NEW DIMENSIONS OF BLUE REVOLUTION

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Integrated fish farming with livestock and horticulture has made the farming practice highly remunerative and farmers' friendly. Through selective breeding, genetically improved Rohu (Jayanti) with 18% higher growth response per generation has been achieved. Almost five-folds growth in mean national pond productivity in last four decades, i.e. from about 600 kg in 1970s to 2900 kg/ha today is a testimony of the sector's vibrancy. With the cap of second largest aquaculture producer in the world, aquaculture today is also considered as a sunrise sector for meeting the increasing fish demand in coming years.

India has a coast line of 8118 km, having a huge potential for aquaculture, inland and marine fisheries. Marine Fisheries is the fastest growing food producing sector in the world with great potential to meet the food, especially protein requirement. As per NFDB, India ranked 3rd in fish production and 2nd in aquaculture in the world. Fisheries contribute 1.07 per cent of the total GDP of the country. Further, as per the central plan scheme under the banner of **Blue Revolution** *(Neel Kranti)*, it has been targeted to enhance the fish production from 107.95 lakh tonnes in 2015-16 to about 15 lakh tonnes by the end of Financial Year 2019-20. It is also expected to augment the export earnings with a focus on increased benefit flow to the fishers and fish farmers to attain the target of doubling their income. This targeted production from fisheries can be achieved by integrated technological interventions from various fields besides blending traditional knowledge and scientific principles.

Biotechnological Interventions:

Aquatic biotechnology has played a crucial role in promoting productivity, boosting efficiency and ensuring sustainability in aquaculture. The key aspects of culture have been optimized through biotechnological application including enhancement of growth rate and feed conversion efficiency, nutrition and product quality, stress modulation, vaccination, disease resistance, modern disease diagnostics and treatment, genetic selection, transgenesis, etc. The genomics and proteomics have the potential to impart production and management of fish genetic resources. **Nano-technology** has opened a new horizon for the analysis of biomolecules, development of non-viral vectors for gene therapy as transport vehicle for DNA, protein or cells, targeted drug delivery, clinical diagnosis, disease therapeutics etc.

Biotechnological interventions have shown great promises in applying the tools of bioremediation and probiotics in environmental management of effluents, toxicants and pathogens apart from its impact on induced breeding, sea ranching etc.

Mariculture using biotechnological interventions has immense potential being a lucrative sector worldwide. The potential area of biotechnology in mariculture include the use of synthetic hormone (GnRH) in induced breeding, transgenic fish, chromosome engineering, cryopreservation and gene banking, marker assisted genetic improvement and health management. The technical development in transgenesis has expanded the possibilities for producing either sterile fish or those whose reproductive activity can be specifically turned on or off using inducible promoters apart from trait specific gene transfer. Chromosome engineering techniques are important in the improvement of fish breeding as they provide a rapid approach for gonadal sterilization, sex control, and improvement of hybrid viability and cloning.

Biotechnological tools such as molecular diagnostic methods, use of vaccines and immunostimulants are gaining popularity for improving the disease resistance in fish and shellfish species. Biotechnological tools such as gene probes and polymerase chain reaction (PCR) are showing great potential in faster detection of pathogens. The increased application of biotechnological tools can certainly revolutionize our fish farming.

Information Technology (IT) Interventions:

The main challenges of fisheries development in the country includes availability of accurate

data on assessment of technologies for fin and shell fish culture, yield optimization, harvest and post-harvest operations, fishery resources survey, monitoring and assessment , welfare of fishermen. IT can help to overcome these challenges and also assist people to be heard through social networking and knowledge sharing.

IT is involved at every stage of the fisheries value chain "from catch to counter" and plays a significant role in sector modernization, from resource assessment, capture or culture to processing and commercialization. Some specialist applications includes **SONAR** (Sound Navigation and Ranging) for locating fish, Global Positioning Systems (GPS) for navigation, **ECHO-SOUNDER** for depth & locating bottom dwelling fishes, mobile phones for trading & emergencies.

IT tools are contributing in very tangible terms to Monitoring, Control and Surveillance (MCS) and Code of Conduct for Responsible Fisheries (CCRF). ITs are now used to support MCS by protecting local fishing grounds from poachers, through the use of GPS, radio telephone (RT) and mobile phones to locate and report abuses monitoring national and regional fishing territories with satellite-enabled tools.

IT tools like community radio, FM radio, DTH TV, video, mobile phones, tele-centers, digital media are now popularizing to share information and knowledge, raising awareness on issues such as safety at sea, weather and sea state condition, thereby saving their life during natural calamities.

