Marine Fish Landings Estimation, Stock Assessment and Spinoffs
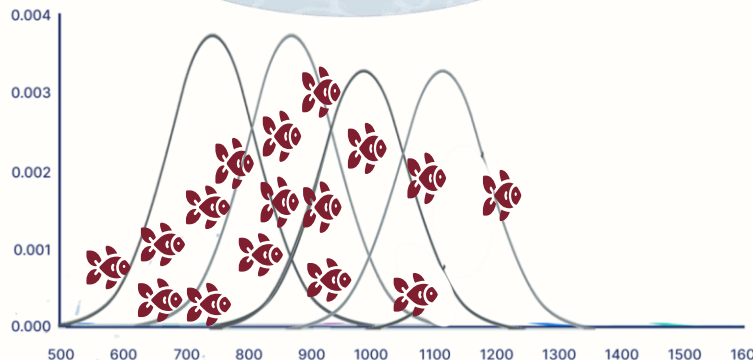
Dr. J. Jayasankar

Principal Scientist & Head

FRAEE Division

**ICAR-CMFRI, Kochi**

Email: jjsankar@icar.gov.in

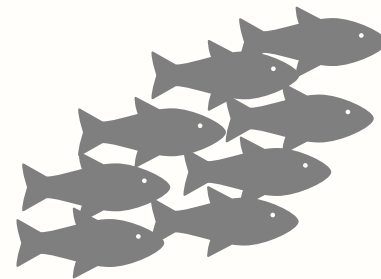**ICAR- Central Marine Fisheries Research Institute**

Fisheries scenario

- **India - third largest fish-producing country**

- **Contributes 8 per cent to the global fish production**

- **Ranks second in aquaculture production**

- **Fisheries contribute 1.1% to India's economy**

- **Marine fisheries – mainly artisanal/small-scale**

- **Most of the vessels are < 24 m OAL**

- **Deploys both mechanized and motorized boats, using a variety of gears**
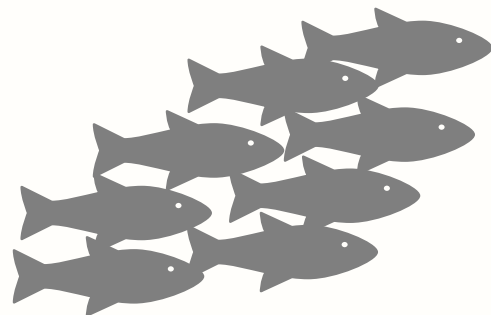
Fisheries scenario

- India - long coastline of 8118 km

- Continental shelf area 0.53 million square km

- Have exclusive rights over the marine living and non-living resources of 2.02 million square km EEZ.

- Marine fisheries - important role in the food and nutritional security, livelihoods and economic prosperity of the nation.

- Major source of employment and livelihoods for one million coastal fishermen households

- Multiplier effect on employment in ancillary activities like fish processing and marketing.
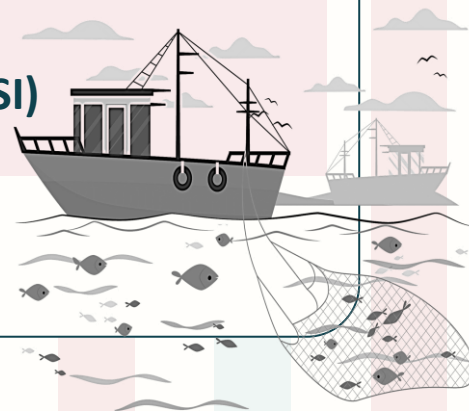
Monitoring and Assessment of Indian Marine Fishery Resources

Accomplished by two approaches

- Sampling done at Landing Centres (by Central Marine Fisheries Research Institute (CMFRI) & Fisheries Departments of State Governments/Union Territories (UT)):- Marine Fish Landings Estimation in India
- Exploratory surveys at Sea (by Fishery Survey of India, FSI)

Monitoring and Assessment of Marine Fishery Resources

Information on

- **catch**
- **effort**
- **biological aspects**
- **socio-economic aspects**

Essential requirements for assessing the exploited stock

Monitoring and Assessment of Marine Fishery Resources

Why monitoring of resources ?

Marine fisheries resources are invisible, frequently migrating and easily affected by the changes in the sea. These characteristics make it unique and complex and hence difficult to monitor, manage and intervene.

