Food and Agriculture
Organization of the
United Nations

FAO
FISHERIES AND
AQUACULTURE
TECHNICAL
PAPER

613

ISSN 2070-7010

Handbook for fisheries socio-economic sample survey

Principles and practice

Cover photograph:
A family-owned small-scale fishing vessel using passive gears in Egypt (Courtesy Mark Dimech).

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Principles and practice

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Dario Pinello
Consultant – Fisheries Economist
FAO Fisheries and Aquaculture Department
Rome, Italy

Jennifer Gee
Fishery Officer
FAO Fisheries and Aquaculture Department
Rome, Italy

and

Mark Dimech
Technical Officer
FAO Fisheries and Aquaculture Department
Rome, Italy

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2017

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ISBN 978-92-109694-9

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Preparation of this document

Fisheries are first and foremost a human activity that produces income and food and generates employment, all of which takes place within an ecological context. The complexity of fisheries systems, characterized as they are by constant interactions between biology, ecology, economics and sociology, means that the economic performance of the sector depends both on the properties of the fish stocks, and on the market conditions and the efficiency of the harvesting process. However, a lack of dependable socioeconomic data has frustrated efforts to make holistic assessments of the fisheries sector.

Most of the variables collected for socio-economic surveys are far less tangible than, for example, catch or landings data and this naturally increases the complexity of collecting socio-economic data, and places greater emphasis on the need for well-trained data collectors. To address this, the Handbook for fisheries socio-economic sample survey: principles and practice proposes a survey methodology selected from established statistical techniques and presents the entire scheme as it has been applied in several countries where fisheries socio-economic data collection programmes are routinely carried out. This field implementation has been conducted by the Food and Agriculture Organization of the United Nations (FAO) through the FAO Mediterranean Fisheries Management Support Projects (AdriaMed, CopeMed, EastMed and MedSudMed), and further tested, adapted and developed, through the Project "EastMed" (Scientific and Institutional Cooperation to Support Responsible Fisheries in the Eastern Mediterranean). It was prepared partially as a response to a request from the Scientific Advisory Committee (SAC) of the General Fisheries Commission for the Mediterranean (GFM).

The aim of this handbook is to address the limited availability of socio-economic data as well as a general lack of capacity for socio-economic data collection, specifically: survey design, data processing, and the analysis and dissemination of this data. It was prepared partially as a response to a request from the Scientific Advisory Committee (SAC) of the General Fisheries Commission for the Mediterranean (GFM). The handbook has been written for those planning surveys and coordinating and supervising all the phases of the survey data collection process, from the sampling design to the final estimates, including the organization of the fieldwork.

The handbook consists of three sections. In the first it introduces the basic theory and background required for understanding the socio-economic survey methodologies. The second section moves from sampling design; fleet segmentation; questionnaire design; and training data collectors, to data quality checks and treatment for making estimations. The final section covers the steps required to move from data collection into the calculation of statistics. Indicators, and the methodology used for their calculation, are presented and this is followed by an in-depth and practical example of how the data can be presented and utilized for policy-level decisions.

Abstract

Socio-economic data are a key component of the scientific advice required for the evidence-based management of fisheries, yet in many countries these data are limited, usually because of a lack of technical capacity for their collection.

This *Handbook for fisheries socio-economic sample survey – principles and practice* aims to remedy this situation. It provides a practical kit of tested and standardized tools for the collection of the most pertinent data required for a socio-economic assessment of a fishery.

The handbook consists of three parts: an introduction to the theory behind setting up a survey; a comprehensive explanation of the data collection process, including a section on operational steps; and an explanation of how to use indicators to interpret and present the results of a sample survey to stakeholders, and monitor the fishery.

Making use of one of the most straightforward sampling schemes available, the handbook guarantees that, if the methodology is correctly applied, statistically sound and robust fisheries data will be produced. Its simple statistical methodology does not require a great deal of resources, allowing adequate resources to be applied to other crucial elements of establishing a robust data collection process, such as selecting the right people; conducting proper training; and developing the capacity of people so as to ensure good data quality.

This handbook was prepared partially as a response to a request from the Scientific Advisory Committee (SAC) of the General Fisheries Commission for the Mediterranean (GFM). The field implementation of the methodology has been conducted by the Food and Agriculture Organization of the United Nations (FAO) through the FAO Mediterranean Fisheries Management Support Projects (AdriaMed, CopeMed, EastMed and MedSudMed), and further tested, adapted and developed, through the Project "EastMed" (Scientific and Institutional Cooperation to Support Responsible Fisheries in the Eastern Mediterranean).Although the handbook was developed through work in the Mediterranean, the methodology is globally applicable and it provides a valuable opportunity for countries to establish a self-sufficient, routine socio-economic data collection programme that facilitates the improved planning, monitoring and management of fisheries.

Pinello, D., Gee, J. & Dimech, M. 2017.
Handbook for fisheries socio-economic sample survey – principles and practice.
FAO Fisheries and Aquaculture Technical Paper No. 613. Rome, FAO.

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Acknowledgements

This handbook was prepared in support of the training courses and field work on fisheries socio-economic data collection and analysis implemented by the FAO through the Mediterranean Regional Project "EastMed" (Scientific and Institutional Cooperation to Support Responsible Fisheries in the Eastern Mediterranean) as funded by the European Commission (EC), Italy, Greece and FAO regular programme funds. Michele De Meo made an important contribution to the statistical components of this handbook and Marcelo Vasconcellos, of the Marine and Inland Fisheries Branch (FIAF) of FAO, provided overall support and feedback. Many thanks to Susana Siar, Fishery Industry Officer, FAO, for providing valuable comments.

Acronyms

AIS	Automatic Identification System
CNR	Complete non-response
CU	Capacity utilization
CV	Coefficient of variation
EAF	Ecosystem approach to fisheries
EC	European Commission
FTE	Full-time equivalent
GCF	Gross cash flow
GFCM	General Fisheries Commission for the Mediterranean
GRT	Gross registered tonnage
GT	Gross tonnage
GVA	Gross value added
HT	Horvitz-Thompson estimator of the total
ILO	International Labour Organization
ISSCFG	International Standard Statistical Classification of Fishing Gear
KW	Kilowatt
LOA	Length overall
MEY	Maximum economic yield
MTI	Medium-term indicator
OECD	Organisation for Economic Co-operation and Development
PIM	Perpetual inventory method
PNR	Partial non-response
PPS	Probabilities proportional to the size
STP	Short-term performance

Executive summary

The limited availability of fisheries socio-economic data often reflects inadequate technical capacity for planning and implementing socio-economic data collection programmes, including survey design, data processing, and analysis and dissemination of data. Using mainstream statistics and in-the-field experience, this handbook provides a practical kit of tested and standardized tools for conducting sample surveys that allow for the collection of the most pertinent data for a socio-economic assessment of fisheries. Above all, the handbook aims to explain the underlying rationale of each section so that managers can independently adapt and customize as needed; it is not a "plug and play" tool! Further, the use of this handbook contributes towards the harmonization of data collection wherever this methodology is applied.

The handbook has three major sections:

1. "Background and theoretical aspects", which includes an introduction and the theory of setting up a survey.
2. "Practice: the data collection process" which covers sampling design; data collection; quality checks and data treatment; raising sample units to the total population; and a section on operational steps and practical advice.
3. "Transforming inputs into statistics" describes the use of selected indicators to interpret and present the results.

The main focus is on the livelihoods of the people directly involved in the activities (fishers and vessel owners); employment; the general profitability of the activity; and demographic patterns. We think that remuneration[1] is among the most important indicators to estimate; it is also the most challenging to estimate and it constitutes the biggest component of a socio-economic analysis of fisheries. Remuneration is important for two reasons: i) it is often paid to the crew as shares proportional to income and therefore its performance is proportional, in the long term, to overall economic performance; and ii) earnings and employment provide a measure of the contribution to the livelihood of fishers. A socio-economic survey that provides estimates of remuneration that are close to reality is a successful survey.

The information obtained will help you plan and manage the fisheries to achieve different objectives:

- Improve (or at least maintain) earnings of fishers.
- Restore the biomass of commercially important species to optimal levels of productivity.
- Promote the reliable supply of fish products to the population at accessible prices.
- Contribute to increased employment opportunities in the secondary fisheries sector.
- Promote equity in the distribution of employment and income between the fleet segments and areas of the country.
- Promote an improvement of the economic efficiency of the fisheries sector.

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[1] In this handbook we use remuneration and earnings interchangeably. Earnings are defined as "the remuneration in cash and in kind paid to employees, as a rule and at regular intervals, for time worked or work done …" from the definition of the International Labour Organization (ILO) available at www.ilo.org/global/statistics-and-databases/statistics-overview-and-topics/income/current-guidelines/lang--en/index.htm

A sampling scheme of *stratified random sampling without replacement* on the defined target population of a commercial fishing fleet is followed in this handbook. Conceptually, this sampling scheme is one of the most straightforward of the probability sampling techniques that do not require advanced statistical programmes. At the same time, if correctly applied, it guarantees statistically sound and robust fisheries data. The handbook identifies principles for the design, collection, processing and analysis of a sample survey (taking into account the quality of the estimates, the constraints and the cost issues).

The stratification should guarantee, as far as possible, that the vessels are homogeneous in terms of productive characteristics and socio-economic structure. The criterion for delineating the strata as homogeneously as possible is based on the following three characteristics: geographical, technical and dimensional. The basic required condition is *randomness* for the selection of the sample. This must be carried out by a computerized routine (humans generally do poorly at generating random values!).

We like to say these types of surveys are *data-collector based*. Therefore, the work of the data collector is crucial and the quality of the data is largely reliant on the work done by the people in the field. Socio-economic surveys present diverse challenges for catch and effort surveys where the variables are more quantitative and physically apparent. Further, the data may not be recorded in receipts, accounting sheets, or other formats. It is up to the data collector to extract this information from the respondent and, as is the case for any such data collection programme, a good rapport and understanding of operations by the data collector is crucial to obtaining good survey results.

The questionnaire is divided into 12 parts that contain the variable groups and the variables are listed in a rational sequence – it is not a mere listing of variables and the variables and definitions should not be considered in isolation. The questions should be delivered in the sequence presented because the explanations and responses build on the previous items. The order of the questions allows the interview to begin with the less sensitive questions, and to build on the complexity of responses.

The parts of the questionnaire are as follows:

- Ownership
- Fixed costs
- Effort
- Investments
- Employment
- Debts and subsidies
- Commercial (destination of the first sale)
- Income
- Variable costs
- Demographic.

The data from the questionnaire provide estimates (because it is a survey rather than a census) and therefore, before making estimates from the sample to the total population, it is critical to conduct the quality check and necessary data treatments. The accuracy of a survey estimate refers to the closeness of the estimate to the true population value; the difference between the two is referred to as the error of the survey estimate. This value – the error – is a fundamental component of the steps that follow when making estimations. In general, in a sample survey, the two types of errors can be distinguished as *sampling* and *non-sampling errors*.

After examining sampling and non-sampling errors, the handbook explains the data editing process in which data are checked, altered or corrected to ensure they are as error-free as possible. The most common non-sampling errors result from data entry, data processing and interviewer errors. Following the completion of the prior sequences (up to the cross-checking and validation of the raw data) the next step in the handbook is to raise the sample data up to the total active population through statistical inference, which is further detailed.

In chapter seven, operational steps and practical advice for working in spreadsheets are provided. The handbook provides a method for operationally organizing the work so that the survey may be conducted in sequential worksheets. Excel is used for examples, but the actual implementation can be customized and conducted in a programme of your choosing, one that best accommodates the way in which you work. The process presented follows a logical progression from entering the fleet, selecting the sample, separating out non-responses, processing the data, producing final estimates, and lastly the indicators. Within each of the steps details are explained, when germane, with references made to the relevant chapters.

In the final chapter of the handbook the process of transforming inputs into statistics is explained. Interpreting the results allows you to create quantitative stories based on data by using indicators. The indicators are provided with definitions and calculations. However, the list is not exhaustive and can be modified to best meet the data and policy needs of the country.

The section on indicators is followed by an example of a hypothetical country. The example demonstrates, in a practical way, how to analyse and interpret results and use them to provide advice to the sector and policy makers.

This handbook proposes simple rules that, when literally applied, produce results that are much more robust than the partial application of complicated methods. This straightforward methodology does not require a great deal of resources and so the remaining resources can be applied for more crucial elements of establishing a robust data collection process, such as:

- selecting the right people
- conducting proper training
- developing the capacity of people so as to ensure correct data quality checks.

In conclusion, the handbook can provide a foundation for countries to establish their own self-sufficient and routine data collection programme that allows for policy development and insights.

Part 1
BACKGROUND AND THEORETICAL ASPECTS

1. Introduction

“Fisheries management controls human behaviours, not fishes’ behaviours”

From ancient times, fishing has been a major source of food for humanity and a provider of employment and economic benefits to those engaged in this activity (FAO, 1996).

Fishing is, first and foremost, a human activity that produces food and generates income and employment. It is a complex system that operates in an ecological context where constant interactions between biology, ecology, economics and sociology take place. The economic performance of the sector depends both on the characteristics of the fish stocks as well as the market conditions and the efficiency of the harvesting process.

Many of the world’s fisheries are challenged by a combination of overcapacity, overharvesting, habitat damage and low economic returns. The description “too many boats chasing too few fish” surely fits most aquatic fisheries today (Grafton *et al*., 2006). Why haven’t fishery managers foreseen this? Part of the reason is that it is not easy to ascertain from the data what is happening to fish stocks at a given time. However, another major driving force can be identified, namely *the failure of fishery managers to understand the economically motivated behaviour of fishers…*” (Grafton *et al*., 2006).

The first data to be collected in a fisheries monitoring programme are often catch or landings data and this is a logical starting point. The fish landed are tangible, discrete entities that can (with a great deal of effort) even be counted one-by-one. On the contrary, most of the variables collected in economic surveys are less tangible and this naturally increases the difficulty of collecting these data. Analyses of the fisheries sector have typically focused on the biological component of the system and this has meant that economic data collection is often an afterthought. As a result, analysts are frequently obliged to make the best use of existing data, or of periodic, ad hoc data collection efforts, rather than relying on an on-going, systematic collection of information well suited to the needs of socio-economic analysis (Grafton *et al*., 2006).

Moving beyond ad hoc data collection, a wide range of sampling schemes may be followed and data may be analysed by unlimited socio-economic perspectives or econometric techniques. Therefore, in keeping with its practical nature, this handbook will not add any new techniques or models to the vast literature (for example, FAO 2013, 2014 and 2016), it will simply propose a survey methodology selected from what is already available and will present the entire scheme as it has been applied in several countries where fisheries economic data collection programmes are routinely carried out.

WHY THIS HANDBOOK?

The limited availability of fisheries socio-economic data often reflects a lack of technical capacity for planning and implementing socio-economic data collection programmes, including survey design, data processing, and analysis and dissemination of data. Using mainstream statistics, the handbook provides a practical kit of tested and standardized tools for conducting sample surveys that allow for the collection of the most pertinent data for a socio-economic assessment of fisheries.

The handbook makes use of experience gained in the field and gathered from a selection of countries where the kit has been successfully used. Further, the use of this handbook allows for the harmonization of data collection, wherever this methodology is applied.

The handbook presents a standardized methodology, but above all it aims to explain the underlying rationale behind each section so that managers can then independently adapt and customize as needed; it is not a plug and play tool!

WHO SHOULD READ THIS HANDBOOK AND WHAT DOES IT ACHIEVE?

The handbook is intended for those involved in the planning of surveys, the coordination or supervision of all of the phases of the survey data collection process – from the sampling design to the final estimates and including the organization of field work. We have assumed that the reader is familiar with fisheries.

The primary target groups are:

- planners and coordinators of sampling surveys
- persons responsible for the data quality and data processing phases
- supervisors of data collectors.

The secondary target groups are:

- data collectors
- fisheries economists
- fisheries managers
- fisheries administrators
- students of fisheries science.

This handbook details how to develop and use the following data collection tools:

- socio-economic sample survey
- segmentation of the fleet
- questionnaire
- training course for data collectors
- data quality checking
- data processing
- indicators for analysis and dissemination.

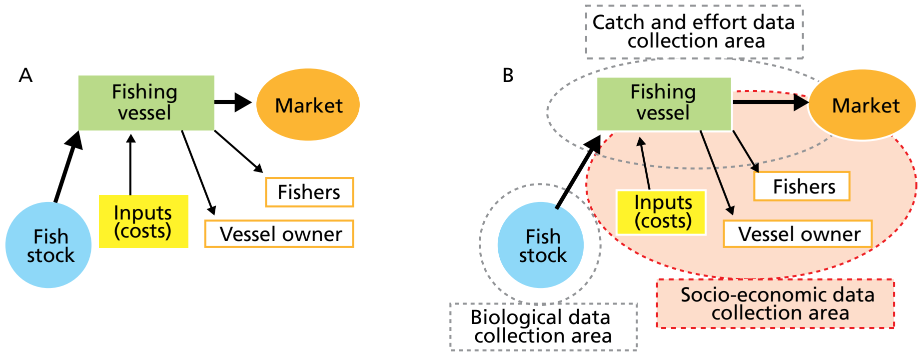
WHY DO WE NEED SOCIO-ECONOMIC DATA?

Fisheries are complex systems where different components interact and need to be investigated. The backbone of the system is the fish stock (the natural capital of the system) and the fishing fleet (the human capital of a fishery). A basic description of the fisheries system constitutes a community with fishing fleets that harvest fish from stocks in order to provide fish for the market, earnings to the fishers and net returns to the fleet owners (Figure 1, part A). Fisheries also form part of cultural identity. Biological data collection covers *what happens below the water*, while the catch and effort data collection cover the harvesting of the fish stocks (Figure 1, part B). Socio-economic data collection focuses on the inputs used, the amount of fish harvested, the interaction with the market and the benefits and returns to those engaged in the activities.

The socio-economic data are part of a larger knowledge domain that includes the catch and effort data as well as the biological data (Figure 1, part B). For this reason, if the different components of the domain are obtained through different statistical methods, the data should be consistent and comparable. The ideal option would be to

FIGURE 1

A simplified representation of the boundaries of the biological, catch and effort and socio-economic data collection domains in the fisheries context. Of course, all these domains operate within the context of management, governments and institutions although they, along with the post-harvest sector, are not represented in the figure.



collect all the data using the same sampling scheme. In any case, if different schemes are in place, their outputs have to be coherent[4] so that it is possible to combine them using indicators, or make comparisons over time, or across different segments.

Harmonization of data collection

The three knowledge domains (biological, catch and effort and socio-economic) are all linked, either directly or indirectly. In particular, the catch and effort and socio-economic domains are directly linked through the landings and effort. Therefore, it is meaningful to collect data for both these domains using the same methodology. This allows you to:

- save time and resources in:
    - the data collection phase (the same sample units are used);
    - data quality checking and processing.
- have statistically comparable data from the different domains.

Socio-economic analysis of fisheries is used to support the conservation and management of fisheries industries (e.g. FAO, 2001), aquatic ecosystems and the people who base their livelihood on the exploitation of aquatic resources. Fisheries economists study the economic activities of harvesting and the effects on aquatic resource stocks and environmental assets. The results of an economic analysis should contribute to the design of fisheries policies and management plans that ensure adequate wealth for the fishers, profitability of the activities, and maintenance of stocks at sustainable levels.

Socio-economic data are therefore collected with the aim of assessing:

- economic performance and cost structure
- livelihoods and employment
- profitability
- level of investments, debts and subsidies
- activity levels
- demographics and ownership structures.

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[4] Coherence of two or more statistical outputs is defined as "the degree to which the statistical processes by which they were generated used the same concepts – classifications, definitions, and target populations – and harmonized methods." (Eurostat, 2009).

Moreover, when integrated with other data assessments, socio-economic data:

- inform decision-making in the resolution of conflicts
- assess the contribution of fisheries to food security
- assess the contribution of fisheries to community development
- assess the management costs.

In this respect, socio-economic data are needed as inputs for the participatory management of fisheries. They are key to formulating and implementing management with an understanding of livelihood contributions and for evaluating the fisheries performance to fulfil regional and international requirements. The extent to which objectives are achieved is assessed using variables and indicators which are generated from data.

The variables need operational definitions that are clear and universally accepted, allow for comparison between sectors and countries and "lend themselves to being adapted to different national contexts, analysed at different levels of aggregation and linked to more detailed indicator sets" (OECD, 2002). Finally, indicators allow policy makers and others to assess the performance of the sector without requiring prior knowledge of economics or statistics (*The Economist,* 2010).

Socio-economic indicators are important for monitoring a fishery in relation to policies required to meet objectives. An indicator has been defined as: "a variable, pointer, or index related to a criterion. Its fluctuation reveals variations in key elements of sustainability in the ecosystem, the fishery resource or the sector and social and economic well-being. The position and trend of an indicator in relation to reference points indicate the present state and dynamics of the system. Indicators provide a bridge between objectives and actions" (FAO, 1999).

A large number of indicators of socio-economic performance of fisheries could be identified (Unal and Franquesa, 2010) but in this handbook emphasis is placed on a suite of indicators that adequately describe the most significant and measurable areas of performance without overburdening requirements for data collection.

The ecosystem approach to fisheries management (EAF) and the need for socio-economic data

The traditional approach to "managing" fisheries has been to place the fish before the fisher. The number one priority has been to maintain fish stocks and it was presumed that by controlling fishing effort this goal could be achieved (Grafton *et al.*, 2006).

The growing understanding that exploited fish populations must be considered as integral components of ecosystem function, rather than units that operate independently of their environment, is a fundamental step in the management process (FAO, 2006). Further, in an EAF the social and economic implications of managing fisheries are explicitly included in the analysis of contributions to meeting regional societal values and objectives (FAO, 2011).

There has been some progress in meeting this challenge, both in terms of moving towards an improved understanding of the social, economic and institutional aspects of fishery management (and EAF in particular), and in terms of developing tools and instruments to improve management by taking this understanding into account. In the context of developing EAF management plans, data on the social and economic aspects of the fisheries are generally lacking or are not usually available. The methodology described in this handbook could support the gathering and compilation of such data which would be essential to assessing trends related to the social and economic factors, and provide information on the status of the fishery in relation to the agreed objectives.

SAMPLE SURVEYS VERSUS CENSUS

Sample surveys are used when it is not possible or practical to conduct a census and count every individual of a population. This is often the case when the availability of staff and financial resource are limited.

A *sample* is defined as the portion of a population that has been selected for analysis. Rather than selecting every item in the population, statistical sampling procedures focus on collecting a small representative group of the larger population. The results of the sample survey are then used to estimate characteristics of the entire population.

The main benefit of choosing a sample approach over a census are the following (Levine *et al*., 2008):

- Selecting a sample is less time-consuming than selecting every item in the population.
- Selecting a sample is less costly than selecting every item in the population.
- An analysis of a sample is less cumbersome and more practical than an analysis of the entire population.
- Selecting a sample guarantees better control of the data collection process and the quality of the data.

In fisheries, like in many other sectors, economic data are frequently collected by means of sample surveys.

