country.

Right from its formative years, CMFRI has contributed significantly towards policy discourses related to marine fisheries sector in India. Some of recent policy initiatives in which CMFRI has taken active participation include:

- Formulation of National Marine Fisheries Policy, 2016- draft
- Report of the Technical Committee to Review the Duration of the Ban Period and to Suggest Further Measures to Strengthen the Conservation and Management Aspects, 2014
- Preparation of the Marine Fisheries Policy documents for ensuring the sustainable management of marine fisheries of Kerala & Lakshadweep Islands, Karnataka & Goa and Andhra Pradesh
- Development of Marine fisheries Management Code
- Policy guidance on Fish Aggregating Device (FAD), based on which Government of Karnataka banned FAD assisted cuttlefish fishery
- Guidance on National Plan of Action (NPOA) for sharks in India for increasing awareness of the need to ensure their sustainable exploitation and conservation
- Policy guidance on Light fishing, submitted to Government of Karnataka & Goa
- Trawl Ban Committee report submitted to Government of Kerala.
- Taskforce Report on 'Use of technology in Agricultural Insurance' submitted to NITI Aayog
- Developed Minimum Legal Size (MLS) estimates for 58 species of commercially important marine fishes aimed at restricting juvenile fishing. Based on this Govt. of Kerala notified MLS for 14 commercially important species in the Gazette

The ICAR-Central Marine Fisheries Research Institute (CMFRI) has developed a GIS-based database about the marine fish landing centres along the Indian coast describing their GIS (Geographic Information System) location, types of fishing activity, seasonality of fishing and the extend of fishing operations from each fishing centres. The Institute handed over the database to the Indian Navy in

order to make the security measures in coastal regions easier. The m@krishi service for fishermen in the State of Maharashtra provides information on Potential Fishing Zones (PFZ) through mobile phones in local language to fishermen reducing the scouting time for fishing by around 50%, reducing the fuel consumption and increasing the profit to the tune of 25-35%.

CMFRI scientists have so far described 255 marine species new to science from various groups of fishes. The researchers at CMFRI have coordinated India's first Marine Stewardship Council (MSC) certification for the short-neck clam fishery in the Ashtamudi Lake, Kerala. Research conducted at CMFRI has helped in delineating the scientific reasons behind the recent decline in oil sardine fishery along the south-west coast of India, to support formulation of management guidelines to improve the status of the fishery.

### **Enhancing Climate Resilience**

Marine fauna responds to climate change in different ways; from changes in their distribution patterns, reproduction, recruitment, growth, mortality and abundance. Changes like this will significantly impact fish production level. As the tolerance and adaptation capacities are different between species, the species that adapt and gain from warming are increasingly becoming dominant. On the other hand, those species, which are already at the threshold limits are vulnerable and may lose to adaptable ones. With regard to fisheries, the changes pose problems on the effectiveness of fisheries management measures. Potential longer-term impacts from climate change need to be factored into alternative livelihood program planning and implementation.

Recently, CMFRI has embarked on climate change adaptation and mitigation research for the marine fisheries ecosystem that can significantly contribute in readying the sector to minimize the impact of climate change. Based on the findings of the studies, several solutions for climate change adaptation and mitigation have been mooted for proactive action against climate change and to equip the fisher folk to adapt to evolving climate scenarios.

### **Wonder Drugs from Sea**

Bioprospecting of marine and oceanic resources is one of the thrust areas of CMFRI's research agenda, through which the institute has produced several nutraceuticals useful for treating life style diseases.

The ICAR-Central Marine Fisheries Research Institute (CMFRI) has been working in the frontier area of marine bioprospecting /bioactive molecule discovery from seaweeds and developing high value nutraceutical products as dietary supplements and health management. The Institute has developed and commercialized the nutraceutical products Cadalmin™ Green Algal extract (Cadalmin™GAe) and Antidiabetic extract (Cadalmin™ADe) as green alternatives to synthetic drugs to combat rheumatic arthritic pains and type-2 diabetes, respectively. Cadalmin™ Antihypercholesterolemic extract (Cadalmin™ACe) has been developed from seaweeds to combat dyslipidemia and obesity, and the product is being out-licensed to a pharmaceutical company.

The research team at CMFRI undertakes genetic and biotechnological studies to understand the population genetic structure of fishery resources in Indian waters. Climate change studies carried out at CMFRI has been instrumental in developing national strategies for climate resilient fishing and fish culture.

### Mariculture

Mariculture, *i.e.*, culture of marine organisms under controlled conditions in sea, has immense potential to meet the growing demand for fish. At a time when capture fisheries production is undergoing a stagnation period, mariculture can be considered as the only option to meet the ever increasing demand for the marine food products. Some of the promising mariculture options include open sea cage farming, integrated multi-tropic farming, mussel and oyster culture, ornamental fish production, pearl culture etc. Unfortunately, the lack of a proper mariculture policy is a major lacuna to enhance mariculture ventures such as sea cage farming in the country. Hence a mariculture policy is essential to promote open sea cage farming of fin fishes and shell fishes in an eco-friendly manner without causing any environmental damage to the ecosystem. Recognizing this need, CMFRI has geared up to prepare guidelines for formulating a national mariculture policy in the country. The areas of focus include development of a leasing policy, demarcation of potential mariculture sites along Indian coasts on a GIS platform, measures to strengthen feed supply for mariculture ventures, guidelines for development of infrastructure and value chains for brood stock management, and large-scale seed production of prospective fish and shell fish species and so on. Some of the promising mariculture ventures that have considerable potential to augment marine fish production in India are elaborated below;

### Open sea cage farming

Open sea cage farming is a promising venture for prospective entrepreneurs to realize high net returns through culture of high-value marine fish species in the open sea. CMFRI is the pioneer to initiate this technique in India by demonstrating open sea culture of several fish species such as cobia, pompano, grouper, seabass, etc. Two different versions of indigenously fabricated 6 m diameter cages (GI and HDPE) have been developed by the institute. On an average, 2-4 tonnes of fish can be produced in a 6m diameter cage per cycle. The net economic return per crop ranges from Rs. 1.5 – 2.5 lakh depending on the species grown. Through successful demonstrations along the maritime states, cage farming has started gaining momentum in various states of India. Several farmers groups and development agencies in the coastal regions of Tamil Nadu, Karnataka, Andhra Pradesh, Kerala, Goa, Maharashtra, Odisha and Gujarat states have made agreement for technical support with CMFRI for cage farming. With the inputs from CMFRI, National Fisheries Development Board (NFDB) has included marine cage farming as one of its developmental schemes.



Cage farm



*Rachycentron canadum*

## Estuarine cage farming

The model developed by CMFRI for estuarine cage fish farming is being widely popularized in different parts of the country especially in the states of Kerala and Karnataka under the technical guidance of the Central Marine Fisheries Research Institute (CMFRI). Even the non-farming community has turned into the less expensive fish farming model after they received the technical and capacity enhancement training of the CMFRI. With the training and guidance received from CMFRI, farmers started the farming of commercially important fish varieties such as pearl spot, seabass, red snapper, tilapia and giant trevally in the brackish and fresh water bodies in their respective regions. The farms are operated as an alternative livelihood to fishers and family members are involved in the management of the cages. Trash/low value fishes collected from harbours and pellet feeds are used for feeding the fishes in cages.

Besides Ernakulam, Kerala where the maximum number of cage farming enterprises is in operation, the initiative has been started in other districts of the state namely Kannur, Malappuram, Thrissur, Alappuzha, Kottayam and Kollam. There are about 278 cage farming units are in operation in the district of Ernakulam.



Estuarine cages

According to CMFRI's technology, cages made of galvanized iron pipes with a size of 4 metre each length, width and 3m depth (48 cubic meter) is suitable for farming in estuarine/backwater areas. The depth of the cage may be varied depending on the depth of the water body. Seabass and pearl spot can be cultured in a same cage at a time. A number of 1000 each seabass and pearl spot seeds can be stocked in a cage with this size. After six months, the seabass is expected to attain a growth of 700 g to 1.2 kg of weight and pearl spot 200 to 250 g depending on the stocking size of the seeds (about 50 g). A total of an average 700 kg of seabass and 250 kg of pearl spot can be harvested from one cage itself within duration of 6 or 7 months with a survival rate of 90 per cent.

### *Integrated multi-tropic aquaculture (IMTA)*

IMTA is the practice which combines appropriate proportions of finfish/shrimp with shellfish/herbivorous fish and seaweeds to create balanced systems in farming for environmental and economic stability. This is an innovative farming concept introduced by CMFRI wherein cage culture of finfishes can be integrated with seaweed farming.



*Integrated multi-tropic aquaculture- Seaweed culture with cages farming*

IMTA can mitigate the potential negative externalities of sea cage farming with simultaneous enhancement in seaweed yield. This technique has proven to enhance sea weed yield with commensurate income enhancement. IMTA is being practiced by several fishermen along the Coromandel Coast in Tamil Nadu.

### *Other promising options under mariculture*

Mussel and oyster culture has gradually spread across the backwater belts of Kerala, Karnataka, Goa and Maharashtra owing to their high profitability. A number of methods such as stake culture, on-bottom culture, long-line culture, raft culture, rack culture, etc. are followed for mussel and oyster farming. Over 1000 farmers are practicing rack culture of green mussel in the Padanna estuary areas in Kasargod, which is contributing to three fourths of green mussel production in India. Other promising mariculture avenues which could be given a thrust in the state include ornamental fish farming, pearl culture, etc. for which technology is perfected by CMFRI. More number of entrepreneurs may be encouraged to take up these ventures by providing technological know-how, financial assistance as well as marketing and logistical support.

### *Hatchery production of marine finfishes and shellfishes*

One of the major requirements for the development of mariculture in the country is the availability of seeds of commercially important species for farming. The institute has developed and popularized hatchery production technology for mussel, edible oyster and marine ornamentals fishes for commercial exploitation of these resources. CMFRI through its constant and focused research effort was successful in developing hatchery technologies for high value marine finfishes like Cobia, Silver Pompano, Indian Pompano, Orange spotted grouper and *Lethrinus lentjan* for the first time in the country. Apart from these species for which currently commercial level hatchery production is available in the country, CMFRI is in the process of developing technologies for three more marine species which will boost mariculture activities.



Silver Pompano (*Trachinotus blochii*)



Juveniles of *Amphiprion percula*

The mariculture sector will address the ever-increasing demand for the quality seafood for human consumption and, to some extent, bridge the gap between demand and supply in marine fish production as the amount of wild caught fish remaining stagnant for the years and scope for increasing production from capture sector is very little. Mariculture can be considered as one of the best alternate livelihood options for the coastal fishermen community.

## Academic Collaborations

CMFRI collaborates with a number of research and academic organizations in and outside the country for strengthening its research programs and for complementing its academic and human resource development activities. Under the Human Resource Development initiatives, CMFRI conducts regular training programmes in fisheries and marine biology. So far, the institute has produced over 300 Masters and 160 PhD degree holders

## Outreach Activities

The Agricultural Technology Information Centre (ATIC) of CMFRI serves as a 'single window delivery system' for the technologies and services as an interface between fisher folk, entrepreneurs and scientists. ATIC regularly takes part in exhibitions and other extension platforms to showcase the research outputs and achievements of CMFRI. Similarly, KVK-Ernakulam of CMFRI develops and disseminates location specific technological modules and acts as Knowledge and Resource Centre for agriculture, fisheries and allied activities. Besides, scientists at various research centres and divisions of the institute regularly take part in various extension and outreach activities for the benefit of the fisher folk at large.

## Consultancy services

CMFRI offers Consultancy Services in specialized areas to over 100 clients generating remarkable revenue. Some of the clients during the last few years are

- Fisheries departments of Various maritime states and union territories
- Vision Varkala Infrastructure Development Corporation (VVIDC) Ltd., Thiruvananthapuram
- Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), New Delhi
- M/s. JSW Infrastructure Limited, Mumbai
- Mott Mac Donald Pvt. Ltd (MMPL), Mumbai
- M/s Asian Consulting Engineers (Pvt.) Ltd., New Delhi-110 048
- TN Corporation for Development of Women, Tamil Nadu
- National Institute of Oceanography, MUMBAI
- TATA consulting Engineers Ltd, Mumbai Dept. of Tourism, Thiruvananthapuram
- M/s. MRPL, Mangaluru
- M/s. KIOCL, Mangaluru
- NTPC, Visakhapatnam
- RGCA, Sirkazhi
- M/s Alpha Marine Emergency Response Service Pvt. Ltd.
- Tamil Nadu Corporation for development of women
- Sindya Power Generating Company Private Ltd
- Surat Municipal Corporation, Gujarat

## Conclusion

Sustainable fisheries management options, if implemented properly, indicate possible enhancement of harvestable potential in Indian EEZ to the extent of 6 million tonnes per annum or more. Opportunities in open sea cage culture and related developments in the field of mariculture during the last 5 years show a way forward in open sea mariculture practices and propose a production ideal to the tune of 4 million tonnes per annum in the coming years from mariculture sector alone. Managing fish and fisheries in isolation will not lead to sustainability of the ecosystem, therefore, the services provided by the entire ecosystem needs to be considered by appropriate management interventions. Hence, it is imperative to shift towards an Ecosystem Approach to Fisheries Management (EAFM) that aims at development and management of fisheries while considering the health of the entire ecosystem. If properly implemented, there are possibilities that the marine fish production may be enhanced to the tune of 10 million tonnes per annum (6 million tonnes from capture and 4 million tonnes from mariculture) by 2050.

## HARMONIZING MANGROVE CONSERVATION WITH LIVELIHOOD PROMOTION

**N. Vasudevan**

Additional Principal Chief Conservator of Forests  
Maharashtra Mangrove Cell  
Govt. of Maharashtra

In a world where the weather pattern is becoming increasingly unpredictable, where cyclones and storm surges have become more frequent, the case for mangrove conservation stands stronger than ever. Possessed with very efficient natural mechanisms for carbon sequestration, mangroves are the frontline soldiers in our war against climate change. By breaking up large storm surges and strong tidal currents, mangroves help to diminish their devastating impact. They are also home to a wide range of life forms—from shellfishes and finfishes, to birds, reptiles and mammals. Many commercially important species of fishes depend on mangroves at some stage of their life cycle, either for nutrition, or for shelter, or both.

However, the conventional methods of conservation such as raising of nurseries, mangrove plantation, intensified patrolling, and awareness drives fall short of promoting a sustainable approach to conservation. The best practices across the globe leads us to the inevitable conclusion that sustainable mangrove conservation can happen when the local communities start deriving livelihood benefits from the mangrove ecosystem. Embodying this principle, the Mangrove Cell of Maharashtra has sought to promote the organic link between conservation and livelihood through several meaningful interventions, which were tested on a pilot scale in Sindhudurg District of Maharashtra. These pilot initiatives were part of a marine biodiversity conservation project, being jointly implemented by the Government of India and United Nations Development Programme, with funding support from the Global Environment Facility.

One of the widely promoted activities in this regard has been the mangrove crab farming. In order to increase the income-earning potential of mangroves, crab farming was introduced in several villages of Sindhudurg with the support of the Rajiv Gandhi Centre for Aquaculture (RGCA), affiliated to the 'Marine Products Export Development Authority' (MPEDA), Kochi. Mangrove crab farming is very popular in countries like Bangladesh, Thailand, Philippines etc., but rarely practiced in India in a scientific manner. Mangrove crab has huge demand in the international market and can fetch premium price, when it reaches more than 600g weight. Aquaculture of crabs can therefore be a very lucrative economic option for coastal communities. As the natural habitat of these crabs, mangroves become an organic imperative for the crab farmer. Crab farming is thus creating a win-win situation, helping in the conservation of mangroves, while meeting the livelihood needs of the coastal communities. It is a potential game changer, which can transform the way people view mangroves—from a coloniser of coastal land to a tangible economic resource.

At present, mud crab farming in India is largely based on collection of crabs from the wild for fattening or grow-out. Hatchery production of mud crabs is a relatively recent innovation, with most research and development taking place over the last few decades. The RGCA runs the only crab hatchery in the country at Sirkazhi in Tamil Nadu. Potential beneficiaries from Maharashtra were given hands-on training at this hatchery. Starting from 2014, a scientifically-backed approach of crab farming was initiated in several mangrove pens and tide-fed farms in the coastal talukas of Sindhudurg District. Currently in its fourth crop, the activity has covered 15 villages, involving 179 beneficiaries and spread over an approximate area of 30 acres. Crab farming has not only led to the creation of substantial income for the farmers, but also generated a renewed interest in the conservation of mangroves.

Another important livelihood activity, being promoted by Mangrove Cell, is the oyster culture programme for women's self-help groups. Oysters are a highly-valued seafood and considered a delicacy in USA, Europe, Japan and other countries. In India, there is a growing demand for oyster meat in some parts of the country. Prior to the introduction of oyster farming programme in Sindhudurg, women from the fishers' community would spend several back-breaking hours harvesting oysters from the rocks during low tide. Years of over harvesting led to the progressive decline in the natural stock of oysters along Maharashtra Coast. Oyster farming, on the other hand, frees the women from this daily drudgery, while helping to replenish the natural stock. It follows a simple method, which involves setting up of a bamboo raft in the creek area, with substrates such as dead oyster shells hanging freely from this raft. The naturally available spat attaches itself to the substrates, and in a span of twelve to fourteen months, the oysters achieve commercial size. The programme requires low investment and very little physical labour, but promises high returns.

A pilot project for oyster farming was initiated in Sindhudurg District with the technical support from the Central Marine Fisheries Research Institute (CMFRI). This was then scaled up to 24 more units, involving large number of women from fishers' families. This experience in Sindhudurg proves beyond doubt that oyster culture can help strengthen coastal livelihood and address food security in the face of declining harvest from the sea and climate-induced stress on fishery resources. A positive spin off from this activity was the increased consciousness among the local community about the need to keep the creek water free from pollution. In areas where oyster farming is practiced, open defecation is beginning to show a declining trend.

Another innovative activity which has shown encouraging results is the mangrove ecotourism. In Mandavi Creek, near Vengurla Port in Sindhudurg, an all-women Self-Help Group was given two row boats, 20 life jackets, and some support for catering. Armed with this basic infrastructure and loads of interesting information about the mangrove ecosystem, this SHG named "Swamini" has been successful in developing a widely acclaimed ecotourism activity. Women themselves row the boats, taking tourists through the creeks while introducing them to the various mangrove species and associated flora and fauna. In the first four months of operation itself, the women earned close to ₹ 70,000 and are eager to develop the site into a one-stop destination for mangrove interpretation.



## State Support

In a significant boost to the idea of linking mangrove conservation with livelihood programmes, the Maharashtra Government, in its Annual Budget for 2017-18, has announced a fund allocation of ₹24 crores for a new scheme for coastal livelihood security. ₹15 crores from this fund will be used for livelihood programmes, primarily meant for the benefit of the people who have mangroves on their private land or in their immediate neighbourhood. The remaining ₹9 crores will be utilised for establishing a multi-species hatchery in Sindhudurg for crabs, bivalves and seabass. The multi-species hatchery and the livelihood support scheme will benefit thousands of families across coastal Maharashtra in the coming years, while helping to protect the State's mangrove wealth through a participatory mechanism.

## Mangrove and Marine Biodiversity Conservation Foundation of Maharashtra

To give better institutional support to coastal and marine biodiversity conservation, the Government of Maharashtra has recently established a 'Mangrove and Marine Biodiversity Conservation Foundation of Maharashtra (or simply, Mangrove Foundation). It is a registered society, entrusted with sufficient autonomy to plan and execute innovative programmes for conservation, research and sustainable livelihood activities in the coastal sector. With the creation of the Foundation, a new chapter in coastal and marine biodiversity conservation is sure to unfold in Maharashtra. Governmental efforts in marine biodiversity conservation can now be complemented well by the corporate sector, semi government and non-governmental organizations.

