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The marine fisheries sector in India provide livelihood to nearly 4.0 million people and contributes to the food and nutritional security of the nation. With a coastline of over 8,000 km, an Exclusive Economic Zone (EEZ) of over 2 million sq km, is blessed with enormous diversity of species. Monitoring of the harvest of the diverse marine fishery resources of the country is being carried out regularly by CMFRI since its inception through a scientific data collection and estimation system from all along the Indian coast for deriving management measures to keep the harvest of the resources at sustainable levels.

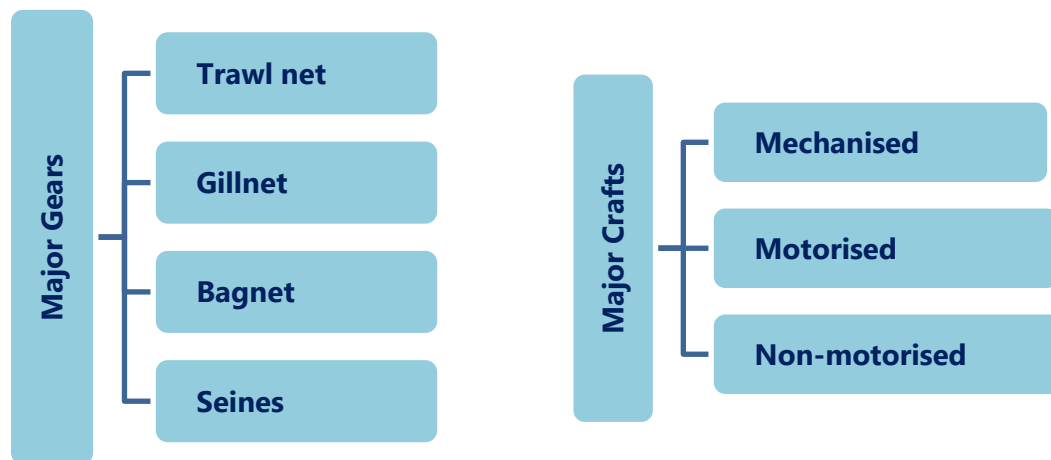
Marine fish landings in India are estimated from the sampling of commercial landings. Statistics on marine fish production are

Indian Marine Fisheries	
Length of coastline (km)	8129
Exclusive Economic Zone (Million square km)	2.02
Continental Shelf (million sq km)	0.53

available from 1950 onwards when the Institute started nationwide sample survey for estimating the marine fish landings in the country. Keeping in pace with the changing marine fisheries scenario, the sampling procedure has been modified over the periods.

The marine fisheries of India is characterized by open access, multispecies and multigear fishery. The resources are exploited using a variety of gears in using mechanised motorised and non-motorised crafts. Fish landings takes place at numerous locations all along the coastline in all seasons during day and night. Sampling and estimation are performed for

geographical area referred as fishing zone. There are 75 fishing zones covering 9 maritime states and two coastal Union territories. All the landing centres are covered under the

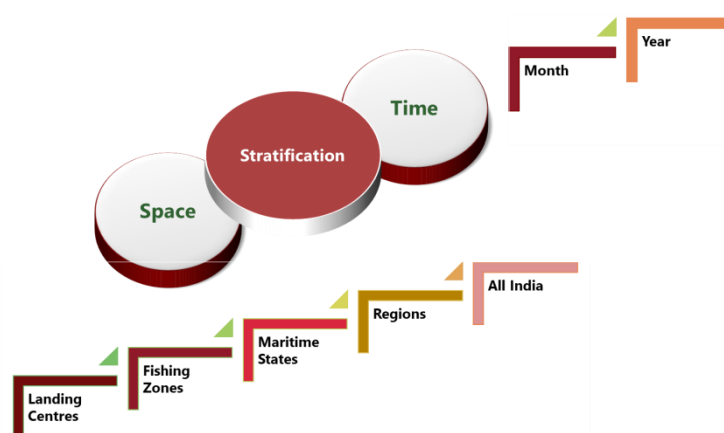


sample design and data collection is by qualified and trained field staff stationed at different locations across all maritime states. The overall operation is coordinated by the Fishery Resources Assessment Division of CMFRI.

The sampling design adopted by the CMFRI to estimate resource-wise/region-wise landings is based on stratified multi-stage random sampling technique. In this, the stratification is over space and time. Over space, each maritime state is divided into suitable, non-overlapping fishing zones. These fishing zones consist of different fish landing centres and the quantity of fish landed in each of the places varies. The landing centres in a zone are again grouped into different strata on the basis of fishing intensity, type of fishing craft and fishing method employed, number of fishing crafts operated and other geographical considerations. The number of landing centres may vary from zone to zone. There are some major fisheries harbours/centres which are classified as single centre zones for which there is an exclusive and extensive coverage.