- ◉ **Productivity of the seas**
- ◉ **The availability of fish at a given point of time**
- ◉ **The fishing effort expended**
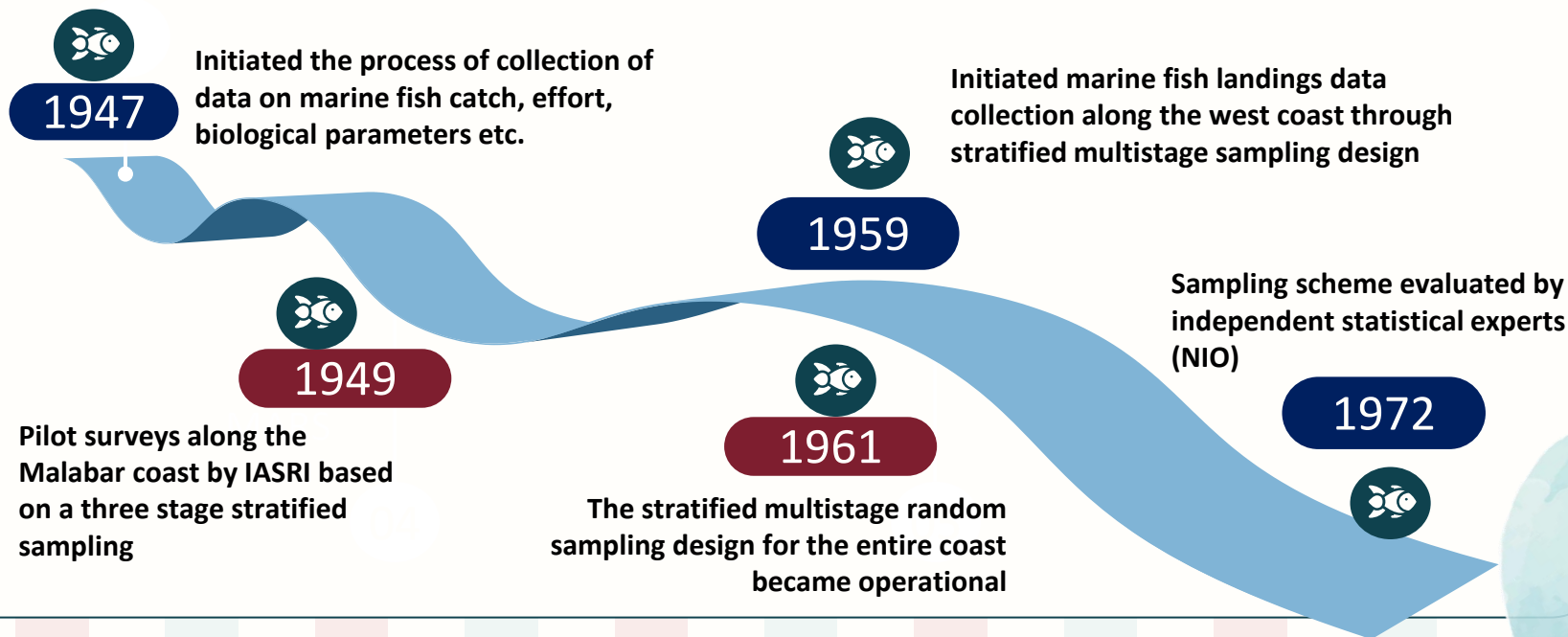- ◉ **Accessibility and vulnerability of the resources**

Marine Fisheries Data Collection

India is one among few countries where a system based on sampling theory is used to collect marine fish catch statistics

1947
Initiated the process of collection of data on marine fish catch, effort, biological parameters etc.

1949
Pilot surveys along the Malabar coast by IASRI based on a three stage stratified sampling

1959
Initiated marine fish landings data collection along the west coast through stratified multistage sampling design

1961
The stratified multistage random sampling design for the entire coast became operational

1972
Sampling scheme evaluated by independent statistical experts (NIO)

HISTORY

Marine Fisheries Data Collection

Why Sampling ?

In 2022, there were 55,05,971 boat trips in the landing centres to be enumerated for arriving at exact landings figure

