GUIDELINES FOR THE COLLECTION OF FISHERY DATA FOR ARTISANAL FISHERIES

by

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1. INTRODUCTION

While the statistical monitoring of fisheries is one of the essential elements for effective fishery policy and management, it is also recognized that data collection methods and data management approaches ought to be cost-effective, realistic and within the manpower, financial and operational capacity of the fishery administration. This means that the methodological and statistical merits of a data collection approach constitute only part of the criteria to be used for its implementation, while equal emphasis should be placed on operational robustness, flexibility in handling changes in the industry, and replacement, to the maximum extent possible, of routine manual operations by automated procedures.

There is a clear distinction between data collection methods for industrial and artisanal fisheries. In the industrial sector, data on catches and landings as well as detailed information on fishing operations, are usually compiled by the operators themselves, through a system of logbooks and/or landings declaration documents, or are recorded by national employees/observers on board fishing vessels when an observer program is in place. Thus, in general, data on industrial fisheries are collected by means of complete enumeration techniques using the fishing vessel as the primary statistical unit. Compilation and submission of such data is often regularized by making the data availability and/or its submission a conditional element in the licensing process.

In the case of artisanal fisheries complete enumeration of landings and fishing effort is not operationally achievable. This results from the fact that, in general, landings are not concentrated on main ports but are dispersed along the coastline, thus requiring a great number of highly mobile data collectors for a complete statistical coverage of all landings and on a daily basis. In theory, such a census approach should result in very accurate results, but its implications in human resources and logistical costs would defeat its utility and purpose, especially if estimates of measured and accepted accuracy, can be obtained by means of alternative and far cheaper sample-based data collection schemes.

This note provides an overview of the basic methodological and operational concepts of the statistical monitoring of artisanal fisheries, with specific reference to shore-based sampling surveys. It describes common characteristics of data collection methods, discusses standard procedures for the derivation of estimates from sample magnitudes, and briefly outlines commonly used approaches for the storage/processing of collected basic data.

2. DATA COLLECTION METHODS FOR ARTISANAL FISHERIES

Major aspects: The space and time context. The boat/gear context. Basic catch/effort relationship. Estimation of total catch through three sampling surveys and a census. Combining the information obtained from the surveys.

The space and time context

In most cases, monitoring of artisanal fisheries has as its target the derivation of estimates of total landings, species composition, and fishing effort by boat and gear type, during the period of a calendar month. Since total statistical coverage in space and time is not achievable, data collection is limited to a representative number of landing sites and takes place on pre-selected sampling days. Due to the usually wide variation in fishing patterns, fishing grounds, type of fishing craft and fishing methods, and other factors affecting catch rates and species composition, sampling and estimating approaches, are performed within the context of a limited geographical area, commonly referred to as "minor stratum". The definition of minor strata allows for more homogeneity in the target population of landings and fishing activities, since it is based on methodological and operational criteria and is independent of other types of geographical partitioning that may be in place for administrative purposes. Thus, in general, the time frame of a sample-based system is a calendar month, and the lowest geographical level at which estimates are computed is the minor stratum.

The boat/gear context

It is generally accepted that different types of fishing craft, fishing gear and fishing method result in different catch rates and species composition. As a result of that, basic approaches in sampling and estimating are each applied within the context of a specific boat/gear type, or of a group of boats/gear for which it has been verified that no statistically significant differences should be expected.

The basic catch/effort relationship

The underlying principle in estimating total catch for a specific boat/gear type, is that the actual total catch can be expressed as the Catch Per Unit of Effort (CPUE) multiplied by the actual total effort exerted by this boat/gear. It is thus assumed that if reliable estimates for the CPUE and the total effort are available, the same relationship can be used for estimating total catch by each boat/gear type. The question then arises as to what types of sampling schemes should apply in order for the CPUE and fishing effort to be estimated in a statistically reliable and, at the same time, cost-effective manner.

Estimation of total catch requires three sampling surveys and a census

For the estimation of CPUE from samples, one sampling survey is required, by means of which a limited number of landings will be recorded by the data collectors during pre-selected sampling days and used for:

a) formulation of species proportions with respect to the total catch; and

b) formulation of a sample overall CPUE by dividing the total catch by the associated fishing effort.

This approach, also referred to as "landings or CPUE survey" involves sampling in space (a limited number of landing sites will be visited), and sampling in time (landing sites will be visited on pre-selected sampling days).

As regards the estimation of total effort, this constitutes a more complex task requiring the parallel implementation of two sampling surveys and the availability of accurate data on the total number of boats and gear operating in the areas covered by the statistical system. The first sampling survey for effort aims at establishing average boat and gear activity ratios for each boat/gear type, that is finding the proportion of fishing units that have been fishing during a sampling day. This approach is referred to as "boat/gear activity survey" and involves sampling in space and time, in a manner similar to that for the CPUE.