Hon'ble Chief Minister of Maharashtra is the Patron for the Foundation and the Hon'ble Forest Minister is the Chairman of the Board of Governors. The Board of Governors consists of representatives from various connected Departments, experts, NGOs and other stakeholders. The Foundation, with a decent corpus of ₹140 crores, is designed as an institution equipped with the necessary skill set and the operational flexibility to address the whole gamut of issues linked to coastal and marine biodiversity conservation and shall ensure the long-term sustenance of the initiatives so far undertaken by the Mangrove Cell.

Mangrove Cell's efforts to create replicable and scalable models of coastal biodiversity conservation are beginning to yield desirable results. The newly announced scheme of the state government will help in scaling up these models along the rest of Maharashtra Coast. If other coastal States also start similar programmes, the future of coastal biodiversity conservation in India will no doubt be more secure.







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For further information:

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Green Algal extract (GAe) provides a unique blend of 100% natural, bioactive anti-inflammatory ingredient extracted from seaweeds with an ecofriendly "green" technology to combat joint pain and arthritic condition.

Concerted research effort by the scientists of CMFRI to explore new sources of secondary metabolites from seaweeds led to the design and development of GAe, a nutraceutical to combat inflammatory diseases (joint pain and arthritic conditions). Major components with anti-inflammatory properties isolated from seaweeds have been used to formulate GAe. These are natural alternatives to synthetic anti-inflammatory drugs for combating arthritis.

The existing allopathic medications used in the treatment of joint pain and arthritis, are reported to produce several undesirable side effects, especially when used for longer duration. GAe is a green alternative to these allopathic preparations.

The active ingredients are chemically engineered to retain the anti-inflammatory properties for an extended shelf life and stability. Packed in low moisture content 'Naturecaps', Cadalmin™ GAe meet the needs of end users.

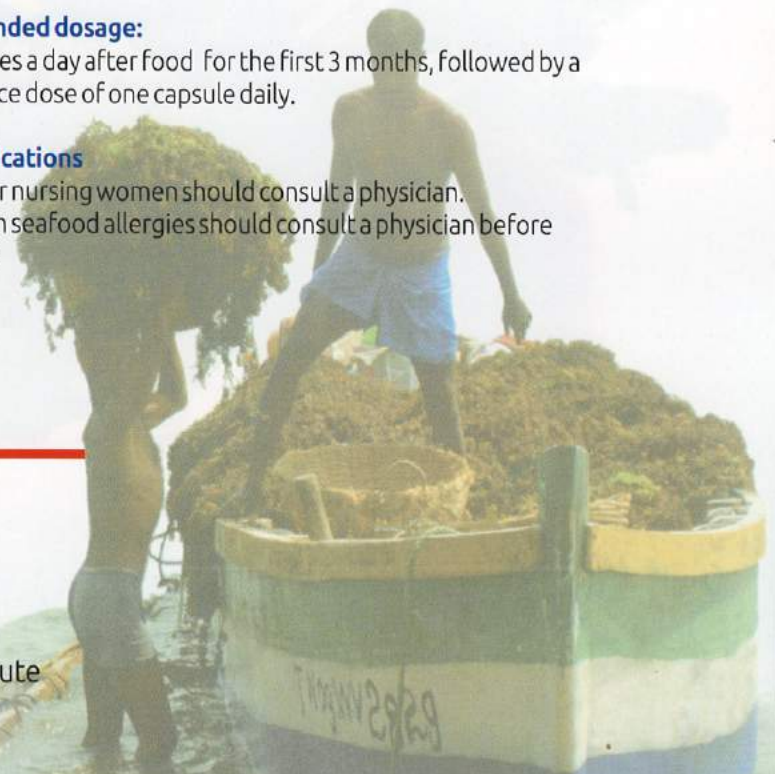
Each capsule contains: GAe active principle 500 mg.

#### **Recommended dosage:**

Two capsules a day after food for the first 3 months, followed by a maintenance dose of one capsule daily.

#### **Contraindications**

Pregnant or nursing women should consult a physician.  
People with seafood allergies should consult a physician before taking GAe



For further information:

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## **UDUPI POWER CORPORATION LIMITED (Subsidiary of Adani Power Limited)**

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### **About Adani Group:**

The Adani Group is one of India's leading business houses with revenue of over \$10 billion.

Founded in 1988, Adani has grown to become a global integrated infrastructure player with businesses in key industry verticals - resources, logistics and energy. The integrated model is well adapted to the infrastructure challenges of the emerging economies.

The Group has also made significant inroads in the Agri-Infrastructure business by setting up grain storage silos and cold storage facilities, catering to storage of apples from Himachal Pradesh. The Adani Group is a market leader in edible oil business with our Fortune brand of oil leading the pack.

**Resources** means obtaining Coal from mines and trading; in future it will also include oil and gas production. Adani is developing and operating mines in India, Indonesia and Australia as well as importing and trading coal from many other countries. Currently, Adani is the largest coal importers in India. They also have extensive interests in oil and gas exploration. Adani's extractive capacity has increased to 5 MMT in 2015 and it aims to extract 200 MMT per annum by 2020, which would be one of the largest mining groups in the world.

**Logistics** denotes a large network of Ports, Special Economic Zone (SEZ) and Multi-Modal Logistics - Railways and Ships.

Adani owns and operates seven ports and terminals – Mundra, Dahej, Kandla and Hazira in Gujarat, Dhamra in Orissa, Mormugao in Goa and Visakhapatnam in Andhra Pradesh, India. Mundra Port, which is the largest port in India, benefits from deep draft, first-class infrastructure and SEZ status. It crossed the 144 MMT mark of cargo

handling in FY15 and is aiming to handle 200 MMT of cargo handling by 2020. Adani is also developing terminal at Ennore in Tamil Nadu, India.

**Energy** involves Power generation & transmission and Gas distribution.

Adani is the largest private thermal power producer in India with an installed capacity of 11,040 MW. Its four power projects are spread out across the states of Karnataka, Gujarat, Maharashtra, Chattisgarh and Rajasthan. Adani has also installed 650 MW Solar Power Plant at Kamuti in Tamil Nadu, which is the world's largest solar power plant in single location.

During the Invest Karnataka Summit – 2016 Global Investors Meeting, Adani Group has declared a lead investment of Rs. 20,500/- crores in the State of Karnataka which includes Rs.11,500/- crores for UPCL's expansion by 2x800 MW; Rs. 7,000/- crores for setting-up of 1000 MW solar power plant; Rs. 2,000/- crores for setting-up of Port in Tadadi. Adani Group is also setting-up 200 MW solar power plant in Pavagada near Tumkur and bagged the award for installation of 20 MW solar power plant in 12 Taluks in the State of Karnataka.

### **About Udupi Power Corporation Limited (UPCL):**

Udupi Power Corporation Limited, a subsidiary of Adani Power Limited, has established 2 units of 600 MW imported coal based power project at Yelluru Village in Udupi District.

It is the first independent power project using 100% imported coal containing 3% to 5% of ash. Fly ash generated from UPCL is being collected in dry form in storage silos and the same has been utilized by various end users.

Nearly 25% of the total power requirement of the Karnataka State is being fulfilled by UPCL. The power generated is being evacuated through 220 kV & 400 kV transmission lines and supplied to 5 Electricity Companies owned by the Government of Karnataka i.e., MESCOM, BESCO, GESCOM, HESCO and CESCO.

The plant has latest pollution control equipment such as high efficiency electrostatic precipitators, 275 M high chimney, flue gas desulphurization plant and low NOx burners to limit the SPM, SOx, NOx emissions.

Now UPCL is expanding its project with another 2 units of 800 MW. With all these 4 units, the total capacity of UPCL will be 2,800 MW, which would be supplied to the State of Karnataka.

Through Adani Foundation, Adani Group ensures development and progress is sustainable and inclusive; not just for the people living in these areas, but the environment on the whole. Adani believe in delivering benefits that transcend their immediate stakeholders.

UPCL, in association with Adani Foundation, is executing many development works in the villages of its project vicinity. Under its Corporate Social Responsibility (CSR) programme, UPCL is giving importance to Education, Health, Rural Infrastructure Development and Support to Sports & Cultural Events. Adani UPCL has created a history in executing various development works under its CSR in Udupi / Dakshina Kannada Districts.



## I) Effluent Treatment Techniques at MRPL

MRPL has three Waste Water Treatment Plants (WWTP), one each for the three phases of Refinery for treating the effluent generated during refining operations. The WWTPs are configured with the latest, advanced and sophisticated treatment technologies with an objective of improving the quality of treated effluent, thereby maximizing the recycle/ reuse of treated waste water within the refinery premises. The three WWTPs have been integrated to improve the flexibility of operation.

A brief description of source of effluent streams and the major pollutants of the Refinery complex is given below.

**Table 1: Major Refinery effluent streams:**

S. No.	Sources of Waste Water	Major Pollutants
1	Process/ Non-process Oily Effluent	Oil, COD, BOD and TSS
2	Desalter Brine	Oil, TSS and TDS
3	Oily Effluents from OWS systems	Oil, Sulphides, phenol and COD
4	Tank Bottom Water Drain	Oil, TSS and TDS
5	Stripped Sour Water	Sulphides, Phenol, Ammonia
6	Spent Caustic Effluent	Sulphides, phenol, org. acid etc.
7	Cooling Tower Blow-Down	Oil, TSS and TDS
8	DM Water Blow-Down	Oil, TSS and TDS
9	Sanitary Waste	BOD and COD
10	Contaminated Rain Water	Traces of Oil and TSS

Depending upon the inlet characteristic of effluent, the effluent streams and treatment systems are classified as follows

### A) Oily water and contaminated rain water:

The oily water streams from process units are treated in main oil treatment section, called as the Dry Weather (DW) system, while the contaminated rain water streams are treated in the Wet Weather (WW) system during the monsoon season.

### B) High TDS effluent:

Effluent streams rich in Total Dissolved Solids (TDS) from the De-mineralization (DM) Plants and Cooling Tower Blow Down (CTBD) water are treated in Ultra Filtration (UF) and Reverse Osmosis (RO) treatment section for removing Total Dissolved Solids (TDS) and Total Suspended Solids (TSS).



Table 2: Effluent treatment facilities in WWTP-III

S. No.	Waste water treatment facilities	Design Capacity, m <sup>3</sup> /h
<b>D)</b>	<b>Main oily effluent treatment units</b>	
<b>A)</b>	<b>Primary treatment</b>	<b>480</b>
	API oil separators	
	TPI oil separators	
	Dissolved Air Flotation (DAF) unit with chemical treatment	
<b>B)</b>	<b>Secondary treatment</b>	<b>615</b>
	Sequential Batch Reactor (SBR)	
	Membrane Bio-Reactor (MBR)	
<b>II</b>	<b>CTBD treatment facilities</b>	
<b>A)</b>	Primary Treatment	<b>525</b>
	DAF Unit with chemical treatment	
<b>B)</b>	Secondary Treatment	
	Dual Media Filters (DMF) and Activated Carbon Filters (ACF)	
<b>III</b>	<b>Ultra Filtration (UF) system</b>	
	Auto Back Wash Filters	<b>600</b>
	UF Skids	
<b>IV</b>	<b>Reverse Osmosis (RO) system</b>	
	Cartridge Filters	<b>1000</b>
	RO Skids	
	Degasser Towers	
<b>V</b>	<b>CRWS treatment unit</b>	
	TPI oil separators	<b>450</b>
	Dual Media Filters	
<b>VI</b>	<b>Sanitary treatment unit</b>	
	Aeration tank	<b>20</b>
	Clarifier	
<b>VII</b>	<b>Wet Air Oxidation (WAO)</b>	
	Neutralization Tank	<b>5</b>
	Oxidation tank	
	Oxidation Reactor	
	Reaction Chamber	

### ❖ Brief description of the treatment:

The treatment facilities are mainly divided into three parts:

- i) Primary treatment section, where Oil, TSS and Sulphides are removed.
- ii) Biological treatment section, in which Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Kjeldahl Nitrogen (TKN) and Phenol are removed by aerobic and anaerobic degradation.
- iii) Tertiary treatment section, where TDS and TSS reduction takes place with the help of membrane technology.

#### i. Primary treatment section consists of the following:

- ★ API Oil Separators (for removal of free oil > 150  $\mu$  globule size and TSS) followed by Vertical Belt Skimmers for oil removal
- ★ Tilted Plate Interceptor (TPI) Oil Separators (for removal of free oil > 60  $\mu$  globule size and TSS)
- ★ Dissolved Air Flotation (DAF) System consisting of Flash Mixing Tank, Flocculation tank, DAF Tank and associated facilities (for removal of emulsified oil, Sulphides and TSS). Poly Aluminum Chloride (PAC) solution as a coagulating agent and  $H_2O_2$  as an oxidant are dosed in the flash mixing tank. De-Oiling Poly Electrolyte (DOPE) solution is dosed into the effluents in the flocculation tanks as a de-emulsifying agent.

#### ii. Secondary treatment section consists of the following:

- ★ Oily effluent streams treated in DAF are biologically treated in SBR followed by MBR to reduce the organic load measured in terms of BOD, COD and TKN in the effluent.
- ★ Sequential Batch Reactor (SBR): This system is operated in a batch mode. The complete process takes place in a single reactor; within which all biological treatment steps take place sequentially. Each cycle, which comprises of filling, aeration, settling and decanting, takes about 4-6 hours for completion.
- ★ Membrane Bio-Reactor (MBR): It consists of Anoxic basins, Pre-aeration basins followed by Submerged Membrane units in the Aeration basins. The filtered effluent or permeate from MBR basins is routed to RO feed tank for further treatment

#### iii. Tertiary treatment sections consists of the following:

- ★ The Ultra filtration (UF) treatment system treats the combined CTBD effluent and the neutralized effluent from the DM Plants for the removal of colloidal suspended solids.
- ★ The RO system is designed to remove TDS and turbidity from secondary treated water. The RO permeate is de-gassed and recycled as make up water in the Cooling Towers of refinery complex. The RO reject effluent is sent to the Waste Disposal sump and finally discharged to the Arabian Sea.

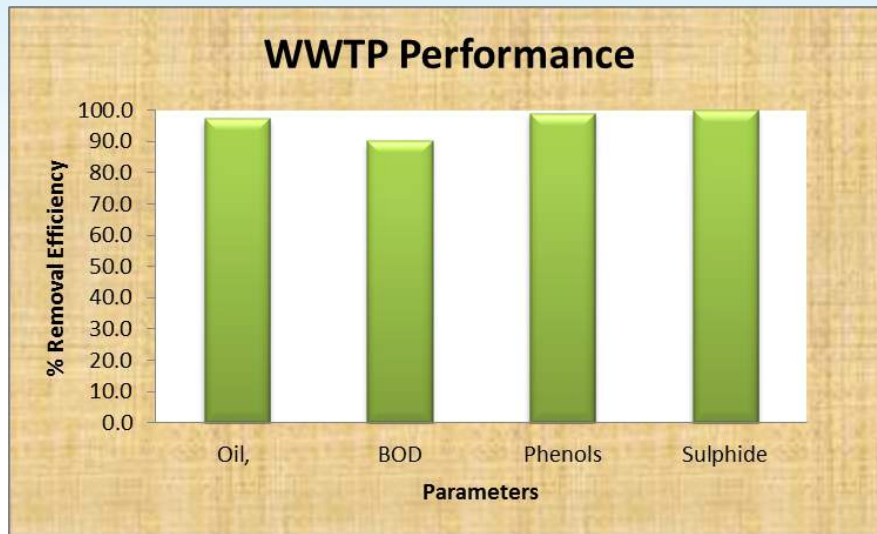


Fig: 2 Removal efficiencies of major pollutants in WWTP

❖ RO Performance Study:

The RO Unit in the WWTP Processes the UF Permeate and secondary treated effluent and the RO permeate is used for Cooling Tower make up in refinery complex. The design capacity of the system is 1000 m<sup>3</sup>/hr. RO system is designed to bring down TDS to < 80 ppm with 75 % recovery of permeate and 25 % of reject.

RO performance study was done with respect to Total Dissolved Solids (TDS).

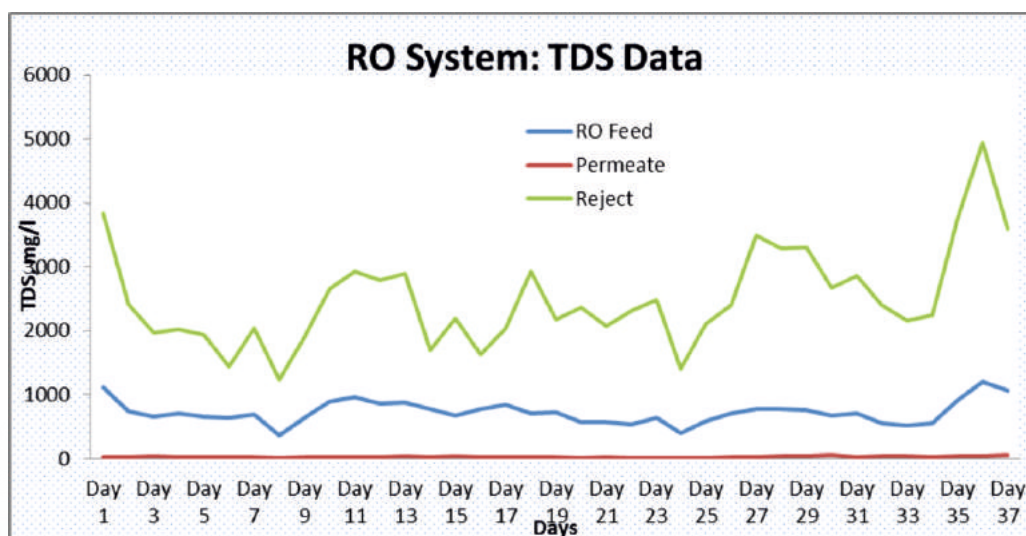


Fig: 3 Performance of RO system

As per the analysis, the average value of TDS achieved in RO permeate and reject are 26 mg/l and 2502 mg/l respectively.

## ❖ Contaminated Rain Water Treatment System (CRWS): (Wet Weather System)

Contaminated rain water collected in the process units during the monsoon season is treated in WWTP separately. CRWS consists of TPI oil separators for oil removal and Dual Media Filters for TSS removal.

Treated effluent quality is continuously monitored to meet the standards stipulated by Karnataka State Pollution Control Board (KSPCB). Efforts are taken to utilise the quantity of treated effluent recycled in the Cooling Towers as make up water. The treated effluent, surplus to the recycle requirement, is sent to Arabian Sea via the Chitrapura outfall (through APMC pump house) and the Mukka outfall (through MSEZ pipeline). An open channel of 500 m length and an intermediate storage sump is provided at the APMC yard as per the requirement of regulatory authorities prior to treated effluent discharge to Chitrapura Outfall. Treated effluent from APMC yard is discharged through submarine pipeline.