We require 30,588 man days/year for complete enumeration

Fish landings take place all along the coast line in 1180 landing centres including fisheries harbours during day and night through out the year
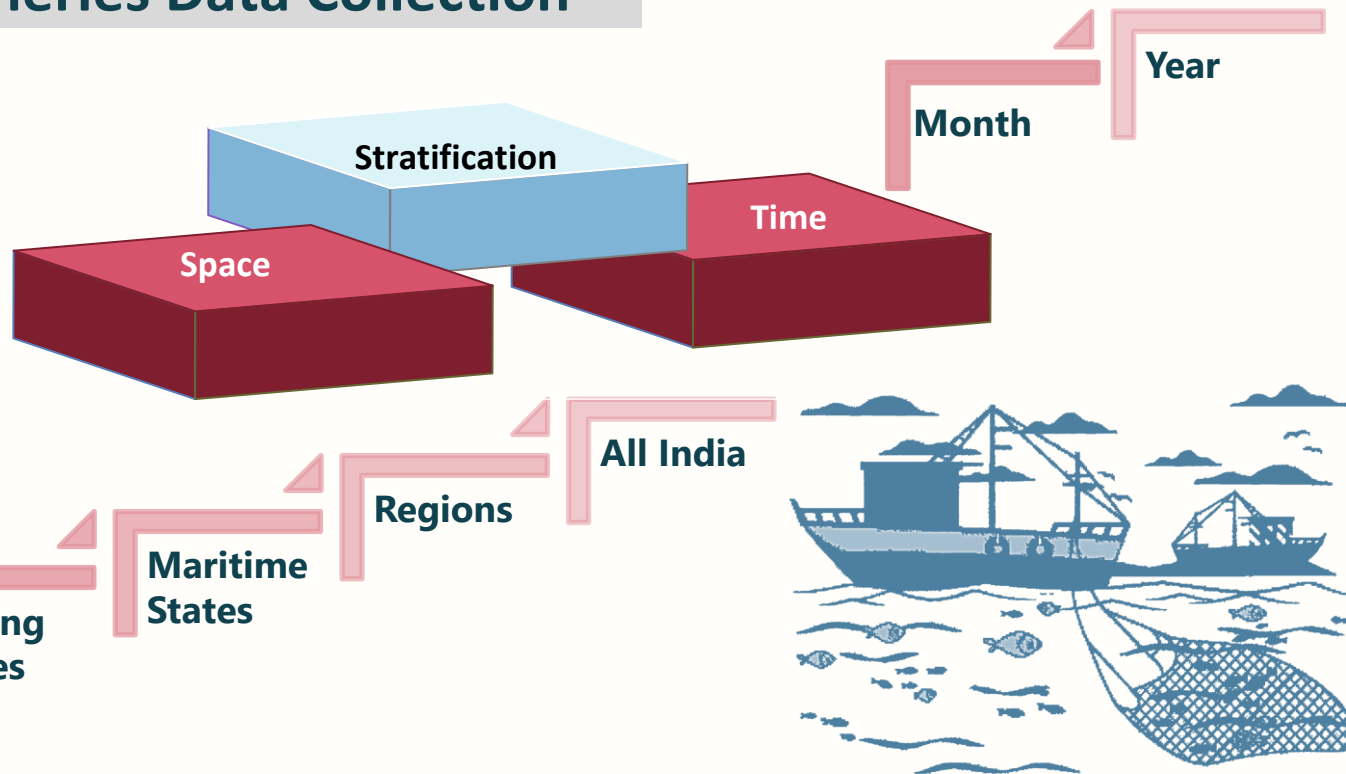
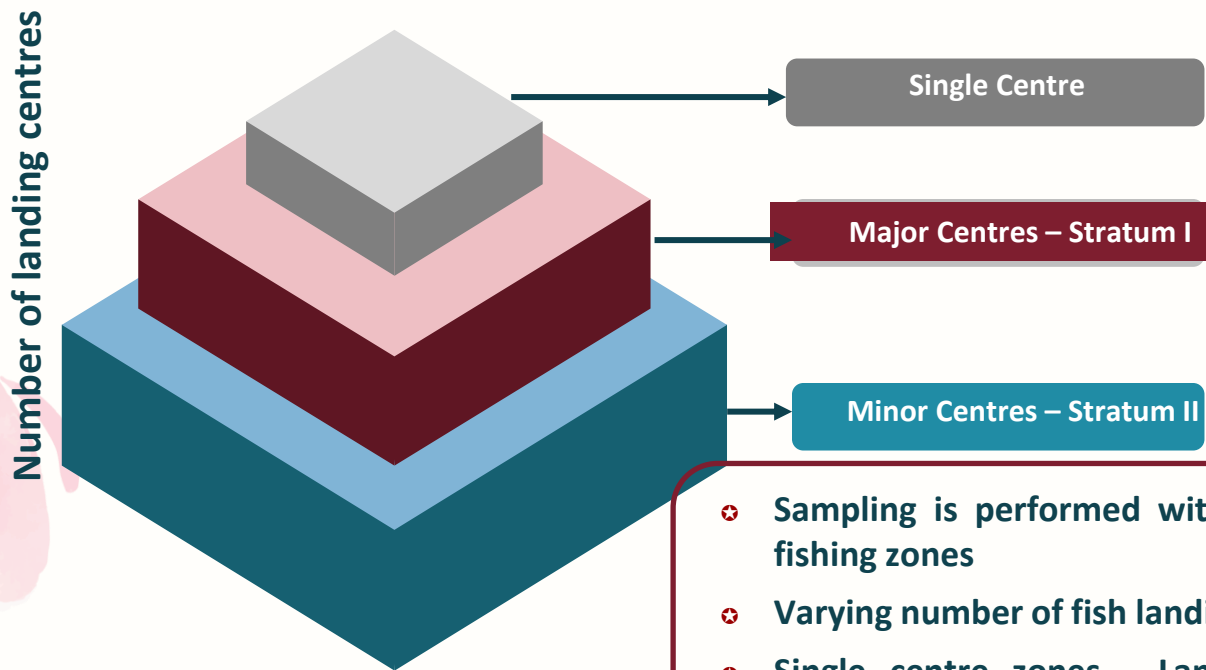A scientifically valid sampling scheme is the only feasible way for estimating fish landings and fishing effort
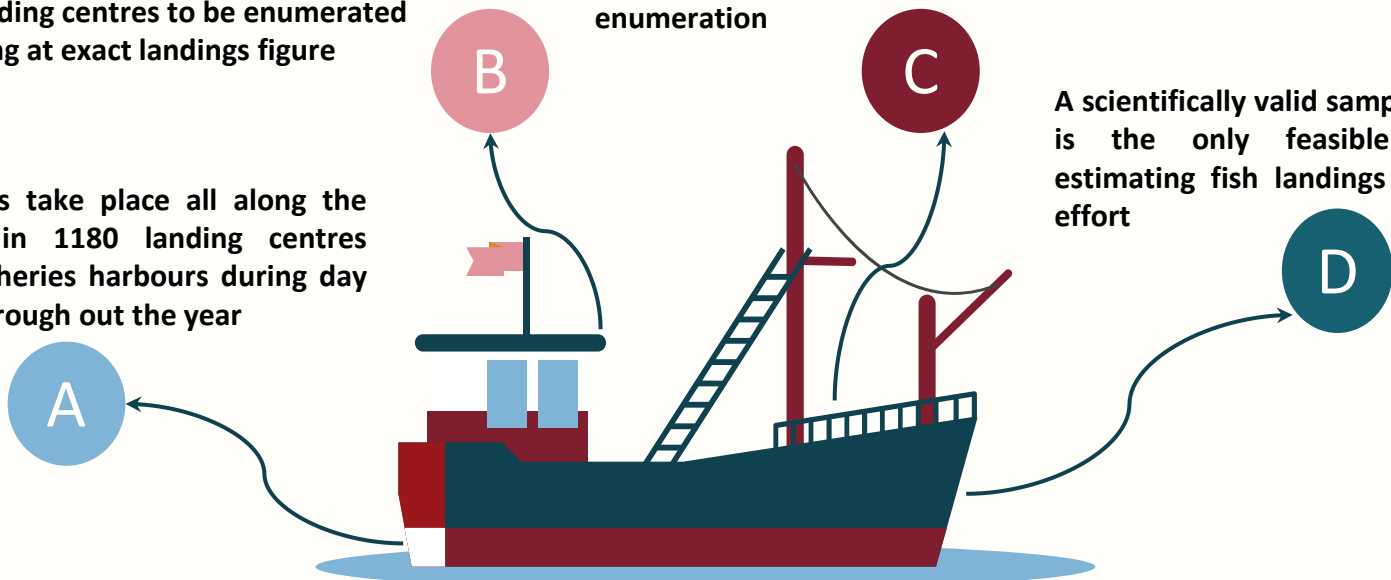
B

C

A

D

Marine Fisheries Data Collection

Stratification

Space

Time

Year

Month

All India

Regions

Maritime States

Fishing Zones

Landing Centres

Stratified Multistage Random Sampling Design

Number of landing centres

Single Centre

Major Centres – Stratum I

Minor Centres – Stratum II

Criteria for stratification within fishing zones

- Variation in fishing intensity
- Type of fishing craft and fishing method
- Number of fishing crafts