The second sample survey is used for the compilation of days related to the average number of days that fishing units of a specific boat/gear type would be active during the month. Active days may vary for different boat/gear types and for different minor strata. This information is usually based on empirical data supplied by the data collectors.

The third survey, commonly referred to as "frame survey", is usually conducted every year in order to set-up total numbers of boats and gear that are operational in the geographical area covered by the statistical program. Frame surveys are based on a census approach, by visiting all landing sites and recording the total number of operational boats and gear for each boat and gear type.

Combining the information obtained from the surveys

The two sample-based surveys for effort (boat/gear activity and active days surveys), combined with data from the frame survey, provide the necessary parameters for estimating total effort by each boat/gear type. By multiplying the boat/gear activity ratio by the total number of boats/gear, the indication of the total number of fishing units that are expected to be fishing on any given day can be obtained. This indicator is then multiplied by the number of active days in order to determine the total fishing effort during the month. The estimated total catch is then expressed as the product of the estimated total effort and the overall CPUE formulated by means of the sample-based survey for CPUEs. Species composition is subsequently derived by using the estimated total catch and the sample species proportions established by the CPUE survey.

Experience has shown that sample CPUEs are rather robust magnitudes if formulated by means of few but well-selected representative landing sites, and that most of the difficulties and problems in sampling surveys for artisanal fisheries are associated with the estimation of total fishing effort. Furthermore, it has also been observed that sample CPUEs require the availability of few but well-trained and experienced staff, especially in what concerns species identification, quick and effective assessment of the weight of landings, and unambiguous indication of the fishing effort exerted by each boat/gear type involved in the sampling exercise. On the other hand, due to higher variation, samples on boat/gear activity would require the involvement of more numerous and even less qualified staff, in order to cover as many landing sites and as many sampling days, as possible.

3. STATISTICAL MONITORING OF ARTISANAL FISHERIES

Major aspects: Government expenditure. Design phase. Implementation of a prototype system. Evaluation/revision. Progressive expansion of a survey programme. Decentralization of office operations. Basic infrastructure.

Government expenditure

Any agency would require some government expenditure for its administration and to carry out the relevant research and information-gathering functions. Thus, for example, if it is appropriate for overall fishery administration expenditures not to exceed a certain proportion of the annual value for a fully developed fishery, then the expenditure of one function, data collection for example, should be a fraction of this figure. No attempt will be made here to generalize on the appropriate level of expenditure for a fishery statistical programme but, in view of the rather general situation of shortages in staff and financial resources, it would seem that the current policy of national fishery administrations is to seek cost-effective data collection approaches that would fit into their staff and financial capacity and which do not require major upgrades of the existing infrastructure. Recognizing, however, that the results would be as accurate as the effort expended to develop and maintain a national fishery statistical programme. Thus, the first thing to do is to identify on one hand, the types of data needed as well as the priorities and procedures for the collection of the spectrum of characteristics required, and on the other hand, determine the budget and manpower available for the design and implementation of the data collection system.

Design phase

Frame Survey

A complete census of the main units (landing sites, boats, gear, fishermen, access routes), is essential for establishing the operational and methodological framework of a sample-based data collection scheme. The result of a frame survey is a set of tables indicating:

a) Existing landing sites;

b) Number of fishing units and information on their components, such as fishermen, and number and type of fishing craft and gear;

c) Fishing and landing patterns; and

d) Access routes to landing sites.

For the collection of the above information, the most common approach is by road or water, and if possible supplemented by low-cost remote sensing techniques (such as aerial surveys). The pattern of rotation of a frame survey, i.e. how often the survey should be conducted, is a function of temporal changes in the size, distribution, and operational patterns of the target fishing population. For artisanal fisheries, it is usually necessary to carry out a frame survey once every one or two years. From the staff requirement viewpoint, frame surveys may mobilize part-time data recorders who need not be regular fishery staff.

Experience has shown that data from frame surveys are, at times, one of the weakest elements in a sampling program, since they are used as extrapolating factors in order to derive general conclusions about the total fishing effort (and at much larger scale) from a rather limited number of sample-based fishing effort parameters. This problem stems from the following two main factors:

a) Even when the frame survey data are fully updated and accurate, sampling fishing effort from a limited number of landing sites may not be representative of the overall fishing patterns (such as frequency and duration of trips, number of gear used during fishing, etc.), thus introducing positive or negative bias in the estimation process for total fishing effort;

b) Frame survey data are "static", that is they are only a snapshot of the operating fishing units during a limited period of time. This situation is assumed to remain more or less constant while the sampling surveys for effort are conducted, and this assumption may lead to inaccurate results if significant changes have occurred to the number and location of the artisanal fishing units. However, under certain conditions related to the scheduling of sample-based effort surveys, the validity of frame survey data depends on the relative rather than actual numbers of fishing units which means that they are still adequate if increases or decreases to the number of fishing craft and gear have occurred in a more or less proportional fashion.