Reporting of economic information may be particularly sensitive because such information may not be officially reported for taxation or quota purposes. Moreover, fishers are often reluctant to disclose sensitive information that they are not obliged to report. For these reasons, a census approach is normally unfeasible for socio-economic data collection. Using sample surveys allows you to sharply reduce the number of individuals to be interviewed (and the number of requests for sensitive information).

The next section explains the basic principles of survey design for fisheries socio-economic data collection.

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Fisheries management

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Sumaila U.R., Lam, V.W.Y., Le Manach, F., Swartz, W. & Pauly, D. 2013. *Global fisheries subsidies*. Note IP/B/PECH/IC/2013-146, European Parliament, Directorate General for Internal Policies, Policy Department B: Structural and Cohesion Policies–Fisheries. Brussels, European Parliament. 44 pp.

Online Resources

The International Labour Organization: www.ilo.org
The Overseas Development Institute: www.odi.org.uk
The Wage Indicator Foundation: www.wageindicator.org/main/salary/minimum-wage

2. Setting up the survey

SURVEY OBJECTIVES

The primary objective of a socio-economic survey is the understanding of the overall socio-economic aspects of the commercial fisheries under investigation. More specifically, the main focus is on the livelihoods of the people directly involved in the activities (fishers and vessel owners); the employment; the general profitability of the activity; and demographic patterns. Remuneration is one measure of livelihoods and it is among the most important indicators to estimate. It is also the most challenging to estimate: a socio-economic survey that provides estimates of the fishers' earnings that are close to reality is a successful survey. Remuneration is often paid to the crew as shares proportional to economic performance; it is also an indicator of the overall economic performance of the fishery activities.

By understanding the earnings of the fishers, and profits generated for the owners, the remaining economic components of fisheries unfold before you. You must proceed stepwise through all the economic components (costs, inputs, etc.) to reach the calculation of remuneration. In summary, the estimation of remuneration constitutes the largest part of a socio-economic analysis of fisheries.

The information obtained will help you to plan and manage the fisheries to achieve different objectives:

- Improve (or at least maintain) earnings of fishers.
- Restore the biomass of commercially important species to optimal levels of productivity.
- Promote reliable supply of fish products to the population at accessible prices.
- Contribute to increased employment opportunities in the secondary fisheries sector.
- Promote equity in the distribution of employment and income between the fleet segments and areas of the country.
- Promote an improvement of the economic efficiency of the fisheries sector.

Keep it simple:

In the early years of the survey, it is best to focus on the process of conducting the survey, not on the potential tools that can be used. It is best to get your hands dirty by understanding all of the steps of the process. To this end, we suggest using paper questionnaires and working with the data in Excel. In this way, the emphasis is on developing a complete understanding of the methodology, and being flexible enough to make customizations as required. Keeping things simple will eventually allow you move to more advanced survey and data management platforms.

DEFINING THE COMPONENTS OF THE SURVEY SAMPLE

Target population and sample units

When conducting a sample survey, a core component of the process is to define the target population to which the results of the survey are to be generalized.

The population is the full list of units for which the survey will be conducted and about which we wish to describe or draw conclusions. As the selection of the sample is directly based on this list, the target population is one of the most important tools in the design of this survey. In the case of this handbook it consists of the list of fishing vessels authorized to practice **commercial** fishing and naturally it follows that the **sample unit** is one fishing vessel. Because it is possible to count all the individuals of this population, it is defined as a *finite population*.

From an operative point of view, the vessel is the focal point of the activities, outputs, inputs and even demographic information. It provides the best fixed point for repeated sampling throughout the survey period (starting at the beginning of one calendar year and ending on the last day of the same year) because it is a discreet, identifiable entity and may be used as the sample unit. Although there are cases where the vessel used is not fixed, or a vessel is not used (such as for cast net and shellfish gleaning) it is most important that the fishing unit can be identified and is distinct.

We suggest that the vessels are grouped into homogeneous groups (called strata or segments) by the use of some common characteristic related to the variables under estimation. For example, in our case, the geographical area where fishing is conducted, the dimension of the vessel (large or small) and the fishing gear. The homogeneity within each stratum guarantees less variability so the sampling rate can be reduced (as detailed in Section 4.1) and also provides greater precision in the estimates of underlying population parameters (Levine *et al*., 2008).

Types of sample approaches

After the population is defined (the fleet), the sample (fishing vessel) is drawn from it. There are two kinds of sampling methodologies that can be followed: nonprobability samples and probability samples.

In *nonprobability samples*, the sample units are selected without knowledge of the probability of their selection. Nonprobability samples present some advantages, such as convenience, speed and low cost. However, the lack of accuracy as a result of selection bias and the fact that the results cannot be generalized, more than offset these advantages. In surveys that use nonprobability sampling methods the bias or sampling error cannot be measured, making the results meaningless (Levine *et al*., 2008; Cochrane, 1977; Lohr, 1999). We caution that nonprobability sampling methods are best used for pilot studies that precede more thorough investigations (Levine *et al*., 2008).

In *probability samples*, the sample unit selection is based on known probabilities, which allows you to make mathematically sound, unbiased inferences about the population of interest (Levine *et al*., 2008). Problems arise when the situation is not clearly understood and sample units are taken that are in fact *nonprobabilty* sample units, but are not correctly identified as such. This case occurs when vessels are selected for sampling based on accessibility/convenience (for example, only sampling vessels that arrive in port within certain hours). This selection would not constitute a random sample of the population because the probability of selection would be unknown, thus invalidating the interpretation of the data (Grafton *et al*., 2006). As an aside, the theories that have been developed for probability sampling cannot be applied to nonprobability samples.

Probability sampling includes, for example, simple random sampling; stratified sampling; and probability proportional to size sampling. These sampling methods can be applied individually or in combination.

In any case, they all have two features in common: *i) every* element of the population has a known non-zero probability of being sampled and *ii)* random selection of the sample is applied.

One of the main weaknesses of probability sampling is the impact of non-responses. [Note, that non-responses are anticipated in every survey and response rates between 60 to 90 percent are considered to be very high (Phillips and Stawarski, 2008)]. So, acknowledging that non-responses occur, it is simply essential to ensure that the non-responses are not resulting in any specific subset of the population being excluded. To confirm that this is not the case, non-responses must be further investigated to ensure that they have the same characteristics as the responses. In-the-field experience has demonstrated that two stratified-without-replacement methods are well suited to the characteristics of the fisheries sector:

a. sampling with equal probabilities: all of the elements of the populations are given an equal probability of being sampled;

b. sampling with probabilities proportional to the size (PPS) (Sabatella and Franquesa, 2003): each element has a different probability of being sampled and the probability is proportional to an "auxiliary variable" (e.g. length overall, LOA).

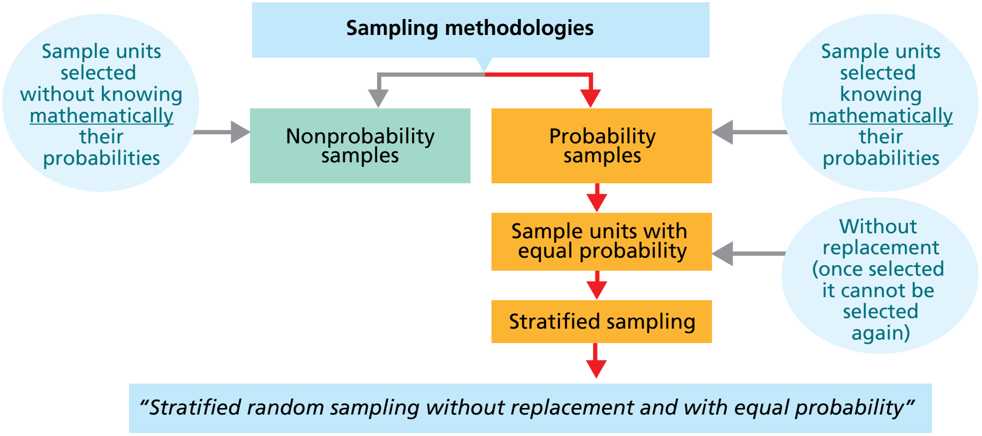
However, a significant issue is posed by PPS sampling related to the auxiliary variables and variables of interest. While LOA may act as a suitable auxiliary variable for fuel consumption, it may not fit with other variables, such as fixed cost. Further, the calculation of the statistical quality indicators (e.g. standard deviation) is complicated to the extent that advanced statistical programmes must be utilized.

Our suggestion is to first group the vessels into homogeneous segments and then select the sample units randomly, ensuring the representativeness of items across the entire population. Sampling without replacement offers the advantage of maintaining the same sample unit for the whole sample period. This is important because some items (e.g. fixed costs) are collected annually and our aim is to follow the selected sample units throughout the survey period.

In conclusion, a sampling scheme of *stratified random sampling without replacement* should be followed. Conceptually, this sampling scheme is one of the most straightforward of the probability sampling techniques that do not require advanced statistical programmes. At the same time, if correctly applied, it guarantees statistically sound and robust fisheries data.

FIGURE 2

Flow chart of suggested sampling methodology leading to stratified random sampling without replacement and with equal probability



In summary: setting up the survey

Population: commercial fishing fleet (see Definition of the target population on page 13)
Sample unit: fishing vessel (see Section 3 Setting up the fleet on page 13)
Sampling approach: *probability sample – stratified random sampling without replacement* (see Types of sample approaches on page 8)
Sample selection: before conducting survey
Time frame: one calendar year (see Section 3 Variables to be collected and time frame on page 12)
Extent: country or region (see Geographical characteristics on page 17)

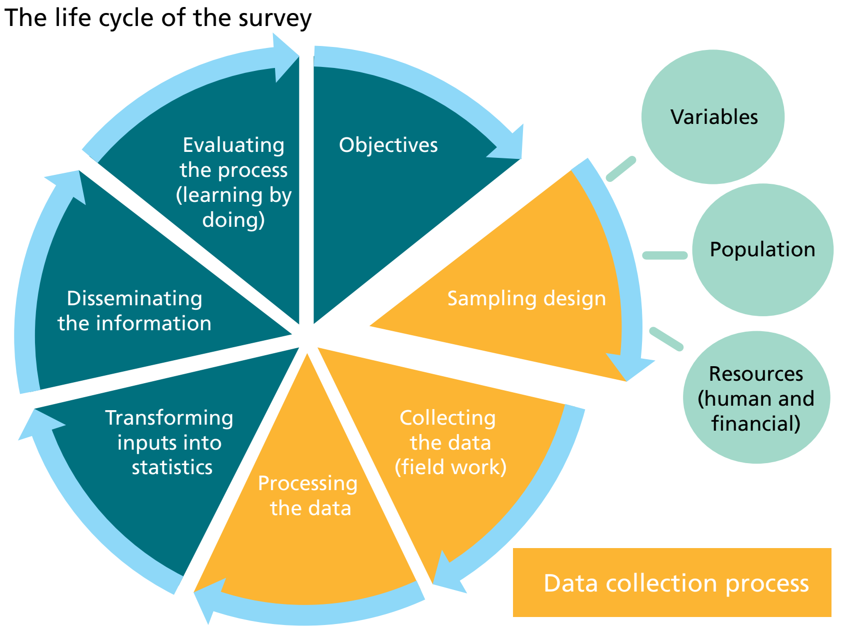
THE LIFE CYCLE OF A SAMPLE SURVEY

For the sake of clarity we present the design and the realization of the sample survey process – from the definition of the objectives to the dissemination of the results – in a structured and simplified scheme that sums up all the main aspects of the process (Figure 3). Moreover, all the steps will be specifically discussed in the following chapters.

The first step presented is determining the objectives. The following step is to set the sampling design. The objectives determine the character of the survey with regard to sampling design. The definition of population and parameters comes first, followed by data collection, but this always takes into account the available resources.

It is important to highlight that this is a learning-by-doing process where the accrued knowledge and experience streamline the process over survey cycles. In the second year the data quality is better (from both the data collectors and the survey managers) and in the third year it is improved yet again.

FIGURE 3
Main steps in the socio-economic survey



Part 2
PRACTICE: DATA COLLECTION PROCESS

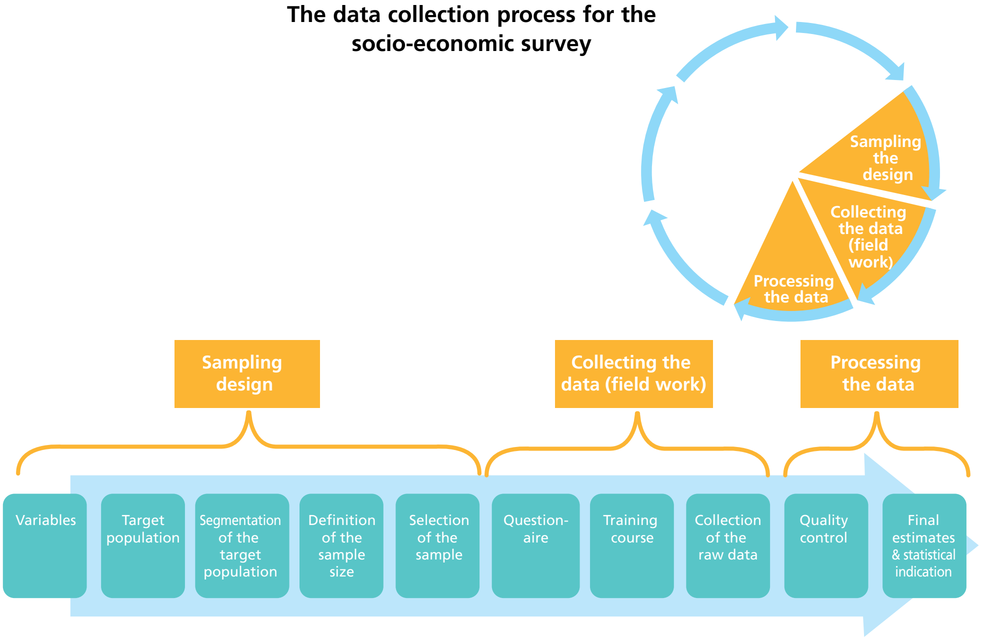
3. Sampling design

The sampling design encompasses all the methodological and organizational aspects of the survey and involves making decisions about how these will be carried out. It is composed of various steps as shown in this section. What is statistically ideal needs to be balanced against what is practical or feasible – especially in developing countries – and needs to take into account the purposes of the survey and the resources available (i.e. human, financial, temporal) and other practical considerations. For example, if resources are limited the stratification should be simple, otherwise the risk is that insufficient resources are available to achieve what has been drawn up in the sampling design.

Issues pertaining to survey design that need to be considered include the following:

- survey objectives and variables to be collected
- population of interest (or target population)
- reference period for the data
- segmentation: geographic and demographic boundaries
- frame and the units
- sample design and sample size
- selecting the sample.

FIGURE 4
The data collection process for the socio-economic survey



VARIABLES TO BE COLLECTED AND TIME FRAME

The primary objectives of the survey are the understanding of the socio-economic aspects of the fisheries under investigation.

The livelihoods of the people directly involved are another primary technical objective because an understanding of the actual earnings of the fishers and the profits generated for the owners is dependent on an understanding of the overall economics of the activities.

The variables that allow for the fulfilment of the objectives are called the “output variables”. These can be grouped in the following categories that will be described later:

- ownership
- effort
- employment
- commercial (destination of the first sale)
- variable costs (energy, personnel, other operational, commercial, repair/ maintenance)
- fixed costs
- investments
- debts and subsidies
- income
- demographics.

Socio-economic data are complementary to a wider data collection scheme where all information pertaining to the harvesting process is collected, including catch, effort and biological data (Figure 1). In Table 1 below, the variable groups are shown in the order they appear in the questionnaire. The table also shows the relevance of the variable to the primary interest of the survey as either “target” or “additional” on the priority scale; the dependency of the variable on the fishing activity; and the collection frequency for each of the variables.

As shown in Table 1, the categories (Effort; Commercial (destination of the first sale); Income and Demographics) are not primary targets of the survey and should indeed be considered as additional or secondary information that may constitute a reference for the cross-checking of the primary information. Normally, effort and income are collected under a catch and effort data collection programme, in a more detailed manner. Regardless of what is collected under the catch and effort survey, it is still recommended that these data are also collected for the socio-economic survey, for two reasons. First, they provide a valuable reference for cross-checking the reported information. For example, in cases where the reported costs exceed income a further investigation is often required to explain the full situation. Further, in the case of anomalously high levels of reported commercial costs, cross-checking with landing volumes may resolve an apparent outlier. Second, the final estimates from these variables also provide supplementary reference points for calibrating the overall data collection programme.

The survey period is one calendar year. Each group of variables requires a different collection schedule, according to their nature. Broadly, variables can be divided into three categories: those that are dependent on the fishing activity; those that are partially dependent; and those that are independent. In other words, when a variable group is “dependent” it means that the more the vessel operates the higher the value of the variables; a typical example is fuel costs. Further, within dependent costs some variables change more often, while others remain consistent for greater periods. This means that there is flexibility in the collection schedule of these variables. For example, the variables related to the commercial destination of the first sale are generally well established, remain stable and can be collected with less frequency than the fuel consumption.

The collection frequency can be set as monthly for the dependent variables and annually for the independent variables, but of course these schedules can be set to best suit the variables or country conditions. The demographic variables and debt and subsidies variables that are scheduled to be collected annually (i.e. once per year) should be collected at the end of the calendar year. In contrast, the ownership variables are only collected once and this should be done during the first interview. For the remaining variables that are scheduled for monthly collection, the interview should be conducted once the interview period is closed (e.g. variable collected for month *i* is collected at month *i+1*).

A note on timing

The survey period is one calendar year. Although variables may be collected at different points throughout the survey period, the raw data should only be processed once, all together, at the end of the survey period because some data are "annual" in nature and the final count of inactive vessels will not be apparent until the survey is complete.

TABLE 1
Group of variables to be collected.

		Priority scale		Dependency on the fishing activity	Collection frequency
Category/group of variables		Target	Additional		
A	Administrative information				
B	Source of the information	X		Independent	Monthly
C	Ownership	X		Independent	Annual
D	Effort		X	Dependent	Monthly
E	Employment	X		Partially	Monthly
F	Commercial (destination of the first sale)		X	Dependent	Monthly
G	Variable costs	X		Dependent	Monthly
H	Fixed costs	X		Partially	Monthly
I	Investments	X		Independent	Annual
J	Debts and subsidies	X		Independent	Annual
K	Income		X	Dependent	Monthly
L	Demographics		X	Independent	Annual

In Table 1, the variable groups are shown in the order they appear in the questionnaire, along with the relevance of the variable to the primary interest of the survey as either "target" or "additional" on the priority scale; the dependency of the variable on the fishing activity; and the collection frequency for each of the variables.

SETTING UP THE FLEET

Definition of the target population

The general definition of the population of interest, or target population, has already been provided in Section 2. Now we will describe it from the operational point of view and provide some examples.

Fleet data requirements

The basic requirement for obtaining the target population is a list of fishing vessels that are licensed to fish. This can usually be obtained from the fleet register, or any other means used to store the list of licensed fishing vessels. In many countries the collection of these data is mandatory for managerial and administrative purposes and is census based. This facilitates the data collection process.

It is important that each vessel on the list is, as far as possible, classified with the specific technical characteristics described in Table 2. Each vessel has to be classified and fitted to a segment – the objective is to place the vessel into the "least-wrong" category; in other words, an exact match may not be possible.

Normally, and for a variety of reasons, the fleet register is updated frequently. Reasons include the buying and selling of boats, fishers not renewing a licence, new licences being issued, etc. The dynamic nature of the vessel list means you must select a single reference point to extract the fleet. It makes sense to use the most up-to-date listing before the start of the survey, which is the last day of the previous year. For example, when the survey is being conducted in Year i, the list of vessels is obtained from the most up-to-date record which is from 31 December of Year *i – 1*. To collect this information at the same point in time every year allows you to have a reference point to compare any changes that may have occurred in the fleet.

Basic information on the population has to be collected on a census basis because the sample survey and its sample size is based on this information. This will depend on the stratification scheme that will be chosen. However, one should at least have the vessel name or registration number, length of the vessel, registration port and contact details of the owner of the vessel (e.g. telephone number).

Table 2 describes in detail the attributes of the population and uses a priority scale to highlight which attributes are mandatory and those that are optional.

The attributes, "vessel registration number"; "LOA"; and "fishing gears" are required to characterize the population while "Year of construction of the vessel (hull)" is essential for estimating the capital costs, as shown in Chapter 6.

All the other attributes are useful for a variety of reasons and allow you to obtain more detailed information and to simplify the data collection activity.

In particular, the "tonnage" (GT or GRT) and "horse power" (hp and/or kW)) constitute part of the technical component for the estimation of the fishing effort, and "main gear" permits a more accurate classification of the vessels when more than one gear is allowed. The "fishing gears" are important for delineating the segments of the fishing fleet and are described further on page 18.

Adding an "internal code" can be useful for confidentiality purposes and for easier data management. The coordinator of the data collection could indeed decide to keep the "vessel name", "vessel registration number" and "ownership information" confidential while using only the internal code, as mentioned in Section 3.

"Ownership information" is primarily useful for understanding the ownership structure (private owner, company owner, number of vessels per owner, etc.), but it is also very valuable for planning activities in the field, when it will be necessary to make contact with the owners. For this reason, if the telephone number and the address of the owner are available it is strongly recommended to include this information in the fleet list.

The purpose of "random number" is related to the selection of the sample units. It is important to set it at the beginning of the survey when setting up the fleet list, and thereafter to consider it as a *technical* characteristic of each individual of the population. The usefulness of the random number and how it is to be generated will be explained in Section 3, with accompanying example.

TABLE 2
Description of the attributes of the population.

Attributes		Priority scale	
		Mandatory	Optional
A	Vessel name		X
B	Vessel registration number	X	
C	Ownership information (name or company name, telephone number, address, etc.)		X
D	Internal code		X
E	Port of registration		X
F	Fishing area		X
G	Gross tonnage (GT); alternatively, gross registered tonnage (GRT)		X
H	Length overall (LOA)	X	
I	Horse power (hp and/or kW)		X
J	Year of construction of the vessel (hull)	X	
K	Fishing gears	X	
L	Main gear		X
M	Random number	X	

Potential errors and proposed corrections for the fleet data

A recurring problem is that the vessel list often includes errors. In order to minimize the bias as far as possible, it is important that these data are thoroughly error checked. Table 3 lists the most common errors reported in fleet registers, the means to detect them, their potential impact and the suggested action.

TABLE 3
Potential errors and proposed corrections for the fleet data.

Problems	Attributes	Method of detection	Impact	Actions
Duplication of records	All	Grouping the vessels for their registration number using a pivot table. The registration number must be unique.	Biased population	Delete the duplicate records
Missing values	• Tonnage (GT or GRT) • LOA • Horsepower • Year of construction	Filter and/or pivot table	Biased estimation of fleet capacity; biased indicators (e.g. investments/ GT or average age of the fleet). Particular attention has to be devoted to the LOA, that is very important for the segmentation.	Extrapolate by means of regression analysis applied to known variables within the same segment. The Excel formula “TREND” can be used.
Missing values	• Fishing gears • Main gear	Filter and/or pivot table	Biased estimation of a segment’s size	Compare with similar vessels in a similar area. If, for example, in a specific fishing port the majority of vessels with a certain LOA, GT and kW use a particular gear, then correct to that gear.