- ✪ Sampling is performed within geographical areas referred as fishing zones
- ✪ Varying number of fish landing centres fall under fishing zones
- ✪ Single centre zones - Landing centres with relatively high intensity of fishing activity

Marine Fisheries Data Collection

Stratified Multistage Random Sampling Design

Primary Stage Unit

Landing centre day

Second Stage Unit

Fishing boats

Selection of Second Stage Units

- ○ Not practical to record the catches of all fishing units (boats) landed
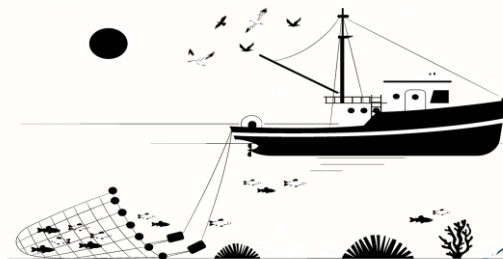- ○ Sampling of the units becomes essential

Marine Fisheries Data Collection

Selection of Primary Stage Units

- ✪ **A month is divided into 3 groups, each of 10 days**

- ✪ **From the first five days of a month, a day is selected at random**

- ✪ **Then, the next 5 consecutive days are automatically selected**

Time strata	Days in a month									
1	1	2	3	4	5	6	7	8	9	10
2	11	12	13	14	15	16	17	18	19	20
3	21	22	23	24	25	26	27	28	29	30

Marine Fisheries Data Collection

Selection of Primary Stage Units

- ✪ **From this, three clusters of two consecutive days are formed.**
- ✪ **In the remaining ten day groups, the clusters are systematically selected with an interval of 10 days.**

Time strata	Days in a month									
1	1	2	3	4	5	6	7	8	9	10
2	11	12	13	14	15	16	17	18	19	20
3	21	22	23	24	25	26	27	28	29	30

Marine Fisheries Data Collection

Fishing unit - Secondary stage unit

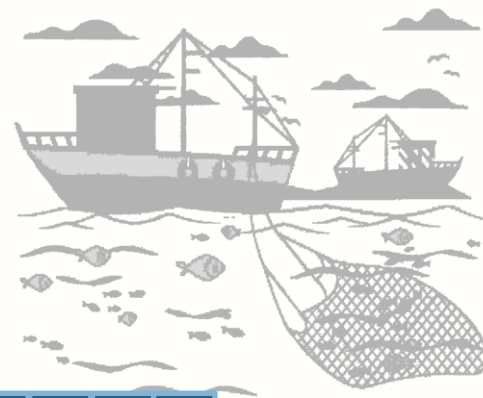| Period	Duration
Period 1	1200 to 1800 hours on 1st day
Period 2	1800 hours to next morning 0600 hour
Period 3	0600 to 1200 hours on 2nd day

Marine Fisheries Data Collection

Period of Observation

Number of Boats landed	Fraction to be observed
Less than or equal to 15	100%
Between 16 and 19	First 10 and the balance 50 %
Between 20 and 29	1 in 2
Between 30 and 39	1 in 3
Between 40 and 49	1 in 4
Between 50 and 59	1 in 5 and so on

Marine Fisheries Data Collection

Recording of Fish Landings

- 01 Species wise catch
- 02 Fishing Effort
- 03 Type of Crafts
- 04 Gears operated
- 05 Hauls
- 06 Other details