**Table 3: Comparison of Final Treated Effluent quality achieved at MRPL with the Standards specified in MoEF-2008 Notification**

S. No.	Parameter	Final TE quality	MoEF standards for Petroleum and Oil Refinery
1	pH	7.6	6 to 8.5
2	Oil and Grease, mg/l	2	5
3	BOD <sub>3</sub> days, mg/l	11	15
4	COD, mg/l	75	125
5	Suspended Solids, mg/l	7	20
6	Phenols, mg/l	0.19	0.35
7	Sulphides, mg/l	0.005	0.5
8	CN, mg/l	ND	0.20
9	Ammonia as N, mg/l	4.7	15
10	TKN, mg/l	7.7	40
11	P, mg/l	ND	3
12	Cr (Hexavalent), mg/l	ND	0.1
13	Cr (Total), mg/l	ND	2.0
14	Pb, mg/l	ND	0.1
15	Hg, mg/l	ND	0.01
16	Zn, mg/l	ND	5.0
17	Ni, mg/l	ND	1.0
18	Cu, mg/l	ND	1.0
19	V, mg/l	ND	0.2
20	Benzene, mg/l	BDL	0.1
21	Benzo (o) - Pyrene	BDL	0.2

**ND: Not Detectable, BDL: Below Detectable Limit**

## II) Water conservation measures in MRPL to reduce the water foot print

Water is a precious natural resource with limited availability. With continuous growth in country's population, per capita availability of water is decreasing. The higher standards of living, industrialization and urbanization demands increasing quantity of fresh water. At the same time, the uncontrolled disposal of domestic and industrial waste water is degrading the ecosystem. Therefore, there is a need to conserve water.

Crude oil processing consumes appreciable quantity of water, part of which is converted to liquid effluents. Generally, crude oil refineries consume huge amount of Raw Water (1.0-2.0 M<sup>3</sup>/T of crude oil processed) for production of petroleum products. In MRPL, fresh water consumption is around 1 M<sup>3</sup>/T of crude processed.

### The actions taken by MRPL for water conservation are:

#### 1. Utilization of STP water in MRPL

- ✓ To reduce the water intake from river, MRPL is utilizing Tertiary Treated Domestic sewage water from Mangalore city.
- ✓ Tertiary Treated Domestic sewage water is received at MRPL in a closed sump and after proper disinfection treatment, it is routed to cooling towers as make-up water.

#### 2. Maximisation of TE recycle and minimisation of discharge to Sea

- ✓ An advanced Waste Water Treatment Plant having SBR, MBR, UF and RO is commissioned in the refinery to improve Treated Effluent quality.
- ✓ Quantity of Treated effluent discharged to Sea is maintained within the KSPCB permitted quantity and MoEF standards.

#### 3. Improvement in Cooling Water Treatment

- ✓ High cycles of concentration (CoC) are maintained in Cooling Towers of MRPL, (around 5 to 6). Improved CoC in Cooling Towers, has reduced fresh water requirement.
- ✓ Improved filter backwash system
- ✓ Optimization of DM Plant load.

#### 4. Utilisation of Stripped Sour Water

- ✓ H<sub>2</sub>S content in the sour water streams generated in the Refinery units is stripped off to maximum extent in the Sour water strippers
- ✓ Sizable quantity of Stripped Sour Water is utilized in Desalters of Crude Distillation Units (CDU) and in the Overhead Fin-fans of Fractionator in Delayed Coker Unit (DCU).

#### 5. Condensate Recovery Units

- ✓ Condensate generated from Refinery units is collected, polished and reused in DM Plant/Cooling Towers as make-up water.

#### 6. Wet Air Oxidation (WAO) unit

- ✓ WAO plant is being operated on continuous basis to treat spent caustic streams generated during refining to improve the quality of treated effluent and recycling rate.

### III) Monitoring and Reporting:

Marine quality monitoring is continuously monitored at Chitrapura Outfall. Currently seawater sampling is carried out by Central Marine Fisheries Research Institute (CMFRI), Mangalore on fortnightly basis near the marine outfall area. Ten sampling stations are selected based on near field and far mixing zones resulting from effluent discharge near the marine outfall at Chitrapura. Sampling stations were situated along a transect perpendicular to the coast at 0m, 5m, 10m, 50m, 100m, 500m and 1000m away from the discharge point (station 1 to 7) Sea ward. Samples were also collected from three stations along a transect parallel to the coast (station 8 to 10).

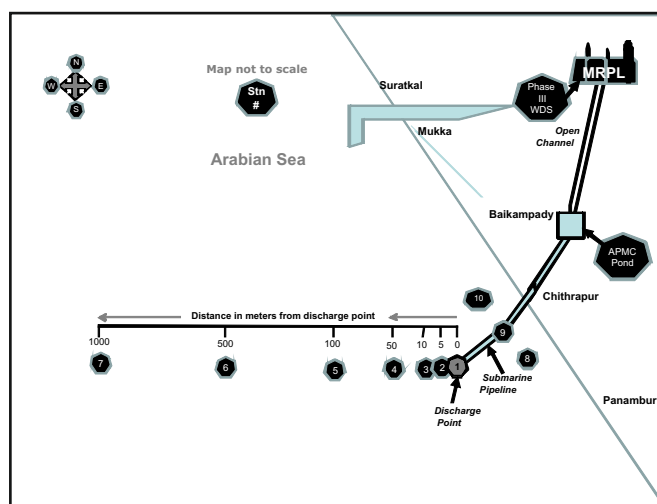


Fig: 4 Map showing the sampling stations in the marine outfall

Table 4: Environmental parameters of sea water sample collected during summer April - 2017

Station/Parameters	1	2	3	4	5	6	7	8	9	10
Temp. (°C)	31.2	31.2	31.3	31.5	31.5	31.5	31.5	31.4	31.4	31.4
Salinity (psu)	34.9	34.7	34.9	35.2	35.2	35.2	35.1	34.6	34.7	35.1
DO (mg/l)	5.13	5.21	5.26	5.20	5.19	5.06	5.17	5.58	5.10	5.66
TSS (mg/l)	68	48	50	54	60	44	50	50	56	44
pH	8.27	8.27	8.30	8.32	8.30	8.31	8.30	8.23	8.26	8.33
Free NH <sub>3</sub> (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AN (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phosphate (mg/l)	0.10	0.096	0.102	0.0193	0.094	0.091	0.099	0.086	0.111	0.089
Silicate (mg/l)	0.32	0.25	0.41	0.47	0.22	0.24	0.33	0.24	0.25	0.49
TRC (mg/l)	0.08	0.07	0.08	0.08	0.07	0.08	0.08	0.07	0.08	0.08
Sulphide (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Oil and Grease (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cyanide (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenol (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BOD (mg/l)	1.91	2.01	1.24	1.56	1.36	1.21	1.20	2.63	2.23	1.69

Note: psu: Practical Salinity Unit, AN: Ammonical Nitrogen, TRC: Total Residual Chlorine

Bio-assay test to estimate the toxicity ( $LC_{50}$ ) of sea water collected from the Marine outfall in the Arabian Sea (off Chitrapuara) for the month of April 2017. Test organism is green mussel (*Perna viridis*) – Bivalve mollusc of size 25 to 30 mm. The tests showed 100 % survival of the Organisms after 96 hr exposure, which indicates no environmental stress on the aquatic life in the receiving coastal water due to the effluent discharged.

**Table 5: Bio-assay test of sea water**

Medium	% Mortality after			
	24 hr	48 hr	72 hr	96 hr
<b>100 % Sea water from the marine out fall</b>	0	0	0	0

#### IV) Corporate Social Responsibilities (CSR), in MRPL

The MRPL CSR activities are promoted under the brand name of “**Samrakshan**” which captures the spirit and commitment of the Company's CSR policy, that is to “**protect, preserve and promote**” the social, cultural and environmental heritage in and around the area of our businesses and to usher in sustainable and equitable development.

MRPL runs the CSR activities mainly in following five focus areas:

##### **Shiksha Samrakshan**

- ◆ Activities that promote education, especially in Anganwadis, Government and Government aided schools.
- ◆ Imparting skill development and vocational courses, targeting the unemployed rural youth, particularly women and candidates from SC, ST, OBC and BPL families.
- ◆ Providing infrastructure for setting up additional class rooms, toilets (especially for girls), kitchen for preparing mid-day meal, science and computer labs, sports facilities and extracurricular activities for overall development of students.
- ◆ Providing nutritious food and clean drinking water, sanitation facilities in educational institutions.
- ◆ Distribution of scholarship

##### **Arogya Samrakshan**

- ◆ Health Care, by way of running Primary Health Centres in rural areas
- ◆ Conducting medical and artificial limb camps.
- ◆ Organizing awareness campaigns on HIV, Hepatitis etc.
- ◆ Providing infrastructural help for OHCs, Government Hospitals.

##### **Bahujan Samrakshan**

- ◆ Infrastructure support to community halls in neighboring villages
- ◆ Women's empowerment, girl child development, gender sensitive projects.
- ◆ Initiatives for physically and mentally challenged.

- ◆ Initiatives for SC/ST communities
- ◆ **"Preparedness and Capacity Building"** in Disaster Management
- ◆ Sustainable Livelihood Projects – Holding hands of all marginalized groups to improve livelihood opportunity, thus improving their quality of life.
- ◆ Rural Infrastructure Development- Need based quality infrastructure to improve quality of life

### **Prakrithi Samrakshan**

- ◆ Providing infrastructural support for drinking water supply to neighboring villages
- ◆ Supporting clean drinking water and sanitation projects in rural area
- ◆ Restoration and development of Lakes
- ◆ Water management including ground water recharge.
- ◆ Conducting awareness programs in schools and villages on environment management

### **Sanskriti Samrakshan**

- ◆ Protection of local historical and cultural artifacts and historical monuments and heritage sites.
- ◆ Promotion of local artisans, craftsman, musicians, artists and their art forms etc. for preservation of local heritage, art and culture.
- ◆ Education especially primary and elementary education.
- ◆ Community Health- Reaching out with basic health care to all (bridging the gap).

**The CSR activities executed in the neighboring villages are as follows:**

### **Facilitating for Primary and Elementary Education**

To improve the quality of education in the government schools surrounding the refinery, MRPL provides support for infrastructural development; by providing drinking water purifiers, storage units, separate toilets for girls and boys. The company also sponsors sports and cultural events in the schools.

To support the poor and needy students in the surrounding villages, MRPL provides education kits in the Government and Government aided schools. MRPL has provided uniforms, books and scholarships. It has also assisted in the setting up of laboratories.

Under **"Swachh Vidhyalay program"** of Government of India (GOI), MRPL has constructed 54 toilets in 31 schools and maintenance of these toilets is being taken up by MRPL.

Construction of toilets in some government schools under '**Green Nurturing Program**' is in progress.

### **Community health initiatives**

As a part of CSR activities, MRPL has been organizing regular multi-specialty medical camps in villages, conducting health awareness programs in collaboration with the nearby reputed hospitals. MRPL strives hard to spread the awareness on health and sanitation issues with women as well as youth groups. Further the importance of sufficient intake of nutritious food is highly required for the growth and development of adult, children and women; hence the CSR section has also planned some awareness programs for the benefit of local population.

### **Sustainable livelihood programmes-towards improving quality of life**

The MRPL has undertaken many initiatives to provide diverse livelihood avenues within the community. The various sustainable livelihood programmes are based on multiple study reports and observations in the vicinity. CSR wing of MRPL is aiming to make the livelihood of people in the community sustainable in three ways such as:



- ◆ Increase the socio-economic status through the income generation activities.
- ◆ Equip the project affected population by improving earning capacity if they are unemployed.
- ◆ Encourage savings.

In addition to the above-mentioned activities, MRPL has taken up various skill development initiatives for the women and youth. MRPL has also planned some innovative techniques in agriculture, provide support for common well and farm pond deepening.

### **Development of Rural Infrastructure:**

Infrastructure projects like establishment of drinking water plants, hand pump installation, construction of public toilets, etc. have been undertaken by the MRPL.

Construction of public toilets is in progress in villages under the Swachh Bharat Abhiyan Program.

Tree plantation programs are organized in Government and Government Aided Schools every year before onset of monsoon as part of World Environment Day (WED) in the month of June. Indigenous fruit bearing saplings are distributed in the schools, thereby developing awareness among the school children regarding the uses of trees.



Fig. 5 Kalavar School-Kotivruksha (Forest dept.)



Fig. 6 KSPCB Awareness Program at DPS



Fig. 7 Government Lady Goschen Hospital Mangalore



Fig. 8 Training at Bantwal for BPL families

**Table 6: Details of CSR Expenditure**

Sl . No	Activity	Amount spent (Rs. in lakhs)
I.	Shiksha Samrakshan	26.29
II	Swachh Bharat Projects	116.06
III	Arogya Samrakshan	3.70
IV	Rural Development	47.42
V	Other CSR Projects	54.47
<b>TOTAL CSR Spent</b>		<b>247.17</b>

Total expenditure spent for CSR is Rs. 2.47 Cr.

### V. Conclusions:

- ◆ MRPL is a jewel in the crown of Karnataka state and is Committed to preventing pollution through adoption of eco-friendly technologies.
- ◆ Various water conservation measures have been implemented in the refinery to reduce the consumption of fresh water, increased reuse of treated effluent is achieved through continuous operations of the Waste Water Treatment Plants
- ◆ MRPL ensures that discharge water quality meets standards set by KSPCB and MoEF.
- ◆ Under the umbrella of Corporate Social Responsibility, MRPL has been undertaking adequate measures for the development of the communities in the neighboring villages.



**Mr. U. V. Aithal, General Manager (HSE)**



**Mr. Srinivas R.**  
Senior Manager (HSE)



**Mr. Sugat N. Maisalge**  
Deputy Manager (HSE)



**Mr. Aditya Singh**  
Engineer (HSE)

*With Best Wishes*



**ಮಂಗಳೂರು ಲಿಫೈನರಿ ಎಂಡ್ ಪೆಟ್ರೋಕೆಮಿಕಲ್ಸ್ ಅಮಿಟೆಡ್  
ಮಂಗಳೂರ ರಿಫಾಝನರಿ ಂಢ ಪೆಟ್ರೋಕೆಮಿಕಲ್ಸ್ ಲಿಮಿಟೆಡ್  
MANGALORE REFINERY AND PETROCHEMICALS LIMITED**

**(A Govt. India Enterprise & A Subsidiary of ONGC Ltd.)**



## ENVIRONMENTAL MANAGEMENT AND CORPORATE SOCIAL RESPONSIBILITY AT KIOCL LIMITED, MANGALURU

**Bobraj V. Jeyaharan**

Executive Director KIOCL Limited  
Panambur, Mangaluru

KIOCL Limited (formerly Kudremukh Iron Ore Company Limited) a flagship Company and a Brand for quality and expertise under the Ministry of Steel, Government of India, had commenced its journey, on April 2, 1976, like a small toddler, with lovely imprints and has sprayed its fragrance all over the world. Even today KIOCL Limited, is being treated as a premium Company in iron ore beneficiation and palletization process globally. Being the country's prestigious 100% export oriented unit, having its Pelletization and Pig Iron Complex (Blast furnace Unit) at Mangaluru in the coastal city of Karnataka.

KIOCL is engaged in the business of manufacturing and exporting high quality iron oxide Pellets and supply of foundry grade Pig iron for domestic market. An ISO 9001:2008, ISO 14001:2004 certified company also compliant with OHSAS:18001:2007 certification for Occupational Hazards and Safety Management System, has its headquarters at Bangalore.



### ENVIRONMENT POLICY

Caressing the environment, KIOCL strives for preserving the natural treasures by retaining greenery. It believes that development can never be sustained if the environment deteriorates. In order to evolve innovativeness to reduce consumption of natural resources and to develop solutions leading to sustainability and protection of global environment, it promotes, reducing, recycling and reusing of resources.

Accordingly, high priority is set as one of the main objectives for environmental protection, taking in to consideration the requisite measures for pollution control as per the new norms. KIOCL has introduced an environment management system as per international standard ISO 14001:2004, which facilitates identifying significant impact and introducing operation controls for implementing environment management programmes for mitigating the impacts.

## ENVIRONMENTAL MANAGEMENT MEASURES

### Physical environment management features

KIOCL has a well-designed plant layout in consideration with the meteorological factors. This includes, proper stack heights for effective dispersion of treated waste gaseous emissions, good drainage facility, safety and others. Around 8,900 saplings of various species have been planted in 4.0 ha in the plant premises and in the neighboring roads and schools. Regular maintenance of roads, drainage facilities, equipment and dust suppression inside plant premises are undertaken.

### Air environment management features

Provision of adequate pollution control equipment with high efficiency of proven design/ technology to remove dust and gaseous emissions at different unit operation sections are installed. These are regularly maintained.

Technologically the plant has installed improved process equipments with conservation of energy, having controls for effective, corrective and preventive action for complete combustion, minimum waste and dust generation, for reducing atmospheric pollution.

Well-designed transfer points with dust collection hoods for fugitive dust control generated during handling and transportation of material exists. Water is sprinkled regularly in dust prone areas. Periodic monitoring of air quality (ambient and emission) is also undertaken.

### Water environment management features

Adequate effluent treatment facilities for 100% recycling of process effluents exists. Treatment of Sewage is done through a plant adopting MBR technology. Water is conserved by recycling treated process water and KIOCL is proud to be a ZERO DISCHARGE UNIT.

### Noise management features

Deployment of machinery with improved acoustic control design having silencers/ mufflers results in noise abatement. Good green belt development reduces noise propagation. Ear-muffs are provided for personnel working in noise prone areas. Regular noise monitoring and corrective measures are undertaken.

### Solid waste management features

- Regular collection of metal scrap and packaging material and disposal to local vendors.
- Clarifier underflow containing iron concentrate and additives received from filtration process and floor washes is recycled back to the filtration process.
- Consolidated solids from cooling pond, collected from various sources having iron values, are de-silted regularly and used in the process.
- Dry dust collected in the multi-clones system and fugitive dust collection system are collected and recycled back to the process.

### Hazardous waste management features:

- Waste sludge having calorific value generated in the Captive Power Plant (CPP) is used in pellet plant for pellet car greasing, and excess quantity is being disposed to agencies authorized by

Central Pollution Control Board (CPCB) and Karnataka State Pollution Control Board (KSPCB).

- Waste lube oil generated in the plant is stored in leak proof sealed container and is disposed to outside agencies authorized by CPCB and KSPCB.
- Scrap lead acid batteries are sold to agencies authorized by Ministry of Environment & Forests (MoEF) and KSPCB.

## KIOCL'S COMMITMENT TOWARDS ENVIRONMENT

KIOCL has taken up several environmental initiatives to protect and nurture the environment as furnished

1. Around 7.5 million saplings have been planted in and around Kudremukh mining area
2. 80 KLD capacity STP has been commissioned and treated effluent is fully recycled in the process.
3. The wastewater generated in the process is treated and is completely recycled. Pellet Plant unit is a Zero discharge unit.
4. The Captive Power plant of 28 MW capacity is being operated using low Sulphur furnace oil to reduce the Sulphur emissions.
5. The DG Sets have been provided with acoustic enclosures to reduce the noise levels.
6. The process chimneys have been provided with control equipments such as Wet scrubbers, Multi-clones and Bag filters.
7. Slurry pumps have been installed to pump back the storm water to the process.
8. Mist type sprinklers and large area type sprinklers have been installed at various locations in the plant to suppress the fugitive dust emissions.
9. The solid wastes generated in the plant premises is composted and used as manure.
10. The hazardous wastes are segregated at source and stored category wise in closed sheds. These wastes are sold to agencies authorised by CPCB and KSPCB.
11. The scrap lead acid Batteries, e-wastes, Biomedical wastes are disposed as per the requirements prescribed in the relevant Acts.
12. Plantation activity is taken up annually within the plant premises and neighbouring areas around Mangaluru.
13. Action has been taken to implement energy efficient lighting systems such as Solar and LED in the plant area
14. Solar panels have been installed over roof top of buildings. The collection area of panels is 3900 sq.m. with 377.6 KW peak capacity with an average power generation of 1100 units per day.
15. At the Blast Furnace Unit, the process has an in-built online Dust Catcher and Gas Cleaning Plant for processing the gases generated in the Blast Furnace. Further, the CO gas, which is a by-product of Blast Furnace, is not let out to the atmosphere but effectively utilised to generate power in our 2 x 3.5 MW Captive Power Plant. Also, this gas is used for preheating process air at Stoves.