Problems	Attributes	Method of detection	Impact	Actions
Missing values	• Fishing area	Cross-checks that interrelate different characteristics, for example the registration port, LOA and gear.	Biased estimation of a segment's size	Fill in the missing value using the same from other vessels with the same registration port and similar LOA and gear type.
Wrong values	• Tonnage (GT or GRT) • LOA • Horsepower	Cross-checks that interrelate different characteristics, for example the LOA with the GT. It's unlikely to find a vessel has a LOA of 20 m and a GT of 2 tonnes.	Biased estimation of fleet capacity; biased indicators (e.g. investments/ GT). Particular attention has to be devoted to the LOA which is very important for the segmentation.	Extrapolate by means of regression analysis applied to known variables within the same segment. The Excel formula "TREND" can be used.
Wrong values	• Fishing gears • Main gear	Cross-checks that interrelate the technical characteristics with the fishing gear. For example, a tuna purse seiner with a LOA of 5 m and a GT of 1 tonne is unlikely. When two out of three characteristics are coherent then it is likely that the odd-characteristic out should be corrected.	Biased estimation of a segment's size	Assign to the mixed segment. For example, if we are not sure about the reliability of either technical characteristic we can use the "polyvalent" segment (Table 5 under section "Multipurpose [polyvalent] vessels").
Wrong values	• Fishing area	Cross-checks the fishing area with the LOA of the vessel. For example, a vessel of 5 m is unlikely to operate very far from the coastal fishing area.	Biased estimation of a segment's size	Fill in the incorrect value using the same from other vessels with the same registration port and similar LOA.

SEGMENTATION OF THE TARGET POPULATION

Once the target population is defined and the list of vessels is carefully checked (so as to be sure all the necessary attributes are present and there is no duplication of vessels) then we can *stratify* the fleet.

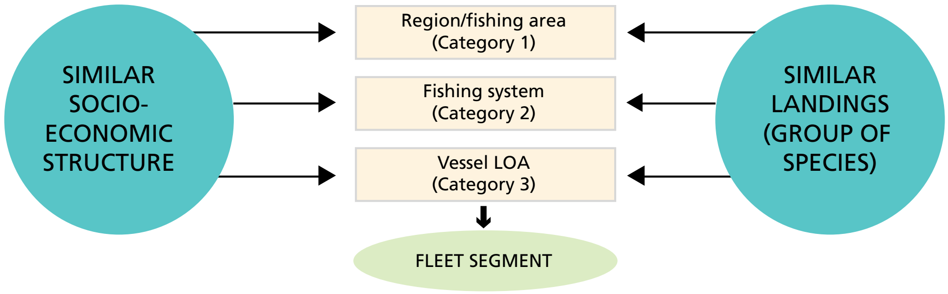
The strata should guarantee, as far as possible, that the vessels are homogeneous in terms of productive characteristics and socio-economic structure (Figure 5) (Accadia and Franquesa, 2006). For this reason, in our case, the criterion for delineating the strata as homogeneously as possible is based on the following three characteristics:

- Category 1: geographical (e.g. region)*
- Category 2: technical (e.g. fishing system)*
- Category 3: dimensional (e.g. length of vessel)

* Please note that the geographical and technical categories are potentially changeable (i.e. a vessel may not always be in the same geographical area or use the same type of fishing gear). This means that when vessels are placed into these strata the categorization is not an absolute one, but rather a matter of placing the vessel in the least-wrong category. After several survey years, with the accrual of more information, the classifications become more precise.

FIGURE 5

Segmentation of the fleet. Categories 1 (geographical) and 2 (technical) are assigned based on the information from the last complete set of information available (i.e. from the previous year)



Geographical characteristics

The first step in the classification of the fleet is achieved by first identifying the geographical area in which the sampled vessel operates. (The definition of the geographical area is best determined by the country conducting the survey.) The geographical areas can be matched to the international standards used in the country or region; they can be the administrative region; the fishing area; the FAO statistical fishing areas or any other statistical area, or even the country. The choice is driven by many factors, mainly political and managerial. If, for example, there are managerial plans that regulate the fisheries in the area, it could be useful to have a geographical disaggregation of the data that coincides with the management areas.

Technical characteristics

The technical characteristics are represented by the "main" gear used during the year, where "main" stands for the gear used most over time. By identifying the main gear, the vessel can be categorized into a fishing system. For our purposes we have chosen the set of fishing systems in the International Standard Statistical Classification of Fishing Gear (ISSCFG) (appendix MII) Coordinated Working Party on Fishing Statistics (CWP) gear type classification.

TABLE 4
Fishing system categories with associated ISSCFG codes.

	Fishing system	Standard abbreviation (ISSCFG appendix MII; FAO 2002b)
1	Bottom trawlers	OTB
2	Pelagic trawlers	TM
3	Surrounding nets with purse lines	PS
4	Tuna seiners	PS
5	Surrounding nets without purse lines	LA
6	Beach seiners	SB
7	Boat seiners	SV
8	Mechanised dredges	DRB
9	Bottom longliners	LLS
10	Drifting longliners	LLD
11	Hooks and lines	LX
12	Set gillnets	GNS
14	Driftnets	GND
15	Pots and traps	FIX
16	Polyvalent static	MIS
17	Polyvalent mobile	MIS
18	Polyvalent	MIS

In this case one has to use all the available sources of information in order to categorize, as far as possible, the target population.

The first source of information about the gears used is normally the fleet register. The licensed gears are usually reported in the register and consequently it constitutes our starting point. The quality of this information depends on how it is collected and managed by the administrators, if and when the lists are updated. In any case, before using it one should make a rapid appraisal of the information available. For example, a visit to the fishing harbour could provide first hand information on the gear that a selection of vessels is currently using. This information could then be cross-checked with the gears reported in the fleet register in order to understand if the fishing licence correctly reflects the actual gear used. When the managerial scheme only allows for the use of one gear this step is simplified.

In general, we can categorize the source of information as direct or indirect.

Direct sources of information:

- fleet register
- visit to the landing points and the local first-sale fishing markets
- interviews with the vessel owners and the fishers
- photographs of the vessels in port.

Photographs of vessels

It is useful to take advantage of the prevalence of smartphone cameras to document the vessels and the port when you, or the team members, have the opportunity to visit the ports. You can organize your photo gallery by port and use it for two things: to get a better idea of how to classify the vessels and to verify whether the gear you see on the vessel, or the vessel's equipment is actually being used. Photos of single vessels are most informative; however a lot of information can be gleaned from photos of groups of vessels.

The vessel is currently operating as a trawler. The tracks indicate that the vessel may also operate as a beam trawler.

Two trawl doors are being used, which means that the vessel uses two different trawl nets.

The vessel is not maintained or equipped with any fishing gears which indicates that it is inactive.

The presence of the radar reflectors indicate that the vessels are using the drifting longlines.

PHOTOS FAO – DARIO PINELLO

Indirect sources of information:

- Interviews with the fishers or with other stakeholders (traders, gears suppliers, fishing cooperatives, petrol suppliers, etc.).
- Photos of the vessels from the internet. It is better if they have been taken recently, relative to the period in which the survey is conducted.
- Internet – several websites provide free and ready-to-use information. Among them is marine traffic (www.marinetraffic.com), which uses the automatic identification system (AIS) to provide very useful information on the fishing area and, indirectly, the fishing gears (combination of area, speed and time). It provides information about the vessels that use the AIS device. The other is Google maps (www.googlemaps.com). By zooming into a specific port or area, it is possible to find photos that could provide useful information on the fishing gears that the vessels are equipped with.
- Logbooks, where existent. Regardless of the information on catches, they provide useful information on the gear used and the activity (days at sea) of the vessels.
- Literature review. Papers and reports that focus on specific fisheries are a very useful source of additional theoretical knowledge on specific fisheries and areas.
- General knowledge of the activities related to the processing and the marketing of seafood in the area under investigation. If, for example, in a specific area there are canning industries producing salted anchovies, it's likely that in the same area there are big vessels using purse seine gear.

When administrative data are used for statistical purposes, the registered population and definitions of the included variables are already fixed, based on the primary purpose of the administrative register or transaction database. These definitions are often not ideal for statistical purposes and may limit the process of defining the target population and target variables. The quality report should include definitions of important variables, including the definition of the population in the register/database, and discuss their relation to the definitions desired by key users of the statistics.

The technical characteristics are represented by the "main" gear used during the year, where "main" stands for the gear used most used over time. By identifying the main gear, the vessel can be categorized into a fishing system.

It should be noted that the proposed list of fishing systems is more disaggregated than the one requested by the FAO standard (FAO, 2002b), but if required it can easily be aggregated in order to coincide with the FAO standard.

Multipurpose (polyvalent) vessels

The first condition for this categorization is that the vessel is authorized to use multiple gears. The multipurpose or polyvalent segment might be a "true" or "artificial" classification, depending on the available knowledge of the vessel's activities. A vessel is categorized as multipurpose or polyvalent when it uses a mix of gears, none of them different from the others. For example, if over 90 days at sea a vessel uses three gears for exactly 30 days each then the vessel is truly polyvalent. In fact, in most cases polyvalent is an artificial classification that is used in all cases where there is inadequate information available about the gears that the vessel operates. After the survey cycle has been conducted one or more times, the resulting accrued knowledge will result in a decreasing number of vessels being assigned to this segment.

The polyvalent category can be divided into three subcategories on the basis of the type of gear:

- Polyvalent static: when more than one static gears is used and it is not possible to know the predominance of any of them.
- Polyvalent mobile: when more than one mobile gears is used and it is not possible to know the predominance of any of them.

- Polyvalent: when the use of one or more mobile gears is combined with one or more static gears and it is not possible to know the predominance of any of them.

The following advice may allow for a reduction in the number of polyvalent categories. When no practical or collateral information exists, the vessels licensed to use multiple gears can be treated according to the criteria outlined below:

TABLE 5

Assigning classifications for polyvalent vessels.

LOA classes	Authorized gears	Actions	Final classification
Vessels with a LOA < 12 m	More than one static gear		"Polyvalent static" and the corresponding LOA class
	More than one mobile gear		"Polyvalent mobile" and the corresponding LOA class
	One or more mobile gears combined with one or more static gears		"Polyvalent" and the corresponding LOA class, regardless of the gear
Vessels with a LOA > 12 m	More than one static gear	Investigate the area and the vessel's category. Prioritize the more economically productive gear that fits better with the economic (cost) structure of the vessel	If the prevalent gear cannot be identified, then the vessel falls into the "polyvalent static" and the corresponding LOA class segment
	More than one mobile gear	Prioritize the more economically productive gear that fits better with the economic (cost) structure of the vessel (e.g. the trawler over the boat seine)	If the prevalent gear cannot be identified, then the vessel falls into the "polyvalent mobile" and the corresponding LOA class segment
	One or more mobile gears combined with one or more static gears	Prioritize the mobile gear over the static gear	If the prevalent gear cannot be identified, then the vessel falls into the "polyvalent" and the corresponding LOA class segment

Mobile gears may be more prevalent than static gears, with the former generally being more economically productive. The bigger the vessel is, the more one can apply this rule. Furthermore, when a market for fishing licences exists, the mobile gears are generally more valuable than the static gears and management rules often first address fishing with mobile gears.

In any case, special attention has to be devoted to the more productive gears and to the large vessels because these categories are higher yielding. For example, the misclassification of two big purse seiners in a total population of 20 vessels can significantly affect the final estimation of the economics of the fleet.

A note on inactive vessels: the number of ***inactive vessels*** *will be estimated through the survey and they will be considered as a separate segment. For this segment, only the capacity, the capital value and the capital costs will be collected.*

Example of how to classify a fishing vessel

The following list provides some concrete examples of how to classify polyvalent vessels:

- Vessel with a LOA = 7 m and with trammel nets and longline in licence => “polyvalent static 6–12 m”.
- Vessel with a LOA = 18 m and with longline and purse seine in licence (it is not possible to identify any main gear) => “polyvalent 12–18 m”.
- Vessel with a LOA = 15 m and with trawler, purse seine and pelagic trawler in licence => “polyvalent mobile 12–18 m”.
- Vessel with a LOA = 20 m authorized to use gillnets and handline => “netters 18–24 m”.
- Vessel with substantial engine power (e.g. > 500 hp) and with pots and traps and trawler in licence => “trawler”.

Dimensional characteristics

After the classification of geographical and technical characteristics of the fishing vessels, the last step is to classify the fleet based on dimensional characteristics, such as LOA or gross tonnage. LAO is the most common dimensional characteristic used because it is a simple measurement of the size of the vessel, it is a less subjective measure and it is usually readily available in any national fleet register. Each fishing vessel is simply classified in the length range that was decided during the stratification scheme. Table 6 provides an example of possible LOA classes.

TABLE 6
Example of LOA classes and ranges.

LOA Classes (m)			
a	0–5.99	g	36–39.99
b	6–11.99	h	40–44.99
c	12–17.99	i	45–59.99
d	18–23.99	j	60–74.99
e	24–29.99	k	75 and over
f	30–35.99		

In most cases this is a relatively easy process, but special attention must be paid to the extremes of the length ranges. For example, a vessel that is exactly 6 m in length belongs to the category 6–11.99 m.

Also note that, when compared with the international requirements (see ANNEXE 2 – GFCM Fleet Segmentation, and ANNEXE 3 – ISSCFV LOA Segmentation) the above length categories are in a slightly more disaggregated form. This can result in more detailed information which is useful for specific and highly productive fishing systems, such as trawlers and purse seiners. In any case, with minimal effort, class g can be combined with class h so as to comply with the classifications in the FAO FF-1 and FF-2 country questionnaire (FAO, 2002b). After the criteria for the stratification of the fleet have been decided, every fishing vessel must be classified according to the agreed stratification.

It is important to point out that although geographical and technical assumptions may create some degree of bias, dimensional assumptions rarely do. This is because the LOA of a vessel is a technical and objective variable, unlike the area where the vessel operates and the main gear. Owing to this intrinsic bias, the vessels operating in some areas, or with some gears, could result in over- or under-representation, or even omissions.

Final segments

Applying all of the steps for segmentation detailed above, Table 7 lists all possible fleet segments. When considering the fleet segments by fishing system, LOA classes and small-scale fleet group, there is a possible total of 122 fleet segments by area, but the actual number of segments is far lower.

For the purpose of the socio-economic analysis, all the vessels under 12 m LOA using static gears may be grouped into the "small-scale fleet" category, while retaining the two LOA classes (0–6 m and 6–12 m). Vessels in this category are usually not specialized in their operations and are particularly flexible in the types of gears they use throughout a period. Although the vessels may not use the same types of gear, they share more social and economic characteristics than vessels outside the small-scale fleet category. For example, very often they are managed as family businesses and the skipper is also the owner of the vessel.

From a statistical point of view, this grouping of the small-scale fleet often helps to facilitate data collection and analysis. However, according to the country-specific conditions, such a grouping of the small-scale fleet may not be applied if there is a need to maintain the fishing system categories separately.

TABLE 7
Fleet segments which are made up of the area + fishing system + LOA class.

Area	Gear Group	Fishing system		LOA classes										
				<6	6–12	12–18	18–24	24–30	30–36	36–40	40–45	45–60	60–75	>75
				A	B	C	D	E	F	G	H	I	J	K
Area x…	Mobile	Bottom trawlers	1											
		Pelagic trawlers	2											
		Surrounding nets with purse lines	3											
		Tuna seiners	4											
		Surrounding nets without purse lines	5											
		Beach seiners	6											
		Boat seiners	7											
		Mechanised dredges	8											
		Polyvalent mobile	9											
	Static	Bottom longliners	10	🟨	🟨									
		Drifting longliners	11	🟨	🟨									
		Hooks and lines	12	🟨	🟨									
		Set gillnets	13	🟨	🟨									
		Driftnets	14	🟨	🟨									
		Pots and traps	15	🟨	🟨									
		Polyvalent static	16	🟨	🟨									
	Poly-valent	Polyvalent	17	🟨	🟨									

🟨 Vessels under 12 m LOA using static gears are classified here as "small-scale fleet".

CLUSTERING AND THE PREPARATION OF THE TARGET POPULATION

Once all the individual vessels have been classified according to their geographic, technical and dimensional characteristics, the first snapshot of the target population can be obtained. At this stage, and before moving on to choose the sample size, one could decide to merge (cluster) the strata that have a low number of vessels with the next closest strata (STECF, 2009). This procedure is considered very important in order to avoid statistical shortfalls due to possible low responses, and to guarantee a certain level of confidentiality in the final estimates. For example, a segment with five vessels with a required sampling rate of 20 percent would necessarily mean that only one vessel would be sampled, but this is too low a sample size (representativeness of the sample) and the final estimates would refer to only five vessels (confidentiality issues). Some fleet segments are more important in terms of landings/effort/target species than others, and therefore these segments should be treated with more care in the case of clustering; they should not be clustered unless strictly necessary for data reporting for confidentiality reasons (European Commission, 2010).

As a general rule, we suggest clustering the segments containing fewer than ten vessels and to clearly state which segments have been merged to a sampling stratum (European Commission, 2010).

In order to simplify the clustering process, we suggest following a two-step strategy where in the first intervention the technical and dimensional characteristics are merged (“clustering A”) while in the next (if any), the geographical disaggregation is also considered (“clustering B”). “

DEFINITION OF THE SAMPLE SIZE

The main aim of determining the sample size is to propose the lowest number of sample units while maintaining the required data quality (bounded by the minimum sample size). Generally, the larger the sample size, the more accurate are the predictions from the sample.

As a general rule, statisticians have found that for many population distributions, when the sample size is at least 30, the sampling distribution of the mean is approximately normal (Levine *et al.*, 2008). However, you can apply the Central Limit Theorem for even smaller sample sizes if the population distribution is approximately bell shaped, which is generally the case for a well-segmented fleet.

The sample size is mainly constrained by budgetary resources. Budget is the factor that caps the maximum number of sample units (n) and is calculated as: available resources (R)/cost per sample unit (c). We suggest that the cost is calculated per sample unit (or questionnaire) and for this reason we need to make a simple assessment of the principal costs associated with each sample unit, as follows (note these costs do not include equipment costs):

- staff cost for collecting data and data entry (including time spent during the interview, assembling and computing the data) (s_a);
- staff cost for quality control and processing of the data (s_b);
- logistics costs, including travel and communications (1).

Thus, the cost estimated per sample unit is c = $s_a + s_b + 1$ and the maximum number of sample units is R/c.

The cap on the number of samples set by the budget provides a maximum threshold for the number of sample units and all the factors (required statistical quality indictors and variance) fall under this threshold.

Another factor that partially determines sample size is the minimum required estimation of variability of each segment (variance) which is calculated through the coefficient of variation (CV).

The minimum required statistical quality indicators are not calculated but are pre-established by the survey objectives or compliance requirements (e.g. legislation, official statistics or international standard requirements).

The estimate of variability can only be set once the survey has already been conducted on the same target population and the variances of the target variables are already known. In this case we can statistically calculate the "optimal" sample size (n_i) for the generic segment *i* through the following strategies:

(A) Applying an algorithm resulting from Neyman's rule[3] to each variable of interest (De Meo, 2013), to choose the sample size. This algorithm provides the most efficient sample size; it balances meeting the statistical requirements and minimum sample size. Once the algorithm has been applied to all of the variables of interest the largest calculated sample size is applied as the overall sample size.

The algorithm is outlined below:

$$n_i = \frac{1}{d^2/(Z^2_{1-\alpha/2} \cdot \sigma_i^2) + 1/N_i} \qquad (1.1)$$

where:

n_i = optimal sample size of segment *i*

d = accepted error (the maximum difference tolerated between the true value and the estimated value from the survey. The lower the acceptable error (d) on the final estimate, the smaller the required sample size, *n*, will be.

N_i = the size of stratum *i*

Z = is the quantile of the normal distribution and is the significance level. Thus *Z* = 1.96 along with

α = 0.05, as common in conventional surveys (Neyman and Pearson, 1933).

σ^2_i = is the variance of the segment's population.

EXAMPLE
Determining sample size by applying Neyman's rule

If we have three variables (A, B and C) for which we have already estimated the standard deviation (σ) and we desire a certain error (d = 10), the outcomes of (1.1) are shown in the table below:

Variable	N_i	*d*	α	*Z*	σ	*n*
A	1 000	10	0.05	1.96	76	102
B	1 000	10	0.05	1.96	86	127
C	1 000	10	0.05	1.96	96	153

And at the end the resulting sample size is n = 153.

(B) The application of Bethel's4 procedure (Bethel,1989) allows for a multivariate application of Neyman's rule to all of the variables simultaneously and this allows for the minimization of the sample size when compared to the application of Neyman's rule to each variable.

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[3] Neyman (1934) derived a sample allocation method of distributing the *n* sample elements among the *h* strata such that the variance of the stratified estimator is minimized and thus the survey precision is maximized.

The application of Bethel's[4] procedure demands advanced knowledge of statistics and the use of some specific programming language. However, for those familiar with R language, ad hoc and ready-to-use libraries are readily located (De Meo, 2013) and other software suites are available.

(C) When the sample survey and the knowledge of the estimation of the population parameters is not known or not well established (generally in the first two to three years), we can apply a "disproportionate allocation" sampling scheme (Sapsford and Jupp, 2006). This strategy allows for keeping the sample as large as possible (within the threshold set by the budget) in order to have a higher coverage rate for the smaller-sized segments, while trying to minimize as much as possible the variance of each stratum. In other words, the size of the sample in each stratum is inversely proportional to the stratum's population size, as follows below:

TABLE 8

"Disproportionate" allocation of the sample size in the strata.

Number of vessels per stratum	Sampling rate
< 50	50%
50–500	25%
500–2 000	10%
> 2 000	5%

As a general rule, large sample sizes provide some assurance that the sample mean and sample standard deviation, for example, are approximately normally distributed about the population mean and population standard deviation (Grafton *et al.*, 2006).

In any case, some deviation from this scheme might happen. If, for example, there is a segment that is considered relevant and consists of less than 50 vessels (say for example 20) one can decide to sample it on a census basis.

SELECTING THE SAMPLE

After strata with adequate boundaries have been set and the sample size for every stratum has been determined, the sample units can be chosen. Each sample must have a unique element, which identifies it from all the other sample units. This can be the vessel registration number (element B of Table 2) or an internal code (element D of Table 2) on page 15.

As discussed in Section 3, within stratified probability sampling the following strategy was proposed: *sample without replacement and with equal probabilities.*

The basic required condition is *randomness* for the selection of the sample. This must be carried out by a computerized routine (humans generally do poorly at generating random values!). Randomness cannot be achieved, for example, by just selecting vessels in one or other fishing harbour, or fishing vessel owners who have a good relationship with the data collectors, or fishing vessels that fish frequently.

The specific operational steps required for applying *sample without replacement and with equal probabilities* is described below.

Each unit of the population has the same probability to be part of the sample and this is:

$Pi = 1/N_i$ where, Ni = the total population of the segment i.

A simple way to carry out a simple random selection in excel is the following:

i. Assign a random number to every fishing vessel belonging to the population, using the "RAND" function in Excel, in order to secure the randomness.