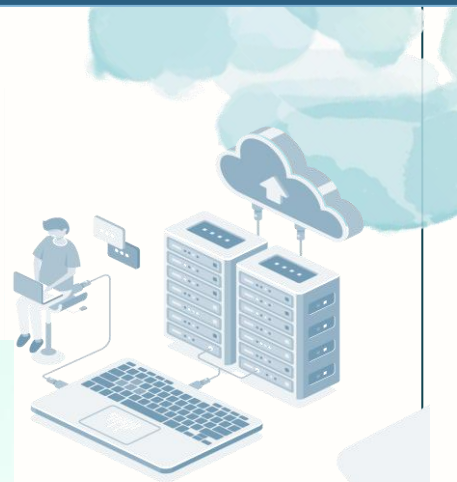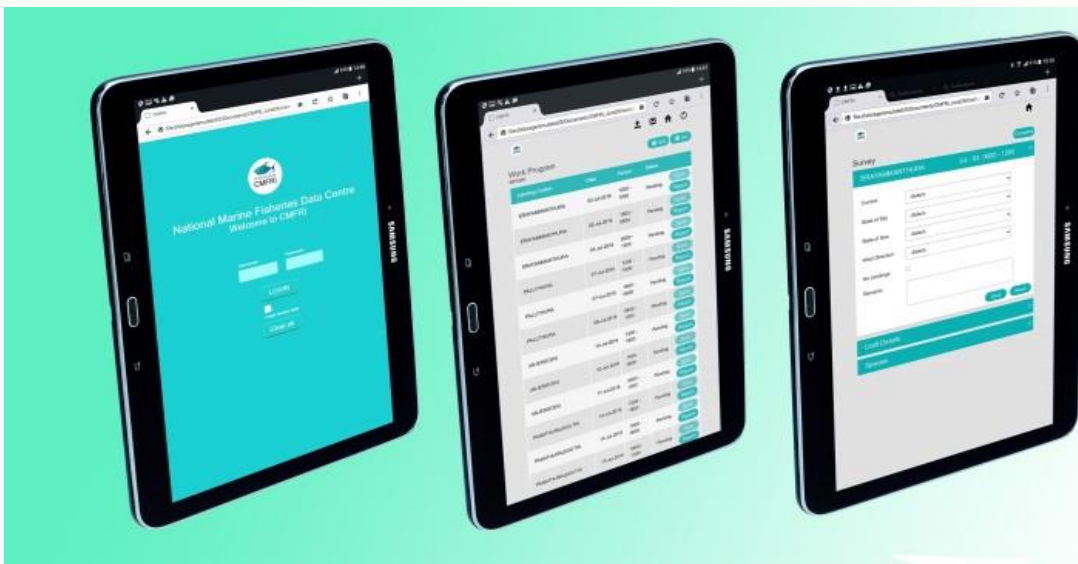## Marine Fisheries Data Collection
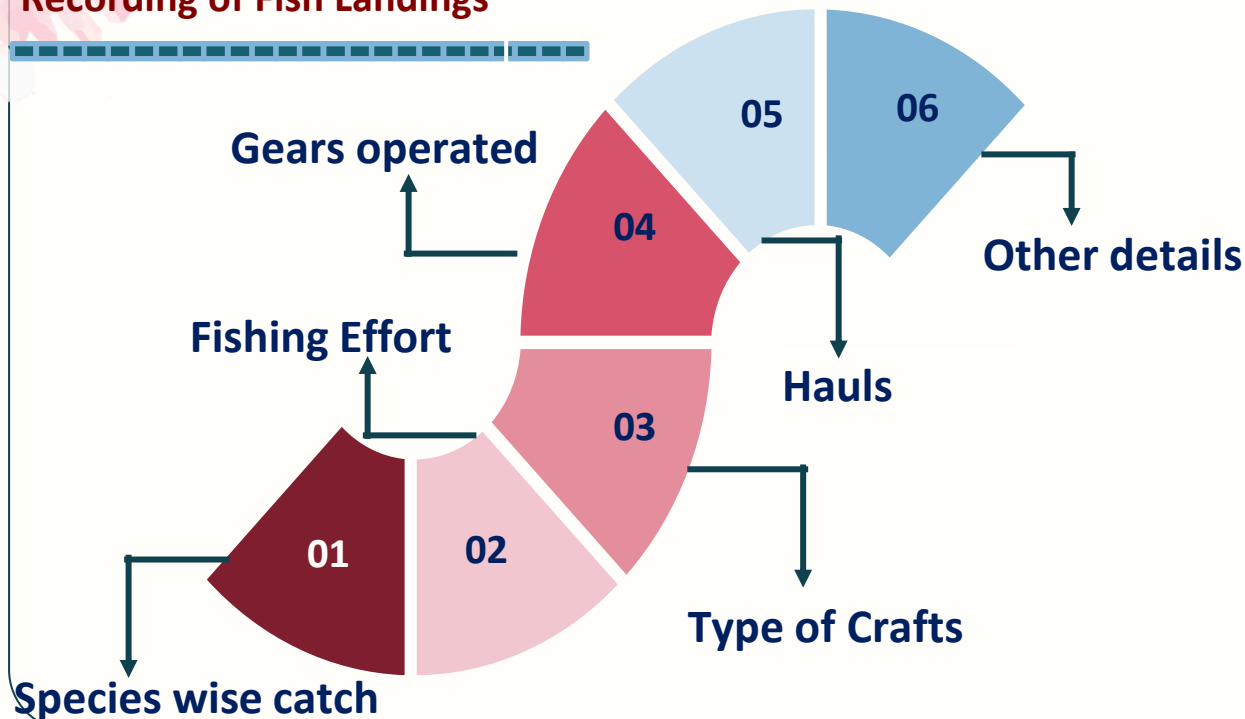
National Workshop on Harnessing Potential of Fisheries in Marine States

Marine Fisheries Data Collection

FCSA Mobile App

Monitoring and Assessment of Indian Marine Fishery Resources

Marine Fish Landings in India-2022

3.49 million tonnes
3.05

Gujarat
5.03 / 5.76
Daman & Diu
0.74 / 0.67
Maharashtra
1.70 / 1.23
Goa
0.52 / 0.52
Karnataka
6.95 / 5.51
Kerala
6.87 / 5.55

West Bengal
1.90 / 1.37
Odisha
1.33 / 1.80
Andhra Pradesh
2.16 / 2.07
Puducherry
0.50 / 0.38
Tamil Nadu
7.22 / 5.62

Landings in lakh tonnes ■ 2022 ■ 2021

South-west	South-east	North-west
41	28	22
		North-east
		9

Region-wise contribution (%)

2021 **2022**
966 1062

	WB	OD	AP	TN	PU	KL	KA	GO	MH	GJ	DD
■ **2021**	268	287	255	663	246	589	258	227	235	264	116
■ **2022**	226	264	278	716	239	707	270	183	329	291	123

Number of Species in Landings

Joint Data Collection System

States implemented joint marine fish landing data collection in collaboration with ICAR-CMFRI under a uniform sampling plan

■ Started

■ Discussion in progress

■ Other coastal states/UTs

Coverage

State	Coverage (%)#	Number of Field Staff
West Bengal	33.33	2
Odisha	33.33	4
Andhra Pradesh	33.33	11
Tamil Nadu & Puducherry	26.67	18
Kerala	40.00	23
Karnataka & Goa	26.67	5
Maharashtra	46.67	26
Gujarat & Daman-Diu	20.00	6
Andaman	60.00	25
	Total	**120**

#The coverage is based on the average number of surveys conducted in a month at major landing centres /single centre zones

Exploratory surveys at Sea (FSI)