It offers a cost-effective means to discover new fishing grounds and monitor environmental impacts so as to enable commercial fishing vessels to exploit stocks in areas once considered too difficult to fish. Furthermore, as technology improves, fishermen may take greater risks, seeking more distant fishing grounds with greater depth zones.

The application of modern IT tools in particular in the fishery sector has generated far reaching results such as wide spread use of mobile phones among the fishermen enable them to fix prices competitively in the open markets so as to earn sizable income. Adoption of post-harvest technology also helps the fishermen to get good value of the harvest.

Satellite Technology Interventions:

Remote Sensing Technology is used for fishery resource management, their conservation and exploitation. Thus, it helps in making more informed management decisions, in adjusting fishing efforts to conditions of fishing grounds and/or stocks, ensuring sustainable exploitation of marine living resources.

Application of remote sensing in estimating fishery resources can be assisted by the measurement of the concentration of chlorophyll pigments. It is considered as an index of biological productivity and it can be related to fish production. Today, SST (Sea Surface Temperature) maps are mainly used by the tuna fishing fleets. Satellites can also assist the fishing industry in many ways other than locating of fish such as a) Search and rescue operations: The

Echosounder

(SONAR)

satellite NOAA-8 carries a special sensor, SARSAT (Search and Rescue Satellite Tracking). b) Radar altimeter: measures wave height and the micro topography of the ocean surface c) Synthetic Aperture Radar (SAR) : measures wave length and direction radar d) Scatterometer SASS: measures near surface wind speed over the oceans in all weather conditions e) Weather reports: Environmental satellites such as NOAA, GOES or METEOSAT can provide weather information. f) helps in identifying **Potential Fishing Zones (PFZ)** based on **chlorophyll** concentration & **sea surface temperature (SST)** g) In providing information on temporal & spatial changes in area under aquaculture, mangrove areas, coral reef mapping.

Implementation of GIS and remote sensing in fisheries is inter-related. The GIS application is commonly employed to display fishing effort in order to control harvest level in certain high pressured fishing ground, while the remote sensing technology mostly applied in the fishing ground forecasting in order to reduce the inefficiency of fishing activity due to time consumed to find fish aggregation, as well as the fuel consumption of the fishing vessel.

The applications of GIS in Fisheries includes: 1) Identification of suitable sites for fresh water & brackish water aquaculture. 2) Management of marine fisheries & coastal regulation zone.3) Study of land-use pattern including mangroves & forest cover of a particular area.4) Planning for water body resource zonation & mapping of aquatic species. 5) Study of temporal/spatial changes in fish production & consumption.6) Environmental Impact Assessment (EIA) 7) Distribution of different fish species in relation to physical habitat characteristics.

The **Global Positioning System (GPS)** is a digital location system based on a constellation of about 24 satellites orbiting the earth at altitudes of approximately 11000 miles. GPS has found its greatest utility in the field of Geographic Information System (GIS).

The applications of GPS in Fisheries are: 1) It provides precision geo location on earth on real time basis for GIS. 2) Provides ground control points (GCP's) for remote sensing applications. 3) GPS helps in field mapping based on the geo location data. 4) In marine fisheries, it allows survey vessel to carry out precise exploratory survey at high sea in deeper waters. 5) GPS is the backbone of VMS (Vessel Monitoring System), and also sends vessel to catch data to the shore station at a specified interval of time for proper monitoring on real time.

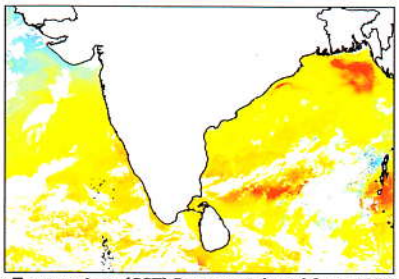
Engineering Interventions:

Some of major engineering interventions that need to be addressed to harness increase in fisheries productivity are:

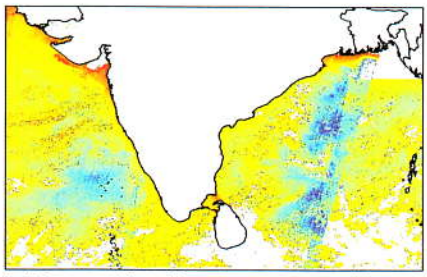
a) Mechanisation of fishing vessels (crafts): Fisheries sector has seen a remarkable growth after 1986 due to intensification of mechanization, motorization of country crafts, multi-day fishing and post harvest technology. The fishermen in the country are now using various types of fishing crafts and gears for fishing.