Survey standards and classifications

The results of the frame survey, supplemented by species identification guidelines and a species list, should be organized into a set of tables containing the following information:

a) A table of major strata for reporting purposes;

b) For each major stratum a table of associated minor strata. All sampling schemes and estimation procedures will each apply within the context of a minor stratum;

c) For each minor stratum a table of landing sites that may be used as primary sampling points, including also the number of fishing craft and gear by boat/gear type;

d) A table of species that will be used for species composition during the CPUE sampling survey;

e) A table of all boat and gear types; and

f) For each minor stratum a table indicating all boat/gear types in the stratum and preliminary estimates as to the expected active days. This table will be due to changes at the end of each survey month in order to include information not known in advance (such as periods of no fishing because of bad weather).

Tables (a) and (f) constitute the statistical standards that are assumed to remain in force during the reference period of a survey (usually a calendar month).

The design of a survey programme takes into consideration methodological, operational and logistical aspects. From the methodological viewpoint, a data collection scheme utilizes the standard approach of conducting three parallel sample-based surveys (CPUE survey, boat/gear activity survey, active days survey), supplemented with a census (frame survey). The computational procedures for formulating sample magnitudes and calculating total estimates should be independent of the specific sampling scenarios used during the survey operations. They also incorporate a full set of statistical indicators related to sample sizes, variation in space and time and confidence limits for all produced estimates, so as to facilitate the identification of problem areas and provide guidance for revisions and improvement.

Survey operations are scheduled by determining the primary sampling units (landing sites) as the target locations to be visited by the data recorders for data on CPUEs and boat/gear activities. The sampling days during which data collection will be carried out, are also pre-selected. This process should take into consideration the number of recorders available as well as the space and time constraints for their movements (such as distances, accessibility, and time and duration of visits). Logistical aspects involve arrangements for the transport of data collectors and supervisors, equipment to be used in the field by the recorders, cash for fuel, meals and lodging, and in general, planning and supporting of the field operations.

Implementation of a prototype system

Experience has shown that during the survey design phase some types of methodological, operational and logistical shortcomings cannot be fully anticipated and they become evident only after a survey programme has entered into its operation. Given the usually large-scale space and time framework of a fully operational statistical system, the number of staff involved, the substantial investment in training and equipment, and the regular operational and logistical costs, it is considered a good practice to first field-test a survey within a limited geographical area, comprising perhaps of one or two minor strata, and for a test period for one to two months. This prototype system will allow early revision of the system components presenting problems and help the staff involved to acquire the necessary experience in the field and office operations.

Evaluation/revision

The results of the prototype system must be critically analyzed and evaluated. Likely problem areas that may arise are:

a) Frame survey: Lack of guidelines for boat/gear identification. Poorly designed data collection forms. Insufficient number of recorders. Insufficient training of staff. Inadequate approach in interviewing fishermen. Inappropriate period for conducting the census.

b) CPUE survey: Lack of guidelines for species and boat/gear identification. Poorly designed landings forms. Insufficient training of staff. Inadequate approach in interviewing fishermen. Non-representative landing sites (systematic gaps in the recording of certain boat/gear types). High variation in CPUE due to inappropriate grouping of boats/gear. Wrong timing of visits (most of boats not landed or landed and mostly no longer attended).

c) Boat/gear activity survey: Lack of guidelines for boat/gear identification. Poorly designed boat/gear activity forms. Insufficient training of staff. Gross inconsistencies between expected numbers of boats/gear (from frame survey) and those observed by the data collectors. Non-representative landing sites (systematic gaps in the recording of certain boat/gear types). High variation in boat/gear activities due to inappropriate grouping of boats/gear.

d) Active days survey: No differentiation between different types if boats/gear. Non representative active days. Omission of some key events that have caused no fishing.

e) Computerization: There should be no software problems if the computer procedures are part of a standard application adaptable to most types of sample-based surveys. Problems may be associated with operational aspects, as for instance bottlenecks in the inputting of primary data or insufficient training of computer operators for handling the various functions of the computer system.

Computerization will assist in the quick analysis of sample sizes and variations in space and time. The combination of these indicators may lead to same tactical decisions related to:

a) More sampling in space and less in time (or the reverse);

b) Reduction of sample size (thus saving on costs) if an expected level of accuracy can be obtained with fewer samples (the computer could be used to simulate a less intensive data collection scheme using existing data); and

c) Impact in accuracy by grouping together certain boat/gear types in order to simplify data collection and computation of estimates.