16. As part of World Environment Day celebrations, awareness programmes on relevant environmental issues are being conducted every year for the employees.

### **Environment Cell**

An environmental cell with qualified and experienced personnel with adequate manpower with defined responsibilities exists for effective environmental monitoring, implementation of the EMS and improvement. This cell reviews the pollution control activities quarterly and ensures the compliance of environmental requirements.

### **Environmental Monitoring**

Monitoring schedule as prescribed by KSPCB in the consent is strictly complied with and the monitoring results are submitted to the local KSPCB. The following are measured:

- Ambient Air Quality at designated locations as prescribed.
- Stack emissions for dust and gases at designated locations.
- Effluent quality monitoring at the STP.
- Noise levels.
- Hazardous waste.

Monitoring of the above are partly done by KIOCL, MoEF empaneled agencies and also by KSPCB when required. The results obtained comply with the prescribed norms and have no adverse or negative impact on the environment, but on the contrary, has significantly contributed towards ameliorating socio-economic environment development of the region, creating job opportunities, genesis of ancillary industries and increased sea borne traffic bringing NMPT on the country's map as one of the major ports.

### **Environmental Monitoring Facilities**

KIOCL is equipped with facilities to monitor various pollutants in the plant as under.

- Four high volume air samplers for AAQ status.
- Apart from this all the stack gas emissions are regularly monitored by a recognized laboratory.
- Noise level meter
- Other facilities include Occupational Health & Safety-Health Center in the plant premises with qualified doctor and staff nurses.

### **Investment on Environmental Management:**

Capital cost: ₹25.55 crores (includes pollution control equipment and monitoring equipments).

Recurring cost: ₹2.0 crores.

**Environmental Audit:** Bi-annual internal audit ISO 14001 for EMS, Annual environmental audit for KSPCB and Surveillance Audit by External auditors are conducted regularly.

### **Corporate Social Responsibility:**

CSR is an essential ingredient of Corporate Governance and being a socially conscious corporate, KIOCL has contributed significantly towards community development in and around its project sites, since inception and is continuing its efforts. KIOCL has ensured that the surrounding areas are benefited from the Company's growth. The focus areas for implementation of CSR programmes has been promotion of education, empowering women, ensuring environmental sustainability, providing healthcare, drinking water and sanitation facilities, employment and enhancing vocational skills.



KIOCL has strived to give a helping hand for the society, few of the activities taken up under Corporate Social responsibilities in and around Mangaluru/Kudremukh are detailed below:

**a) Toilet construction:** KIOCL has constructed a Toilet Complex at Sri Satya Sai PU College, Alike, Sullia Village and also has constructed and maintaining new toilets at 6 Schools in Mangaluru/Kudremukh under Swacch Bharath-Swacch Vidyalaya Scheme. Awareness programme

towards promoting usage of toilets in various schools

is being conducted on a regular basis. At Balpa Village in Sulia, toilets have been constructed at a rural area where the households did not have toilets at their residences.







### b) Construction of School building:

KIOCL has built a new building for DKZP Higher Primary School, Tannirbhavi, Panambur by demolishing the old school which was in dilapidated stage, located near Pellet Plant Unit.

### c) Water supply system

KIOCL has provided with water supply system at Porkodi Colony. One overhead tank of 50,000lts capacity was constructed by KIOCL in the year 2014-15 and subsequently during 2015-16, the water distribution system from bore well pump to the overhead tank and overhead tank to individual houses (16 Nos.) of the colony were provided.



### d) Solar powered street lights

Solar powered 40 Street Lights have been provided to Mudar Village which is located between Mangaluru & Kudremukh at Bajagoli and it comes under hilly terrain.

### e) Scholarship and uniforms for students

Meritorious students belonging to poor/BPL families in and around Mangaluru, studying in Govt PU College and Govt Polytechnic were provided with scholarship. School uniforms to Primary School students were also provided at Kalladka, Dakshina Kannada.

### F) Infrastructure development

Extension, upgradation and facelift for the existing building by providing, additional facilities like extension of roof, grills and doors at Keshava Shishu Mandira, Vidya Nagara, Kulai Mangaluru has been taken up and completed.



Green nurturing programme in various schools under KSPCB have been taken up at a cost of Rs.10 lakhs. Contributed about 25 lakhs towards development of Tree Park for the conservation of endangered plant species of Western Ghats at Pilikula Nisarga Dhama, Mangaluru.



KIOCL has also taken up similar CSR activities in other locations wherein KIOCL is having its offices/units.



KIOCL has significantly contributed a great deal towards integrated and sustainable development by taking adequate measures for abating pollution, maintaining and improving all the regimes, water, air, noise, socio-economic and welfare. Considerable efforts have been made and implemented in respect of adaptation of cost effective eco-friendly technologies for process upgradation, development of Electronic Monitoring System (EMS), waste management for resource maximization and conservation with minimal impact on the environment aiming regional development with earning foreign exchange for the country.



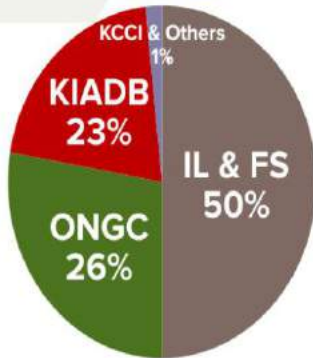
**Bobraj V. Jeyaharan**  
Executive Director  
KIOCL Limited, Panambur, Mangaluru



## Mangalore SEZ Limited

# A Multi Product SEZ

### PROMOTERS



Mangalore SEZ Limited has a non-governmental company structure and is a unique combination of Central and State Government entities, a reputed financial institution and an industrial body. It has got the core state-of-the-art infrastructure to cater to the Pharmaceutical sector.



Mangalore SEZ Limited is one of India's most successful SEZs with investments exceeding INR 16,000 crores thus far. With exports worth over INR 4,500 crores till date from its units, it has emerged as one of the most vibrant operational multi-product SEZs in India.

WATER INFRASTRUCTURE	POWER INFRASTRUCTURE	EXCELLENT CONNECTIVITY	COMMON EFFLUENT TREATMENT PLANT	MARINE OUTFALL DISPOSAL SYSTEM	ENVIRONMENT FACILITIES
ABUNDANT SUPPLY OF WATER FOR INDUSTRIAL USE FROM RIVERS & STPs	110/33/11 kV DISTRIBUTION SUB STATION AUTOMATED WITH SCADA	PIPELINE CUM ROAD CORRIDOR FROM PORT TO MSEZ WELL INTEGRATED ROAD WITHIN	CETP FOR THE TREATMENT OF PROCESS WASTE WATER & CONTAMINATED RAIN WATER	1.2 kms LONG PIPELINE LAID INTO THE SEA FOR DISCHARGE OF TREATED EFFLUENT	ENVIRONMENT CLEARANCE FROM MOEF, DELHI 33% OF PROJECT AREA MAINTAINED AS GREEN BELT ON BEHALF OF UNITS

### FISCAL INCENTIVES AS PER SEZ POLICY WHICH ARE INVESTOR FRIENDLY

## KEY ADVANTAGES



Clear Title Land



Well Connected By Rail, Road, Air and Sea



Port Connectivity



Environment Clearance



Quick Start Advantage



Availability of Feedstock nearby



Attractive Incentives



Hazardous solid waste disposal



Effluent Collection, Treatment & Disposal

## ENVIRONMENT SAFETY PROJECTS AND MONITORING MEASURES TAKEN BY MSEZ

### Mangalore Special Economic Zone (MSEZ)

#### Introduction

The SEZ policy introduced in the export and import (EXIM) policy effective from April 1, 2000, is the Government of India's most aggressive and far reaching initiative aimed at attracting foreign investment in India. SEZs are defined as 'delineated duty-free enclaves and are deemed foreign territories for the purposes of trade operations, duties and tariffs'. Different units may be set-up for the manufacture of goods, providing services, and other activities including processing, assembling, trading, repairing, reconditioning, making of gold/silver, platinum jewellery and others.

Units that are set up within the SEZs are entitled to import all types of goods that are required for operations, including capital goods, whether new or second hand (except those prohibited under the policy), without payment of any duties. In addition, the policy allows inter-unit transfer of goods between SEZs, without any customs scrutiny. Further, duty remission will be available on destruction of goods within the SEZs. Units have also been permitted to dispose obsolete goods on payment of the applicable custom duties.

Mangalore Special Economic Zone Ltd. (MSEZL) is a Special Purpose Vehicle incorporated in Feb. 2006 for developing a multi-product Special Economic Zone at Mangalore. Mangalore SEZ Phase-I has acquired around 1,620 acres of land and project is notified as a Sector Specific SEZ for Petroleum & Petro Chemical Industries by Ministry of Commerce & Industries, Govt. of India. Further, during September 2013 MSEZL was notified as multi-product by Ministry of Commerce & Industries. Mangalore SEZ is one of the few functioning multi-product SEZ in India focusing on promotion of manufacturing sector for exports, perfectly in harmony with the "Make in India" programme of Government of India.

Units like ONGC Mangalore Petrochemicals, Cardolite Speciality Chemicals are operational since 2015 at Mangalore SEZ. Other units like JBF Petrochemicals, Authentic Ocean Treasure (AOT) are under commissioning stage. Further, units like Syngene International, Anthea Aromatics Pvt. Ltd. Ulka seafood's Pvt. Limited, Gadre Marine Exports & Yashaswi Fishmeal & Oil Company are in construction stage.

The Mangalore SEZ has taken up infrastructure works like industrial plot development, pipeline cum road corridor between Port and SEZ, water infrastructure from river sources and city sewage treatment plants, internal roads, storm water drainages, waste water collection system, marine outfall pumping system, power distribution network system and also common effluent treatment plant to support the export oriented units located in the zone. Most of the projects are completed and operational.

## Environment safety projects and environmental monitoring measures taken by MSEZL

### 1. Tertiary Treatment Plant:

With the aid of Asian Development Bank, MCC took up development of waste water management system (sewerage system) in Mangalore City.

The development programmes initiated were as follows:

- ★ Development of 4 STPs at Kavoor (43.5MLD/9.5MGD), Bajal (20MLD/4.40MGD), Surathkal (16.5MLD/3.63MGD and Pachanady (8.75MLD/1.92MGD)).
- ★ Associated wet wells (22 nos)
- ★ Development of trunk mains and UGD collection network.

To meet the water requirements of units coming up inside MSEZL; the MSEZL has considered treated waste water from 3 STPs as one of the source. MSEZL approached MCC and formed SPV-Mangalore STP Limited for reusing the secondary treated sewage water.

The main role of Mangalore STP Limited is operation and maintenance of three Sewage Treatment Plants (Kavoor, Surathkal and Bajal) and connected wet wells/ pumping station from wet wells to STP. The cost sharing of operation and maintenance by Mangalore SEZ Ltd. (MSEZL) and Mangalore City Corporation (MCC) is by a ratio of 70:30.

Mangalore SEZ has constructed 5MGD (22.7MLD) Tertiary Treatment Plant (TTP) using state-of-the-art GE membrane technology (Ultra filtration) for re-use of secondary treated sewage water from Kavoor STP during the year of 2011. Plant is commissioned and MSEZL is supplying treated water to MRPL/MSEZL from November 2012. **Tertiary Treatment Plant mainly involves the following process**

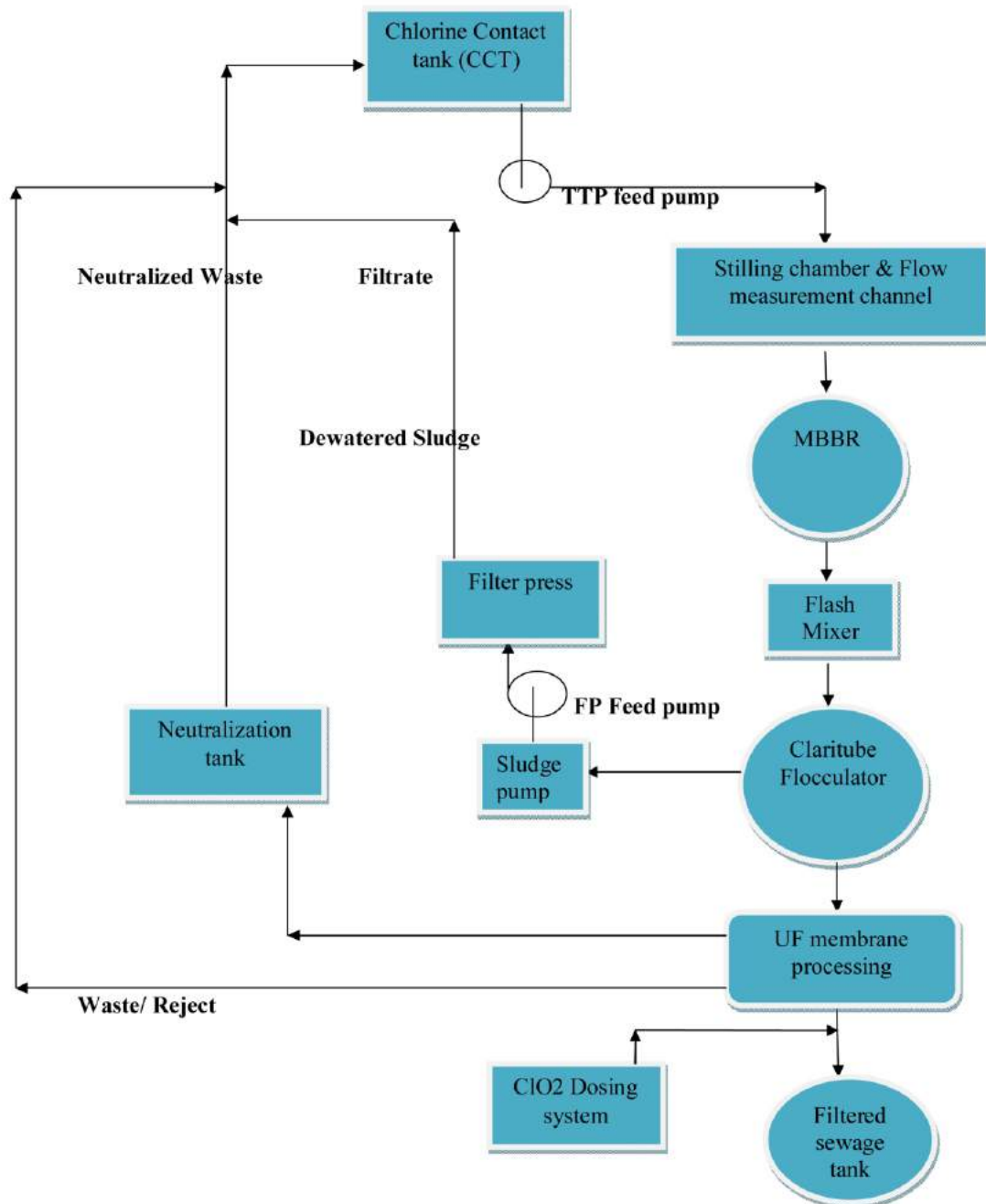
- Biological treatment comprising of Aerobic Treatment in Moving Bed Bio-Reactor (MBBR) followed by Flocculation-Clarification in Claritube flocculator (CTF)
- Filtration by membrane based Ultra filtration system
- Disinfection using Chlorine dioxide (ClO<sub>2</sub>)
- Sludge handling Filter Press Unit.

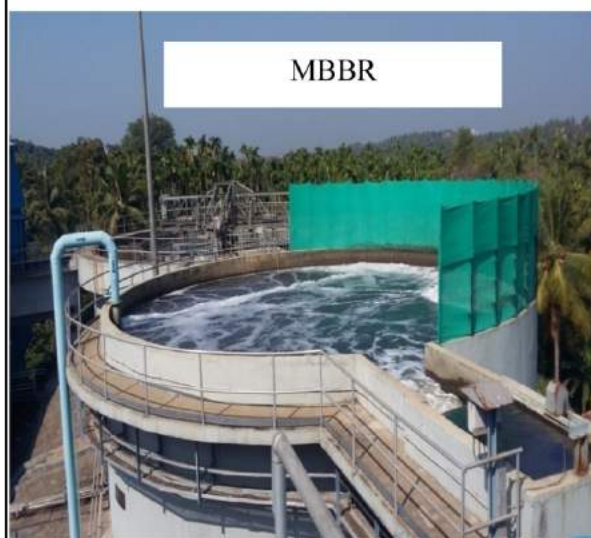
The tertiary treated sewage is then stored in a tank, from where it is pumped to MRPL and MSEZL units.

### Advantages of STP water reuse:

- Tertiary Treatment Plant installed here is the first such large-scale plant in India for the treatment of Secondary Treated Sewage Water and the plant is having Zero discharge into the Environment.
- Avoiding disposal of secondary treated sewage in natural river bodies avoids pollution of freshwater sources and retains environment quality. Earlier the secondary treated sewage water was directly discharged into the rivers or oceans.
- Reuse of tertiary treated water for industrial purpose reduces the load on natural resources.
- Major decrease in incidence of waterborne disease, since most effluent streams have the potential to mix with drinking water supplies and may have dermal contact.
- Revenue generation from effluents of sewage treatment & Employment Generation.

**Process Flow Chart**







## 2. Marine Outfall System:

As a part of Environmental Clearances in order to safely dispose the treated effluent from MSEZL units and MRPL Phase-3, MSEZL has installed Marine outfall pipeline facility which consist of

1. Marine Outfall Pump House
2. 12.5 km Pipeline over land (12 km DI pipe line and 0.5 km HDPE)
3. 1.2 km HDPE pipeline inside sea.

The Marine Outfall disposal location was identified by NIO, Goa and as approved by MoEF & KSPCB for discharge of treated effluent from MRPL Phase-III, OMPL & MSEZL units. The said Project has been completed in the year 2014 and MSEZL has obtained Consent For Operation (CFO) vide letter dated 9 Sep 2014, 8 Oct 2015 & 27 August 2016 from KSPCB for discharge of treated effluents to marine environment. Presently MSEZL is discharging treated effluents of MRPL Phase-3, OMPL and JBF after meeting the discharge standards prescribed by KSPCB/MoEF. Each unit has installed online analyzers for the parameters like pH, COD, TSS, conductivity, DO and other parameters at their end. This is then connected to MSEZL SCADA system. Further, MSEZL has installed online analyzers to monitor parameters like pH, TSS, COD, Conductivity and DO at the outlet of discharge line for ensuring all monitored parameters within the limit before discharging into Marine Outfall Facility.