The major crafts used are of 3 different categories namely mechanized, motorized and non-motorized. The mechanized sector includes trawlers, gill-netters and tuna long-liner vessels. The vessels

(GPS)


(Sea Surface Temperature (SST) Image retrieved from AVHRR)

(Flow Chart of Potential Fishing Zone)


(Chlorophyll Image retrieved from Oceansat-2 Satellite Data)

Data updated on: 18-03-2018 13:39:02

Potential Fishing Zone

MAHARASHTRA

SATELLITE DATA SHOWS LIKELY AVAILABILITY OF FISH STOCK TILL 19 MAR 2018

From the coast of	Direction	Bearing (deg)	Distance (km) From-To	Depth (mtr) From-To	Latitude (dms)	Longitude (dms)
Murud	SW	253	87-92	70-75	18 5 15 N	72 9 47 E
Arnalapada	SW	249	78-83	55-60	19 11 57 N	72 3 0 E
Diveagar	SW	250	69-74	52-57	17 57 2 N	72 22 17 E
Mazgaon	SW	254	88-93	76-81	18 8 49 N	72 7 18 E
Kudgaon	SW	252	84-89	63-68	18 0 41 N	72 13 21 E
Revadanda	SW	248	96-101	69-74	18 12 14 N	72 3 42 E
Srivardhan	SW	258	48-53	34-39	17 57 28 N	72 32 23 E

(Actual PFZ Advisory for Fisher folks)

in the mechanized sector use machines for both propulsion and operation of the gear. Major gears used by the mechanized vessels are trawl nets, gill nets, bag nets, hooks & lines and purse seines.

b) Hatchery construction for quality seed production

c) Feed Mill for manufacture quality feed for aqua farms.

d) Manufacture of quality gear materials for fabrication of nets.

e) Construction of landing centers

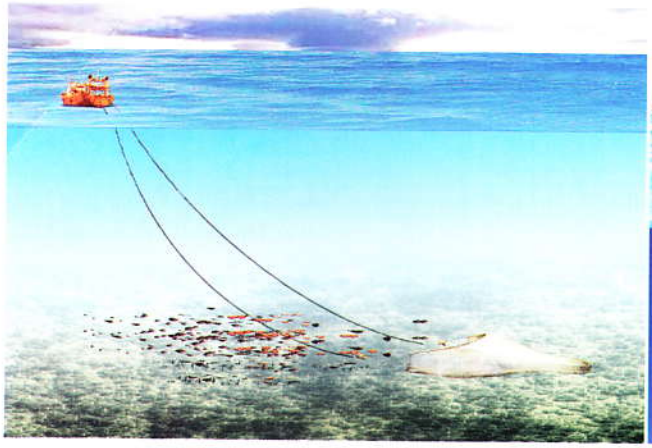
f) Infrastructure development for cold chain process.

Technological Interventions in New National Policy For Marine Fisheries: Leading Towards Blue Revolution:

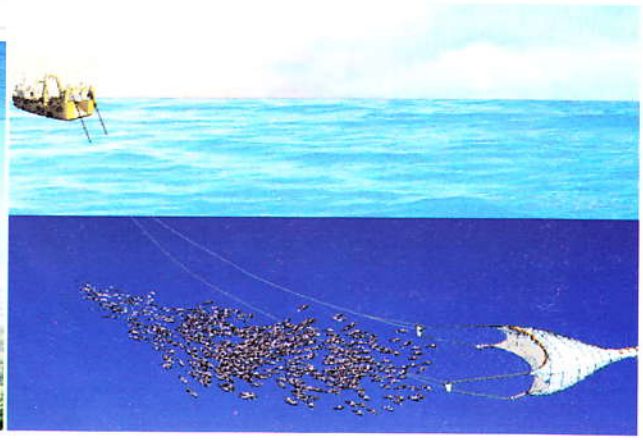
On 28th April 2017, the Ministry of Agriculture & Farmer's Welfare has come out with a new national policy on fisheries paving the way to achieve "Blue Revolution" through implementation of an ambitious scheme for integrated development and management of fisheries.

The new policy will cover development and management of inland fisheries, aquaculture, marine fisheries including deep sea fishing and all activities undertaken by the National Fisheries Development Board (NFDB) towards realizing a 'Blue Revolution' in the country with an outlay of Rs 3,000 crores for a period of five years. Focusing on fisheries, particularly the inland ones, will also help in realizing the goal of doubling the income of farmers in next five-six years by tapping various water bodies including newly dug out ponds across the country.