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[4] Bethel's procedure transforms the analysis into a linear programming model that allows the identification of the optimal sample size across strata, minimizing the variances of all variables simultaneously.

ii. Copy and paste using “paste special – value” to insert the value only in the column with the random number.
iii. Sort the list of vessels of a specific segment (N_i) by their random number, from the smallest to the largest (or vice versa).
iv. According to the sample size (n_i) of the segment, select the first n_i vessels of the list, they are the randomly selected sample units.

This simple and straightforward procedure secures the perfect randomness of the sample. It is suggested to assign the random number at an earlier stage of the survey, when the fleet is set up, and to consider this element just like a technical characteristic of each vessel.

Example

If the segment consists of 20 vessels and the required sampling rate is 50%, all the vessels should be ordered by their random number from the smallest to the largest value. The top ten vessels constitute the randomly selected 50% of the target population. This simple and straightforward procedure secures the perfect randomness of a sample.

Population	Random number
Vessel 1	0.3513
Vessel 2	0.2557
Vessel 3	0.2075
Vessel 4	0.8816
Vessel 5	0.8414
Vessel 6	0.6739
Vessel 7	0.6604
Vessel 8	0.6973
Vessel 9	0.0525
Vessel 10	0.4802
Vessel 11	0.7328
Vessel 12	0.6586
Vessel 13	0.7699
Vessel 14	0.9082
Vessel 15	0.4910
Vessel 16	0.6107
Vessel 17	0.2708
Vessel 18	0.3881
Vessel 19	0.9592
Vessel 20	0.2700

↖ Assigned by the "Rand" function

List sorted by the random number, from the smallest to the largest

Population	Random number	
Vessel 9	0.0525	Sample 1
Vessel 3	0.2075	Sample 2
Vessel 2	0.2557	Sample 3
Vessel 20	0.2700	Sample 4
Vessel 17	0.2708	Sample 5
Vessel 1	0.3513	Sample 6
Vessel 18	0.3881	Sample 7
Vessel 10	0.4802	Sample 8
Vessel 15	0.4910	Sample 9
Vessel 16	0.6107	Sample 10
Vessel 12	0.6586	
Vessel 7	0.6604	
Vessel 6	0.6739	
Vessel 8	0.6973	
Vessel 11	0.7328	
Vessel 13	0.7699	
Vessel 5	0.8414	
Vessel 4	0.8816	
Vessel 14	0.9082	
Vessel 19	0.9592	

Randomly selected sample list

Population = 20
Coverage rate = 50%
Planned samples = 10

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4. Collecting the data

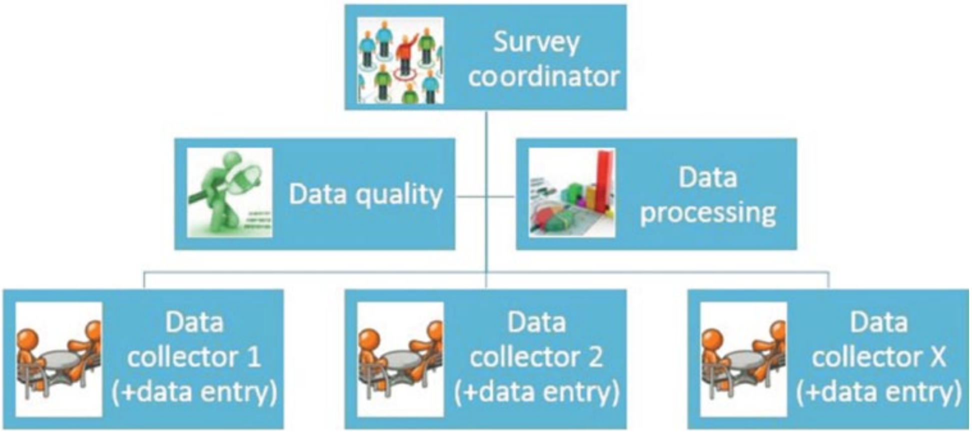
PLANNING THE SURVEY

We like to say these types of surveys are *data-collector based*. Therefore, the work of the data collector is crucial and the quality of the data is largely reliant on the work done by the people in the field. Socio-economic surveys present diverse challenges compared to catch and effort surveys where the variables are more quantitative and physically apparent. Further, the data may not be recorded in receipts, accounting sheets, or other formats. It is up to the data collector to extract this information from the respondent and, as is the case for any such data collection programme, a good rapport and understanding of operations on the side of the data collector is crucial to obtaining good survey results.

The following are a selection of practical suggestions:

- Before starting with the survey, two-phase training has to be carried out with all the data-collectors: the first phase is lectures and the second phase is training, practice and feedback in the field (with trial field-questionnaires).
- The interview duration should be no more than 30 minutes (excluding time for discussion of other matters).
- The interview has to be done face-to-face (not via telephone or email), preferably with someone who knows the entire operation of the vessel (in order of preference: owner, skipper, experienced crew member).
- Each data collector has to be alone with the respondent when conducting the interview (this creates a better atmosphere and ensures confidentiality).
- The data collector should also be responsible for the data entry.
- The data entry should be completed on the same day as the interview.
- The data should be made available to the officer responsible for data quality as soon as possible (no later than two to three days after the interview).
- Each data collector will be responsible for interviewing representatives from a number of vessels that represents a reasonable workload (less than 40 vessels).
- The telephone number of the interviewee must be collected (for possible cross-checking).

FIGURE 6
Organogram for the organization of the survey scheme



The survey has to be coordinated by a professional who has a deep understanding of the rationale behind the survey and all of the associated steps and roles, and who manages all of the activities (both methodology and human resources).

The person responsible for data quality must have strong and holistic knowledge about the aspects of the fishery, and on-the-ground understanding of the national fishery sector – both its economic and operational aspects. Data processing requires significant attention to detail coupled with an understanding of the underlying characteristics of the fishery activities. Both the roles of data quality and data processing require strong computer skills and the ability to customize the activity because the work is very context-dependent. Data collectors should be aware that their work will be regularly checked and they need to be: committed; familiar with the fisheries sector in the area where they operate; ideally "speak the same language" as the fishers; ideally recruited specifically for this activity and can be, if necessary, replaced. They do not necessarily have to have a detailed understanding of the entire survey process because they are only required to focus on the survey work.

QUESTIONNAIRE/TRAINING COURSE

This section addresses the training course for the data collectors through the lens of the questionnaire. The questionnaire is the tool used for collecting the data, and therefore the data collectors need to be familiar with all of the variables and their core meanings. Further, the language in the questionnaire and the terms used by the data collectors must be well understood by the respondents. To facilitate this understanding, the general questionnaire is presented in detail with practical examples provided, as required. Variations from this general questionnaire will depend on the objectives of the survey and on the characteristics of the fishery system under investigation. Large changes to the format or questionnaire are not recommended at this stage but an in-the-field test allows for both additional data collector training, as well as any refinements that may be required.

Structure of the questionnaire

The questionnaire is structured into 12 parts that contain the variable groups:

- Part A: Administrative information
- Part B: Source of the information
- Part C: Ownership
- Part D: Effort*
- Part E: Employment
- Part F: Commercial (destination of the first sale)
- Part G: Variable costs
- Part H: Fixed costs
- Part I: Investments
- Part J: Debts and subsidies
- Part K: Income*
- Part L: Demographic

The groups of variables are assigned different priority scales – "target" and "additional" (denoted by *). This distinction is relevant for any country in which a catch and effort sampling programme is already in place. Under these conditions, the additional variables would already be collected under the catch and effort data collection programme. These additional variables have two uses. First, they provide a valuable reference for cross-checking the primary information. For example, in cases where costs exceed income a further investigation is often required to explain the full situation. Second, the final estimates from these variables provide reference points for calibrating the data being collected and are of interest to the overall data collection and statistical programmes that are already in place. Table 9 provides a summary of the typical variables included in each part of the questionnaire.

TABLE 9

Summary of the variables included in the questionnaire.

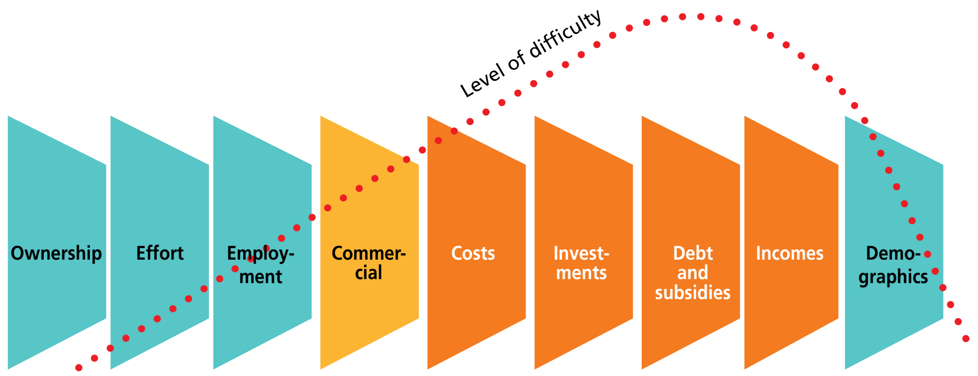
Source of information		**Ownership**	
-	Owner	02	Owner engaged on the vessel
-	Partner	03	Owner engaged in the activity of the vessel
-	Skipper	04	Owner's sole occupation engagement
-	Fisher	05	If NO to (04), is fishing the main source of income for the owner
Effort		**Employment**	
06	Number of fishing trips	11	Engaged crew per vessel - daily average (including owner)
07	Average duration of fishing trip (hours)	12	Number of different individuals working on the vessel (including owner)
08	Days at sea	13	Working hours on board (daily average on 24-hour basis)
09	Average hours at sea (daily average on 24-hour basis)	14	Number of people engaged in onshore activities
10	Gears used	15	Number of different individuals engaged in onshore activities
		16	Working hours onshore (daily average on 24-hour basis)
Commercial (destination of the first sale)		**Energy costs**	
17	Wholesaler	19	Fuel type
17	Auction	20	Fuel costs
17	Exporter	21	Fuel consumption (litres)
17	Processing industry	22	Lubricant costs
17	Fishmonger	23	Lubricant consumption (litres)
17	Direct selling to the final customer	24	Fuel price
17	Direct selling to the restaurant		
18	Self consumption		
Personnel costs		**Other operational costs**	
25	Renumeration of crew (including owner)	31	Purchase of food
26	Renumeration of crew (excluding owner)	32	Purchase of bait
27	Renumeration based on a fixed amount	33	Purchase of other consumable materials (e.g. battery)
28	Average daily renumeration of one fisher (the basic fisher)	34	Cost for truck required for vessel operations
29	Social security, social costs & pension contributions per fisher	35	Other operational costs
30	Crew member insurance per fisher		
Commercial costs		**Repair and maintenance costs**	
36	Fish market commission	41	Maintenance and repairs to vessel
37	Transportation to the fishing production	42	Maintenance and repairs to engine
38	Purchase of ice	43	Maintenance and repairs to on board machineries
39	Purchase of boxes and packaging	44	Maintenance and repairs to gears
40	Other commercial costs	45	Other maintenance and repair costs
Fixed costs		**Investments**	
46	Book-keeping	52	Purchase of engine
47	Vessel insurance	53	Purchase of fishing gears
48	Legal expenses	54	Purchase of equipment (mechanical, hydraulic, electrical equipment)
49	Bank costs	55	Other investments
50	Fishing licence renewal (vessel)	56	Current market value of vessel (excluding licence)
51	Other fixed costs	57	Current market value of vessel (including licence)
		58	Current market value of fishing licence and/or the fishing rights
Debts and subsidies		**Income**	
59	Were any loans taken in relation to any aspect of the fishery activity?	63	Revenue obtained by using the vessel for activities other than fishing?
60	If YES, specify the source: (a) Bank; (b) Company; (c) Buyer; (d) Other	64	Total quantity of fish landed
61	% of the asset covered by the loan	65	Total quantity of fish landed by group of species
62	Direct monetary subsidies received		
Demographic		**Demographic**	
66	Year of birth and gender	71	Number of household members engaged in gleaning
67	Literacy level	72	Number of household members engaged in onshore activities
68	Nationality	73	Year of birth of each family member
69	Household size	74	Literacy level of the family members of each crew member
70	Number of household members engaged in fishing	75	Proportion of total household income from fishing activity

Sequence of the variables

In this questionnaire the variables are listed in a rational sequence – it is not a mere listing of variables and the variables and definitions should not be considered in isolation. The questions should be delivered in this sequence because the explanations and responses build on the previous items. This order allows the interview to begin with the less sensitive questions and build on the degree of complexity of responses (Figure 7).

FIGURE 7

Sequence of questionnaire variables and level of complexity



In each of the categories there are three levels of hierarchy: variable group; variable; and microvariable. The variable is the level that is used to make the final calculations; the microvariables are tools that enable a more accurate quantification of the variables because they break down the variables into definitions that are more easily followed by the respondents. The variable groups simply provide a means of organizing all of the variables. In each section the microvariables are listed and explained. A number of examples are presented in separate boxes.

For all items: the answer can be a value, zero or unknown and it is CRITICAL that the unknown responses are kept separate from the zero values.

Any special cases, items worth highlighting, or uncertainties that are important for the analysis of the data, should be reported in a notes field; this extra information will be tagged with the microvariable response in question.

Part A: Administrative information

Variable group: administrative information

Code of the vessel	*System-generated*
Date of the interview	*Auto-generated*
Reference period	*Monthly; yearly*

- <u>Code of the vessel:</u> this can be system generated and stays with the vessel throughout the year.
- <u>Date of the interview:</u> the date on which the interview is actually conducted.

- Reference period: the number of the week or month during which the questionnaire is deployed. This can also be system-generated based on the exact date of the questionnaire/survey.

Part B: Source of the information

Variable group: source of information

Code		Variable	Unit
01	Source of information	owner	*Yes or no*
	Source of information	partner	*Yes or no*
	Source of information	skipper	*Yes or no*
	Source of information	fisher	*Yes or no*

01 Source of information: select whomever is responding to the questionnaire.

Part C: Ownership

Variable Group: owner

Code		Variable	Unit
02	Owner	Owner engaged on board the vessel	*Yes or no*
03	Owner	Owner engaged in the onshore activity of the vessel	*Yes or no*
04	Owner	Owner's sole occupation is engagement in fishing	*Yes or no*
05	Owner	If NO to (04), is fishing the main source of income for the owner?	*Yes or no*

Owner: these distinctions between levels of engagement are important. In some studies, the efficiency of vessels where the owner was engaged in vessel operations was found to be higher than for those without owner-engagement (Pinello *et al.*, 2016).

02. Owner engaged on board the vessel: select yes if the owner works on the vessel during fishing activity.
03. Owner engaged in the onshore activity of the vessel: select yes if the owner is engaged onshore.
04. Owner's sole occupation is engagement in fishing: select yes if the owner is only engaged in fishing and no other activities in any other sectors.
0.5 If NO to (04), is fishing the main source of income for the owner? Select yes if the owner is engaged in other sectors, but still receives the greatest proportion of their income from fishing.

All figures in the following examples are intended as an example only.

Example 4.2.1

The vessel X has a crew of three fishers, all employees. The vessel owner owns three other vessels and his occupation is managing the activities of the vessels and selling the products.

The ownership part of the vessel is detailed as follows:

02. Owner engaged on board the vessel: NO
03. Owner engaged in the activity of the vessel onshore: YES
04. Owner's sole occupation is engagement in fishing: YES
05. If NO to (04), is fishing the main source of income for the owner?

Example 4.2.2
The vessel X has a crew of three fishers, one of whom is also the owner. Once the vessel lands the products the owner manages their marketing.

The ownership part of the vessel is detailed as follows:
02. Owner engaged on board the vessel: YES
03. Owner engaged in the activity of the vessel onshore: YES
04. Owner's sole occupation is engagement in fishing: YES
05. If NO to (04), is fishing the main source of income for the owner?

Part D: Effort

Variable group: effort

Code	Variable	Unit
06	Number of fishing trips	*Number*
07	Average duration of a fishing trip (hours)	*Number*
08	Days at sea	*Number*
09	Average hours at sea (daily average on 24-hours basis)	*Number*
10	Gears used	*Days and/or hours*

06. Number of fishing trips: the number of fishing trips conducted during the interview period. The fishing trip is defined as any voyage by a fishing vessel from a land location to a landing place and excluding non-fishing trips.
07. Average duration of a fishing trip (hours): the number of hours, on average, a fishing trip lasts during the interview period.
08. Days at sea: any continuous period of 24 hours (or part thereof) during which a vessel is at sea during the interview period.
09. Average hours at sea (daily avg. on 24-hours basis): in any 24-hour period the amount of time spent deploying/hauling/running for fishing activities.
10. Gears used: for every gear used during a fishing trip, provide the number of days or hours each gear was used. This variable allows for a more precise identification of the amount of time spent fishing with each gear type.

In the case of passive gear, soak time is not included in the calculation of time the gear is "used".

Example
The vessel carried out ten fishing trips in one month. Each fishing trip lasted on average 40 hours, with the vessel leaving the port at 2 a.m. on day *i* and coming back at 6 p.m. on day *i+1*. The time spent from the port to the fishing area lasted on average six hours, and for the remaining time the crew members were actively engaged in fishing activities, using the handline.

The *effort* of the vessel over the month was broken down as follows:
06. Number of fishing trips: 10
07. Average duration of a fishing trip (hours): 40
08. Days at sea: 20
09. Average hours at sea (daily avg. on 24-hours basis): 20
10. Gears used: handline used 20 days per 14 hours each day
13. Working hours on board (daily avg. on 24-hours basis): 14
16. Working hours onshore (daily avg. on 24-hours basis): 2

Example

The vessel X is a small-scale vessel with a LOA of 5 m and a crew of one fisher who is also the owner of the vessel. Its typical fishing operation is composed of two phases: a) day i: leaving the port late in the evening, setting the net on the fishing grounds and coming back to the port. The breakdown of the trip is as follows: 1 hour for running (round trip) + 2 hours for setting the net; b) Day *i – 1*: leaving the port early in the morning, taking the nets and landing the product. The breakdown of the trip is as follows: 1 hour of running (round trip) + 4 hours for taking the net + 2 hours onshore for sorting the fish and cleaning the nets. Over the interview period it carried out one trip of this fishing operation.

The *effort* of the vessel over the interview period was broken down as follows:

06. Number of fishing trips: 1
07. Average duration of a fishing trip (hours): 8
08. Days at sea: 1
09. Average hours at sea (daily avg. on 24-hours basis): 8
10. Gears used: fixed net used 1 day per 6 hours
13. Working hours on board (daily avg. on 24-hours basis): 6
16. Working hours onshore (daily avg. on 24-hours basis): 2

This is a typical case for the small-scale vessels that operate close to the port. Although the fishing operation comprised two phases and two voyages, it ended once the product was landed and so one fishing trip was carried out. The definition of a fishing trip is then related to the economic activity of the vessel.

Part E: Employment

Variable group: employment

Code	Variable	Unit
11	Engaged crew per vessel (including owner)	*Number*
12	Number of different individuals working on the vessel (including owner)	*Number*
13	Working hours on board (daily avg. per crew member on 24-hours basis)	*Number*
14	Number of people engaged in onshore activities	*Number*
15	Number of different individuals engaged in onshore activities	*Number*
16	Working hours onshore (daily avg. on 24-hours basis)	*Number*

11. Engaged crew per vessel (including owner): the total number of engaged crew per vessel, daily average including the owner, if present. This number will reflect the number of working positions on the vessel (e.g. skipper and two crew members).
12. Number of different individuals working on the vessel (including owner): number of different individuals working on the vessel; all people engaged throughout the interview period. For example, if there are two crew positions there may be three different people who at some point work in those crew positions.
13. Working hours on board (daily avg. per crew member on 24-hours basis): this refers to any time on board the vessel that the crew is required to do work, including fishing activity, but also any other activities like cleaning, repair and maintenance.
14. Number of people engaged in onshore activities: all people engaged in onshore activities related to the vessel (e.g. cleaning nets, repairing the gears, preparing the

bait, sorting fish for the market, etc.). Usually, the majority of them are the same on board crew members.

15. Number of different individuals engaged in onshore activities: the total of all people engaged in onshore activities related to the vessel throughout the interview period.
16. Working hours onshore (daily avg. on 24-hours basis): provide, on average, the number of hours of work conducted onshore in support of the fishing activity. Working hours/day: about the onshore component; for example, the time spent cleaning the net, preparing the catch, repairing the vessel. This is requested as an average amount of time of all/any.

Example

The vessel went to sea six times over two weeks, three times per week. The fishing trips were daily and all the crew members were also engaged in the cleaning of the nets at the end of each trip. For each fishing trip, the crew was composed of two fishers, one of whom was also the owner of the vessel. The first week the crew was composed of: fisher X (owner of the vessel) and fisher Y. The second week fisher Z replaced fisher Y and the crew was then composed of: fisher X and fisher Z.

The *employment* of the vessel over the two weeks was then composed as follows:

13. Engaged crew per vessel (including owner) = 2
14. Number of different individuals working on the vessel (including owner) = 3
15. Number of people engaged in onshore activities = 2
16. Number of different individuals engaged in onshore activities = 3.

Part F: Commercial (destination of the first sale)

Variable group: commercial (destination of the first sale)

Code	Variable	Unit
17	Destinations (wholesaler, buyers, processors, exporters, fishmonger, retail market, restaurant, direct export, others)	%
18	Self-consumption: quantity of landings per trip not sold but used by the fishers for their own consumption or their families' consumption, including sharing of catch for crew remuneration	%

Commercial (destination of landings) the percentage of the different channels the fishers use to sell their product.

17. Commercial (destination of the first sale): this describes the first commercial step of the fish from the vessel (ex-vessel) to the first buyer (e.g. wholesaler, auction, exporter, processing industry, fishmonger, final consumer, restaurant).
18. Self-consumption: the part of the production that is not sold commercially but is distributed amongst the crew members.

Example

The production of the vessel over the interview period was sold to: small pelagic fish to the local wholesaler (50%); the large pelagic fish to the processing industry (20%); direct consumer sales at the landing point (20%) and the final portion (10%) was distributed among the crew members.

The destination of landings was therefore as follows:

17. Main and secondary destinations (wholesaler, buyers, processors, exporters, fishmonger, retail market, restaurant, direct export, others):
Wholesaler = 50%
Processors = 20%
Retail market = 20%
18. Self-consumption = 10%

Part G: Variable costs
They are composed of:

- energy costs
- personnel costs
- other operational costs
- commercial costs
- repair and maintenance costs.

Some vessels may not have items for each of these microvariables; only complete those that are relevant.

At the end of each variable group there is a generic microvariable called "other" that allows for the addition of any items that do not fit into the previous microvariables (from within the same variable).