Marine Outfall pump house

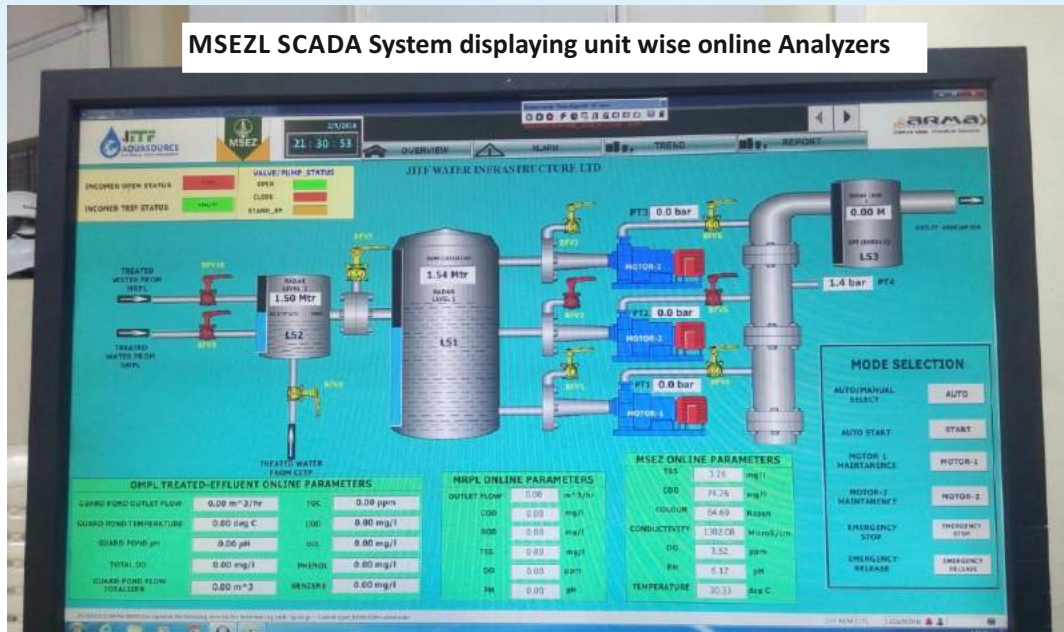


Marine outfall pipeline (sea portion)



MSEZL Online Analyzers





### 3. Air, water and noise monitoring:

MSEZL is carrying out air monitoring in 5 locations, ground water monitoring in 10 locations of surrounding area and noise monitoring in 2 locations for every month and report is submitted to MoEF/ KSPCB as a part of compliance report. The results are also displayed in MSEZL website for public reference.

Further, MSEZL has installed Continuous Ambient Air Quality Monitoring Station (CAAQMS) inside MSEZL and the commissioning work is under progress.



## 4. Green Belt Development:

As per MSEZL Environmental Clearance (EC) condition 33% of the project area shall be dedicated for green belt development. Presently MSEZL has completed Green Belt development in **207** acres of **272** acres by planting **93150** saplings. Remaining area of 65 acres development is under progress and will be completed during 2018-19.

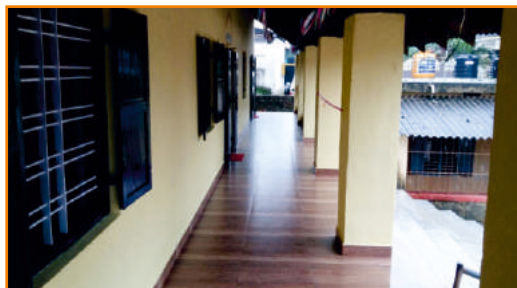


Green Belt



## 5. MSEZL CSR Activity:

MSEZL has allocated 5% of the total cost of the project for CSR activities. MSEZL has taken many activities like development of roads, over head tanks and water pipeline facilities, bus shelters, Skid STPs, drain works, UGD facilities, community facilities, educational sponsorships, event sponsorships, medical camp, repairs and renovation of class rooms, distribution of saplings, construction of toilets to schools and distribution of books at schools near the project area and villages.



## STRATEGY ON IMPLEMENTATION OF NEW INITIATIVE ON SOLID WASTE MANAGEMENT FOR MANGALURU CITY

**Madhu S. Manohar**

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### Introduction

Mangaluru, which was earlier known as Mangalore is situated in the west coast of Southern India and is the fourth largest city in Karnataka State. Being the headquarters for the District of Dakshina Kannada, it is the largest urban coastal city in the State. The city with more than 5 lakh population faces the challenges of managing solid waste. This article is a case study on the implementation of a new project on Solid Waste Management in Mangaluru.

### City Profile

Mangaluru is located at 12°52'N latitude and 74°49'E longitude. The city is located at the confluence of Netravathi and Gurupura rivers and is bounded by the Western Ghats to its east and by the Arabian Sea to its west. It is one of the fastest growing city in the area of education, commerce and industry. Three National Highways, namely, NH-17 linking Panvel to Kanyakumari, NH-48 linking Mangaluru to Bengaluru, NH-13 linking Mangaluru to Sholapur passes through the city. The airport located at Bajpe, 15 km from city connects domestic and international destinations. Mangaluru is also linked to major cities in India by rail. New Mangalore Port, an all-weather major port is also located in Mangaluru. The topography of the city is from plain to undulating hilly terrains towards the Western Ghats. The ambient temperature varies minimum from 17°C to a maximum 37°C. There is a heavy rainfall of about 4000mm per annum of which about 90% is received during the monsoon period. The relative humidity is generally very high reaching saturation levels during the summer period. The geology of the city is characterized by hard laterite in hilly tracts and sandy soil along the coast.

### Mangaluru City Corporation, Health Department: Role in SWM

Health Department in Mangaluru City Corporation (MCC) plays a key role in managing basic services for the citizens such as, sanitation, public health services, issuing birth and death certificates, managing solid waste disposal and others. The rapid urbanization and changing lifestyles have led to the generation of huge amount of garbage and wastes in the urban areas, to the extent that, over the past few years, handling Municipal Solid Waste has become the major organizational, financial and environmental challenge faced by the Local Bodies.

Despite Municipal Solid Waste Management being major task of the local government accounting for a sizeable portion of the municipal budget, the Urban Local Bodies are unable to provide effective and efficient services. Currently, the waste is disposed in an unscientific manner, by crude open dumping in

low-lying areas by most Urban Local Bodies. This has resulted in environmental problems associated with foul smell, breeding of flies and other pests as well as generation of liquid runoffs (Leachate) posing serious threat to the underground water reserves. The area coming under the jurisdiction of Mangaluru City Corporation produces 310 to 320 TPD of wastes, with a daily collection frequency of 310 TPD. The waste collected has a composition of 60% of organic, 25% of inorganic, 5% of combustible and 10% of recyclable wastes.

The Municipal Solid Waste (Management & Handling) rules 2000, include all administrative, financial, legal planning and engineering functions involved in the whole spectrum of solutions to problems of solid wastes thrust upon the community by its inhabitants.

The major components of solid waste management are:

- 1) Segregation at the source
- 2) Primary (Door to Door) collection
- 3) Secondary storage
- 4) Transportation
- 5) Treatment and processing
- 6) Disposal

Mangaluru City Corporation has implemented a new project on garbage collection, street sweeping, weed cutting, drain cleaning and garbage transportation as per the Municipal Solid Waste (Management & Handling) Rules 2000.

### **Situation before the new initiative**

- a) Mangaluru City Corporation outsourced 47 wards out of 60 wards as 8 packages. The scope of work included door to door collection, street sweeping, vegetation cleaning, drain cleaning (<1.0m width), divider cleaning, garbage collection and transportation.
- b) Door to door collection was initiated in the entire 60 wards from the year 2007 clubbed with the conventional sanitation tender, wherein the contractors are responsible for user fee collection. The success rate was less than 30% owing to the contractor's non-professionalism and public hesitation to pay user-fee.
- c) Secondary transportation in the form of Twin container dumper placers found only partial success due to the poor door to door collection. Old traditional trucks and lorries were being used for transportation of garbage.
- d) Elaborate procedures involved in repairing the vehicles.
- e) Operation and maintenance of newly built Sanitary landfill site and compost plant were not fully operationalized. An average of 80 T/day of MSW was only processed in compost plant.
- f) Local players with lack of professionalism used to bid for the contract and maintained it for a year.

- g) Period of Tender was the main criteria for deployment of new vehicles and permanent workers.
- h) Lack of Transparency in the deployment of contract workers and vehicles.

## Description of the new initiative/ Implementation Strategy

### 1. Objectives

- a) The 100% door to door collection from entire 60 Corporator wards covering 90% of the properties, by using hydraulic vehicles of the types of Auto-tipper/refuse collector etc.
- b) The 100% deployment of hydraulically-operated secondary collection vehicles.
- c) Adoption of GPS technology for all the primary and secondary collection vehicles, recording the real-time fuel level and vehicle location.
- d) Mechanized sweeping in south zone for a stretch of 25 km/day.
- e) All the vehicles/equipment's to be deployed, operated and maintained at the cost of the contractor.
- f) Collection of SWM user-fee charges as SWM cess on property tax.
- g) Avail Carbon credits from SWM treatment unit through the contractor on 50:50 sharing basis.
- h) The concepts aim at implementing the MSW (Rules & regulations) 2000, on cent basis avoiding multiple handling of garbage, door to door collection, optimization of routing system and GPS system as the highlight of the project.

### 2. Milestones

- a) Council body approval for the new proposal.
- b) Approval from the State level committee.
- c) Approval of the proposal from the Cabinet, Govt of Karnataka.
- d) Draft Tender Schedule preparation and approval.
- e) Tendering procedure of the proposal.
- f) Directorate of Municipal Administration Technical and Administrative approval.
- g) Evaluation of the Tendering process and approvals.
- h) Finalization of contract agreement and signing.
- i) Issue of Work Order and implementation as per the objectives.

### 3. Governance practices involved

- a) Scientifically prepared estimates considering the market rates of different SWM vehicles, GPS system, EMI's for vehicles, vehicle insurance costs, road transportation, office costs and other expenditures, resulted in arriving at more realistic estimates.
- b) Solid Waste Management tender document was made in line with the Finance department approved document for the first time.
- c) Practical terms and conditions like Escalation clauses for fuel and labour as per Karnataka Transparency in Public Procurement (KTPP), cushion for increment in garbage quantity, Corporation limits expansion etc., might attract many of the high quality eligible companies for the bidding process.

#### 4. Coverage of the targeted population

The project is targeted on the entire Mangaluru City Corporation area of 132.45 sq.km. consisting of 60 wards and having a population of 4,99,489 (as per 2011 Census).

#### 5. Cost effectiveness of the project.

- a) The rates quoted by the bidder, M/s Antony Waste Handling Cell Pvt Ltd, Mumbai is Rs. 3,201.00/ton for North Zone and Rs. 2,051.00/ton for South Zone.
- b) For Operation & Maintenance for Processing & Disposal Facility the rates quoted by M/s Unique Waste Management Pvt Ltd., New Delhi is Rs. 238.00/ton.
- c) Minimal of 40-50% of the cost is expected to be recovered through Solid Waste Management Cess under property tax.

### 1. Initiatives and Implementation Strategy

#### i. Collection and transportation system

- a) 100% door to door collection from entire 60 Corporator wards covering 90% of the properties using hydraulic vehicles of the types of Auto-tipper/refuse collector etc.
- b) Since, MCC Pourakarmikas workers are also involved in sanitation activities, it was mandatory to cover the Pourakarmikas wards also. So, the proposal was designed to suit the present scenario and the objective to achieve and implement as per MSW Rules, 2000.
- c) The 100% deployment of hydraulic operated secondary collection vehicles.
- d) All the secondary transportation vehicles should have complete covered and automatic unload mechanism.
- e) Reduce the number of manpower deployment.
- f) Reduce the manual contact with garbage.
- g) Adoption of GPS technology to all the primary and secondary collection vehicles, recording the real-time fuel level, vehicle location and routing system.
- h) The south zone consisting of the major commercial area and concrete roads shall be deployed with night sweeping using machine sweeper.
- i) Mechanized sweeping in south zone for a stretch of 25 km/day.
- j) Collection of SWM user-fee charges as SWM Cess on property tax.

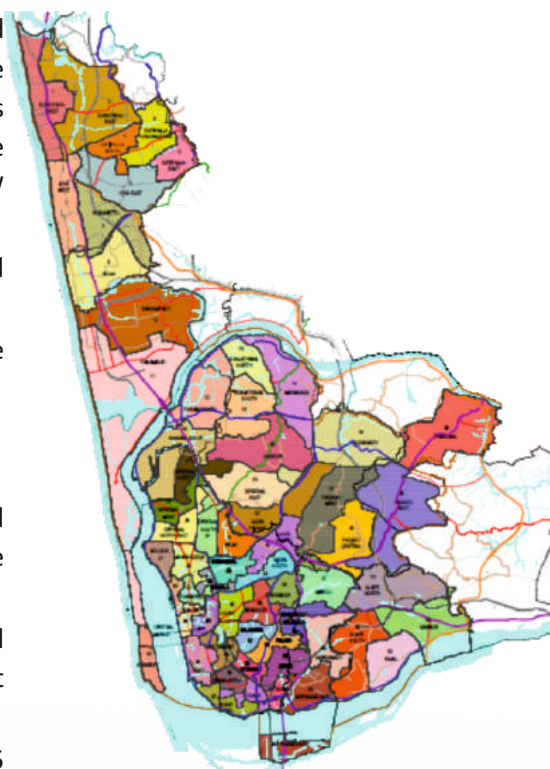




Figure 1 Door to Door Collection Vehicle



Figure 2 Street Sweeping Machine



Figure 3 Compactor Vehicle



Figure 4 Drain Cleaning machine

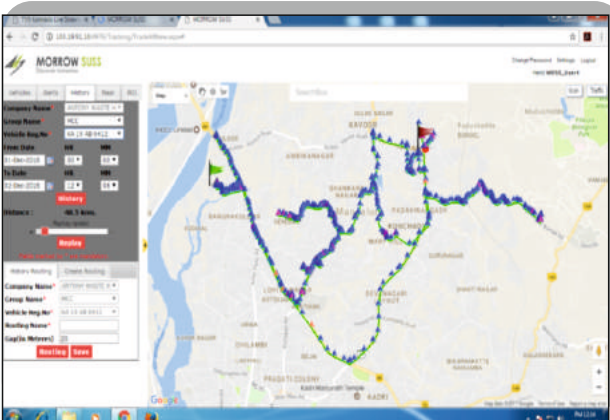


Figure 5 GPS tracking of the Vehicle and the movement

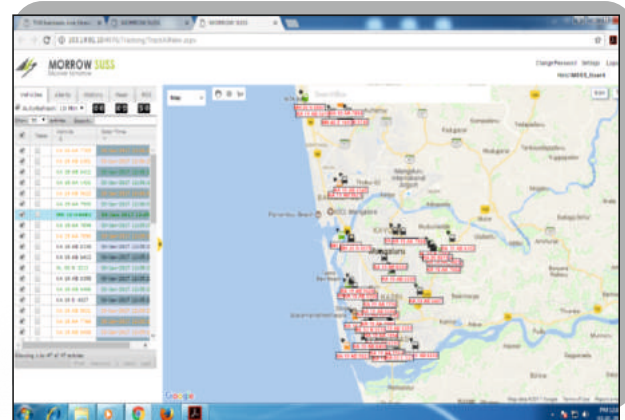


Figure 6 GPS tracking of Vehicle location



## **ii. Processing and disposal of Waste**

- a) Windrow composting and vermi-composting is provided under KUDCEMP (Karnataka Urban Development and Coastal Environment Management Plan) program.
- b) Provision of 175 TPD of waste is aerobically composted through Windrow method and 25 TPD of waste by vermi-composting method.
- c) Rejects from compost plant will be transported to sanitary landfill site.
- d) Mangaluru City Corporation is handling the operation and maintenance of compost plant since 2008.
- e) Both the processing and disposal are being outsourced to M/s Unique Waste Processing Company Limited, New Delhi since 2013 for a period of 6 years.
- f) Operation of vermi-composting is operational since 2010.

## **iii. Disposal / Land filling**

- a) Development of the landfill would be done in 4 phases. Phase I for 6 years time frame, phase II, III and IV for 3 years, 6 years and for 10 years time frame consecutively.
- b) Landfill site is operational since 2010.
- c) Rejects from the compost plant will be land filled.
- d) Daily soil top cover of 30 cm will be provided.

## **iv. Decentralized treatment method**

- a) To reduce the burden on the centralized processing plant and sanitary landfill site, MCC started with a pilot project on converting waste to energy i.e., biomethanation Plant.
- b) Bhabha Atomic Research Centre Technology was selected for decentralization system.
- c) Urwa market was selected for the construction and implementation of biomethanation plant.
- d) Two tons per day capacity plant was designed and was tendered to M/s Wipro Eco Energy for construction and Installation at a cost of 25 lakhs and followed by 2 years of Operation and Maintenance of the plant.
- e) The plant was commissioned in September 2011 and running successfully.
- f) The plant is generating 150-160 m<sup>3</sup>/day of gas and 100 - 120 kg/day of manure.
- g) It is also proposed to utilize the gas for generating power and illuminate the surrounding area.



Weighbridge, Receiving yard, Pre-sorting machine, Segregation at Receiving yard, Windrows



Windrows at Processing Yard, uploading waste through hopper, Sieving through 4mm, city compost Bagging



Vermi-composting process & Bio-methanation plant

## 7. Benefits derived from implementing the initiative

- a) 100% of door to door collection from all the households with the Mangaluru City Corporation limits.
- b) Segregation of bulk waste separately, which can be utilized for composting and generation of energy.
- c) Secondary Transportation of Municipal solid waste in all the entire 60 corporator wards
- d) Sanitation works viz street sweeping, vegetation cutting, desilting of storm water drains (<1.0m width), foot path/divider cleaning, maintaining sanitation of open space /building maintained by MCC proposed wards.
- e) Reducing the number of manpower deployment.
- f) Increasing the efficiency of garbage collection.
- g) Quantification of the garbage collected.
- h) Staff accountability towards each one's role and responsibility
- i) Strengthen the field and office executive's communication
- j) Minimise the MCC response towards the grievance.
- k) Effective Routing system.
- l) Transparency in collection of garbage from door to door.
- m) Mechanized sweeping
- n) Beach cleaning
- o) Proposed Contract period is for 7 years
- p) Deployment of all Hydraulic vehicles from the contractor.
- q) Collection of Solid Waste Management Cess.
- r) GPS system implementation
- s) Operation and Maintenance of Compost plant and Landfill Site for entire incoming garbage.

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## LEGISLATIONS AND POLLUTION CONTROL ACTIVITIES IN MANGALORE

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### Introduction

Karnataka State Pollution Control Board (KSPCB) is constituted under the Water (Prevention & Control of Pollution) Act 1974, enforcing the pollution control laws in Karnataka and plays an important role in promoting a better quality of life for everyone. The KSPCB touches almost every aspect of the environment and delivers integrated environment management. The KSPCB enforces laws to control pollution, defines monitoring standards, responds to pollution incidents, creates awareness and acts as an advisor to stakeholders.

Vision of the Karnataka State Pollution Control Board is 'Cleaner and Greener Karnataka' and is committed to a pollution free environment for a better-quality life through effective implementation of laws, creating awareness among public with co-operation of stakeholders.

The Government of India has enacted separate legislations, rules and notifications for the protection of environment.

Legislations for environmental protection (Karnataka)

### **A. Karnataka State Pollution Control Board enforces the following environmental legislations enacted by Government of India:**

- 1. The Water (Prevention & Control of Pollution) Act 1974:** This act establishes an institutional structure for preventing and abating water pollution. It establishes standards for water quality and effluents. The KSPCB issues consent under this Act to all Industries and local bodies, which discharge effluents.
- 2. Air (Prevention & Control of Pollution) Act 1981:** This Act provides for the control and abatement of Air pollution. KSPCB issues consent to industries which emit Air pollutants into atmosphere.
- 3. The Environment (Protection) Act 1986:** This act encompasses the environment, including water, air and land. It empowers KSPCB to take measures to protect and improve the quality of the environment through prevention, control and abatement of pollution and punish to those who fail to comply.
- 4. Public Liability Insurance Act, 1991**
- 5. The National Green Tribunal Act 2010:** This Act is for the establishment of a National Green Tribunal for effective and expeditious disposal of cases relating to environmental protection, conservation of forests and other natural resources including enforcement of any legal rights relating to environment and giving relief and compensation for the damage to persons and property and matters connected therewith.