11 survey vessels operated from bases distributed all along Indian coasts
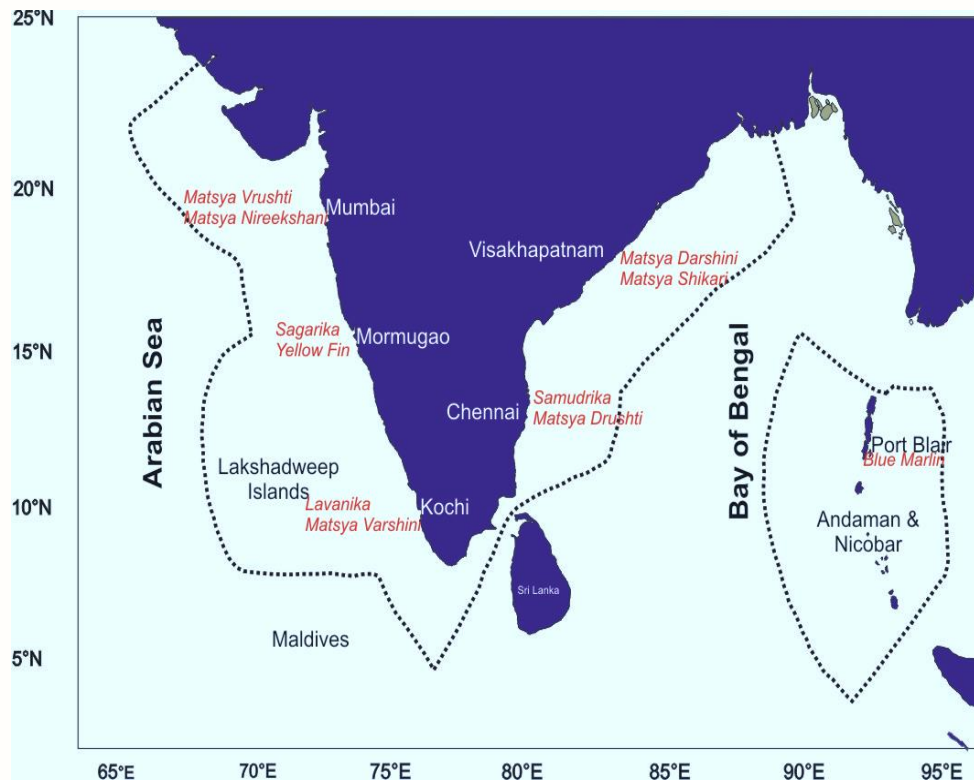
Survey Components - FSI

- Demersal resources survey and research programme along the coasts of India

- Survey of oceanic tuna and allied resources in the Indian EEZ

- Pelagic resources surveys in the continental shelf areas using pelagic trawls and drift gillnets and

- Experimental fishing with traps, hand line, purse seining, squid jigging, bottom set longlining, trawling and bottom set vertical long lining.

Stock Assessment

- For the management of marine fisheries, it is essential to assess marine fish stocks.

- Measurement of the exploitation status of fish stocks is the key to their assessment.

- Well-developed fish stock assessment techniques are adopted by many countries to evaluate their marine fish stocks and these methods heavily depend on the ability to estimate the abundance or biomass of both the exploited and unexploited fish stocks.

- However, the efficacy and reliability of the stock assessment techniques are debatable, especially when it comes to applying the techniques uniformly over various types of fisheries practiced around the world.

Data Requirements

- Total catch (by species, area, and type of gear)
- Fishing Effort (by area and type of gear)
- Length-frequencies (by species and sex)
- Biological data (eg. Maturity stages, length/weight relationship etc.)
- Data on fishing gears (eg. Mesh size) and fishing operations

Commercial fisheries

Fishing surveys

You need a boat

Methods/Models for Stock Assessment

Single Species Assessment

- Length-based analytical models
- Length Based Indicators (LBI)
- Length Based Spawning Potential Ratio (LBSPR)
- CMSY/BSM approach
- Stock Status Plots
- Surplus production model-based approaches
- Environmental Performance Index

Multispecies Assessment

- Multispecies virtual population analysis
- Multispecies Biomass Dynamic Model
- Size spectrum model
- Ecopath with Ecosim Models
- Model for Intermediate Complexity Ecosystem (MICE)

Recent Stock Assessment

1) Fish Stock Status (FSS)

$$\text{FSS} = \sum_{i=1}^{n}(mp_i * el_i) / \sum_{i=1}^{n} el_i$$

where

- ✓ el_i is estimated landings of the ith resource/ group in the latest year
- ✓ mp_i is level based on the moving average of proportion to the optimal biological removal of ith resource/ group
- ✓ i is index of resource/ group ranging from 1 to n

2) Weighted Trophic Level Index (WTLI), which is equivalent for MTI (Marine Trophic Index)
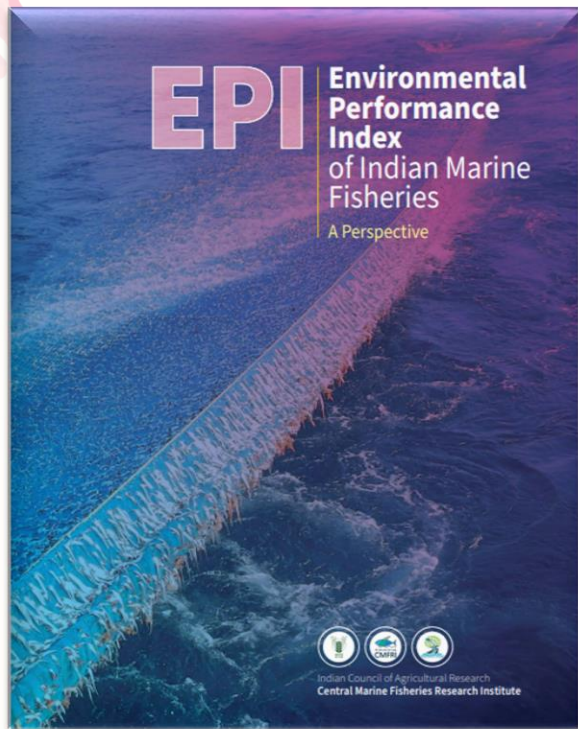
$$\text{WTLI} = \sum_{i=1}^{n}(mtl_i * el_i) / \sum_{i=1}^{n} el_i$$

where

- ✓ el_i is estimated landings of the ith resource/ group in the latest year
- ✓ mtl_i is the mean trophic level of ith resource/ group
- ✓ i is index of resource/ group ranging from 1 to n

Recent Stock Assessment

Highlights of 2020 FSS assessment

86.2% of the marine fish stocks in the Indian EEZ remain at the sustainable/early/developing phase of harvesting.