Variable group: energy costs

Code	Variable	Unit
19	Fuel type (diesel/petrol)	*Diesel or petrol*
20	Fuel – value of consumption	*Monetary value*
21	Fuel – volume of consumption	*Litres*
22	Lubricants – value of consumption	*Monetary value*
23	Lubricants – volume of consumption	*Litres*
24	Fuel price	*Monetary value/Litres*

19. <u>Fuel type:</u> the fuel used for the main engine of the vessel (petrol vs. diesel).
20. <u>Fuel cost:</u> the total cost for the interview period of all of the fuel consumed by all on board vessel activities (main engine, secondary engine, generators, machinery used on board).
21. <u>Fuel consumption:</u> the total amount of fuel consumed for the interview period by all on board vessel activities (main engine, secondary engine, generators, machinery used on board).
22. <u>Lubricant cost:</u> the total cost for the interview period of the lubricant used by all on board vessel activities (main engine, secondary engine, generators, machinery used on board).
23. <u>Lubricant consumption:</u> The total cost for the interview period of all of the lubricants consumed by all on board vessel activities (main engine, secondary engine, generators, machinery used on board).
24. <u>Fuel price:</u> The weighted average (if the price of fuel changed over the interview period then this can be derived from the total cost divided by the total volume).

Example

The vessel A is a purse seiner. In the interview period it operated for 10 days, consuming a total amount of diesel of 20 000 litres that was bought at an average price of $0.3/litre. The fuel was principally consumed by the main engine (80%) and partially (20%) by the generator in order to keep the lights on. The main engine also used 600 litres of lubricants bought at an average price of $1/litre.

The energy consumed by the vessel in 10 days was broken down as follows:

19. Fuel type (diesel/petrol) = diesel
20. Fuel – value of consumption = 6 000
21. Fuel – volume of consumption = 20 000
22. Lubricants – value of consumption = 600
23. Lubricants – volume of consumption = 600
24. Fuel price = 0.1

Variable group: personnel costs

Code	Variable	Unit
25	Remuneration of crew, including owner	*Monetary value*
26	Remuneration of crew, excluding owner	*Monetary value*
27	Remuneration based on a fixed amount If NO formula used for the calculation of the remuneration	*Yes or no (if NO, then select one of the options)*
28	Average daily remuneration of one fisher in the area (the basic fisher)	*Monetary value*
29	Social security, social costs and pension contributions per fisher a) Number of crew participating in social security scheme	*Monetary value*
30	Crew member insurance per fisher a) Number of crew covered by insurance	*Monetary value*

This is the most important group of variables in socio-economic terms. In many cases the compensation of the crew is on a *share* basis, which means the greater the value of the catch landed, the more money each crew member gets as a *share* of the total. The share is usually calculated as a percentage of revenue, or revenue minus certain categories of cost. It is important to know exactly which formula is used for the compensation of the fishers.

25. Remuneration of crew, including owner: the total remuneration includes social security costs for all crew members *including* the owner. This is often the same value as that reflected on the official payslips.

26. Remuneration of crew, excluding owner: the total remuneration includes social security costs for the crew, excluding the owner. This is often the same value as that reflected on the official payslips.

27. Remuneration based on a fixed amount: yes/no, if no proceed below: select which of the following formulas are used for the calculation of the remuneration:
    a) Percentage of revenue: in this case, the crew receives a set percentage of the revenue no matter the costs associated with the fishing trip [e.g. "one-third of the revenues"].
    b) [= revenue – fuel]: only fuel costs are discounted from the revenue.

c) <u>[= revenue – fuel – food]:</u> fuel costs and food costs are discounted from the revenue.

d) <u>[= revenue – fuel – food – bait]:</u> fuel, food and bait costs are discounted from the revenue.

e) <u>[= revenue – fuel – food – bait – commercial costs]:</u> fuel, food, bait and any commercial costs (e.g. ice, boxes, fish market commission, etc.) are discounted from the revenue.

f) <u>[= revenue – fuel – food – commercial costs]:</u> fuel, food and any commercial costs (e.g. ice, boxes, fish market commission, etc.) are discounted from the revenue.

g) other (specify).

<u>Percentage that goes to the crew:</u> If b, c, d, e and f selected, then from the calculation what percentage goes to the crew? After any costs (as seen in b, c, d, e, f) are discounted from the revenue, this is the percentage share that goes to the crew.

28. <u>Average daily remuneration of one fisher (deckhand):</u> This is not the average for a specific fisher on a single vessel, but rather the general average for fishers of a certain fishery in that specific port. Generally, this is the value used for fishers' remuneration when they are paid per day. For example, in a certain port the average casual fisher working on a purse seiner would be paid $20/day.

Item 28 will not be processed with the remainder of the data, but is just an average benchmark that may be used to compare data from other questions – this is a checkpoint and helps reinforce the remuneration information that is included in the other questions.

29. <u>Social security, social costs and pension contributions per fisher:</u> the portion of the remuneration that is required by law to be paid for items such as pension for an average crew member.
    a) <u>Number of crew participating in social security scheme:</u> the total number of crew members who received item 29 (social security, social costs and pension contributions per fisher).

30. <u>Crew member insurance per fisher:</u> the cost of insurance paid for an average crew member.
    a) Number of crew covered by insurance: the total number of crew members who received item 30.

Example

The vessel X is a purse seiner with five crew members, and the owner is engaged in activities on board the vessel. The remuneration of the crew is usually delivered when the vessel stops its activities during the full moon period. The remunerations are calculated through a share system where the fuel and the food consumed, and the commercial costs, are discounted from the revenue and the resulting amount is then shared as follows: 60% to the crew and 40% to the vessel's owner. The average social security costs per fisher were $30 per month and four out of five crew members participated in the social security scheme. The fifth is a retired fisher. None of them pay for private insurance.

In the area, the average daily remuneration of a basic fisher engaged in the purse seine fishery in the past year was about $20 per day.
The *personnel* costs are then broken down as follows:
25. Remuneration of crew, including owner:
26. Remuneration of crew, excluding owner:
27. Formula used for the calculation of remuneration: (f)
28. Average daily remuneration of one fisher in the area (the basic fisher): 20
29. Social security, social costs and pension contributions per fisher: 30
a) Number of crew participating in social security scheme: 4
30. Crew member insurance per fisher:
a) Number of crew covered by insurance: 0

Variable group: other operational costs

Code	Variable	Unit
31	Purchase of food	*Monetary value*
32	Purchasing bait	*Monetary value*
33	Purchasing other consumable materials	*Monetary value*
34	Cost for other services required for vessel operations	*Monetary value*
35	Other operational costs	*Monetary value*

All the purchased consumable inputs relate directly or indirectly to fishing effort. Included are the bait; food to be consumed during the fishing trip; costs for delivery of any of these consumables; and components of any assets (gear or vessel) that are not related to maintenance and are consumed within the given year.

31. Purchasing food: the cost of food purchased for all of the crew.
32. Purchasing bait: the cost of bait purchased.
33. Purchasing other consumable materials: the cost of the purchase of items such as lightbulbs, batteries, etc.
34. Cost for other services required for vessel operations: this item refers to the costs associated with other services related to the vessel operation (for example, the cost for the truck that hauls the boats out of the water at the end of a fishing operation).
35. Other operational costs: any items that do not fit into the previous microvariables.

Variable group: commercial costs

Code	Variable	Unit
36	Fish market commission (as a percentage of the revenues or monetary value)	*Monetary value*
37	Transportation of the fishing production (from vessel to place of selling)	*Monetary value*
38	Purchasing ice	*Monetary value*
39	Purchasing boxes and packaging	*Monetary value*
40	Other commercial costs	*Monetary value*

All the costs related to selling the production resulting from the activity of the vessel.

36. Fish market commission (as a percentage of the revenues or monetary value): the transaction cost paid to the fish market or middleman for selling the product. This can be reported as either a percentage of the value of the sale or as the monetary amount.
37. Transportation of the fishing production (from vessel to place of selling): the cost for transportation from the vessel to the first point of sale.
38. Purchasing ice: the cost of ice purchased.
39. Purchasing boxes and packaging: the cost of any boxes and packaging purchased.
40. Other commercial costs: any items that do not fit into the previous microvariables.

Example

In the last month the vessel X used the longline method and carried out 10 fishing trips of two days each, setting the gear twice per trip. The food consumed by the crew members was worth $50/trip, while the cost of the bait was $100 per fishing operation (setting the gears). At the end of each fishing trip, after approaching the landing site, the vessel was towed onshore by a truck shared by ten vessels. The total cost per month relating to the truck was $200, equally shared between the vessels regardless of the time the truck was used. Therefore, the cost per vessel was $20 per month.

The total landings were worth $10 000 and they were sold through the local auction fish market, which charges 6% commission on the value of the sale. About 10% of the production was shared between the crew as in-kind remuneration. The transportation of the catch from the landing point to the fish market is carried out by a private individual who charged $10/trip. The ice consumed per fishing trip was worth $20 and the cost for boxes was $300 in total for the month.

The other *operational costs for the month* are then broken down as follows:

31. Purchase of food = 500
32. Purchase of bait = 2 000
33. Purchase of other consumable materials (e.g. battery) =
34. Cost for other services required for vessel operations = 20
35. Other operational costs =

While the *commercial costs in the month* are broken down as follows:

36. Fish market commission (as a percentage of the revenues or monetary value) = 540 [= (10 000–1000) *0.06]
37. Transportation of the fishing production (from vessel to place of selling) = 100
38. Purchase of ice = 200
39. Purchase of boxes and packaging = 300
40. Other commercial costs =

Variable group: repair and maintenance costs

Code	Variable	Unit
41	Maintenance and repairs to vessel	*Monetary value*
42	Maintenance and repairs to engines	*Monetary value*
43	Maintenance and repairs to on board machinery	*Monetary value*
44	Maintenance and repairs to gears	*Monetary value*
45	Other repair and maintenance costs	*Monetary value*

Costs of maintenance and repair of the vessel and gears – including both routine and extraordinary maintenance/repairs.

41. Maintenance and repairs to vessel: the cost of any repairs or maintenance for the vessel.
42. Maintenance and repairs to engines: the cost of any repairs or maintenance for the engines.
43. Maintenance and repairs to on board machinery: The cost of any repairs or maintenance for any on board machinery, e.g. winches.
44. Maintenance and repairs to fishing gears: the cost of any repairs to or maintenance of all fishing gears.
45. Other repair and maintenance costs: any items that does not fit into the previous microvariables.

Example

In the last month the vessel X bought 100 m of nets in order to fix part of the gillnets currently in use. The total cost of the nets was $200. Some repair work was done to the winch, during two days of bad sea conditions. This extra work was carried out by the crew members in cooperation with a professional mechanic who was paid $50/day, and worked for two days.

The *repair and maintenance costs* are then broken down as follows:

41. Maintenance and repairs to vessel =
42. Maintenance and repairs to engine =
43. Maintenance and repairs to on board machineries = 100
44. Maintenance and repairs to gears = 200
45. Other repair and maintenance costs =

Part H: Fixed costs

Variable group: fixed costs

Code	Variable	Unit
46	Bookkeeping (e.g. accountant)	*Monetary value*
47	Vessel insurance	*Monetary value*
48	Legal expenses	*Monetary value*
49	Bank costs	*Monetary value*
50	Fishing licence renewal (vessel and fisher)	*Monetary value*
51	Other fixed costs	*Monetary value*

The costs not directly connected with operational activities (effort and catch/landings). Fixed costs do not change in relation to the level of activity of the vessel (they remain the same whether there is one trip per year, or 200 trips per year).

46. Bookkeeping (e.g. accountant): the cost for the accounting activity.
47. Vessel insurance: the cost of insurance for the vessel.
48. Legal expenses: the cost of the use of a lawyer or legal service (for example, the cost of having documents notarized for business licences).
49. Bank costs: the cost of any banking related services (related to the vessel).
50. Fishing licence renewal (vessel and fisher): the cost of renewing a fishing licence for the fisher and/or vessel.
51. Other fixed costs: any items that do not fit into the previous microvariables.

Example

The vessel X has a crew of three fishers. In the last year it paid $1 000 to the fishing cooperative for accounting and bookkeeping services and paid $100 for the annual fishing licence renewal. Each crew member paid $100 for the annual fishing licence renewal and the vessel also paid a lawyer $1 000 to register business documents.

The *fixed costs* are then broken down as follows:

46. Bookkeeping (e.g. accountant) = 1 000
47. Vessel insurance =
48. Legal expenses = 1 000
49. Bank costs =
50. Fishing licence renewal (vessel and fisher) = 400
51. Other fixed costs =

Part I: Investments

Variable group: investments

Code	Variable	Unit
52	Purchase of engine	*Monetary value*
53	Purchase of fishing gears	*Monetary value*
54	Purchase of equipment (mechanical, hydraulic, electrical equipment)	*Monetary value*
55	Other investments	*Monetary value*
56	Current market value of the vessel (excluding licence)	*Monetary value*
57	Current market value of the vessel (including licence)	*Monetary value*
58	Current market value of the fishing licence and/or the fishing rights	*Monetary value*

Improvements to a vessel/gear aim to improve the "lifetime" of the assets, but are not consumed within the given year.

- The investment costs are only for items that were purchased during the interview period.
- The investments differ from maintenance costs which are consumed within a given year.
- For the investments it is unnecessary to distinguish between new and second hand purchases – you just need the investment amount. If the government has provided an engine for free then this is listed as ZERO value.

52. <u>Purchase of engines:</u> the cost of engines purchased.
53. <u>Purchase of fishing gears:</u> the cost of fishing gears purchased.
54. <u>Purchase of equipment (mechanical, hydraulic, electrical equipment):</u> the cost of equipment purchased (for example, winches, generators, radios, GPS, etc.)
55. <u>Other investments:</u> the cost of other items purchased (for example, fish storage boxes).

56. Current market value of the vessel (excluding licence): the price that would be obtained if the vessel were to be bought – the current replacement price (without the licence).
57. Current market value of the vessel (including licence): the price that would be obtained if the vessel were to be bought – the current replacement price (with the licence).
58. Current market value of the fishing licence and/or the fishing rights: the price that would be obtained if the licence or fishing rights were to be sold – the current replacement price.

Items 56, 57 and 58 are all related and although all variables should ideally be filled in, as long as two out of the three are known, the remaining variable can be derived.

Part J: Debts and subsidies

Variable group: debts and subsidies

Code	Variable	Unit
59	Were any loans taken for the vessel or the equipment?	*Yes or no*
60	If yes to 59, specify the source: a) bank; b) company; c) buyer; d) other	*Yes or no (if YES, then select one of the options)*
61	Percentage of asset covered by the loan	%
62	Direct monetary subsidies received	*Monetary value*

Items 59 to 61 pertain to measuring the level and source of indebtedness of the vessel and the general ability to access credit. More generally, this information can act as a benchmark in the data assessment phase: higher debt ratios may explain higher vessel economic performance.

Subsidies are monetary payments received from the government that can be in the form of money or monetary reimbursements for purchases that modify the potential profits of the industry in the short, medium or long term.

59. Were any loans taken in relation to any aspect of the fishery activity (yes/no): whether any loans were taken out for any aspect related to fishery activity during the interview period.
60. If yes to 59, specify the source: a) bank; b) company; c) buyer; d) other.
61. Percentage of asset covered by the loan: the assets referred to here are those from items 52 to 57 (investments in physical assets) and the loan can be any amount owing from any prior period.
62. Direct monetary subsidies received: the total amount of direct monetary subsidies received from the government, either for the activity or for the investments.

Example

The current year is year *i*.

The skipper reports that a similar vessel (with the same age, technical characteristics and licence), in the same port, was sold for $100 000.

The vessel X received a loan from the bank for $50 000 in year *i – 3*. In the current year, **year** *i*, the remainder owing is $30 000. In **year** *i – 1* payments were made to the bank which comprised $9 000 in principal and $1 000 in interest.

Year *i – 1* (last year) the vessel bought a new fish-finder for $2 000 and received $5 000 in subsidies from the government to reduce fishing activity.

The *subsidies and debts* are then broken down as follows:

49. Bank costs: $1 000
52. Purchase of engine:
53. Purchase of fishing gears:
54. Purchase of equipment (mechanical, hydraulic, electrical equipment): $2 000
55. Other investments (e.g. fish storage box):
56. Current market value of the vessel (excluding licence):
57. Current market value of the vessel (including licence): $100 000
58. Current market value of the fishing licence and/or the fishing rights:
59. Were any loans taken for the vessel or the equipment (yes/no): NO
60. If yes to 59, specify the source: a) bank; b) company; c) buyer; d) other:
61. Percentage of asset covered by the loan: 30%
62. Direct subsidies received: $5 000

Part K: Income

Variable group: income

Code	Variable	Unit
63	Revenue obtained by using the vessel for activities other than fishing	*Monetary value*
64	Total quantity of fish landed by group of species	*Kilograms*
65	Total value of fish landed by group of species	*Monetary value*

The total income may come from both fishing activities and also from other non-fishery uses of the vessel, although the primary output of the fishing activities is the capture of species. The distinction between species groups allows for a further articulation of the vessel activity beyond gear types.

63. Revenue obtained by using the vessel for activities other than fishing: whether the vessel is used for activities such as tourist trips, or if the vessel is rented to act as a support boat for aquaculture activities. Revenue might also be obtained by leasing the quota or fishing rights.

64. Total quantity of fish landed by group of species: this pertains to the total amount of fish landed and can then be further broken down by species group. The division can be made either by kilograms or by proportion – either option is acceptable.

    The species groups can be: a) demersal; b) large pelagic; c) small pelagic; d) crustaceans; e) molluscs.

65. Total value of fish landed by group of species: this pertains to the total value of fish landed and can then be further broken down by the species groups landed. The division can be made either by monetary value or by proportion – either option is acceptable.

    The species groups can be: a) demersal; b) large pelagic; c) small pelagic; d) crustaceans; e) molluscs.

Part L: Demographic

Variable group: demographic

Code	Variable	Unit
66	Year of birth and gender	*Number*
67	Literacy level and years in school for each crew member	*Number*
68	Nationality	*Select option*
69	Household size	*Number*
70	Household members engaged in fishing	*Number*
71	Household members engaged in gleaning	*Number*
72	Number of family members engaged in onshore activities	*Number*
73	Year of birth of the family members	*Number*
74	Literacy level and years in school of the family members	*Number*
75	Proportion of total household income from fishing activity	%
75	If fishing is not 100%, indicate the other activity/ies and their proportional importance	*Select option*
76	Crew members in collective organization or groups	*Number*

For each of the demographic variables the response should be for each crew member engaged on the vessel during the interview period, not every crew member engaged throughout the year. The motivation for the variables under demographics is to assess the demographic patterns and the total reliance on the fishery sector for livelihoods (beyond those directly engaged in the fishing activity). The skipper should be included as one of the crew members under these variables.

66. <u>Year of birth and gender:</u> the year of birth provides the age in a more accurate reporting format.
67. <u>Literacy level and years in school of each crew member:</u> for each crew member indicate whether illiterate or literate and the number of years in school.
68. <u>Nationality:</u> the country of nationality.
69. <u>Household size:</u> the total number of household members living with the fisher.
70. <u>Number of household members engaged in fishing:</u> the number of household members involved in fishing activity (not necessarily related to that of the survey unit).
71. <u>Number of household members engaged in gleaning:</u> the number of household members involved in gleaning or harvesting (e.g. clam gleaning) activity (not necessarily related to that of the survey unit).
72. <u>Number of household members engaged in onshore activities:</u> the number of household members involved in onshore activity (not necessarily related to that of the survey unit).
73. <u>Year of birth of the family members:</u> the year of birth provides the age in a more accurate reporting format.
74. <u>Literacy level and years in school of the family members:</u> for each family member indicate whether illiterate or literate and the number of years in school.
75. <u>Proportion of total household income from fishing activity:</u> what percentage of the household income comes from the crew member's fishing activity? For example, in the case of a family-based, small-scale fishery, the number of household persons depending on the fishery for their livelihood is an extremely important parameter. If fishing is not 100 percent of household income, indicate the other activity/ies and their proportional contribution to household income.
76. <u>Membership of collective organizations or groups:</u> the number of crew who are part of a collective organization or group, e.g. an association of fishers, union, etc.

5. Quality check and treatment of the data

ERRORS IN STATISTICAL DATA

Prior to making estimations from the sample to the total population, a critical step is the quality check and necessary data treatments. The accuracy of a survey estimate refers to the closeness of the estimate to the true population value and the difference between the two is referred to as the error of the survey estimate. This value – the error – is a fundamental component in the following steps for making estimations.

In general in a sample survey, the two types of errors can be distinguished as **sampling** and **non-sampling errors**.

Sampling error is one of two reasons for the difference between an estimate of a population parameter and the true, but unknown, value of that population parameter. The other reason is non-sampling error. Even if a sampling process does not have non-sampling errors then estimates from different random sample units (of the same fleet segment) will vary from sample unit to sample unit, and each estimate is likely to be different from the true value of the population parameter. Unfortunately, in practise, we can never obtain a true measure of sampling error, but only an estimate of it, and the influence of non-sampling error is also entangled in that estimate.

Sampling errors

Definition

Sampling errors refer to those errors which are encountered in the estimate of a parameter of the universe because of the fact that not all the population, but only a subset of it (the sample), is the object of observation.

Factors

Many factors cause sampling error, including the:

- sample size
- sampling fraction
- variability within the population.

Sampling errors simply reflect that a sample is being extracted from the total population and is a reflection of the difference between the values derived from the sample estimate and what would (theoretically) be found from a full census. With careful application of sampling principles, the sampling error can be both measured with accuracy and minimized. It is important to report the sampling error when publishing survey results to give an indication of the accuracy of the estimate.

The measures of sampling error we propose are the following:

- standard error (SE)
- variance (VAR)
- coefficient of variation (CV).

These are calculated, for each variable and within each segment, as follows:

Standard error

The standard error is a measure of the spread of estimates around the “true value”. The standard error is an indication of how close the sample survey estimate is to the result that would have been obtained from a census under the same operating conditions (an equal complete coverage). It can be derived mathematically from the population variance as follows:

$$SE_{\bar{x}} = \frac{s}{\sqrt{n}}$$

where:
x = the estimate of the variable of interest
s = standard deviation of the sample
n = sample size (number of sample units).

The standard deviation is the square root of the variance, where the variance is calculated as follows:

Variance
The variance is defined as the average of the squared differences from the mean.

$$\mathrm{VAR}\hat{x} = \frac{1}{N}\sum_{i=1}^{N}(x_i - \bar{x})^2$$

Where:
N = total population
n = sample size (number of sample units)
$\bar{x}$ = is the mean value of the variable x.

According to sampling theory, when the sample size n is not small in comparison to the population size N (i.e., more than five percent of the population is sampled) so that n/N > 0.05, a finite population correction factor is used. This correction factor approaches zero as the sample size (n) approaches the population size (N). This makes intuitive sense because when N = n, the sample becomes a census and sampling error becomes moot.

The estimation of the variance that includes the correction factor is expressed as the following, as modified according to De Meo (2013):

$$\mathrm{VAR}(\hat{x}) = \frac{N^2}{n}\left(1 - \frac{n}{N}\right)\underbrace{\frac{\sum_{i=1}^{n}(x_i - \bar{x})}{n-1}}_{VAR\ in\ excel}$$

where:

N = total population

n = sample size (number of sample units)

$\bar{x}$ = is the mean value of the variable x

Coefficient of variation (CV)
It shows the extent of variability in relation to the mean of the population and is defined as the ratio of the square of the variance (standard deviation) to the mean, but it is often expressed as a percentage rather than as a ratio.

$$\mathrm{CV}(\hat{x}) = \frac{\sqrt{VAR(\hat{x})}}{\bar{x}}$$

Actions
Usually sampling errors can be decreased by: increasing the sample size (but this is not a directly proportional relationship); ensuring the sample selection is truly random;

and making careful segmentations of the population (to increase homogeneity of the segments).