## **B. Rules have been published under EP Act 1986 by Government of India and implemented by Karnataka State Pollution Control Board:**

### **i. The Hazardous and other waste (Management and Handling & Transboundary Movement) Rules 2016**

This rule empowers the KSPCB and other Government Departments to permit hazardous chemicals covered in the rules within the threshold limits to be imported, stored, transported and or used in an environmentally safe manner. This rule provides legal provisions for safe handling of various hazardous chemicals with an overall objective to minimize the possibility of chemical accidents by taking adequate on-site and off-site emergency measures.

### **ii. The Manufacture, Storage and import of Hazardous Chemicals Rules 1989 & 2016.**

The objective of this rule is to control generation, treatment, import, storage and handling of hazardous waste. Board issues authorization under this rule to enable the applicant to know about responsibilities in the legal framework. It provides cradle to grave or comprehensive guidance to the generators, transporters and operators of disposal facilities.

### **iii. Bio-Medical Waste (Management & Handling) Rules 2016.**

This rule pertains to the health care institutions to streamline the process of safe handling of, collection, segregation, storage, transportation treatment and disposal Bio-Medical waste. In Karnataka, KSPCB is the prescribed authority under this rule and issues authorization to enable the applicant to discharge the responsibilities as per the rules.

### **iv. Plastic Waste Management Rules, 2016.**

These rules shall apply to every waste generator, local body, Gram Panchayat, manufacturer, importers and producers. These rules are amended from time to time, providing a regulatory framework for management of plastic waste generated in the country.

### **v. The Municipal Solid Wastes (Management & Handling) Rules 2000 & 2016.**

These rules were enforced in India since 2000. The Municipal authority is responsible for collection, segregation, storage, transportation, processing and disposal of municipal solid wastes. According to these Rules the municipal authority or an operator of a facility shall obtain authorization for setting up waste and disposal facility from the KSPCB.

### **vi. Noise Pollution (Regulation & Control) Rules 2000, 2002 & 2006**

This Rule provides for abatement of noise pollution from the sources like industrial activity, construction of generator sets, loud speakers, public address systems, music systems, vehicular horns and other mechanical devices which have harmful effects on human health and psychological well-being of the people.

### **vii. The Batteries (Management and Handling) Rules 2001**

This Rule is applicable to the manufacturer, importer, reconditioner, assembler, dealer, recycler, auctioneer, consumer and bulk consumer of lead acid batteries. It ensures that the used batteries are collected back against the sale of batteries excluding those sold to original equipment manufacturer and bulk consumer. The lead recycler has to register with the Ministry of Environment & Forest or CPCB and the State Board monitors the recycling process.

## **C. Notifications By MoEF:**

- i. Environment Impact Assessment Notification (EIA) 2006
- ii. Fly Ash Notification 1999 & 2008
- iii. E-Waste Management Rules 2011 & 2016.

The objective of this rule is to regulate the collection, sale, segregation, recycling & disposal of e-waste.

- iv. Notification for Coastal Regulation Zone (CRZ) 1991, 2011

The objective of this notification is to ensure livelihood security to the fisherman communities and other local communities, living in the coastal areas to conserve and protect coastal stretches, its unique environment and its marine area and to promote development through sustainable manner based on scientific principles taking into account the dangers of natural hazards in the coastal areas; sea level rise due to global warming, thus declaring the coastal stretches of the country and the water area up to its territorial water limit as coastal Regulation Zone (CRZ) and restricts the setting up and expansion of any industry, operations or processes and manufacture or handling or storage or disposal of hazardous substances.

## **D. The Karnataka Regulation of Stone Crusher Act 2011.**

The Hon'ble High Court of Karnataka by its order dated: 10.07.1998 in Writ Petition No.17078/1997 has directed the State Government to formulate a policy regulating the carrying on the business related to the crushing of stones by prescribing reasonable conditions including guidelines and licenses and their renewals. Accordingly, the Karnataka Regulation of Stone Crusher act 2011 is enacted by Karnataka State legislature.

## **Environmental Monitoring**

The coastal waters are valuable resources as they provide food, recreational opportunities, commerce pathways and are home to enormous marine and estuarine species. A systematic regular study of pollutants discharged from industries and other institutions is required, to know the effects on water, air and aquatic life, hence it is being done regularly.

Karnataka has a coastline of 320 km covering Dakshina Kannada, Udupi and Uttara Kannada Districts. The coastal water receives considerable amount of treated and untreated effluents from various point and non-point sources. This includes industries; urban and rural domestic waste; fishing harbour, port and harbour activities along the coast. In Karnataka, coastal districts are fast developing and industrializing. Three major industries in Mangalore discharge treated trade effluents into the deep sea through submerged pipe lines, after obtaining consent from KSPCB.

Pollution of coastal waters also arises from various sources such as the dumping of wastes in deep sea through discharge of sewage and trash from ships as well as oil cargos. The Arabian Sea is a major oil tanker route to east Asia hence, time to time deposition of tar like residue on the coast of Mangalore is observed. Few ships have capsized in the Arabian Coast of Mangalore in the recent past, but oil pollution has not been observed.

## Industries in Dakshina Kannada and role of KSPCB

In Dakshina Kannada District about 4,498 units are registered with KSPCB, which includes 2,004 large, medium & small industries, about 184 stone crushers, 291 infrastructure projects, apartments & educational institutions & 1,235 health establishments which include hospitals, nursing homes, clinics and others. The industrial belt of Mangalore comprises major industries like MRPL, an oil refinery and related units like ONGC-OMPL, JBF, HPCL(POL, LPG, MLIF), BPCL (POL & LPG), IOCL storage and bottling, MCF a fertilizer industry, Sequent Scientific Limited a Pharmaceutical industry, Cardolite Specialty Chemicals LLP India Limited a CNS oil processing industry, BASF India Limited a paint, dye & dispersion industry, KIOCL a iron ore pelletization plant, United Breweries Limited a brewery, Mukka & Kotepura fish processing and fishmeal plants apart from few engineering, fabrication, plywood plants and ready mix plants.

KSPCB Issues consent for Red, Orange & Green category industries depending upon the pollution load. The Entrepreneurs take Consent for Establishment (CFE) in the beginning for setting up an industry and take Consent for Operation (CFO) within the stipulated time for operating the industry.

KSPCB covers a wide range of activities from advising the industry on its operational procedure to reduce and control waste and pollution through consent and authorization mechanism and through enforcement with transparency and accountability to avoid prosecution. KSPCB regularly checks and monitors the environment and license holders if the standards set by the Board are being met or not. To ensure compliance to the rules & regulations, KSPCB also initiates action, when they are violated. Show cause notices are issued to the non-complying industries/units and directed to furnish explanation. The Board also issues notices of proposed punitive actions like disconnecting power or water supply to an industry or any other essential services, conducting personal hearing for non-complying industries about violations, issuing closure orders and issuing seizure orders. KSPCB also files criminal cases against any defaulting industry in the court of law depending on the extent of violation and damage to the natural resources and local environment.

KSPCB, Mangalore has taken keen and necessary steps to upkeep the environment of the DK District. The industries are advised and directed to upgrade their technologies in the process and pollution control systems. KSPCB is ever vigilant on the activities of industries. As per the suggestion and directions of KSPCB, all the major industries have upgraded their technologies in the process side and also in the pollution control aspect.

- i) **Mangalore Chemical & Fertilizers Limited (MCF)** was earlier discharging their treated effluent to sea through submerged pipeline. As per the advice and directions of the Board the company has installed advanced wastewater treatment system by installing RO, UF to reduce the fresh water consumption and recycle the treated water. They are the first to become zero discharge industry. They have also installed a CAAQM station and online analyzers for monitoring stack gases and real-time data are displayed and uploaded to CPCB & KSPCB website.

- ii) **M/s. Mangalore Refineries & Petrochemicals Limited (MRPL)** has advanced wastewater treatment facilities with RO, UF system as well as condensate recovery plant to reduce freshwater consumption. MRPL provides real time online water quality monitoring sensors for certain parameters. About 70% of the treated wastewater is reused and remaining treated wastewater is discharged into the sea at 650m seaward as per the advice of National Institute of Oceanography, Goa. To control and monitor air pollution real-time online stack monitoring sensors are installed. They have also installed 2 Continuous CAAQM stations for Continuous Air Quality monitoring. Mangalore Refineries & Petrochemicals Ltd, Kuthethur uses natural gas as internal fuel in the sulphur pastillation unit for Phase III as a green fuel policy.
- iii) **M/s. BASF India Limited**, Dyes and Dye intermediates have provided adequate treatment facilities with diffused aerator system for biological treatment and treated effluents confirming to the standards stipulated by the Board. Treated wastewater is being discharged into sea at 1400m seaward as per the advice of National Institute of Oceanography, Goa. The industry has provided adequate air pollution control measures for all the sources and also installed scrubber for monomer storage tanks to control fugitive emissions.
- iv) **Kudremukh Iron Ore Company Limited (KIOCL)** (Pellet Plant) have sewage treatment plant with MBR technology. The industry recycles treated water and provide sprinklers to arrest fugitive emissions and have air pollution control system for the stacks.
- v) **New Mangalore Port Trust (NMPT)** The port handles several of ships and cargos. It has provided adequate treatment facilities for sewage and ballast water. Frequent sprinkling of the concreted roads where goods are transported is also undertaken.
- vi) **Mangalore Special Economic Zone** has put up a tertiary treatment plant for Mangalore City Corporation sewage at Kavoor and the treated water is being supplied to industries in the SEZ area for industrial use and the treated trade effluent from the industries is discharged through pipeline at 1.4km deep into the sea.
- vii) **Fishmeal and fish oil manufacturing Industries** (14 units) located at Kotepura, Ullal have installed 600 KLD capacity Common Effluent Treatment Plant (CETP) and Multiple evaporators and deodorizers in the industries to control odour nuisance. Three units located at Mukka have installed ETP, multiple evaporator and deodorizer to control odour nuisance. They have also put up a pipeline of 250m into sea for discharge of effluents.

All Hazardous waste generating industries are following the CPCB and KSPCB guidelines and the Hazardous wastes are being disposed to TSDF site at Dabbaspet near Tumkur. Incinerable Hazardous waste from BASF is transported to cement industry for incineration. Recyclable Hazardous waste is being sent to the authorized recyclers approved by KSPCB. Lead battery reprocessing, e-waste recycling, waste plastic recycling, waste oil reprocessing units have been established in Mangalore, thus reducing the waste discharged to the environment.

As per the directions of the Board all the industries are required to monitor and submit the reports of their treated wastewater quality, stack emissions and ambient air quality within their industrial premises. All



major industries are carrying out the monitoring regularly in in-house laboratory and by third party laboratory as per the direction of the Board.

KSPCB, Mangalore is monitoring seawater quality every month at Chitrapur & Panambur Beach and no significant changes have been observed and effect on the coastal water by the discharges of effluent from these industries. The marine outfall of BASF, MRPL and UPCL are being monitored regularly by third party laboratory since long and no adverse observations have been reported.

KSPCB, Mangalore is monitoring water bodies every month under MINARS programme of CPCB. The stations include Netravathi River drinking water source at Dharmasthala, before joining Kumaradhara River at Uppinangady, drinking water pumping station at Thumbbe, Kumaradhara River at Uppinangady, at Pilikula Lake and Borewell near MSW site Vamanjoor. The results are sent to CPCB Delhi and KSPCB Bangalore and uploaded to CPCB data bank.

National Ambient Air Quality Monitoring (NAMP) Station is operational in Baikampady as per Central Pollution Control Board (CPCB) guidelines. The air quality test results from the station are regularly sent to CPCB & KSPCB Bangalore and are uploaded to CPCB data bank and website. The concentrations of the pollutants are well within the stipulated standards. Another CAAQM station will be operational in Kadri shortly which will give the air quality parameters of Mangalore city.

Oceans cover about 71% of the Earth's surface and play an important role in the chemical and biological balance of the life on the earth and are vital to our food security, commerce and transportation. Marine pollution is associated with the changes in physical, chemical & biological conditions of the seawater. It is our prime duty to protect the marine waters and conserve marine life.

KSPCB is carrying out environmental awareness programmes throughout the State to create awareness among students and public about the ill effects of pollution and control measures, so as to get everyone's support in protecting this beautiful Mother Earth.

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## INDIAN FISHMEAL AND FISH OIL INDUSTRY: RAPIDLY TRANSFORMING INTO A RESPONSIBLE SECTOR-AN OVERVIEW

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### **Introduction**

The fishmeal and fish oil industry in India as such originated in the erstwhile undivided South Kanara District of Karnataka State (present Dakshina Kannada and Udupi districts) in the year 1967 and the region remained as the hub of this industry ever since. Though the industry had a very humble beginning, it has now emerged as one of the fastest growing commercial enterprise in the region with commendable contribution to the local as well as the state economy. This industry contributes around INR. 4,700 million to the nation's foreign exchange earnings. Nearly half of the fishmeal and fish oil production (over 0.35 million tons) in India is currently exported, while the other half is utilized by the domestic aquaculture and poultry feed industry. The region accounts for more than 80% of the exports of fishmeal and fish oil from the country. The industry has also generated significant employment opportunities and paved the way for developments in the rural areas where most of the factories are located.

### **Role of Indian Fishmeal and Fish oil Exporters' Association**

IFAFEA (Indian Fishmeal and Fish oil Exporters' Association) established in the year 2012, has 22 producer members and has been contributing towards the overall development of this industry and was successful in projecting Indian fishmeal and fish oil industry globally.

IFAFEA has been assisting the industry in several ways such as obtaining incentives and other benefits like duty drawbacks; settling matters raised by agencies like Export Inspection Agency (EIA), Marine Products Exports Development Authority (MPEDA), state and central governments amicably, besides sharing relevant information on notifications, regulations, certifications and other important information among its members



**Typical modern Fish Meal and Fish Oil Factories**

### **Developments in fishmeal and fish oil industries**

The fishmeal and fish oil sector witnessed an exponential growth over the past two decades. There were only a handful of these factories in the 1970s and 80s while at present there are, around 60 fishmeal and fish oil factories along the Gujarat, Maharashtra, Goa, Karnataka, Kerala and southeast coast. Fishmeal and fish oil industry today has managed to assert its importance as a major player in the marine products industry in India and is increasingly gaining prominence.

The main reason for the rapid development of this industry is the abundant supply of oil sardines (*Sardinella longiceps*) for which there exists a robust fishery that is fairly sustainable at the current levels of exploitation. Fast growth and rapid recruitment with very high fecundity greatly contribute to the landings of oil sardines. Oil sardines is an excellent raw material by virtue of its high protein and oil content. Sardine oil is rich in omega-3 fatty acids and thus has a very high demand. Indian fishmeal and fish oil is therefore considered to be one of the best in the world due to high content of quality proteins, oil and low histamine content.



**Indian oil sardine (*Sardinella longiceps*)**

### **Steps towards responsible manufacturing practices**

The IFAFEA has initiated a Fishery Improvement Program (FIP) for Indian Oil sardine (*Sardinella longiceps*) for the entire west coast of India. It also seeks IFFO-RS (International Fishmeal and Fish oil Organization-Responsible Supply) certification for its participating members thus asserting its stand as a responsible entity striving towards sustainability of the oil sardine resources and also adhering to responsible manufacturing practices.

The fishmeal factories in recent years have adopted state of the art modern plant and machinery to conform to the strict specifications and certifications enabling them to be on par with the global standards.



**State of the art modern fishmeal plant and machinery**



**Fishmeal dryer**



**Hygienic Packing**



**Stacked fishmeal bags**



**Laboratory facility**



**Fishmeal**



**Fish Oil**

**Fish Soluble**

Rapid development of the fishmeal industry raised concerns of environmental pollution in many localities. The industry was also held responsible for the over-exploitation of oil sardine resources by offering high prices to the fishermen and also encouraging fishermen to catch and supply undersized sardine.

The undesirable impacts on the environment and resources caused by the fishmeal industry were partly caused by the lack of awareness among the industrialists and poor enforcement of the regulations. The adverse effect was gradually mitigated with growing awareness among the producers. The Pollution Control Board and various other government agencies also brought in a lot of pressure on the industry to rectify the deficiencies. Gradually, almost all the factories implemented necessary measures to ensure a responsible operation. Major technological improvements introduced in the industry to minimize the pollution issues are the following:

- 1) Evaporators:** One of the major steps adopted by these factories was to introduce a evaporation phase in the production process, where, the entire stick water emanating from the production process is evaporated to ensure zero discharge. This also yielded an additional product called 'fish soluble paste' which has a very high protein content as well as demand as an additive in poultry and aquaculture feeds. The installation of evaporators eliminated the incidence of pollution of nearby water bodies or ground water.



Evaporators are used in fishmeal industry to completely evaporate the stick water emanating from the process of cooking and pressing the fish to remove the water and oil content. The stick water is passed through centrifuges and decanters and the oil is skimmed off from the top. The decanted stick water is passed through the evaporators. Evaporators are huge cylindrical towers heated by excess steam available after use in the cookers and dryers. Cylindrical chamber is heated and the stick water, containing suspended and dissolved proteins are sprayed onto the heat exchanging surface. The proteins are retained on the surface and the water evaporates and moves upwards. The thick soluble paste of concentrated proteins is collected into a collection tank. This paste with about 40% moisture is a by-product with high protein content. Evaporators can be of single-stage or multi-stage. The major purpose of installing evaporators in fishmeal industry is to prevent stick water discharge into the nearby rivers or directly into the sea which is detrimental to the surrounding ecosystem.

- 2) **De-odorizers:** One of the major pollution effect of fishmeal and oil industry is the production of foul odour caused by the volatile base nitrogen and minute foul odour causing particles that are released in vapour form during the fishmeal production process. Air pollution is controlled by installing tall chimneys and by providing filters for trapping fine particles. The off-odour resulting from the process is reduced significantly by using de-odorizers. Installation of improved designs of de-odorizers has significantly reduced the bad odour in the premises and surrounding area of the plants. Foul smelling vapour that are generated during the process are sent through scrubbers with a mist containing organic solutions which trap the fine particles and base nitrogens and break them into harmless substances with the help of bacteria. The vapour then pass through chemical solutions which neutralize ammonia and hydrogen sulphide before the vapour is sent out through exhaust fans or chimneys.



**Heightened Chimney**



**De-odorizer**



**Effluent treatment plant (ETP):** The ETP treat the waste water discharge from the fishmeal plant before being released to the environment. An aerobic treatment system is used in the ETP to breakdown organic matter and to reduce bacterial load, Bubbling compressed air in the liquid effluent in a tank, oxygenates the effluent and the organic particles are broken down by the bacterial fauna. Later, the bacteria and solids settle down as sludge and the cleaner supernatant effluent is discharged. Filtration plants filter out suspended and dissolved proteins.



**Stick water filtration unit**



**Effluent treatment plant**

Thus, the industry is largely working in conformity with the guidelines stipulated by the Pollution Control Board, Export Inspection Agency, State Fisheries Department and MPEDA. Furthermore, the industry is marching towards a tag of eco-friendly and green technologies. One of the factories has recently moved to renewable energy sources by installing solar panels which provide an impressive proportion of their energy needs.

Another significant development in the recent times was a resolution on conservations of oil sardine resources passed in the recent oil sardine fishery FIP stakeholders meet organized by IFAFEA on July 27, 2017 at Kochi. The the stakeholders included grass-root level fishermen association leaders, institutions such as CMFRI, CIFT, MPEDA, Directorates of fisheries, fisheries cooperative societies, and scientists & NGOs working in the sector. As a fallout of this stakeholders meet, the producer members of IFAFEA pledged not to procure undersized sardines and adhere to the minimum legal size decided by the respective governments of the maritime states of west coast of India. The associations of fishermen especially from Malpe which contributes very significantly towards sardine landings have announced soon after the stakeholders meet, that the mesh size of their nets will be increased to 30 mm from the current 16 mm as a measure to protect the resources. They have also instructed their respective members not to bring in by-catches which generally includes young ones of many commercially important species of fish which adversely affects the fishery stock and recruitment. The Directorates of Fisheries of the maritime states of west coast of India have also indicated stringent steps in favour of the above developments.