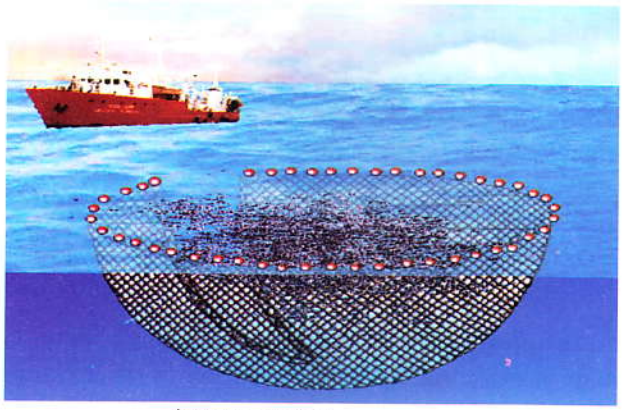
India will provide big private investments in deep sea fishing and take foreign technical support to realize the full potential of the sector, which supports an estimated 4 million fishermen and their family members and contributes Rs 65,000 crore annually to the economy. Billed as the roadmap for a blue revolution, the new National Policy on Marine Fisheries lays emphasis on bringing sustainable utilization of the fisheries wealth from marine and other aquatic resources. Some of the important features of the National Policy on Marine Fisheries 2017 include the use of IT and space technology for improving the capacities of the fishing communities, strengthening the MCS system by introducing chip based smart registration cards for fishermen to avoid the crossing the international marine boundary line. The new policy also focuses on maximizing fleet size, mainstreaming biodiversity conservation in production processes, species specific and area specific management plans, and



(Demersal trawling)

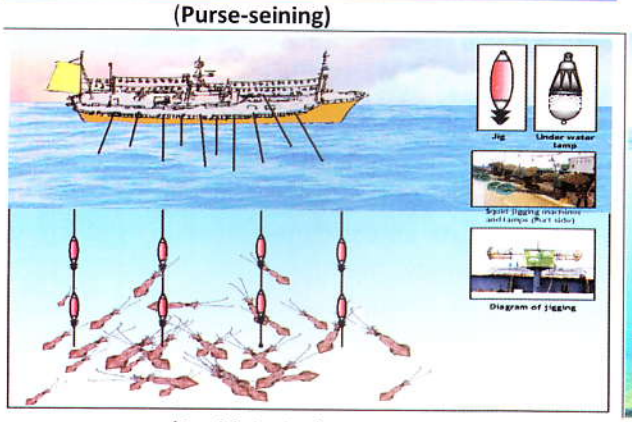


(Pelagic / Mid water trawling)

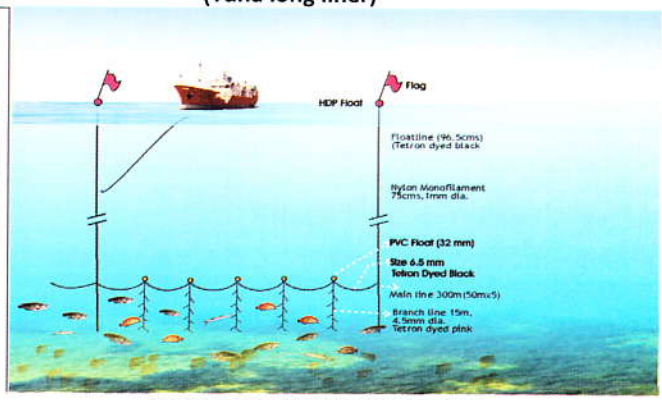


(Purse-seining)

(Tuna long liner)



(Squid Jigging)



(Bottom Set Vertical Long Line)

spatial and temporal measures for sustainable utilization of resources. It is aimed at encouraging an integrated approach on fisheries management, besides blending traditional knowledge and scientific business principles. Simultaneously, the government will also undertake review and periodic evaluation of the existing marine protected areas. Government would also go for providing legislative support to ensure that tenure rights of traditional fishermen are secure and their livelihood not affected by conservation measures. It says entrepreneurship development, private investment, public-private partnership and better leveraging of institutional finance for marine fisheries sector will be encouraged so as to develop the capacity building for deep sea fishing.

The blue revolution is being implemented to achieve economic prosperity of fishermen and fish farmers and to contribute towards food and

nutritional security through optimum utilization of water resources for fisheries development in a sustainable manner, keeping in view the bio-security and environmental concerns. Under the scheme, it has been targeted to enhance the fish production from 107.95 lakh tonnes in 2015-16 to about 150 lakh tonnes by the end of Financial Year 2019-20. It is also expected to augment the export earning with a focus on increased benefit flow to the fishers and fish farmers to attain the target of doubling their income. The department has prepared a detailed National Fisheries Action Plan 2020 for the next 5 years with an aim of enhancing fish production and productivity and to achieve the concept of Blue Revolution.