The estimation of the optimal sample allocation using Neyman's or Bethel's Rule for the variable under estimation (as described in Section 3) allows sampling errors to be limited.

Further, we have seen that sampling error can only be reliably estimated if the selection of respondents has been random. At best, random sampling will allow unbiased estimates of sampling error; at worst, quota and opportunity sampling will provide little or none.

Example sampling error in the estimation of fuel cost for Area X – Fleet segment Y
Number of vessels: 100
Coverage rate: 10%
Number of planned sample: 10
Achieved sample units: 8
Response rate: 80%
Fuel cost estimation: 5 000
CV: 12%
Standard error: 600

Non-sampling errors

Definition

Non-sampling errors can be simply defined as all of the *other* errors in the estimate arising during the course of all survey activities other than sampling (e.g. the way you run the survey). Unlike sampling errors, they can be present in both sample surveys and censuses and are extremely difficult, if not impossible, to measure mathematically. In general, non-sampling errors increase with increasing sample size.

With this in mind, both survey designers and data quality evaluators have to ensure that non-sampling error is avoided as far as possible, or at least randomly distributed in order to eliminate its effect on the calculation of population estimates, or brought under statistical control.

The most common non-sampling errors result from poor coverage and selection bias, low response rates, non-responses, interviewer errors and data entry errors, as explained below.

Factors

- can occur in all aspects of the survey process other than sampling
- exist in both sample surveys and censuses
- can occur regardless of sample size
- are difficult to measure.

A. Poor coverage and selection bias

Errors in coverage result from the omission, duplication or incorrect segmentation of the population or sample and this results in either under or over-coverage.

Coverage errors are caused by defects in the phase of the sampling design where the fleet and segments are set, or when the survey is conducted. These errors result from inaccuracy, incompleteness, duplications, or other inadequacies when the fleet population is set, or if the data collector misses sample units.

Selection bias occurs when sample units are selected in such a way that proper randomization is not achieved because some members of the population are less likely to be selected (and as a result, the sample obtained is not representative).

B. Low response rates

When data are incorrectly requested, provided or recorded, response errors result. These errors may occur because of shortcomings of the data collector, or with the interviewee responding to the questions, or with the survey process (for example, the timing of the interviews). Further, it is essential that sample survey questions are worded carefully because misleading or confusing questions result in poor responses. For more information on questionnaire design, refer to Section 4 Questionnaire/training course.

Data collectors have a significant influence on the way in which a respondent responds to the questions. The manner of delivery of the questions affects the response given and so the training course is essential, along with an in-depth understanding of the questions, as outlined in Section 4. Not only the manner of delivery, but also the level of understanding of the data collectors impacts on how the questions are delivered. To control for this, it is important that the data collectors have as-similar-as-possible levels of understanding of the questions. If an interviewer changes the way a question is worded, it may impact the respondent's answer. Training of the data collectors must emphasize the need to remain neutral throughout the interview.

Reliability of data collectors

Aside from the importance of training the data collectors well, there is also the matter of understanding the integrity of their work. In an extreme case the skilled data collector, if so inclined, has the capacity to falsify records in reporting in such a way that it is difficult to spot through the standard data checking processes.

By keeping the personal contact details of the interviewee, like the phone number, you allow yourself an opportunity to double check the reporting. When conducting the training of the data collectors you explain that the phone number is collected for the purpose of conducting double checks. This alone is often enough to discourage falsification, but if you have any doubts about the reporting you can follow up on specific variables.

Certainly, the interviewees may also provide incorrect answers owing to poor recall, tendencies to exaggerate or underplay events, and avoiding reporting confidential data (because of concerns about taxes, legal issues or even competition). We suggest that the target interviewee is the owner of the vessel so that they have the most complete oversight of all of the economic components of the activity of the vessel. The second choice of interviewee is the skipper, although in many cases the skipper and the owner are the same person.

C. Non-response errors

Non-response errors are the result of not having obtained sufficient answers to survey questions. There are two types of non-response errors: complete (CNR) and partial (PNR). CNR refers to a statistical unit, which does not supply responses to any of the questions given, the interviewee is unavailable or temporarily absent, or they are unable or refuse to participate in the survey. PNR errors result when no information is provided for a subset of the questions. CNR errors can be reduced through the replacement of vessels with similar characteristics, on the assumption that the CNRs do not over- or under-represent specific groups.

Generally, if the data collector is able to obtain a response in the first survey period then they will continue to receive responses. In other words, the CNR rate can be determined with a fair degree of certainty at the beginning of the survey period.

D. Typing errors

Typing errors can occur while data are being recorded, coded, edited or imputed. Data collectors who are poorly trained, receive incomplete instructions, or are tired may cause further errors. Sometimes, errors are incorrectly identified during the editing phase. Even when errors are discovered, they can be wrongly corrected because of poor imputation procedures.

Actions

Non-sampling errors are systematic errors that tend to accumulate over the entire sample and these types of errors often lead to a bias in the final results. While sampling errors diminish with an increase in sample size (annulling themselves for census) this will not, in general, be true for the non-sampling error.

CONTROL PROCEDURES – DATA EDITING

Data editing is a process in which data are checked, altered or corrected to ensure they are as error-free as possible. In particular, a number of non-sampling errors can be eliminated or reduced through this process. The most common non-sampling errors result from data entry, data processing and interviewer errors.

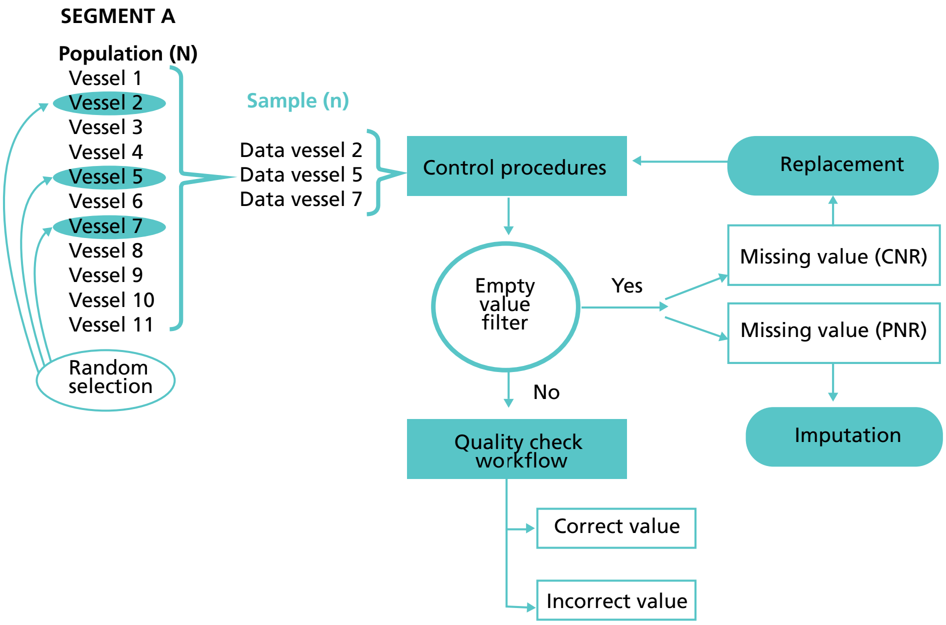
Data editing is not a stand-alone component, but rather it is an integral part of the data collection cycle. Editing is implemented by applying a set of rules or restriction on the value of the variable which must be met if the data are to be considered validated. If these restrictions or rules are not met then corrective action can be, but isn't always, taken. These rules are only intended as a tool to identify anomalies, however the final decision on whether or not a variable is accepted has to be made through human intervention. Often, it is not necessary to identify every error and the degree of careful attention required is set by the goals of the collection. If the final estimate is coherent with the expected results then it may be acceptable to ignore errors at the sample level because they have not impacted on the overall soundness of the final estimates. However, there is a set of reasons that motivates closer, more systematic data editing of the sample data:

- In the early stages of the survey when structured time-series are not available it is difficult toassess the soundness of the final estimates in a precise manner.
- Careful examination of the sample data allows for an examination of the work done at the sample level by each data collector. This examination is an opportunity for capacity development of the survey team (by evaluating the work of the collectors to identify areas for improvement).
- There may be administrative requirements that demand this level of detail, such as statistical standards that are set at the national level.
- In some cases the payment of the data collectors may be directly linked to the quality of their work and this has to be assessed carefully.
- The sample data may be part of the output required by the client (e.g. public administration/ministry) and this raw data may also be necessary to conduct a detailed analysis.

This handbook explains the data editing procedure that is applied to each of the sample units within each segment as follows:

FIGURE 8

The two processes for the control procedures are applied to each of the sample units within each segment (e.g. Segment A)



Operational steps (Figure 8):

<u>Action 1.</u> Organize the sample data by vessels with the microvariables both disaggregated and grouped into their respective variables (e.g. variable group "Energy cost" with all of the microvariables: fuel type; fuel – value of consumption; fuel – volume of consumption; lubricants – value of consumption; lubricants – volume of consumption; fuel price).

<u>Action 2.</u> Run a filter on the data to identify empty cells. Once the empty cells are separated you can proceed to step 3 with the non-empty values. See Step 4 for treatment of CNR missing values.

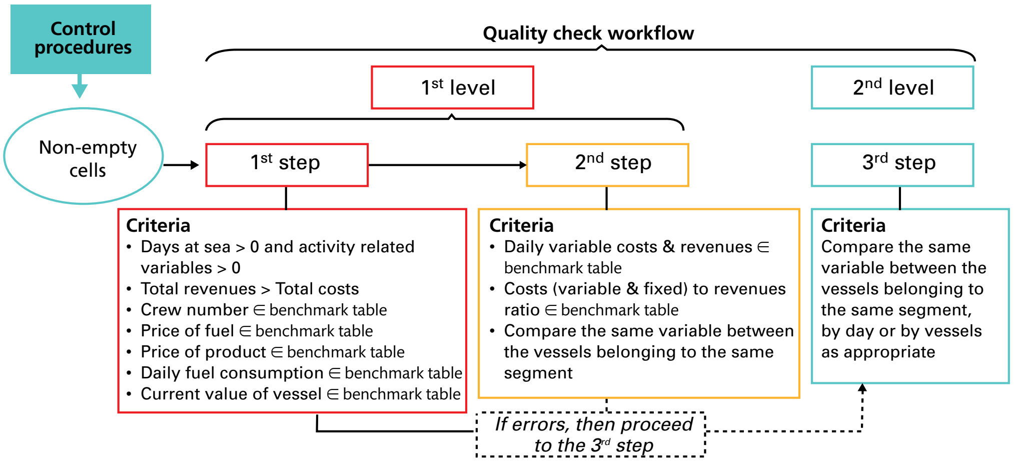
<u>Action 3.</u> Run the quality check workflow (as detailed in Figure 8) so that the incorrect values are identified and then selected for imputation (along with the missing values – PNR identified in Step 2).

<u>Action 4.</u> Missing values are either CNR or PNR. If CNR "replacement" may be used if necessary. See Solutions below for details.

Quality check workflow

FIGURE 9

Details of the quality check workflow levels and steps



Operational steps:

The quality check workflow has two levels, containing three steps, in which you move from less to more disaggregated data forms. The two steps in the first level are differentiated only as a means of working through the criteria. The first step is an assessment applied to variables that address activity, employment and the general economics of the sample units; the next step assesses costs and revenue variables. If, after the checks in the first level you still consider that the flagged data are incorrect then the criteria of the third step are applied at the microvariable level. An important point is to check the variables that are not explicitly included in the quality check workflow (above) or benchmark tables (below). These excluded variables do not have fixed acceptable ranges and so they cannot be handled in the same manner. Generally, you can compare the variables within the same fleet segments for the vessels and the observed values can then be used to shape the bounds of acceptable values. These reported values and your own judgement (experience) can then be used to check the data.

First level: these criteria are systematically applied to all of the sample data organized by segment.

First step: this is the logical starting point because anomalies in the selected items are usually the easiest to spot through checking. They include, for example, unbalanced prices; mismatches with zero-reported days at sea with other activity-related variables (e.g. fuel consumption); total revenues less than total costs, etc. A number of the criteria make use of benchmark and range tables (see fig. e in Worksheet Details on page 68) that provide acceptable ranges of values for number of crew, price of fuel and price of product.

Second step: This level of checking is conducted on revenue and variable cost data with the sample data normalized to daily values and individually cross checked against ranges. Both fixed and variable costs are checked in ratio to revenues. All of the variable are then compared to other values within their same segments.

Second level: if after the checks in the first level you still consider that the flagged data are incorrect then the criteria of the third step are applied at the microvariable level.

Third step: you only arrive at the third step of checking if anomalies have not been resolved in the first two steps. At this point you must proceed backwards to identify where the error was located within the microvariables. This checking is best done with the data normalized to daily costs (rather than monthly or annual costs). This refines the error checking process because the values naturally have a more restricted range.

In general, the control procedure of the survey in question is interactive univariate graphic micro-editing (i.e. checking variable by variable for each of the sample units). Simply put, the sampling units whose responses flag errors (identified though graphic tools such as scatter-plots) are corrected through human intervention. This micro-editing has the result that, within each stratum, the vessels have a nearly normal distribution. Experts are usually present during this control phase so that in each phase they can make evaluations and determine whether the data are effectively erroneous. It is possible, in fact, that in time the distribution of functions of control undergo variations in position and dispersion and that the state of error marked by the functions of control are therefore not actually due to the effective presence of anomalous data, but to a structural variation in its distribution. In such cases, therefore, it is necessary to reconsider the threshold limits of the range of acceptance as, for a stratum to be considered meaningful it must follow a close-to-normal variation. During such phases, in order to achieve a correct execution of the procedure of localization of errors, graphic tools are extremely helpful. For any of the cost variables, the procedure ends when no states of error are indicated for any of the strata generated in the various levels.

Useful tools:

1. Conditional formatting to identify out-of-range values for both: (*i*) daily values; and (*ii*) ratio to revenue (see example 5.2).
2. Scatter plots for comparison of the same variables within the same segments (see example 5.2).

Benchmark tables

The benchmark tables are only created to provide a tool that assists in spotting errors. They establish the minimum and maximum threshold values, define the bounds of acceptable range for groups of variables and are structured by fleet segment (or subsegment). The minimum–-maximum ranges need to be set to best match the situation in each country because there is no global benchmark that can be applied across countries. The establishment of these tables with benchmark ranges for each of the economic variables is essential to expedite (and systematize) the quality check phase.

Before beginning with the survey the benchmarking tables need to be completed. After the first year of the survey cycle the previous year's data can be used, but the challenge is to complete the tables before the first cycle. This can be done by using indirect sources (e.g. prior studies) or direct sources (e.g. interviewing the fishers). The benchmarking tables are flexible and can be adapted to better reflect the changing conditions or responses as the survey proceeds because the purpose of the tables is to assist the quality control phase.

The table below presents the structure of the benchmark tables. The tables reflect the fact that some variables are presented as the annual average per vessel; the daily average; and as costs as a percentage to revenues.

TABLE 10
Structure of the benchmark tables.

Type of benchmark table (all created per fleet segment)	Variables	Values to be completed	
		Min	**Max**
Annual average per vessel	Days at sea		
	Fixed costs		
	Fuel price		
	Price of production		
	Value of the vessel		
Daily average	Crew members engaged on board		
	Landings		
	Revenues		
	Gross cash flow		
	Fuel consumption (litres)		
	Earnings per fisher	*	
Costs as percentage to revenues (annual average)	Personnel		
	Fuel		
	Other operational		
	Commercial		
	Repair and maintenance		
	Fixed		

* We suggest using the national legal minimum wage (when present) for the lower end of the range.

Detecting outliers

Presented below are some examples of visual methods for detecting outliers that are potential errors. The first items presented are benchmarking tables; these are followed by a scatter plot with an accompanying table showing the minimum, maximum and mean values.

The benchmarking tables show *daily cost values* cross-checked against minimum and maximum value ranges (in green) using conditional formatting followed by cost to revenue ratios. The outlier values are highlighted in red and provide an example of how easily outliers are revealed using these tools. We suggest that it is important to include the LOA (not only the LOA class) for each of the vessels in the benchmarking table and to use the LOA to sort the vessels for easier comparison. Additionally, the name of the data collector can be added.

The scatterplot shows the values for all of the sample while the table only shows the maximum and minimum values of the sample. Although the depth of data presented is limited, it does allow for the simultaneous visualization of multiple segments.

Example

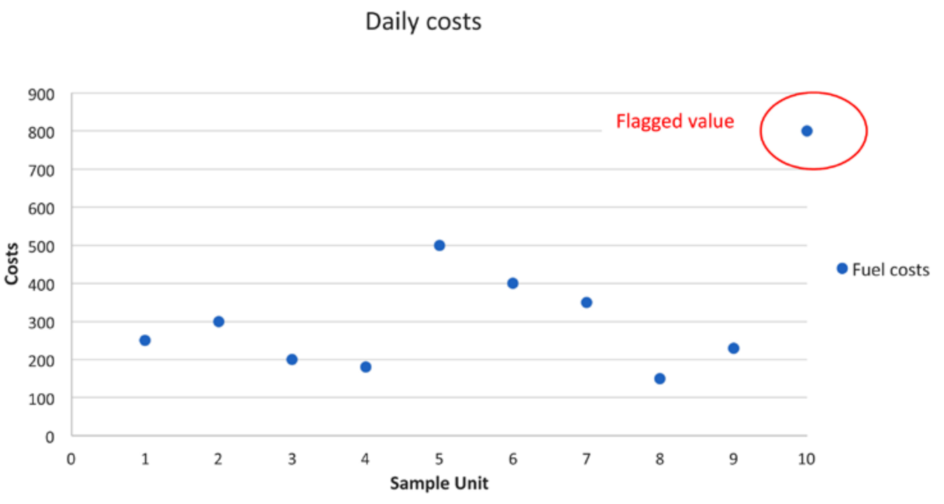
Conditional formatting used to identify outliers (i.e. out of range values) for the costs to revenue ratio. The first benchmark table is for daily values and the second table shows the cost to revenue ratios. The values in red have been identified as outliers. The scatter plot is another means of visualizing outliers and is shown at the bottom for daily fuel costs.

TABLE 11
Example of conditional formatting for the identification of outliers.

Segment: Longline 12–18 m							**Daily values**		
Sample	LOA	Revenue	Personnel costs	Personnel costs/fisher	Fuel costs	Other operational costs	Commercial costs	Repair and maintenance	Total variable costs
Vessel 1	12.5	1 000	312	125	250	150	80	10	927
Vessel 2	17.5	1 500	585	146	300	150	75	20	1 276
Vessel 3	12.4	900	246	123	200	200	90	50	909
Vessel 4	15.0	850	253	127	180	180	68	5	813
Vessel 5	17.0	1 200	264	132	500	200	60	15	1 171
Vessel 6	16.0	1 300	433	144	400	100	78	30	1 186
Vessel 7	16.5	1 800	661	189	350	150	198	40	1 588
Vessel 8	15.6	600	169	85	150	120	48	5	577
Vessel 9	14.0	950	323	161	230	120	62	10	906
Vessel 10	13.5	1 100	250	125	800	150	99	25	1 449
Range values		600–2000	100–800	50–200	100–500	100–400	15–250	05–80	300–1 500

Segment: Longline 12–18 m						**Costs to revenue ratio**		
Sample	LOA	Personnel costs	Fuel costs	Other operational costs	Commercial costs	Repair and maintenance	Fixed costs	Total costs
Vessel 1	12,5	0,31	0,25	0,15	0,08	0,01	0,10	0,90
Vessel 2	17,5	0,39	0,20	0,10	0,05	0,01	0,11	0,86
Vessel 3	12,4	0,27	0,22	0,22	0,10	0,06	0,01	0,89
Vessel 4	15,0	0,30	0,21	0,21	0,08	0,01	0,05	0,86
Vessel 5	17,0	0,22	0,42	0,17	0,05	0,01	0,04	0,91
Vessel 6	16,0	0,33	0,31	0,08	0,06	0,02	0,13	0,93
Vessel 7	16,5	0,37	0,19	0,08	0,11	0,02	0,06	0,84
Vessel 8	15,6	0,28	0,25	0,20	0,08	0,01	0,06	0,88
Vessel 9	14,0	0,34	0,24	0,13	0,07	0,01	0,06	1,32
Vessel 10	13,5	0,23	0,73	0,14	0,09	0,02	0,12	1,32
Range values		0,15–0,40	0,15–0,35	0,10–0,30	0,03–0,15	0,01–0,04	0,05–0,20	<1,0

FIGURE 10
Example of a scatter plot for the visualization of outliers for daily fuel costs



Solutions:

Imputation for incorrect and missing values (PNR)
Imputation is simply a procedure that fills in the gaps identified through the control procedures as either missing (PNR) or incorrect values. The missing values identified in the control procedure and the incorrect values identified in steps one and two of the quality check workflow are then corrected at the microvariable level. Missing and incorrect values are treated the same by applying corrections.

Four single-imputation methods are proposed here for making corrections: "mean of the group", "hot deck/cold deck", and "regression". The choice of method depends on the variables that are being addressed with the imputation.

Anchor variable method
Filled variables are used to estimate the missing variables through indirect calculations, rather than relying on filling with the mean or other methods. This can only be applied with variables where the other, related required variables are present. For example, days at sea can be calculated this way. The total landings can be divided by the average daily landings value of the segment to calculate the number of days (1 000 kg landings/50 kg landings per day = 200 days at sea).

Mean of the group
When using mean imputation the missing or error values are replaced with the value equal to the mean of those variables that are available.

$$\hat{c}(s,i) = \bar{c}(s) \cdot g(i)$$

where:
$g(i)$ is the number of fishing days of the i – th vessel;
$\bar{c}(s)$ is the average daily cost of the strata s (the i – th vessel belongs to strata s);
$\hat{c}(s,i)$ is the imputed cost for the i – th vessel.

Cold deck/hot deck

Cold deck makes use of a fixed set of values for a segment, which covers all of the data items. These values can be constructed by making use of the benchmarking tables described in Section 6.