The stratification over time is a calendar month. For observation, 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, and the



next 5 consecutive days are automatically selected. From this three clusters of two consecutive days are formed. One zone and a calendar month is a space-time stratum and primary stage sampling units are landing centre days.

If in a zone, there are 10 landing centres, there will be $10 \times 30 = 300$ landing centre days in that zone for that month (of 30 days). For example, for a given zone, in a given month, from

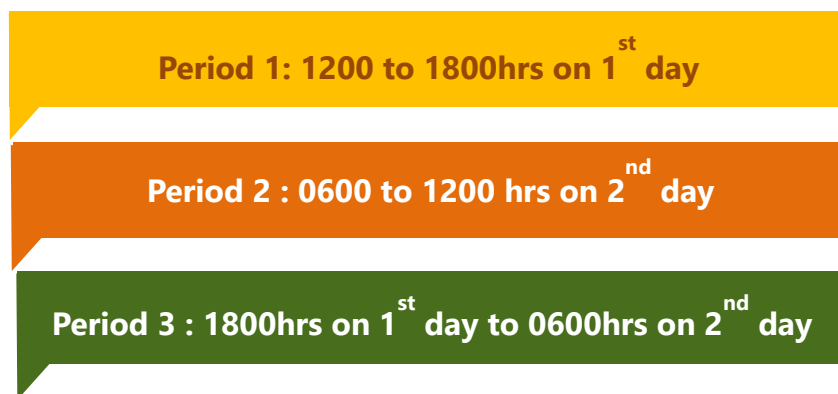
the five days if the date (day) selected at random is 4, then these clusters are formed, namely, (4, 5); (6, 7) and (8, 9) in the first ten day group. In the remaining ten day

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

groups, the clusters are systematically selected with an interval of 10 days. For example, in

the above case, the cluster of observation days in the remaining groups are (14, 15), (16, 17), (18, 19) (24, 25), (26, 27) and (28, 29).

Normally, in a month there will be 9 clusters of



two days each. From among the total number of landing centers in the given zone, 9 centres are selected with replacement and allotted to the 9 cluster days. Thus in a month 9 landing centre days are observed in a zone. The observation is made from 1200 hrs to 1800 hrs on the first day and from 0600 hrs to 1200 hrs on the second day, in a centre. For the intervening period of these two days, the information on landings from 1800 hrs of the first day of observation to 0600 hrs of the 2nd day of observation of a landing centre-day,-night landings- are collected by enquiry. The 'night landing' obtained by enquiry on the second day covering the period of 1800 hrs of the first day to 0600 hrs of the next day are added to the day landings so as to arrive at the landings for 24 hour period (landing centre day).

Selection of fishing crafts and recording of landings

The second stage units are fishing crafts landed on a selected landing centre. When the total number of boats landed is 15 or less, the landings from all the boats are enumerated for species-wise catch and other particulars. It may not be practicable to record the species-wise catches of all boats landed during an observation period, if the number of boats/craft landed is large. A sampling of the boats/craft becomes essential. When the total number of boats exceeds 15, the following procedure is followed to sample the number of boats.

The data collection official should reach the landing centre before the commencement of the observation time and have to make local enquiry on the number of units gone for fishing and the number of units expected to land during his observation period. This information is required for determining the number of units to be selected for observation. Depending on the fraction of selection, choose a number from the random number table. Check all the other numbers

systematically at intervals appropriate to the fraction. As soon as the fishing unit for corresponding to the checked number lands, the field staff should examine and record all

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

information. From the boats, the catches are normally removed in baskets of standard volume. The weight of fish contained in these baskets being known, the weight of different species of fish in each boat under observation is obtained. Names of species of all commercially important fishes and shell fishes should be recorded along with the quantity landed.

The species wise landings for each craft-gear combinations are estimated from the observed boats during each period of observation. The monthly estimates for each zone are obtained by pooling these information for different landing centre days in different strata. Estimates

of district-wise, state-wise, region-wise and all India landings are also computed from these estimates. The estimates of sampling errors at each level are also worked out. The different schedules used for data collection along with detailed procedure on estimation of landings and their standard error are given in Srinath *et al.* (2005) (available online at <http://eprints.cmfri.org.in/4053/>).

Execution of the survey

The data collection is usually carried out by the staff of CMFRI and immediately after recruitment each person undergoes training on identification of species and data collection methodology. Work programme schedules for data collection indicating the landing centre to be visited, date and period of observation are send every month from HQ to field staff. The programme is carefully designed at the headquarters by the staff of Fishery Resources Assessment Division. From 2017 onwards data collection is carried out using electronic tablets and centralized processing and retrieval of marine fish landings data at headquarters through the database server. Each survey staff is provided with an electronic tablet and is provided with login id/username. They can login and download the work program for the month. Using the web application software for online data entry, they can directly record the information from landings centers and can transmit the information to the server. The estimation of landings will be carried out at headquarters.