Concluding Remarks and Recommendations

The primary objective of this study was to critically evaluate the existing CMFRI sampling design and to suggest modifications to improve it. Rather than providing an estimator, we mainly concentrated on the scientific background of the methodology and reliability of the estimator. The study was mainly based on data collected through the regular surveys and periodic census by CMFRI. Due emphasis is given to utilize the schemes suitable to marine fishery sector from the available schemes of multi-stage sampling and estimation techniques.

The detailed study based on the available data revealed that

(i) The fishery data is highly unstable over time and hence does not yield to any scientific procedure of predictions even over short periods.

(ii) The total variability in the estimate of fish landings data in a zone is the joint effect of several components such as landing centre, landing day, fishing boat type and several other random factors.

(iii) The major share of the total variation is often due to the fishing boat type and several other random factors known as residual, which were not explicitly taken into account so far.

(iv) The sampling fraction attained is very low in all the zones.
The distinguishing feature of our study is that we could identify the major sources of variation in the highly unstable fishery data and propose new methods of estimation which accounts for these variations. A method for estimating the optimum sample size is also developed.

Based on the findings of the study, three new sampling designs are proposed – one intended for single centre zones and other two for multi-centre zones. The proposed first new design - two stage post-stratified design is more or less similar to the existing design, with an additional facility to account for the variation due to fishing unit types. This design though assumes post-stratification of the data based on gear types, stratification based on any other more suitable observable characteristics also can be considered equally well. The proposed second new design - three stage post-stratified design, though more scientific, may involve very high operational cost as every selected centre in a stratum must be observed for the same fixed number of days in a month. The significant feature of this design is that it ensures relatively higher sampling fraction in addition to accounting for variation due to all relevant sources. Subsequently, a third new design, which is operationally very simple and may cause a slight reduction in the sampling fraction by utilizing past information is proposed. Depending on the need and convenience, either the second or the third design can be chosen for multi-centre zones. The method developed for estimating the optimum sample size can be utilized for planning and administration of the survey. Though the optimum sample size are derived for the third design, given an appropriate cost
function, they can be estimated in the case of other designs also in a similar manner.

On the basis of the findings of the study the following recommendations are made.

(i) Whatever is the sampling scheme adopted, the sampling fraction must be increased to the optimum level.

(ii) In the case of multi-centre zones, it is recommended to use the three stage post-stratified design. However, if structural simplicity and reduction of cost are of prime concern then the two stage PPS design may be adopted.

(iii) For all single centre zones the new two stage post-stratified design may be adopted.

(iv) There has to be a compulsory recording system at all landing centres for all fishing trips whenever they go for fishing. The record may contain details on the category of the fishing unit, capacity, manpower, total catch, craft details, actual fishing hours, landing time etc. This will provide the actual information on the count and category of the fishing units which form a part of the estimator. This will increase the accuracy of the estimator and also cause reduction in its variance.

(v) In the case of getting actual data on the number of boats operated at each centre, more reliable estimators can be developed even when the sampling fraction is very small.

(vi) The present practice of splitting an observation day into three periods may be discontinued. Instead the observation day may be considered as a single unit. The count of fishing units may be recorded continuously during the day of observation, while recording the landings is to be restricted to the forenoon and afternoon sessions only.
(vii) The selection of fishing units for recording landings may be made at intervals of 15 to 20 minutes during the time of field visit with priority for distinct gear types if available. In the case of no new gear types available, priority is to be given to get at least two or three boats of the same gear. The night landings are to be considered only for recording count by enquiry in the forenoon of the following day of visit. Treating the 24 hour duration of a day into a single unit will give more freedom to the filed staff to ensure adequate representation to each distinct gear type operated on the day. The forenoon session of the following day can be mainly targeted to select new gear types as well as to give adequate representation to the already noted gear types.
Details of the Papers Presented and Conference/Workshop Attended

As part of this study, we have made the following presentations at national/international seminars.