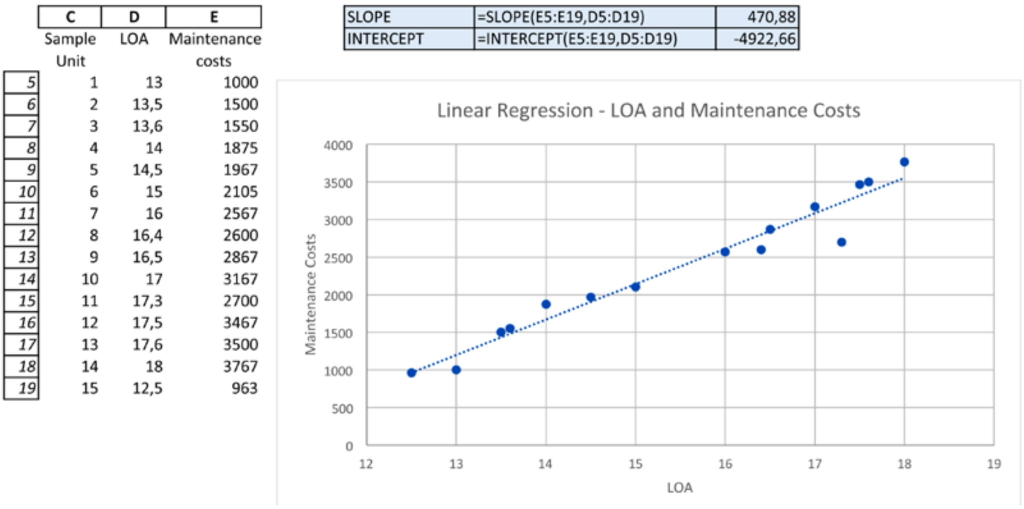
The hot deck method uses a system of matching, where similar respondents are used as donors and a random donor is selected from within the same strata to fill in the missing or incorrect value.

Regression

Regression analysis is a method used to analyse data in which it is possible to identify a dependent variable (Y) and one or more independent variables (X). Y and X must be "properly" represented by the relation or function that is used in the regression. The values of X must be known for the sample units in which the variable Y is estimated. Regression is generally a functional relationship, but in this case we will refer only to the linear relationship because it is easily applied in Excel and is valid in many contexts.

FIGURE 11

Regression analysis of LOA and maintenance costs



	C	D	E
	Sample Unit	LOA	Maintenance costs
5	1	13	1000
6	2	13,5	1500
7	3	13,6	1550
8	4	14	1875
9	5	14,5	1967
10	6	15	2105
11	7	16	2567
12	8	16,4	2600
13	9	16,5	2867
14	10	17	3167
15	11	17,3	2700
16	12	17,5	3467
17	13	17,6	3500
18	14	18	3767
19	15	12,5	963

SLOPE	=SLOPE(E5:E19,D5:D19)	470,88
INTERCEPT	=INTERCEPT(E5:E19,D5:D19)	-4922,66

For example, if we want to estimate the cost of maintenance (Y) according to the size of a boat, we have to know its size (variable X).

Y = INTERCEPT + SLOPE * X

So, imagine that you have a PNR for the maintenance costs of a trawl boat with a LOA of 15.5 m, the estimate would be simply:

Y= -4923 + 471 * 15.5 = 2376

Obviously, the estimate of the model would be based on "similar vessels data" without missing responses (**columns E and D** of the example in Figure 11).

The SLOPE function should be used as follows:

= SLOPE (E5: E19, D5: D19)

where E5: E19 select the cells of the variable Y to be estimated (maintenance costs), while D5: D19 of the X variable used with input cells (LOA example).

The INTERCEPT function is used in a similar manner:

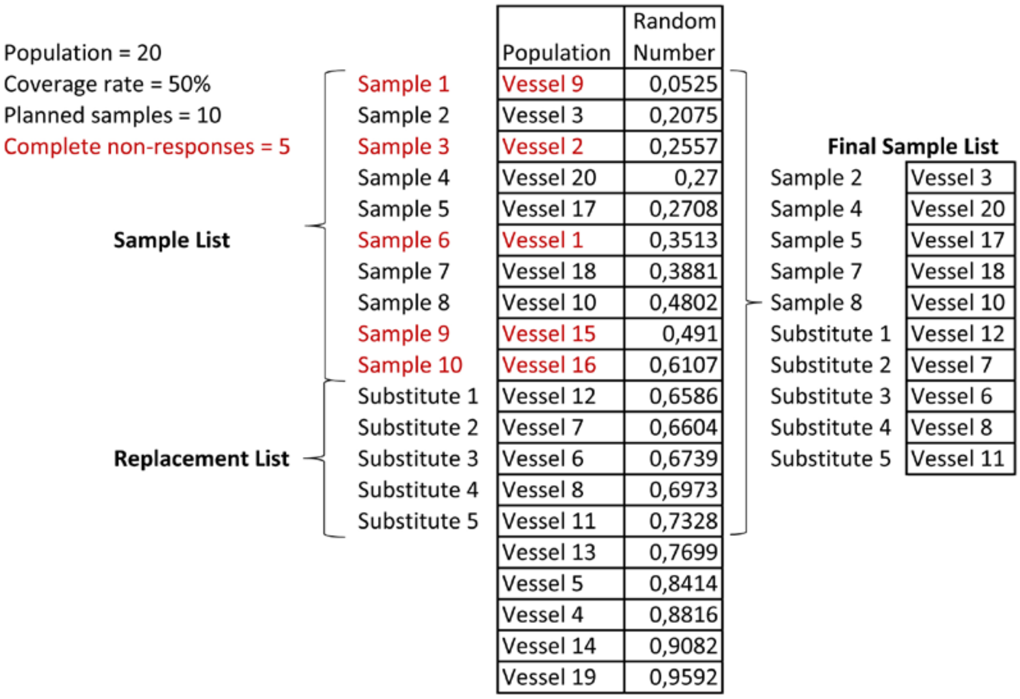
= INTERCEPT (E5: E19, D5: D19).

Replacement of missing values (CNR)

If there are too many CNRs and the response rate is deemed too low (which may particularly be the case when you have few sample units) then you may wish to use replacement to obtain a higher response rate. If you decide to use replacement then the “substitute” vessels can be pulled from the subsequent next-in-sequence list of vessels identified in the random sampling procedure explained in Section 3 and shown below in Figure 12.

FIGURE 12

Replacement procedure for correcting CNRs when required



Population = 20
Coverage rate = 50%
Planned samples = 10
Complete non-responses = 5

	Population	Random Number
Sample 1	Vessel 9	0,0525
Sample 2	Vessel 3	0,2075
Sample 3	Vessel 2	0,2557
Sample 4	Vessel 20	0,27
Sample 5	Vessel 17	0,2708
Sample 6	Vessel 1	0,3513
Sample 7	Vessel 18	0,3881
Sample 8	Vessel 10	0,4802
Sample 9	Vessel 15	0,491
Sample 10	Vessel 16	0,6107
Substitute 1	Vessel 12	0,6586
Substitute 2	Vessel 7	0,6604
Substitute 3	Vessel 6	0,6739
Substitute 4	Vessel 8	0,6973
Substitute 5	Vessel 11	0,7328
	Vessel 13	0,7699
	Vessel 5	0,8414
	Vessel 4	0,8816
	Vessel 14	0,9082
	Vessel 19	0,9592

Final Sample List

Sample 2	Vessel 3
Sample 4	Vessel 20
Sample 5	Vessel 17
Sample 7	Vessel 18
Sample 8	Vessel 10
Substitute 1	Vessel 12
Substitute 2	Vessel 7
Substitute 3	Vessel 6
Substitute 4	Vessel 8
Substitute 5	Vessel 11

MACRO-LEVEL EDITING

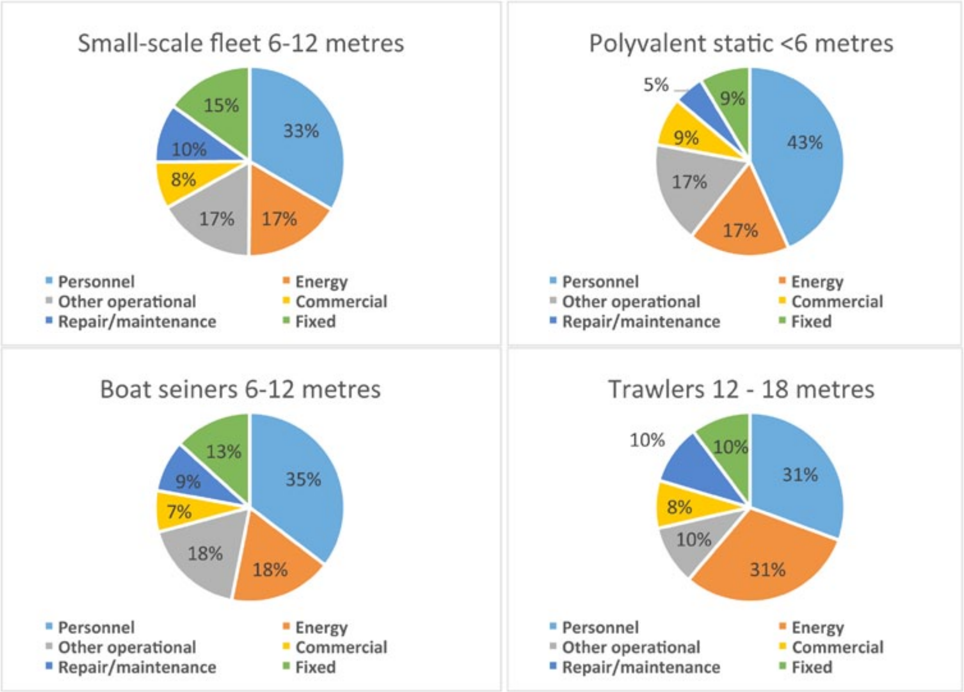
At this stage, a supplementary rapid cross-check can be applied to the output variables from each fleet segment against the range values. The first step should be to compare the average values per fleet segment against the previous year’s values. The average values per vessel and per day (only for activity-related variables) are assessed. A final cross-check can be conducted by using a series of graphic tools which allows for quick visual checking. Examples of this are provided below using pie and waterfall charts.

Pie charts

Based on the assumption that the proportion of the components of the cost structure are relatively stable, per fleet segment, each of the components has an expected ratio to the total. The pie chart allows for a quick examination of whether the components fall within the expected ratios. Here we show the comparison of ratios for four different segments: small-scale fleet 6–12 m; longline 12–18 m; boat seiners 6–12 m; and trawler 12–18 m.

FIGURE 13

Pie charts for comparison of relative cost ratios for each fleet segment

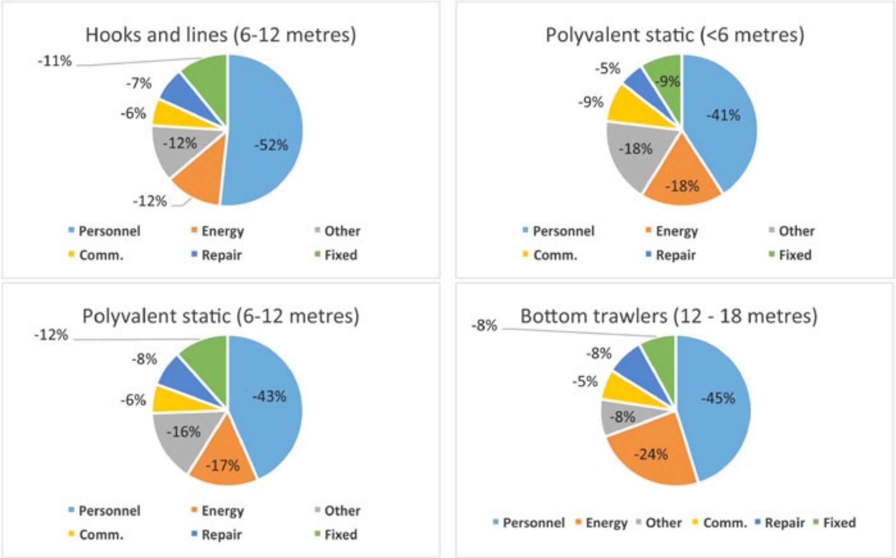


Waterfall charts

The waterfall charts show the values of revenue, the costs that are deducted and the final gross cash flow and are helpful for visualizing the relative costs.

FIGURE 14

Waterfall charts highlight the incremental steps as costs are subtracted from revenue with the final gross cash flow

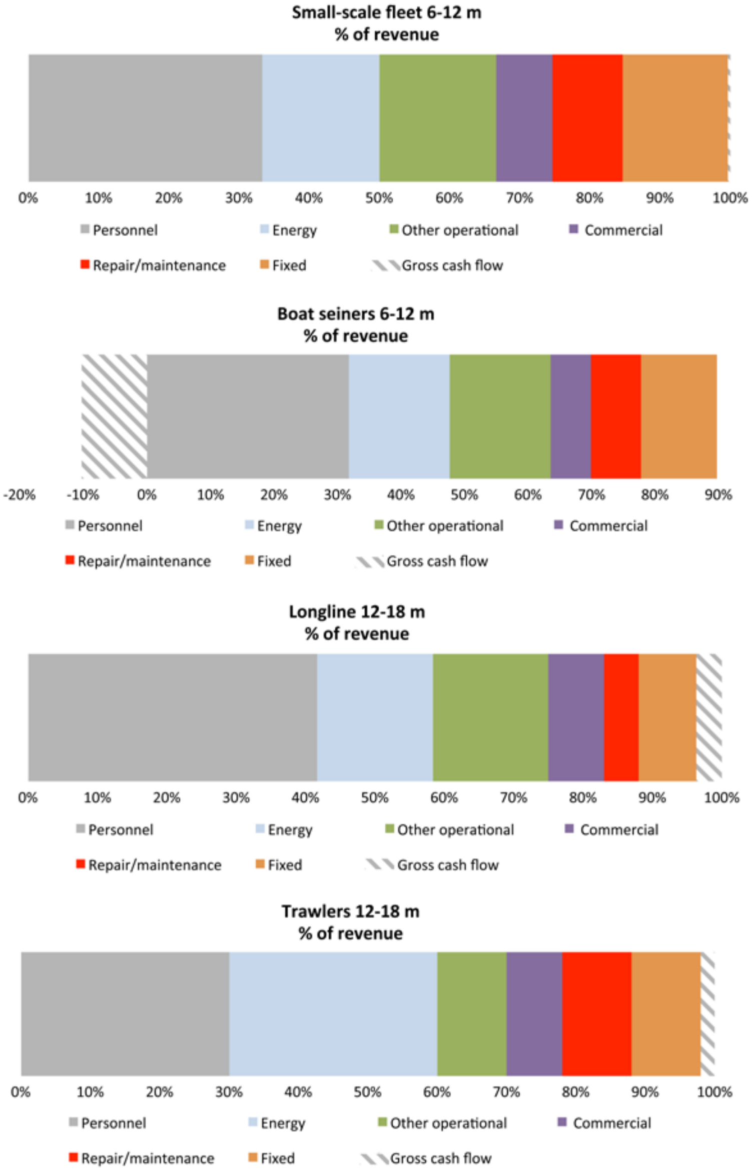


Horizontal stacked bar charts

A stacked bar chart of revenue, with profits versus costs, which allows you to gain snapshots of the final estimates.

FIGURE 15

Horizontal stacked bar charts provide an insight into the relative proportion of the costs to the revenues



QUALITY REPORTING

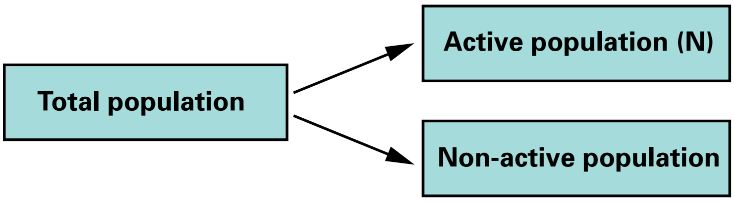
At the end of the phase "Quality check and treatment of the data" we recommend the preparation of a quality report that includes a detailed listing of the adjustments made to the raw data. This reporting is often a required component of the survey cycle because the number of interventions gives an indication of the data quality (STECF, 2009). Additionally, it facilitates the maintenance of a register of errors and the corrective actions taken (or not taken). This can be used in the future as a guide for resolving errors and improving the overall process.

6. Estimations from the sample

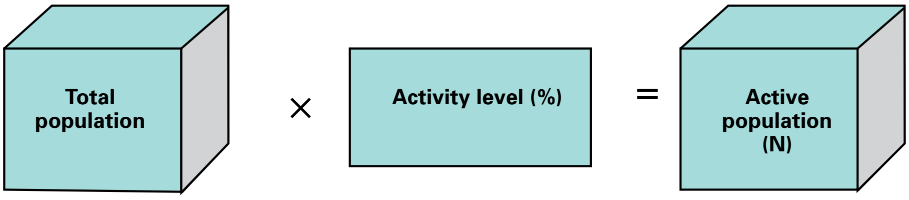
Following the completion of the earlier sequences and ending with the cross-checking and validation of the raw data, the next step is to raise the sample data up to the total active population through **statistical inference**.

Active population

The first action is to separate the active component of the population from the inactive. The active population is those vessels that conduct any fishing activity during the survey period. This action serves two aims: a) the active population is defined, which is used for making inferences; and b) an indicator of the total number of inactive vessels in the population may be calculated



The calculation of the active population (N) first requires the calculation of the activity level. This is simply the active sample divided by the number of sample units that were achieved (number of planned sample units less the non-responses). The active population (N) is the activity level multiplied by the total population. This is detailed below.



Inference

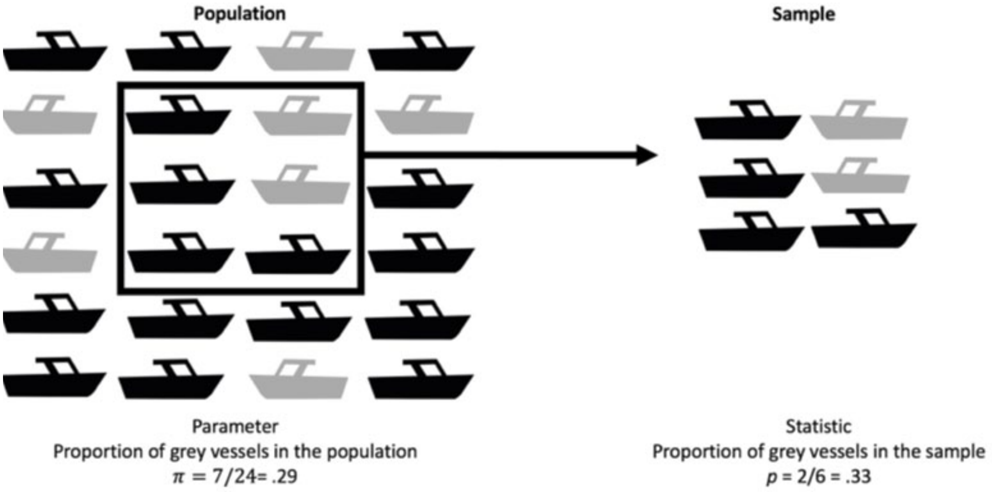
Recall from Chapter 4 Collecting the data, that the variable is the level used to make inferences and the disaggregated level of microvariables allows for more accurate quantification of the variables. This is because they have definitions more readily followed by the respondents.

A few statistical considerations warrant a reminder at this stage:

- Estimates are not the truth.
- We make an estimate of the population mean based on the sample and, intuitively, this is done by simply taking the sample mean.
- Necessarily, the average of the sample must be "similar" to the average of the population for the estimate to be meaningful.
- The central limit theorem states that the distribution of the mean of the sample tends towards normal distribution with increasing sample size, regardless of the distribution of the mean of the sample units.

FIGURE 16

Demonstration of the relationship between the sample and the population and how the sample represents the population

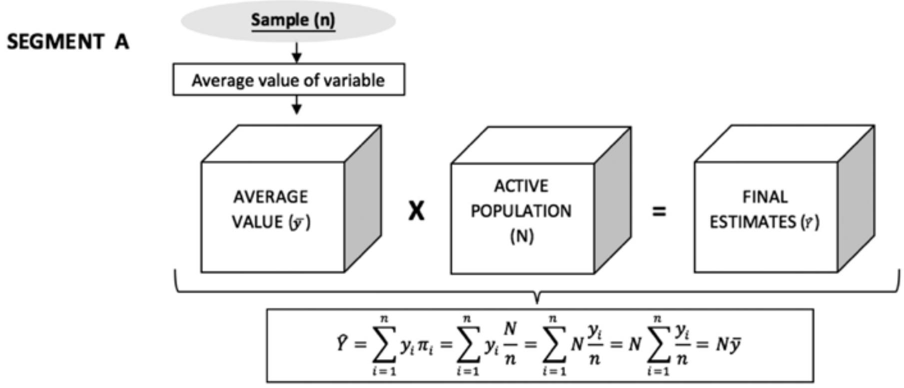


Statistical inference is about drawing conclusions for the population based on the sample, and understanding the quality of the estimated parameters. Quality can be measured as the distance between the estimated values and the true (actual) values. This can be measured through a variety of sampling error calculations, for example, the standard error, variance or CV. Estimates generally vary from one sample to another and this sampling variation suggests our estimate may be close (but they will never be equal). Standard error provides a measure of how un-true the estimate is compared to the population.

Considering only the active population of the segment, you attribute a weighting factor (π_i) to the sample units and then raise the sample data to the total population. In our case, simple random sampling with equal probabilities, where all of the elements of the populations are given an equal probability of being sampled, the weighting factor is equal for each sample within the segments (π_i = N/n). Exceptions to the calculation scheme, shown below in Figure 17, are found with the **capital costs**, namely, depreciation and opportunity costs, which are detailed in their own section below.

FIGURE 17

Raising the sample data to the total population (statistical inference) as applied to the variables, excluding capital costs



$$\hat{Y} = \sum_{i=1}^{n} y_i \pi_i = \sum_{i=1}^{n} y_i \frac{N}{n} = \sum_{i=1}^{n} N \frac{y_i}{n} = N \sum_{i=1}^{n} \frac{y_i}{n} = N\bar{y}$$

The formula below, the Horvitz–Thompson (HT) estimator of the total (Horvitz and Thompson, 1952), is used to raise the sample to the active part of the population:

$$\hat{Y} = \sum_{i=1}^{n} y_i \pi_i = \sum_{i=1}^{n} y_i \frac{N}{n} = \sum_{i=1}^{n} N \frac{y_i}{n} = N \sum_{i=1}^{n} \frac{y_i}{n} = N\bar{y} \qquad (6.1)$$

Where N is the active population of the stratum,
n is the sampled active population of the stratum
π_i = N/n in case of simple random sampling without replacement
$\bar{y}$ is the mean of the parameter of the stratum.

Example
Population of the stratum = 100
Sample = 20
Active sample (n) = 18
Activity level = active sample/sample = 18/20 = 0.90
Total active population (N) = 0.90 *100 = 90
Inactive vessels = 10
Average fuel cost = $10 (y)
Final estimate (total fuel costs) = average value ($10) * active population (90) = $900

Capital costs

Capital costs (depreciation and opportunity costs) are intangible costs, without an implied outflow of cash.

Depreciation costs

To calculate depreciation costs you should apply a mixed strategy where data from the survey are used to feed the perpetual inventory method (PIM). This method is recommended by OECD as well as by various national statistical offices. The PIM model calculates the values of the physical capital by aggregating the active fleet by age classes in the current year. A template model with full methodological details is available in the EC study No. FISH/2005/03 (EC 2006) and it is applied in many countries.

The model is based on some assumptions and requires the input of the following parameters:
a) price/capacity unit
b) depreciation rates
c) share of capital components in total value
d) asset lifespan
e) yield of long-term government bond.