Among the eight groups of fishes which are tagged as overfished, Barring rock cods and Perches, others form only minor fishery along the Indian coast such as Skates/ Guitar fishes, Chinese pomfret, Mullets, Octopus and Large trevallies.
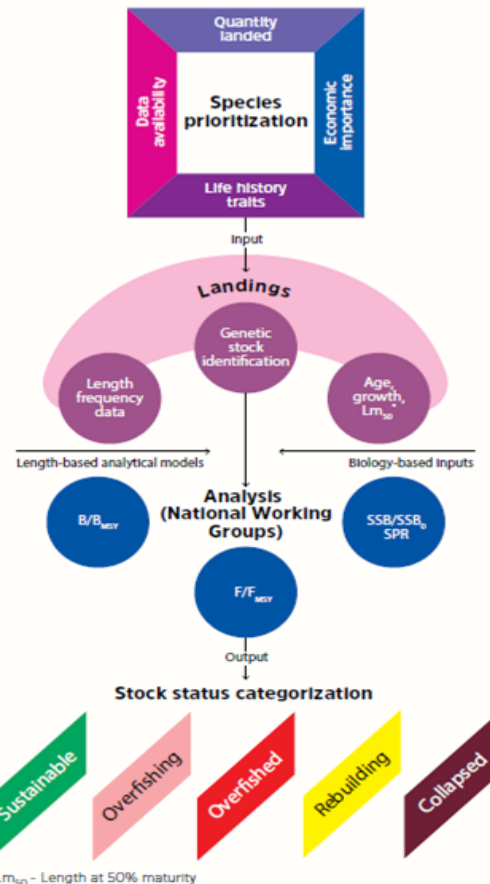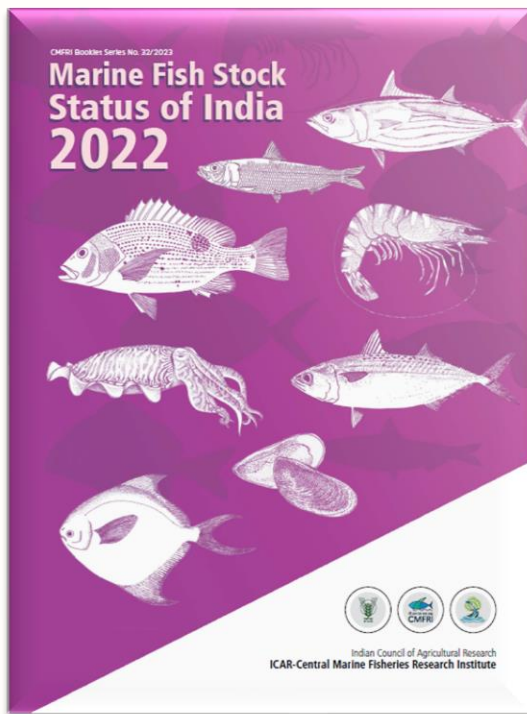
Recent Stock Assessment

Recent Stock Assessment

Marine fish stock status of India, 2022
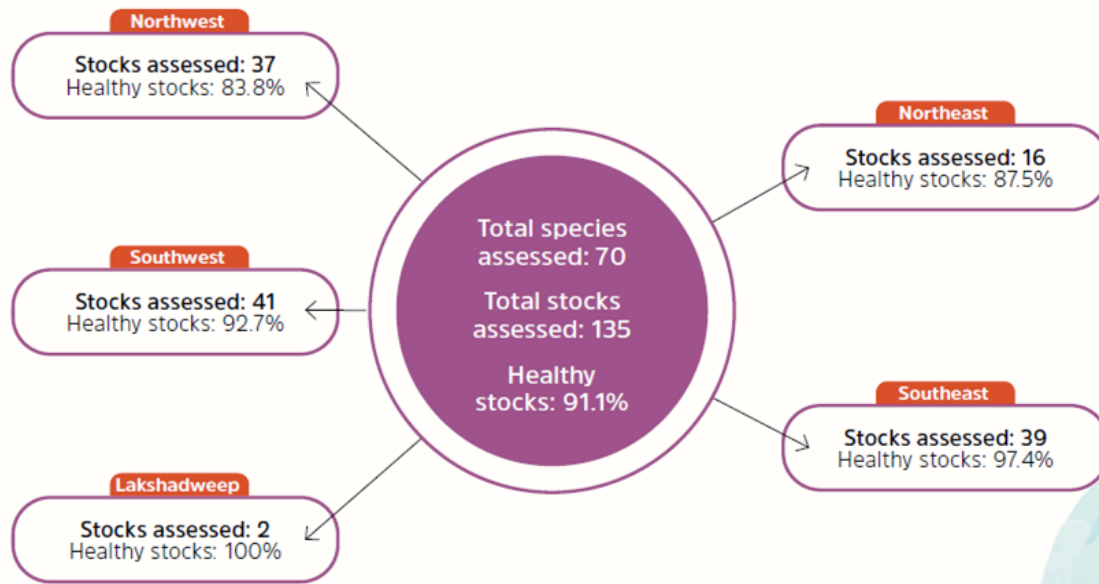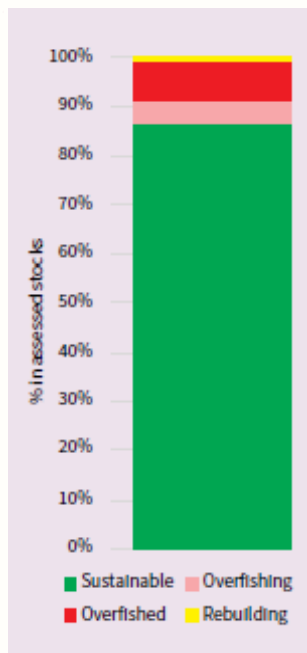
Way Forward

- Establishment of a grid-based repository of presumptive fished biomass of Indian waters and habitat suitability index for the resources

- Automated System for marine fishery resources landing data collection via computer vision and AI-driven deep learning algorithms for species identification and quantification from visual images

- Creation of an open access platform for assessing the status of marine resources that enables the assessors to perform macro / micro level models depending upon the data availability of Indian fishery resources

- Revalidation of harvestable potential for Indian EEZ

- Fisheries Census of India, 2023-2024

Ecolabeling for Marine Capture Fisheries

Dr. Shinoj P.