Technological interventions in aquaculture and mariculture have lead to fisheries development. The sector have shown a considerable diversification in recent years with adoption of other species like catfishes, fresh water prawns, ornamental fishes and cold water fishes apart from Indian major carps in aquaculture; culture of Pacific white shrimp apart from black tiger prawn under brackish water system and **cage culture** of sea bass and cobia owing to their higher market demand and economic advantages. Integrated fish farming with livestock and horticulture has made the farming practice highly remunerative and farmers' friendly. Through selective breeding, genetically improved Rohu **(Jayanti)** with 18% higher growth response per generation has been achieved. Almost five-folds growth in mean national pond productivity in last four decades, i.e. from about 600 kg in 1970s to 2900 kg/ha today is a testimony of the sector's vibrancy.

A demonstration Cage Culture Farm

A Cage is getting ready for installation

With the cap of second largest aquaculture producer in the world, aquaculture today is also considered as a sunrise sector for meeting the increasing fish demand in coming years.

Conclusion:

Fisheries and aquaculture's contribution to human well-being is widely known. Fish as a protein source, plays an important role in maintaining food security for the human population. The World Health Organization (WHO) reports that over the last four decades fish, crustaceans, and molluscs have contributed to 13.8 - 16.5% of animal protein consumed by human populations (WHO 2016). Meanwhile, in the term of economy, fish products are classified among the most traded commodities and manage to assist creation of employment, income provision and regional economic growth and development. In India, Fisheries was recognized as an important allied sector of Indian agriculture only after independence. The vibrancy of the sector could be visualized by 14-folds increase in fish production in just six decades, i.e. from 0.75 million tonnes in 1950-51 to 11.41 million tonnes at present (2016-17). The unparallel average annual growth rate of over 4.5% over the years has placed the country on the forefront of global fish production. Besides meeting the domestic needs, the dependence of over 14.5 million people on fisheries activities for their livelihood and foreign exchange earnings to the tune of Rs.37,871 crore (2016-17) from the fisheries produce, amply justifies the importance of the sector on the country's economy and also livelihood security.

The technological interventions made in the development of fish harvest technologies in areas of modernization of boats and fishing gears, mechanization of propulsion system, introduction of synthetic gear material; developments in acoustic fish detection and satellite-based remote sensing techniques; advances in electronic navigation; enhancement of the fishing capacity, provisions for onboard fish processing and preservation; and improvement of the working conditions not only have been able to sustain the growth of the marine capture fisheries, but also reduced the drudgery of fishermen to a great extent. Appropriate management interventions viz., restriction of fleet size, regulation of mesh size, declaration of closed season, ban on operation of the destructive gears, installation of artificial reefs/fish aggregating device (FAD), promotion of sanctuaries, ranching of commercially important and threatened species and above all implementation of effective code of conduct for responsible fishing have been suggested as a management measures for long-term sustenance of fisheries.

It is estimated that the fish requirement of the country by 2025 would be of the order of 16 million tonnes, of which at least 10 million tonnes need to come from aquaculture. Therefore, development of road map based on available resources, through technological intervention is necessary to achieve this target.

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BLUE REVOLUTION : TOWARDS ECONOMIC PROSPERITY OF FISHERMEN

Realizing the immense scope for development of fisheries and aquaculture, the Government of India has restructured the Central Plan Scheme under an umbrella of Blue Revolution. The restructured Central Sector Scheme on Blue Revolution: Integrated Development and Management of Fisheries (CSS) approved by the Government provides for a focused development and management of the fisheries sector to increase both fish production and fish productivity from aquaculture and fisheries resources of the inland and marine fisheries sector including deep sea fishing.

The Blue Revolution is being implemented to achieve economic prosperity of fishermen and fish farmers and to contribute towards food and nutritional security through optimum utilization of water resources for fisheries development in a sustainable manner, keeping in view the bio-security and environmental concerns.

Under the scheme, it has been targeted to enhance the fish production from 107.95 lakh tonnes in 2015-16 to about 150 lakh tonnes by the end of the financial year 2019-20. It is also expected to augment the export earnings with a focus on increased benefit flow to the fish farmers to attain the target of doubling their income.

The Department has prepared a detailed National Fisheries Action Plan-2020(NFAP) for the next 5 years with an aim of enhancing fish production and productivity and to achieve the concept of Blue Revolution. The approach was initiated considering the various fisheries resources available in the country like ponds & tanks, wetlands, brackish water, cold water, lakes & reservoirs, rivers and canals and the marine sector.