Lessons learned during the prototype phase will greatly assist in the implementation of the survey program on a larger scale That is, when the system will be expanded in a progressive manner to cover other geographical areas.

Progressive expansion of a survey program

Expansion of a prototype survey program is not merely a matter of increasing its geographical and time reference scope. It mainly involves an in-depth study of the population characteristics of the new areas to be statistically monitored and, almost invariably, leads to sampling schemes and data collection scenarios that are not essentially the same as those in force for other areas.

For instance, for certain minor strata, it may be feasible to collect effort data by means of a census in space and sampling in time, an approach that could not be applicable in other strata. Or, it may be essential for certain strata to use different species and boat/gear classifications that have little in common with other sectors of the artisanal fisheries. In general, however, different classification schemes and tactical changes to the data collection approach should not have any impact on the standard methodology used in the estimation process, nor should they affect the general-purpose computer systems used throughout the entire geographical area.

Decentralization of office operations

Experience has shown that computer operations with primary data (inputting, editing, error-checking), as well as estimating the total catch and effort at minor stratum level, are more effective if performed closest to the minor strata where field operations are taking place. Such decentralized office operations require some higher investment in computing units and computer training, but offer the following advantages:

a) Inputting effort is more evenly distributed, thus avoiding bottlenecks in the computer operations;

b) Error-checking and data revisions are performed in a more timely manner and are more effective, since they involve staff with local knowledge and experience in the artisanal fisheries sector under their responsibility;

c) Basic reports on estimated catch and effort are directly available to local users for their own regional needs; and

d) Headquarters need only obtain pre-processed computer files with estimated catch and effort, which can be easily integrated at various aggregation levels, thus speeding up the process of preparing reports and documents at national level.

Basic Infrastructure

The design and implementation of a statistical monitoring system with integrated data collection and computer procedures, requires some extent of re-organization of the human resources available in order to better handle a wide variety of field and office operations. A general scheme of such an infrastructure is given below:

Regional Focal Points (RFPs)

Responsible for data collection and basic computer operations within an administrative region, comprising several major and minor strata, the staff of RFPs consist of data collectors, supervisors, computer operators and a fishery officer whose overall responsibility is this survey component. RFPs use statistical standards and stratification schemes determined by the HQ offices and which are used within the same methodological and operational context throughout the entire survey program.

Primary data are stored locally in computer files. Files with estimates are regularly submitted to the HQ offices for integration with similar data sets produced by the other regions.

Headquarters (HQs)

Usually, the staff of the HQs are also the RFPs responsible for a specific survey component. In addition, the HQ Offices are responsible for:

a) Distributing computer software to RFPs;

b) Setting-up statistical standards and stratification schemes;

c) Organizing training courses and workshops for participants from the various regions;

d) Coordinating the exchange of data between RFPs and HQ;

e) Provide advice and assistance to RFPs in aspects concerning statistical methodology, field operations, and computer techniques;

f) Integrating regional data with catch and effort estimates into the national databases; and

g) Preparing reports and statistical bulletins and performing statistical analyses.

HQ staff consists of data collectors, supervisors, computer operators and a fishery officer whose overall responsibility is the entire survey program.

4. CONCLUSIONS

From the discussion above, the following major points may be taken into consideration in the process of setting-up a statistical monitoring system for artisanal fisheries:

a) For operational and logistical reasons the census approach is in general, not applicable in the statistical monitoring of artisanal fisheries. Well-defined sampling schemes should be used for the estimation of total catch, fishing effort and species composition. The effectiveness and accuracy of a sample-based programme is in reverse proportion to the number of assumptions as regards the homogeneity of the population and the representatives of the samples. Any reduction in the number of such assumptions (i.e. reducing the statistical risk of obtaining inaccurate results), will automatically imply higher operational and logistical costs;

b) Standard statistical methodology, well-planned operational approaches and application of standard computer software are essential components in the design and implementation of sample-based survey programs. A typical approach is the implementation of three sampling surveys and a census (frame survey), and combining the information obtained for the derivation of estimated totals for catch and fishing effort;

c) Need for sufficient budget to cover operational and logistical expenditures in the design and implementation of a prototype system and its progressive expansion at national level;

d) Medium/large-scale survey programs operate more effectively if the field operations, as well as computerization of primary data, are performed in a decentralized fashion, with the HQ office being responsible for coordinating and supporting the entire statistical monitoring system; and

e) Sample-based survey programs should be dynamic and flexible so as to easily adapt to changes in the artisanal fishery without methodological and software implications. The accumulated knowledge resulting from regular field operations should, over time, be interpreted into new and improved stratification and classification schemes, thus also increasing the effectiveness of the sampling and estimation approaches.

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