Senior Scientist

FRAEE Division

ICAR-CMFRI, Kochi

Email: pshinoj@gmail.com

Ecolabeling for Marine Capture Fisheries

- Ecolabeling is a market instrument to ensure fish is sourced from a sustainable fishery.

- An Ecolabel is assumed to be anchored on three basic incentives:
  - Premium prices for the fishers for adhering to sustainable fishing practices
  - The government has the incentive to upgrade fisheries management practices and monitor the health of fish stocks
  - The food chain fraternity can derive better market access and avoid any reputational risks associated with the food they deal with.

- Focus on the health of the ecosystem *versus* the safety/quality of the product in the case of conventional certification schemes.

Approaches for Ecolabeling

- Ecolabeling is done based on a set of standards that define fisheries sustainability and an assessment protocol.

- Certificate is issued to a group of operators in the fishery for a fee and a period.

- Cost of management is to be borne by the state.

- Possible approaches:
  - ✓ Self-declaration by the fisher - may not be feasible in open-access fishery
  - ✓ State declaration subject to third-party verification and equivalence (Eg: EU Ecolabel, FranceAgriMer)
  - ✓ Labels promoted by industry groups / retail groups
  - ✓ Private/third-party certification (Eg: MSC; Friend of the Sea, other NGOs)

Ideal Conditions for Success

1. There does not exist a boundary conundrum
   - The resource area is confined

2. The number of harvesters is limited
   - Easy traceability of the chain of custody
   - Clear guidelines on benefit sharing
   - Easy to monitor equity implications

3. Closely-knit management regime with a semblance of privatization.
   - Easy administration of rules and fishery governance
   - Quick ascent to management efforts
   - Consensus-based management

Ecolabeling – Pros and Cons

Pros

- Harnesses the **collective power of value chain agents** to achieve ecosystem sustainability
- Promises **premium prices** for fishers
- Better market access, profits, and credibility for the retail chains

Cons

- May not be suitable for complex fisheries with a diversity of fishers and varying interest groups
- Concerns of monopoly by a few leading players – **the threat of ecolabel becoming a condition for market access** and **potential trade barrier**
- Concerns of equitable sharing of benefits – the threat of exclusion of some fisher groups
- Possibility that the **larger pie of profit be appropriated by exporters / retailers**
- Other hurdles (eg: microbial contamination) that prevent the export of Eco labeled products (Eg: Ashtamudi Short-neck clam)
- Ecosystem benefits limited to a few high-value products only (eg: shrimps, squids, etc.)

Impact of Ecolabeling

- There is a broad consensus that ecolabels create an enabling atmosphere for compliance with sustainable practices.

- Certain studies (eg: Martinez-de-Ibarreta and Valor, 2017) indicate insufficient impact in bringing about perceivable changes in sustainability – mostly due to limited coverage.

- Other studies (Pérez-Ramírezet al, 2016; Martinez-de-Ibarreta and Valor, 2017) report limited impact in terms of the realization of consistently high prices for eco-labeled products.

- High cost of certification and problems of affordability.

- Reported confusion among consumers about diverse types of certification schemes.

- Undue interventions by certifying agencies to influence market conditions (Foley and Havice, 2016).

Ecolabeling – Policy Dilemmas in the Indian Context

- Lack of clarity on the real impact of eco-labeling on fishery sustainability
  - Limited **empirical evidence**
  - Lack of clear **ex-ante impact assessment studies**
  - Impact of such instruments in **tropical fishery context** – where fishery is NOT limited to single species
  - Social justice is not a yardstick in ecolabel

- Policy decisions on the format
  - Whether a single third-party player is desirable? **Can there be multiple players**?
  - **Is there scope for a National Ecolabeling Scheme** with a provision for third-party verification? – Need not preclude other private ecolabels
  - The possibility of **Regional Ecolabels** (Eg: BoB Ecolabel, ASEAN Ecolabel, etc.)

Ecolabeling – Policy Dilemmas in the Indian Context

- Need for formal mechanisms to be in place to monitor-
  - Whether there is **undue misappropriation of benefits** by certain parties or not;
  - **Whether some fishers are excluded or not**? How can we ensure access to all?
  - To **assess the impact in terms** of price premium and improved ecosystem sustainability and stock status.
  - Whether the schemes **are transparent** and consistent with guidelines

- To mobilize Corporate Social Responsibility (CSR) funds to contribute to fishery sustainability programs.

Thank you

Carlos Martinez-de-Ibarreta and Carmon Valor (2017) Is it worth getting labeled? The Case of MSC- Certified Seafood: JIFAM pp-197-215

M. P´erez-Ramírez, M. Castrej´on, N.L. Guti´errez, O. Defeo, The Marine Stewardship Council certication in Latin America and the Caribbean: a review of experiences, potentials and pitfalls, Fish. Res. 182 (2016) 50–58

Paul Foley and Elizabeth Havice (2016) The rise of territorial eco-certifications:New politics of transnational sustainability governance in the fishery sector: Geoforum, 69: 24-33