### **Corporate Social Responsibilities**

The fishmeal industry today is fully aware of their responsibilities towards the betterment of the livelihood, health, well-being and education of the populace in their surrounding locales. The industry has initiated programs to fulfil the Corporate Social Responsibilities (CSR) by adopting villages in which they are located. The major activities include funding several projects related to healthcare, education, rehabilitation and others by active participation.



Rural Primary School



Rural Primary Health Center

Some of the important measures undertaken by the industry as part of their CSR are;

1. Funding and promoting educational institutions like primary schools, high schools and colleges
2. Distribution of free books and clothes to the needy
3. Setting up of trusts by some industries to manage and fund the above activities, besides, provision of scholarships to meritorious students of the area as encouragement for pursuing education
4. Involvement in the primary health care of the local populace by funding and supporting primary health centres
5. Promote social forestry by procuring and distributing saplings
6. Contribution towards infrastructure maintenance such as roads, street lights and others
7. Providing health insurance and provident fund coverage to employees apart from provision of food grains free of cost regularly.
8. Organising entertainment programs like drama and musical programmes for the benefit of local populace

## Conclusion

The fishmeal and fish oil industry, in current terms with the introduction of modern technology and equipment, improvements in the processing methods, pollution control measures implemented, measures initiated for resource conservation and the social responsibility measures implemented can now be classified as an economically progressive, ecofriendly and a socially responsible sector. The initiative to launch an FIP for Indian oil sardine fishery of west coast of India, wholly funded by the participating producer members of IFAFEA, with the active participation of institutions like the Central Marine Fisheries Research Institute, Central Institute of Fisheries Technology, Marine Products Exports Development Authority; Directorates of Fisheries of west coast maritime states; NGOs like World Wildlife Fund, India and fishermen societies & fishermen associations is an evidence for the support of the idea that this Industry is indeed transforming rapidly towards a responsible sector.



## SKILL DEVELOPMENT TO REDUCE COST AND WASTAGE IN SEAFOOD PROCESSING INDUSTRY

**U.J.N. Namboori and M.R. Sreenivas Bhat**  
Blue Water Foods and Exports Private Limited

### **Introduction**

Blue Water Foods and Exports Private Limited, a venture established in 1998 at Calicut and later buoyed by its success, launched its production setup at Mangalore in 2005. It is one of the pioneers in the field of processing and export of seafood products in the country. Blue Water Foods is marked for highly technological and innovative facilities.

The efficient management of the company is headed by Shri. M.R Sreenivas Bhat, the Chairman & Managing Director, who has a vast experience of 25 years in the field of seafood processing, management and exports. Smt. Veena S. Bhat, Director, has a commendable experience of more than 15 years in the field of seafood exports and quality control. Shri. U.J.N Namboori, Director, has a wide experience of more than 20 years in the fields of finance, tax matters and administration.

### **1. Infrastructure**

#### **a. Processing and storage facilities**

The processing plant of Blue Water Foods and Exports Private Limited is located in Baikampady Industrial Area in an extensive area of about 5 acres of land, with the build-up area for the processing unit amounting to 125,000 sq. ft. and another 40,000 sq.ft area for Cold storage capacity of 3,500 metric tonnes.

The futuristic processing facilities and storage facilities of the company includes 4 tunnel freezers, 3 plate freezers (capacity of 115 tonnes/days), one IQF machine (10 tonnes capacity/day), 3 grading machines (45 tonnes/day), 2 flake ice machines (50 metric tonnes/day), one ice plant (250 metric tonnes/day), 3 generators (1575 KVA), 4 cold storages (3500 metric tonnes), 60 insulated/refrigerated vehicles for inward and outward movement of seafood from the processing units, 3 trailers with 7 tails for exports, 4 fork lifts in cold storage.

#### **b. Energy efficient technologies**

Blue Water Foods and Exports also has a modern roof-top solar plant with a capacity of 150 KW, connected to MESCOM grid and has earned the title of being the biggest solar plant in the Baikampady industrial area, Mangalore. The company also plans to come up with another 30 KW roof-top solar plant in the near future, for efficient use of renewable energy leading to additional benefit of cost reduction in electrical usage.



Solar Panels established on the cold storage roof top

## 2. Processing

The company undertakes two main seafood processes, such as Whole and Whole Cleaned Processes. It includes washing, cutting, cleaning, peeling, grading, freezing and packaging of cuttlefish, squid, octopus, shrimp (*Litopenaeus vannamei*), ribbonfish and mackerel. There is a modern in-house laboratory and well experienced technologist for testing raw material and finished goods for ensuring the quality of the products.

## 3. Exporting countries

Major exporting countries/ destinations are Valencia, Barcelona, Ancona, Genova, Haiphong, Belgium, Penang, Singapore, Bangkok, South Africa and Middle East.

## 4. Effluent Treatment and Water Treatment facilities

The company has also established a proficient Effluent Treatment and Water Treatment Plant to eliminate any risks of pollution to environment or water bodies nearby.

The Effluent treatment plant is designed (3lakh liters/day) in such a way that the waste water is directed to a series of seven screening chambers. The segregated solid waste is then passed to micro filter having three different types of meshes, and then to the secondary settling tanks comprising of 12 tanks. The first tank is installed with Alum Doser. At the end of the second settling tank there are two trickling filters where bacteria are added and treated water passes out through three step chambers, where it is dechlorinated. The treated water again passes through the carbon, sand filters and it moves to the R.O. water treatment plant. This efficient mode of recycling benefits in converting effluent water to clean water.

In the water treatment plant, untreated water collected in underground tanks passes through sand, iron, carbon and cartridge filter and later to R.O. filter (membrane). After R.O treatment, water gets collected in a storage tank and is effectively used in the processing plant.



Water Treatment Plant (RO)

Blue Water Foods is also planning to setup a Biogas plant for utilizing approximately 5,000kg of solid waste accumulated per day, for producing about 100kg of natural biogas. This can be effectively utilized in the kitchen of company's canteen facility as well as for operating the generators. The slurry, produced as a by-product is proposed to be dried and used as dry manure.



Effluent Treatment Plant

## **5. Employment opportunities and skill development**

Blue Water Foods and Exports Private Limited has a colossal staff capacity of around 500 employees in the processing plant and cold storages, as well as an expansive amount of staff who work for the company indirectly. The company provides its employees the coverage of Employees State Insurance and Provident Fund. The company also provides its employees with free healthcare facilities within the company's premises, owing to the services of a qualified medical practitioner. Blue Water Foods also proves as a generous and noble company by providing free meals round the clock as well as free accommodation facilities and conveyance facilities for the employees.

## **6. Safety, Social responsibilities and welfare schemes**

The company has also constituted a committee for the welfare and prevention of harassment against women employees. The committee is headed by eminent personalities such as Dr. Gayatri Bhat (MBBS, MD, MSc), Mrs. Manjula N.A (BCom, LLB, DPM), Mrs. Vandana Kamath (BCom) as well as representatives of

the company, Mrs. Rukmini (Warden of Womens' Hostel), Mrs Devaki C.K (Senior worker) and Mr. Chaithanya Pai (HRD Manager).

Blue Water Foods and Exports Private Limited is a part of various charitable and philanthropic activities. As part of corporate social responsibilities and commitment to fellow human beings, the company provides daily mid-day meals to 650 students in a Government primary school through Akshaya Patra Foundation. The company delivers 5 tankers of clean drinking water to villages deprived of drinking water in summer season (February to May every year) in the outskirts of Mangalore.

The achievements of Blue Water Foods and Exports Private Limited has been recognized through many awards including ISO 22000 Certification and BRC Certification for the past 8 years; European Union approval for the last 10 years and CRISIL rating SME 2 in the last 5 years.

## 7. Skill development

A prime concern for Blue Water Foods and other leading seafood processing companies is the shortage of skilled workers in the field of seafood processing. This sector is falling behind compared to other industries and struggling to reach prospective heights, due to this reason. Our suggestion to the Central Marine Fisheries Research Institute to overcome this limitation by training youth in seafood processing. Such training courses can provide employment for talented students, reduce unemployment for the less-privileged and overcome the shortage of skilled workers in this sector. Such timely steps would pave the way for skill development and reduction of cost and wastage in seafood processing industry.

## 8. Vision and Mission

Leading by the philosophy of pursuing excellence, Blue Water Foods and Exports envisions being an innovative player in Seafood Processing and Export and to develop strengths and be amongst the leading Seafood Processing and Exporting Companies in India.

- To develop by an ecofriendly way of sea processing and exporting with a pledge to give back more than what is taken from Mother Nature.
- To grow LEAPS AND BOUNDS WITH ROOTS GROUNDED TO THE NATION AND SOCIAL COMMITMENT TO EVERY INDIVIDUAL OF THE SOCIETY.



**U.J.N. Namboori and M.R. Sreenivas Bhat**  
Blue Water Foods and Exports Private Limited

## KARNATAKA MARINE FISHERIES SCENARIO

H. S. Veerappa Gowda and C. K. Murthy  
Directorate of Fisheries  
Government of Karnataka

### Introduction:

Fishing is an age-old activity along coastal Karnataka. There is a remarkable advancement in fisheries sector of the state from traditional livelihood occupation to a modern commercial activity. Traditionally, Karnataka Coast is known as “mackerel coast” and is endowed with rich resource of small pelagic finfishes. The fisheries sector plays an important role in the socio-economic development of the state in view of its contribution to the food sector, nutritional security, foreign exchange earnings, employment generation and income. Karnataka State has a coastline of 320 km in three districts. Further the State has 27,000 sq.km. of continental shelf area and 87,000 sq.km. of EEZ area.

### Marine Fisheries Resources:

The estimated marine fisheries potential of the State is 4.25 lakh tonnes. This comprises 2.25 lakh tonnes in inshore and 2.00 lakh tonnes in deep sea. The major share of this resource is pelagic fishery forming 54%, followed by demersal resources 29%, crustacean resources 8% and molluscs 6%.

### Marine fisheries sector of Karnataka:

#### Marine Fish Production:

The 320 km coastline of Karnataka distributed in three coastal districts viz. Dakshina Kannada, Udupi and Uttara Kannada, has an average landing of 3.81lakh MT (2012-2017). Karnataka stands fourth in marine fish landings among maritime states of the country. The fisheries sector contributes around 5.28% to

Sl.no	Profile/ infrastructure	Numbers/Capacity
1.	Fishing villages	191
2.	Fishing community population	9.61 lakh
3.	Active fishermen	2.96 lakh
4.	Fishing harbours	8
5.	Fish landing centres	88
6.	Cold storage capacity (metric tons)	9661
7.	Fisheries co-operative societies	612
8.	Fish Markets	598
9.	District fish marketing federations	02

Agriculture Gross Domestic Product (AGDP) and 0.52% to total Gross State Domestic Product (GSDP). The per capita availability of marine fish in the State is 6.74 kg as against the minimum requirement of 11kg.

Table-1: Details of marine fish catch

Year	Marine fish Production (lakh MT)
2012-13	3.57
2013-14	3.58
2014-15	3.90
2015-16	4.10
2016-17	3.90

### Fishing Crafts and Gears:

Gears deployed in coastal Karnataka for harvesting the marine fishery resources can be broadly grouped into seines, trawls, gillnets and hooks & lines. Smaller traditional crafts operate gears such as gillnet, hooks & lines, trammel nets, while the larger mechanised units operate trawls and purse seines.

At present high-speed diesel engine with horsepower up to 350 HP are being used in large purse-seiners and trawlers. The use of electronic equipment onboard the fishing vessel to locate, target, and capture fishes is a common practice. Most of the large fishing boats are equipped with GPS, VHF radio and echo sounder.

Table-2 Details of fishing boats

Year	Registered Boats			
	Mechanised boats	Motorised boats	Traditional boats	Total
2012-13	3454	5966	6325	15342
2013-14	3742	6670	7515	17927
2014-15	3780	6978	8119	18877
2015-16	4026	7469	8442	19937
2016-17	4277	7831	8759	20867

Fishing Regulation Mechanism: As per the provisions of the Karnataka Marine Fisheries Regulation Act, 1986, Department of Fisheries is empowered to regulate, manage the fishery resources. In Karnataka following regulatory mechanisms have been imposed

- a. Restriction on introduction of new purse-seine boats
- b. Ban on bull trawling in territorial waters of the State
- c. Ban on light fishing in the territorial waters of the State
- d. Implementation of annual fishing ban from June 1st to July 31st
- e. Demarcation of fishing zones for various category of fishing boats
- f. Ban on harvesting certain species of shark
- g. Ban on harvest of cuttlefish by nonconventional methods
- h. Restriction on introduction of new fishing boats

Introduction of Minimum Legal Size (MLS), square mesh cod end in trawl to prevent juvenile fishing need to be effected in the coming years. Further, protected area / marine sanctuary / juvenile abundance area need to be notified. It is observed that marine fish production has reached near maximum level. Therefore, more emphasis needs to be given for promoting exploitation in the deep sea and oceanic waters and also for coastal aquaculture and mariculture to increase the fish production. This will also help in reducing fishing pressure in the traditional fishing areas.

◆ Harvest of deep sea resources: Resource specific deep sea fishing boats may be encouraged. Under Centrally Sponsored Scheme, subsidy is provided for construction of deep sea resource specific fishing boats.

◆ Mariculture: Karnataka is endowed with 26 major and minor brackish water creeks providing 8000 ha of suitable water body for small scale cage culture. Mariculture of finfishes and shellfishes is practised along Dakshina Kannada and Udupi districts. Karnataka is one of the ideal places for the development of scientific mussel farming primarily due to abundance of natural mussel seeds. Efforts by CMFRI to popularize scientific mussel and oyster farming in estuarine areas, has resulted in the adoption of this farming practice in Dakshina Kannada and Udupi districts.

## ICAR-CMFRI, MANGALORE RESEARCH CENTRE: ACTIVITIES AND ACHIEVEMENTS

Prathibha Rohit, A.P. Dineshababu, Sujitha Thomas, Geetha Sasikumar,  
K.M. Rajesh, Bindu Sulochanan, G.B. Purushottama, Divya Viswambharan

The southern part of Karnataka Coast (encompassing the erstwhile Dakshina Kannada District, which was bifurcated into two districts in 1997, viz., Dakshina Kannada and Udupi) is known for its rich marine fishery resources. Considering the need for scientific exploitation and all-round development in the marine fishery sector, the Central Marine Fisheries Research Institute had established its 'Unit' at Mangalore in 1957, which was upgraded to the status of a 'Substation' in 1969. Subsequently in 1976 this establishment was renamed as the **Mangalore Research Centre of Central Marine Fisheries Research Institute**



Mangalore Research Centre of Central Marine Fisheries Research Institute

The new Laboratory cum Office building of the Research Centre of CMFRI, Mangalore was inaugurated on 13 April 2012. The Bhatkal Field centre at Bhatkal, Uttara Kannada is attached with this Research Centre.

The erstwhile Dakshina Kannada District with a coastline of 140.8 km runs almost straight and has a continental shelf area of 13,636 km<sup>2</sup> with a width of 50 nautical miles. It receives moderate to heavy rainfall annually. Owing to the flow of five major rivers and 12 minor rivers carrying nutrient rich water into the Arabian Sea and the presence of tropical hydrographic features, the inshore waters of this coast are very productive. The marine fisheries of the region are constituted by pelagic species like oil sardine, mackerel, whitebaits, carangids, seerfishes, ribbonfishes; demersal fishes like threadfin breams,



Oil sardine



Ribbonfish



Threadfin breams



Black Pomfret



Rockcods



Rays



silverbellies, flatfishes, lizardfishes, whitefish, croakers, rockcods, bullseyes, pomfrets; sharks, rays; crustaceans such as penaeid prawns, crabs and stomatopods and molluscs like squids, cuttlefishes, octopus, mussels, clams and edible oysters.



Indian white prawn



Cuttlefish



Squid

The coast is historically known as “mackerel coast” due to the predominance of mackerel fishing activities by the now defunct *rampani* nets. The popular gears of the region at present are trawl net, purse seine, ring seine and gillnet. The mechanised units contribute 99% of the annual catch and the rest is contributed by artisanal gears, which operate mostly during southwest monsoon period. The fishing scenario of the area (Dakshina Kannada and Udupi Districts) witnessed rapid changes with the introduction of mechanized fishing vessels with improved gears during the past four decades. These, innovative and intense fishing activities together with the establishment of fishing harbours for fish landing and other infrastructure facilities for fish preservation, processing, distribution and marketing have augmented the marine fish production of the Karnataka State from 0.2 lakh tonnes in 1956 to the present level of about 5.2 lakh tonnes in 2016. This changing pattern in the fishery over the years has resulted in variations in species contribution to the total catch.



Purse seiner

## Major Research Achievements

### Capture Fisheries

- ★ Management plans for Marine Fisheries of Karnataka prepared with the following recommendations:
  - ✓ Overcapacity may be reduced by strict compliance of registration of fishing vessels with a validity of 10 years and fleet strength to be maintained at 1,312 for multi-day fleet (MDF), 729 for single-day fleet (SDF), 182 for mechanized purse seiners and 2,330 for Out board (OB) crafts.
  - ✓ Controlled license measures for craft-gear combination and engine speed- length ratio.
  - ✓ Compliance of mesh size regulation, Minimum Landing Size and maintenance of log books.
  - ✓ Regulated light based fishing.
  - ✓ Strengthen cold chains and marketing infrastructure.
  - ✓ Subsidy to be linked to compliance and given as incentive to those following responsible fishing practices.



Malpe Fishing Harbour

- ✓ Ecologically sensitive areas identified and breeding as well as juvenile grounds to be declared as fish refugia.
  - ✓ State to impress upon the Centre to formulate fisheries laws for fishing between 12-200nm.
  - ✓ Welfare programmes for traditional fishers to be implemented and Safety net for migrant labourers to be introduced.
- 
- ★ Stock classification of major exploited species along Karnataka Coast studied for period 1990 to 2016.
  - ★ Taxonomy, fishery, biology and distribution of exploited finfishes, crustaceans and molluscs carried out.
  - ★ Biological Reference Points, growth parameters, stock parameters, spawning stock biomass, standing stock biomass, recruitment numbers, maximum sustainable yield, average long-term potential yield, estimated for 40 commercially important species
  - ★ The food and feeding habits of 36 dominant species contributing to the fishery were analysed for the Index of Relative Importance (IRI). Seasonal variations in prey availability studied.
  - ★ Remote sensing & GIS tools used for Ecosystem based marine living resources management. Seasonal spawning grounds and juvenile grounds of some commercial species identified and participatory GIS program for fishery data collection was standardized
  - ★ Clam and mussel landings from important estuaries of Karnataka were estimated.
  - ★ Documentation of vulnerability of marine fishery resources to synergetic effect of climate change studied.
  - ★ Developed a mass balance model with trophic interactions of the Arabian Sea ecosystem of Karnataka and in major estuaries of Goa using the Ecopath analysis.
  - ★ Protocols for tagging large sized yellowfin tunas with pop up satellite tags standardized and the migratory path of yellowfin tuna in the Indian seas obtained.
  - ★ Statolith (hard-part) based methodologies for ageing squids from Arabian Sea standardized.
  - ★ Marine census of crafts, gears, fisher-folk carried out every five years.

## Socio-economics

- ★ Gender roles of fishermen and fisherwomen involved in the dry fish wholesale trade studied.
- ★ In the marine fisheries sector of Karnataka 25.4% were observed to be multi- dimensionally poor. The Karnataka fishers fared better than those of Odisha, Andhra Pradesh and Tamilnadu but less compared to Kerala. Fishers in Dakshina Kannada preferred microfinance institutions to Institutional and non-institutional sources of credit.



- ☆ Techno-economic feasibility assessment of crafts and gears (multi-day trawlers, motorized gill netters and purse seiners were estimated.
- ☆ Capacity development for ecosystem based responsible fisheries management in India was taken up in Mangaluru through co-learning action. Crew aboard multiday trawlers and purse-seiners were aware of fishing ban for mechanized units during monsoon and agreed that uniform ban throughout India should be in place as it resulted in considerable increase in the catch.
- ☆ The main factors of migration in the sector were a) lack of employment, b) less wages in the agricultural sector, c) drought incidence and d) lack of own land for cultivation in their native districts.
- ☆ Supply chain management of marine fisheries sector in Karnataka was studied.
- ☆ Utilization of marine bio-resources, market linkages and access benefit sharing in marine sector of Karnataka.
- ☆ Programme on global learning for local solutions initiated to reduce the vulnerability of marine-dependent coastal communities



## Pollution and environment monitoring

- ☆ Pollution and litter in the coastal beaches, estuarine and marine stations along Mangaluru Coast is monitored to assess the impact of anthropogenic activities.
- ☆ Contaminants and levels of trace metals in coastal and open sea waters regularly monitored to assess the health of the marine water bodies.



Pollution monitoring



Trace metal analysis in Atomic Absorption Spectrophotometer



Mangrove habitat hydro-biological monitoring

- ☆ Levels of habitat degradation along the coast, mangrove and estuarine bivalve fishing areas studied, documented and restoration plans were charted. Mangrove saplings planted in degraded area of Gurupur Estuary.
- ☆ Marine Mammal survey and sightings/ stranding along the coast of Karnataka was recorded and documented.



Dolphin sighting



Masked Booby

☆ During avian surveys 41 species of seabirds and coastal birds were identified and photographed.

## Mariculture

The pristine coastal waters of Dakshina Kannada is suitable for mariculture and sea farming of fin fishes (sea bass, snappers, carangids) and shellfishes (edible oyster, mussel, clams, shrimps and crabs). Of the bivalves, the edible oyster *Crassostrea madrasensis* and the green mussel *Perna viridis* are important; the former has extensive natural beds in almost all estuaries like Nethravathi-Gurpur, Mulki, Udayavara, Hangarcatta, Kundapur and the latter in the inter tidal rocky shores of Dakshina Kannada and Udupi districts. Estuarine cage farming of finfishes in small customized cages was initiated by taking up demonstrations in four cages along the Dakshina Kannada and Udupi Districts during 2009. The success of this mariculture venture is evident from the increase in number cages from a mere four cages in 2009 to over 200 cages in these districts.



Estuarine cages for culture of finfishes



Mussel culture in estuarine area

Successful demonstration and popularization of

- ☆ Mud crab farming initiated and popularized in Karnataka.
- ☆ Bivalve culture (mussels and edible oysters) using raft/rack & rope method in estuaries, and longline method for mussel farming in open sea. More than 60 rafts have been erected in Dakshina Kannada and Udupi districts.
- ☆ Suggested establishment of collection and marketing centers, and common depuration units to improve quality as well as price of farmed products.
- ☆ Cage culture of finfishes (Seabass, snappers and carangids) in estuaries over 200 cages present in Dakshina Kannada and Udupi districts.



- ★ Customized economically feasible cage models made from locally available materials designed
- ★ Feasibility of fish culture in these customized cages demonstrated and popularized.
- ★ Integrated Multi-Trophic Aquaculture (IMTA) introduced. Integration of mussel and finfish farming carried out.
- ★ Formulate water policy for mariculture activities.



## Biodiversity

- ★ Inventorying and database creation of marine and coastal aquatic biodiversity in the three coastal districts of Karnataka completed.
- ★ Coral reef diversity (under water visual survey of Netrani waters (Karnataka), and Grande Island (Goa) carried out.



Marine biodiversity studies in Netrani island



Under water visual survey of Netrani waters

## Awareness / popularization of technology Programmes

- ★ The impact of derelict fishing gear (DFG) to passively attract, trap and kill various marine organisms, fishes, marine mammals, crustaceans, sea turtles and seabirds was studied.



Olive ridley released by fishermen



Amphipod and polychaete entangled by fragments of nylon and plastic strands at 10 m depth



Litter awareness poster

- ★ Awareness programmes on beach cleaning, maintaining general cleanliness in the campus, fishing harbours and reducing use of plastic conducted regularly for school children and general public.
- ★ Awareness on maintaining the health of the oceans done through street plays and display of posters and banners in important places.
- ★ ICAR-CMFRI Mangalore Research Centre and M S Swaminathan Research Foundation jointly have initiated piloting and upscaling PAN India Fisher Friend Mobile Application (FFMA) in

Karnataka. This application is an effective decision support tool for the fishermen.

- ★ Benefits of fish culture in cages and culture of bivalves as a source of income and alternate livelihood programme was demonstrated to Tribals under the Tribal Sub-plan Project.
- ★ Farming technologies popularized in Karnataka and in Maharashtra.



- ✓ Mud farming potential in brackish water stretches between Velas and Dabhol in the Ratnagiri District of Maharashtra carried out.
- ✓ Demonstrated of bivalve farming at Sindhudurg District of Maharashtra.

## Wealth from waste

The Research Centre has always strived towards minimizing waste and maximizing productivity. In line with this thought, the Research Centre is gainfully converting the fish waste to biogas, which is used for cooking in the Departmental Tiffin Room. The slurry from the biogas unit is converted into manure and used in the vegetable patch as well as the terrace garden of the office.

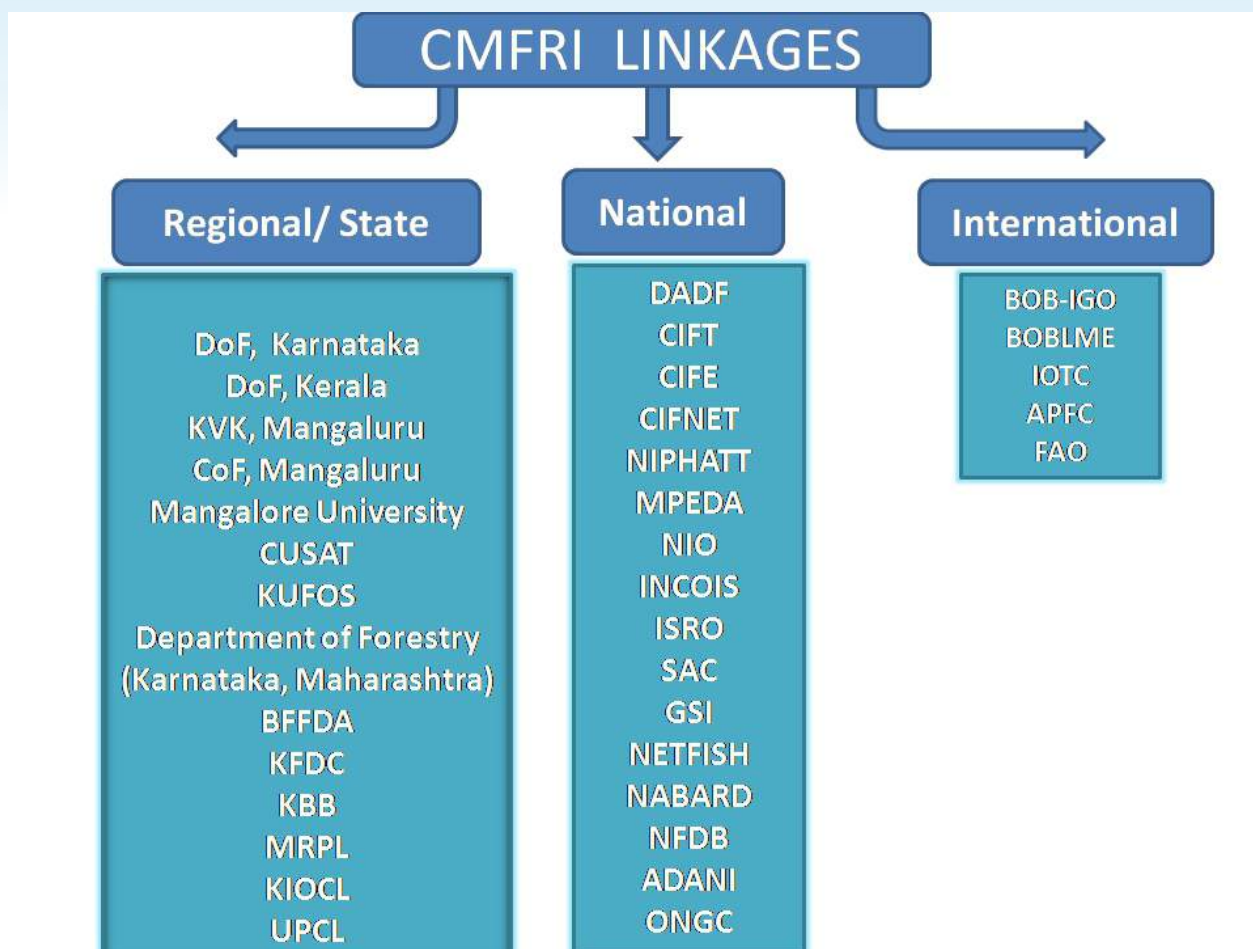


## Policy advisories provided to implementing agencies

- ★ Policy guidance on cuttlefish fishery using Fish Aggregating Devices, ICAR-CMFRI Policy Series 1
- ★ Management Plans for the Marine Fisheries of Karnataka- ICAR-CMFRI Policy Series No. 5
- ★ Inputs provided to State Fisheries authorities on Pair trawling and regulated Light based fishing by purse seines.
- ★ Inventory of marine fish landing centres made in GIS platform and submitted to Indian Navy.
- ★ Spatial planning concept for site selection for coastal aquaculture and methodologies developed for estimation of carrying capacity to ensure sustainable development of coastal aquaculture.

## Completed and on-going programmes on consultancy mode were undertaken for the following organizations

- ★ National Agriculture Technology Project (NATP), Government of India
- ★ National Agriculture Innovation Project (NAIP), Government of India
- ★ Kudremukh Iron Ore Company Limited (KIOCL)
- ★ GMR Energy Ltd., Mangalore
- ★ M/s Water and Power Consultancy Services (India) Ltd., New Delhi.
- ★ BASF
- ★ Mangalore Chemicals and Fertilizers Ltd. (MCF)
- ★ Karnataka Biodiversity Board (KBB)
- ★ Pollution Control Board, Karnataka
- ★ Mangalore Refinery and Petrochemicals Limited (MRPL)



### Future Thrusts

- ❖ Continue to provide issue based advisories regularly to implementing agencies for sustainable management of marine fishery resources of Karnataka.
- ❖ Initiate of Ecosystem Approaches to Fisheries Management in Karnataka and evaluate Fishery Performance Indicators (FPI) for selected marine species landed in Karnataka.
- ❖ Provide scientific inputs towards getting FIP (Fishery Improvement Programme) to get IFFO RS certification for oil sardine along the west coast and MSC (Marine Stewardship Council) Certification for tunas of Lakshadweep Islands.
- ❖ Horizontal expansion of mariculture of finfishes and shellfishes in existing area and in newer areas. Evaluate carrying capacity of our waters so as to provide advisories for optimum number of cages/ rafts to be deployed.
- ❖ Advisories to develop suitable mariculture policies for Karnataka for sustainable mariculture development and diversification of candidate mariculture species.
- ❖ Biodiversity and valuation of coastal, estuarine and islands ecosystem of Karnataka.
- ❖ Marine and estuarine environmental monitoring to assess anthropogenic impacts on ecosystem.

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**The Director**  
ICAR- Central Marine Fisheries Research Institute  
Ernakulam North PO  
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(Cadalmin™ ADe)

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Cadalmin™ Antidiabetic extract (Cadalmin™ ADe) is a nutraceutical product, which provides a unique blend of 100% natural bioactive ingredients extracted from a blend of seaweeds as a natural remedy to type-II diabetes. The bioactive leads with antidiabetic activity were isolated from the seaweeds with an ecofriendly "green" technology.

Cadalmin™ ADe is a natural alternative to the allopathic medications used in the treatment of type-II diabetes.

Antidiabetic activities of Cadalmin™ ADe revealed that the nutraceutical product significantly reduces the blood glucose levels below 100 mg/dL and HbA1c levels below 5% (when used at 65 mg/kg body weight). The active principles significantly inhibit dipeptidyl peptidase-4, tyrosine phosphatase, and  $\alpha$ -glucosidase, which are responsible to cause type-II diabetes.

The preclinical trials showed (1) no test substance-related general organ or systemic toxicity and (2) no hypoglycemic symptoms, following long term oral administration of Cadalmin™ ADe.

#### Ingredients (60 capsules)

Cadalmin™ ADe (per capsule) active principle 400 mg enriched with 100% natural antidiabetic ingredients. The active ingredients have been encapsulated in low moisture content 100% vegetarian based hydroxypropyl methylcellulose capsules.

#### Recommended dosage

Two capsules twice daily for 3 months. Two capsules once daily thereafter, after monitoring the blood sugar and HbA1c levels. Strictly follow the diabetic diet along with capsule intake.

**Discontinuing /dosage alteration of the current medication should be based on the advise of a physician.**

#### Contraindications

People with seafood allergies should consult physician. If pregnant, nursing or under medication, consult your physician before using the product.

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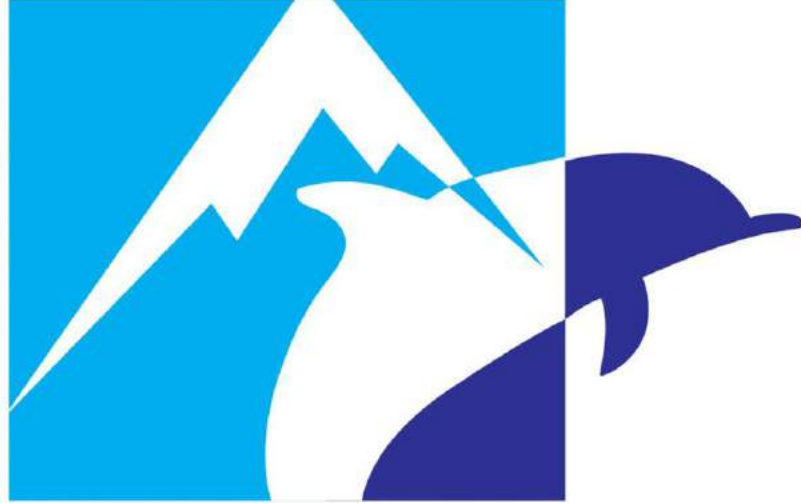


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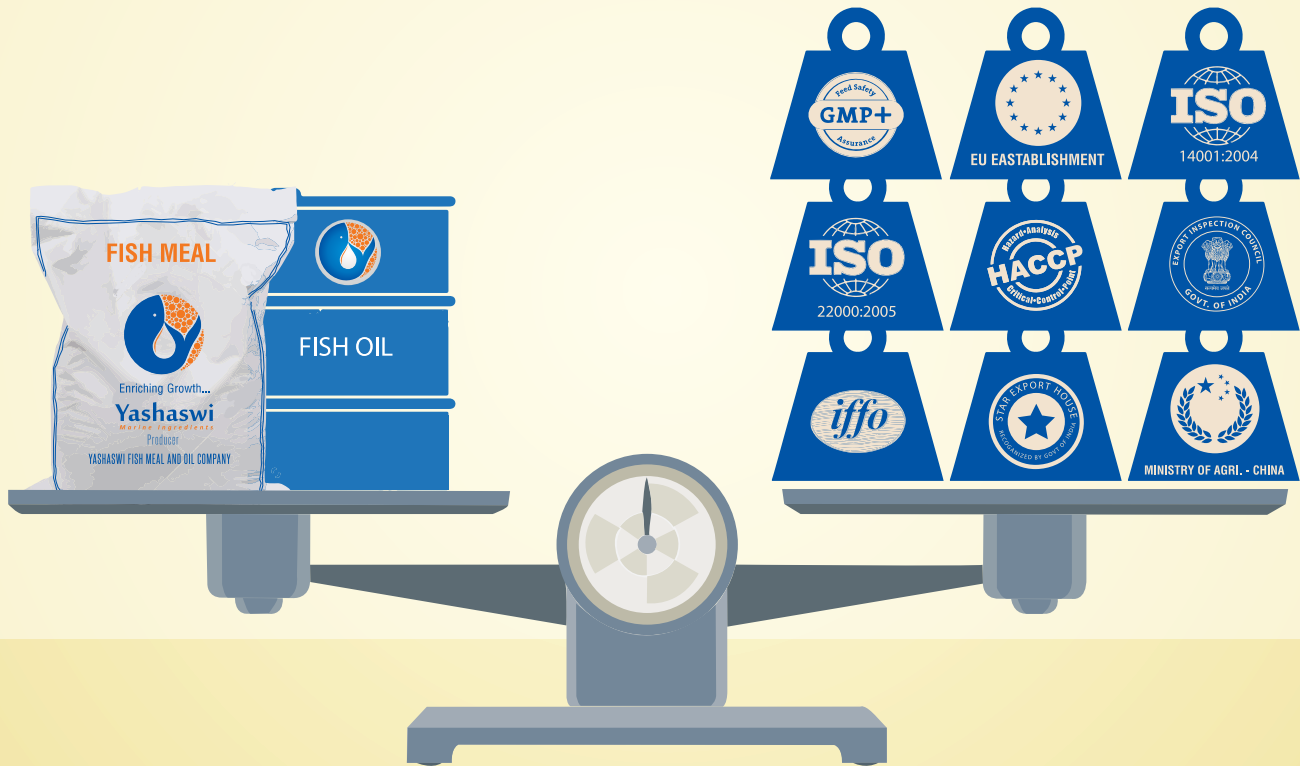
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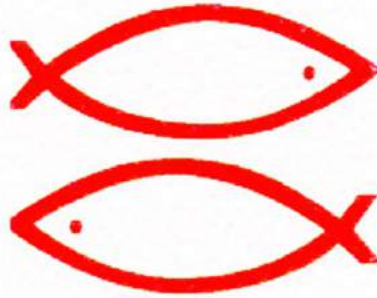
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







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-  **KFDC is the Oldest Corporation** in the Country. Corporation, since its inception is **pioneer** in establishing Cold Chain, **Marketing of Marine Fish** in the inland Cities and towns of Karnataka
-  **Diesel Sales:** Supplying Sales Tax free Diesel to Fishing Boats at Mangalore, Maple, Gangoli, Tadri and Karwar.
-  **Ice Plants:** Providing Ice at reasonable price to Fishing Boats and Fisherwomen at Mangalore, Maple, Gangoli, Honnavara, Bhatkal and Karwar with a production capacity of 220 MT per day.
-  **Marketing of Purse-seine Catches:** KFDC is Marketing Purse-seine catches at Bhatkal, Honnavara and Tadri thereby providing better prices to fishermen.
-  **Implementation of Mathsyashraya Scheme:** KFDC is the Nodal agency for implementing Mathsyashraya Scheme throughout the State.
-  **Modern Air-Conditioned Fish Retail Outlets and Matsydarshini Fish Restaurants:** Modern Air- Conditioned Fish Retail Outlets and restaurants in 17 cities and towns of Karnataka to provide Fresh and Frozen Fish and Value Added Fishery Products, Fish delicacies to the general public at reasonable price.
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-  **Mobile and Online Fish Sales:** Initiated mobile canteen, mobile fish sale and online sale of fish
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