The price/capacity unit (a) has a disproportionately large impact on the results of the model. It can be estimated through various sources, such as:

- new vessel construction prices
- second-hand price
- insurance values for the current year
- book values
- scrapping values
- ad hoc surveys.

Parameters b), c) and d) all have assumptions based on EC study No. FISH/2005/03. The depreciation function utilised assumes that renovations are conducted on the following schedule:

- Engine – 10 years
- Electronics – 5 years
- Other equipment – 7 years.

While the share of the capital components in total value are:

- Hull – 60%
- Engine – 20%
- Electronics – 10%
- Other equipment – 10%.

Opportunity costs

The implicit cost incurred when an alternative action is forgone but a payment is not made.

Opportunity costs can be calculated using the PIM, as outlined above, or they may be calculated as:

(fixed tangible asset value) × (real interest)

Where real interest (r) = $[(1 + i)/ (1 + \pi)] -1$.

And where i is the nominal interest rate of the year concerned and π is the inflation rate in the year concerned.

Number of fishing companies

Although the number of fishing companies is not queried in the survey, this information is often available in the fleet register. This information allows for the characterization of the ownership structure of the fleet; for example, if there are concentrations of ownership in certain segments. Shared ownership (between more than one person or company) should still be regarded as ownership by one company.

The ownership information extracted from the fleet register should be taken from the last day of the year for the previous year. For example, when the survey is being conducted in Year i, the list of vessels is obtained from the most up-to-date record which is from 31 December of year $i - 1$. Collecting this information at the same point in time every year allows you to have a reference point to compare any changes that may take place in the fleet.

7. Operational steps and practical advice for execution in spreadsheets

Here we provide a method for operationally organizing the work of the survey in sequential worksheets. Excel is used for examples, but the actual implementation can be customized and conducted in a programme of your choosing one that best accommodates the way in which you work.

The process presented is a logical progression from entering the fleet, selecting the sample, separating out non-responses, processing the data, producing final estimates and, lastly, the indicators. Within each of the steps details are provided whenever germane, with references made to the relevant chapters.

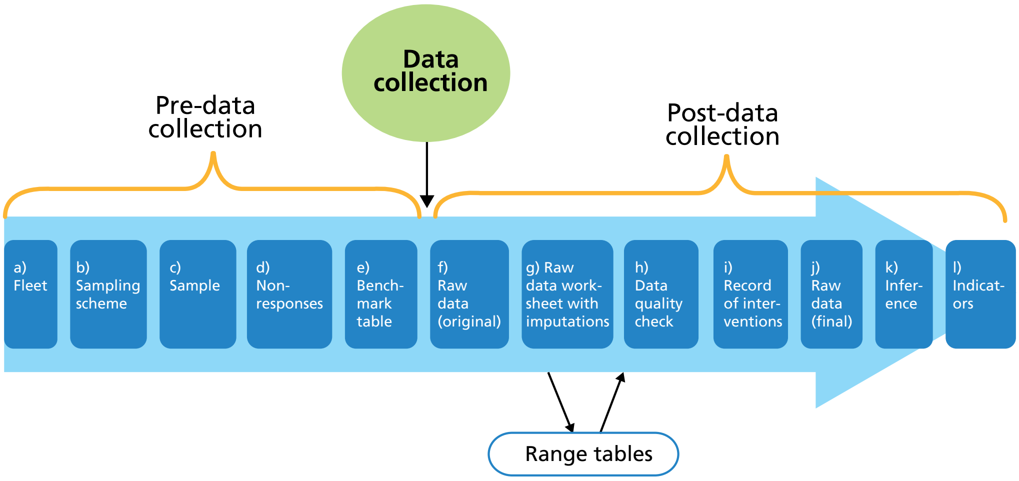
Broadly, the steps can be broken into two phases separated by a data collection phase (see Chapter 4):

- pre-data collection
- post-data collection.

Figure 18, Structure of the workbook, details the sheets within one Excel workbook that spans the entire survey process. In the context of Excel, it is important that the sheets are all located in the same workbook. This is so that they can be linked together with active cells. In particular, all the post-data collection sheets should be linked together with active formulas. This allows for ready navigation between sheets, but also ensures that any changes made with imputations are immediately reflected across all relevant sheets.

FIGURE 18

Schematic organization of the workbook with sheets presented in a logical work sequence



GENERAL GUIDELINES

This section briefly sets out the conventions we suggest using throughout the workbook. Specific items are not detailed here, but are rather presented and explained in their respective sections.

- Plan and set the worksheets carefully at the outset. This saves time and simplifies the procedural steps because you are able to move through them sequentially. Further, some of the steps are linked and need to be in place ahead of time so that the sheets can be properly referenced in the calculations.
- Set a “Legend” worksheet to define all of the codes that will be used during data entry (if applicable).
- Be sure that all cells are filled correctly with the correct unit of measurement and following the code specified in the worksheet “Legend”; be sure that “0” and “empty” cells are correctly codified.
- In other words, be sure that “0” corresponds to zero and not to an empty value.
- Keep note of all interventions made in a separate sheet where you (sheet h, above): identify the exact location of the problem; identify the type of problem it was and which action was taken (see details in the post-data collection section). Further, be sure to clearly mark any corrections in their respective worksheets.
- It is best to standardize all units of measure (the same units used across all relevant variables and across sheets). Further, it is best to use the base order of the units (i.e. kilograms, litres).

WORKSHEET DETAILS

Pre-data collection

a. Fleet

Prepare a table with all of the attributes of the fleet as listed in Table 2 on page 15.

A	B	C	D	E	F	G	H	I	J	K	L	M	
Vessel name	Vessel registration number	Ownership information (name or company name, telephone number, address, etc.)	Internal code	Port of registration	Fishing area	Gross tonnage (GT); alternatively, gross registered tonnage (GRT)	Length overall (LOA)	Horse power (hp and/or kW)	Year of construction of the vessel (hull)	Fishing gears	Main gear	Random number	Fleet segment

🟨 Optional

🟦 Mandatory

b. Sampling scheme

Prepare a table with each of the fishing segments and the number of vessels per fleet segment. Insert the coverage rate (see Section 3 Definition of the sample size on page 24) and the number of planned sample units (= coverage rate × number of vessels). The table should also be prepared with columns for achieved sample units and response rate; however, these will not be completed until after the survey has been conducted.

FISHING SEGMENT	Number of vessels	Coverage rate %	Number of planned samples	Achieved sample	Response rate
Area x Hooks and lines (6–12 metres)					
Area x Polyvalent static (<6 metres)					
Area x Polyvalent static (6–12 metres)					
Area x Surrounding nets with purse lines (6–12 metres)					
Area x Bottom trawlers (12–18 metres)					
Area y Hooks and lines (6–12 metres)					
Area y Polyvalent static (<6 metres)					
Area y Polyvalent static (6–12 metres)					
Area y Surrounding nets with purse lines (6–12 metres)					
Area y Bottom trawlers (12–18 metres)					
Total					

c. Sample

Make the selection of the sample from the fleet (a) following the method in Section 3, Selecting the sample. The selected sample units grouped by fleet segment should be placed into a dedicated sheet.

d. Non-responses

Should be recorded during the data collection process with the same reported details and the reason for non-response. The details allow for checking that the non-responses are not selective (i.e. over or under-representing a particular group in the population [Section “Inference” page 65]).

Vessel name	**Vessel registration number**	**Ownership information (name or company name, telephone number, address, etc.)**	**Internal code**	**Port of registration**	**Fishing area**	**Gross tonnage (GT); alternatively, gross registered tonnage (GRT)**	**Length overall (LOA)**	**Horse power (hp and/or kW)**	**Year of construction of the vessel (hull)**	**Fishing gears**	**Main gear**	**Random number**	**Fleet segment**	**Reason for non-response**

e. Benchmark table

Following the examples (see Benchmark tables) to create the next table. Note that the benchmark table values are based on previously reported data.

FISHING SEGMENT	**ANNUAL AVERAGE PER VESSEL**									
	Days at sea (total/year)		Fixed costs		Fuel price ($/Kg)		Price of production		Value of the vessel	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Area x Hooks and lines (6–12 metres)										
Area x Polyvalent static (<6 metres)										
Area x Polyvalent static (6–12 metres)										
Area x Surrounding nets with purse lines (6–12 metres)										
Area x Bottom trawlers (12–18 metres)										
Area y Hooks and lines (6–12 metres)										
Area y Polyvalent static (<6 metres)										
Area y Polyvalent static (6–12 metres)										
Area y Surrounding nets with purse lines (6–12 metres)										
Area y Bottom trawlers (12–18 metres)										

FISHING SEGMENT	**DAILY AVERAGE PER VESSEL**									
	Crew members engaged		Landings day (Kg)		Revenues day ($)		Gross cash flow		Fuel consumption (litres)	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Area x Hooks and lines (6–12 metres)										
Area x Polyvalent static (<6 metres)										
Area x Polyvalent static (6–12 metres)										
Area x Surrounding nets with purse lines (6–12 metres)										
Area x Bottom trawlers (12–18 metres)										
Area y Hooks and lines (6–12 metres)										
Area y Polyvalent static (<6 metres)										
Area y Polyvalent static (6–12 metres)										
Area y Surrounding nets with purse lines (6–12 metres)										
Area y Bottom trawlers (12–18 metres)										

FISHING SEGMENT	**COSTS AS % OF REVENUE**													
	Labour		Energy		Operational		Commercial		Maintenance		Fixed		TOTAL	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Area x Hooks and lines (6–12 metres)														
Area x Polyvalent static (<6 metres)														
Area x Polyvalent static (6–12 metres)														
Area x Surrounding nets with purse lines (6–12 metres)														
Area x Bottom trawlers (12–18 metres)														
Area y Hooks and lines (6–12 metres)														
Area y Polyvalent static }(<6 metres)														
Area y Polyvalent static (6–12 metres)														
Area y Surrounding nets with purse lines (6–12 metres)														
Area y Bottom trawlers (12–18 metres)														

➔ Data collection (see Chapter 4 Collecting the data on page 29)

Post-data collection

f. Raw data (original)

Keep the "original raw data" in a separate sheet exactly as they are reported. A second sheet of raw data should be created with imputations made there.

g. Raw data (working sheet with imputations)

This is the sheet referred to above in (f) where the imputations are made on the raw data. All imputations should be marked in a different colour so they are easily visualized. These imputations need to be recorded in sheet (i), below.

Planning your time – data quality check

This step requires the largest amount of time of the post-data collection steps. By methodically applying all of the data checks, a solid foundation is laid and this allows the final steps on inference to be completed with confidence and ease.

h. Data quality check

Order the data by fishing segment and LOA. The complete non-responses are then filtered out.

Apply the quality check workflow, including imputation (see Section 5 Quality check workflow on page 53).

It is best to apply these checks one segment at a time. This process begins at the variable level and proceeds to the microvariable level, when required. During the quality checks it is crucial that the sample data retain some identifying characteristics, such as geographical region, fleet segment, LOA and data collector (see Section 5 Quality check workflow on page 53). Although these characteristics may not be directly part of the quality check they provide the necessary context for the quality evaluator to make the assessments.

Range tables: As shown in the workflow diagram, range tables provide an important means of conducting a quality check. They are created from the raw data and have a two-pronged function: they allow for outliers to be spotted and they can also provide the mean value for imputation when PNRs are present and need to be corrected. They are actively linked to sheet (g).

1. Days at sea (DAS)		Reported values		
FISHING SEGMENT	No. of samples	Min	Max	Mean
Area x Hooks and lines (6–12 metres)				
Area x Polyvalent static (<6 metres)				
Area x Polyvalent static (6–12 metres)				
Area x Surrounding nets with purse lines (6–12 metres)				
Area x Bottom trawlers (12–18 metres)				

2. Revenues		Reported values		
FISHING SEGMENT	No. of samples	Min	Max	Mean
Area x Hooks and lines (6–12 metres)				
Area x Polyvalent static (<6 metres)				
Area x Polyvalent static (6–12 metres)				
Area x Surrounding nets with purse lines (6–12 metres)				
Area x Bottom trawlers (12–18 metres)				

3. Total costs		Reported values		
FISHING SEGMENT	No. of samples	Min	Max	Mean
Area x Hooks and lines (6–12 metres)				
Area x Polyvalent static (<6 metres)				
Area x Polyvalent static (6–12 metres)				
Area x Surrounding nets with purse lines (6–12 metres)				
Area x Bottom trawlers (12–18 metres)				

4. Engaged crew per vessel - Average number		Reported values		
FISHING SEGMENT	No. of samples	Min	Max	Mean
Area x Hooks and lines (6–12 metres)				
Area x Polyvalent static (<6 metres)				
Area x Polyvalent static (6–12 metres)				
Area x Surrounding nets with purse lines (6–12 metres)				
Area x Bottom trawlers (12–18 metres)				

5. Average price of product		Reported values		
FISHING SEGMENT	No. of samples	Min	Max	Mean
Area x Hooks and lines (6–12 metres)				
Area x Polyvalent static (<6 metres)				
Area x Polyvalent static (6–12 metres)				
Area x Surrounding nets with purse lines (6–12 metres)				
Area x Bottom trawlers (12–18 metres)				

6. Energy consumption (daily)		Reported values		
FISHING SEGMENT	No. of samples	Min	Max	Mean
Area x Hooks and lines (6–12 metres)				
Area x Polyvalent static (<6 metres)				
Area x Polyvalent static (6–12 metres)				
Area x Surrounding nets with purse lines (6–12 metres)				
Area x Bottom trawlers (12–18 metres)				

i. Record of interventions

All the interventions done on the original data have to be reported in this sheet.

j. Raw data (final)

The final output data, produced after conducting the steps of the data quality workflow and making any required imputations, are found in this sheet. The inferences are based on these values as are the calculations for the indicators.

k. Inference

Apply the steps described in Chapter 6, Inference.

l. Indicators

Make an excel sheet with the mean, variance, CV and standard error for each fleet segment. See Section 5 Errors in statistical data on page 47. The indicators are selected as described in Chapter 8 “Indicators: interpreting the results and disseminating information" and organized by fleet segment and variable group. Finally, ensure that you associate the CV and standard error to each of the variables.

For the purpose of the analysis, it is important that the sequence of total value -> average value -> average per day be followed with the statistical quality indicators, such as CV and standard error, at the end.

Area x ...

TOTAL VALUE	**AVERAGE PER VESSEL**					**AVERAGE PER DAY**					**Coefficient of Variation (CV)**					**Standard error**				
Variable	**Hooks and lines (6–12 metres)**	**Polyvalent static (<6 metres)**	**Polyvalent static (6–12 metres)**	**Surrounding nets with purse lines (6–12 metres)**	**Total**	**Hooks and lines (6–12 metres)**	**Polyvalent static (<6 metres)**	**Polyvalent static (6–12 metres)**	**Surrounding nets with purse lines (6–12 metres)**	**Total**	**Hooks and lines (6–12 metres)**	**Polyvalent static (<6 metres)**	**Polyvalent static (6–12 metres)**	**Surrounding nets with purse lines (6–12 metres)**	**Total**	**Hooks and lines (6–12 metres)**	**Polyvalent static (<6 metres)**	**Polyvalent static (6–12 metres)**	**Surrounding nets with purse lines (6–12 metres)**	**Total**
REVENUE																				
Value of landings																				
Employment																				
Employment on board (Total)																				
Total different individuals on board																				
Full Time Equivalent (FTE)																				
COSTS																				
Energy costs																				
Maintenance costs																				
Operational costs																				
Commercial costs																				
Fixed costs																				
Crew share (salary)																				
Total operating costs																				
ECONOMIC PERFORMANCE																				
Gross cash flow																				
Gross value added																				
Salary per crew member																				
Salary per FTE																				
CAPACITY																				
Volume of landings (Kg)																				
Effort (days at sea)																				
Energy consumption (l)																				
Fleet - number of vessels (Tot)																				
Fleet - number of vessels (active)																				
Capacity utilization (%)																				
Fleet - average LOA																				
Fleet - average HP																				
Value of the fleet																				
Investments																				

Part 3
TRANSFORMING INPUTS INTO STATISTICS

8. Indicators: interpreting the results and disseminating information

Interpreting the results allows you to create quantitative stories based on data. This can be done by using a multitude of models or techniques, but it can also be done simply by using indicators.

An indicator has been defined as: "a variable, pointer, or index related to a criterion. Its fluctuation reveals variations in key elements of sustainability in the ecosystem, the fishery resource or the sector and social and economic well-being. The position and trend of an indicator in relation to reference points indicate the present state and dynamics of the system. Indicators provide a bridge between objectives and actions" (FAO, 1999).

Interpreting the results by indicators has the following benefits:

- You don't need to be an econometrics expert to conduct the analysis, nor does your reader/end user require this knowledge.
- You complete the survey cycle in a coherent way with the survey methodology, using clear and simple techniques that can be precisely carried out.
- After dissemination interested experts can use the variables/indicators produced to make further, more specific, analyses.

Indicators can be either composed of a combination of variables (e.g. revenues = (income from landings + other income) or they can be a single variable (e.g. total number of people engaged (NUMBER) = number of crew members). Indicators can be presented by day, year, vessel, fisher, etc., allowing flexibility in the dissemination of the most relevant form. Further, they can be compared against reference points, time series or amongst segments. It is often most meaningful to present the indicators disaggregated by fleet segment and also with a total for the whole fleet.

Here we suggest indicators, providing a detailed explanation for each. However, additional indicators can be used when appropriate to your needs. An example of additional indicators which may be of interest (but are not included below) would be the total number of onshore workers. The same indicators for "employment on board" (shown below) can be replicated for onshore employment using variables 14–16 (Chapter 4 – Part E: Employment on page 35).

Engagement

Indicator: Ownership

Engagement of owner on the vessel and ownership structure. The distinction between levels of engagement is important: in some studies, the profitability of vessels where the owner was engaged in vessel operations was found to be higher than those without owner-engagement.

Methodology for the calculation
Single variable indicator – *directly obtained from variable*
Performance benchmark
As a rule of thumb, the smaller the vessel the more likely it is that the owner is engaged on board.
Deliberate omissions
In the case of multiple owners the relative share of ownership is not known.

Indicator: Engaged crew (on board)
The engaged crew is defined as the number of jobs on board. This includes temporary crew as well as rotational crew.
Methodology for the calculation
Single variable indicator – *directly obtained from variable*
Performance benchmark
Because it is difficult to assign an independent benchmark value, it is best to assess the trend against previous years or against similar fleet segments to give an indication of performance.

Indicator: Total number of individuals for the vessel (on board)
The number of different individuals working for the vessel: all people ever engaged in the reference period. For example, if there are two crew positions there may be three different people who, at some point, work in those crew positions.
Methodology for the calculation
Single variable indicator – *directly obtained from variable*
Performance benchmark
Because it is difficult to assign an independent benchmark value, it is best to assess the trend against previous years, or against similar fleet segments, to give an indication of performance.

Indicator: Average working hours per crew member
The average working hours accounting for all of the individuals ever engaged during the reference period.
Methodology for the calculation
[(Number of vessels per segment from the fleet register) × (average number of days at sea) × (average number of crew per vessel) × (average number of hours of work per crew member per day at sea)] / [(number of vessels per segment from the fleet register) × (average number of individuals)]
Performance benchmark
National or ILO Convention C180 (see text box below). Note that exceeding the benchmark limit is not an indication of positive performance; it just means the threshold has been surpassed.

Indicator: Working hours
This refers to any time on board the vessel that the crew is required to do work on account of the vessel, including fishing activity, but also any other activities like cleaning, repair and maintenance.
Methodology for the calculation
Single variable indicator – *directly obtained from variable*
Performance benchmark
Because it is difficult to assign an independent benchmark value, it is best to assess the trend against previous years, or against similar fleet segments to give an indication of performance.

Indicator: Total engaged crew

The total number of crew engaged across the whole fleet.

Methodology for the calculation

(Number of vessels per segment from the fleet register) × (average number of individuals)

Performance benchmark

Because it is difficult to assign an independent benchmark value, it is best to assess the trend against previous years, or against similar fleet segments to give an indication of performance.

Deliberate omissions

Onshore crew is not included in this indicator.

Full-time equivalent (FTE)

It is a unit that indicates the workload of an employed person in a way that makes workloads comparable.

Indicator: Engaged crew (FTE national) (on board)

Full-time equivalent (FTE) national is based on the national reference level for FTE working hours of the crew members on board the vessel and the working hours onshore. The FTE equals the ratio between the hours worked and the reference level. In some exceptional cases, it may be appropriate to apply a cap at the threshold value where any working hours per crew member in excess of the reference level are corrected downward to 1 FTE.

Methodology for the calculation

[(Number of vessels per segment from the fleet register) × (average number of days at sea) × (average number of crew per vessel) × (average number of hours of work per crew member per day at sea)] / (threshold*)

* The threshold is defined according to the features of the fishery sector in the country. For example, it can be the same value used in a similar sector (e.g. agriculture) or it can be the national definition of a full-time worker (e.g. 1 760 = 8h/day * 20 days/month * 11 months).

Performance benchmark

Because it is difficult to assign an independent benchmark value, it is best to assess the trend against previous years or against similar fleet segments to give an indication of performance.

Deliberate omissions

Onshore crew is not included in this indicator.

Indicator: Engaged crew (FTE harmonized)

Full-time equivalent (FTE) harmonized is based on a threshold of 2 000 hours per FTE.

Methodology for the calculation

[(Number of vessels per segment from the fleet register) × (average number of days at sea) × (average number of crew per vessel) × (average number of hours of work per crew member per day at sea)] / (threshold*)

* The threshold is set at 2 000 hours per year, because that is an international threshold commonly used in the agricultural sector and therefore can be considered as the standard unit of measurement for a full time working position.

Performance benchmark

Because it is difficult to assign an independent benchmark value, it is best to assess the trend against previous years, or against similar fleet segments, to give an indication of performance.

Deliberate omissions

Onshore crew is not included in this indicator. Note that in some countries typical working hours may regularly be above the 2 000 hour threshold and in these cases an additional adjustment of the calculation may be required.

Note on working hours from the ILO:

C180 Seafarers' Hours of Work and the Manning of Ships Convention, 1996. (No. 180)
Convention Concerning Seafarers' Hours of Work and the Manning of Ships (Entry into force: 08 Aug 2002). The convention was incorporated into EU law by the Council Directive 1999/63 of 21.6.1999.

Article 2
(b) the term "hours of work" means time during which a seafarer is required to do work on account of the ship;
(c) the term "hours of rest" means time outside hours of work; this term does not include short breaks.

Article 4
…that the normal working hours' standard for seafarers, like that for other workers, shall be based on an eight-hour day with one day of rest per week and rest on public holidays. However, this shall not prevent the Member from having procedures to authorize or register a collective agreement which determines seafarers' normal working hours on a basis no less favourable than this standard.

Article 5
ILO promotes working conditions of workers through international agreements and conventions.
The working hours of seafarers should adhere to the following principles:

The limits on hours of work or rest shall be as follows:
maximum hours of work shall not exceed:
– 14 hours in any 24-hour period; and
– 72 hours in any seven-day period; or

minimum hours of rest shall not be less than:
– ten hours in any 24-hour period; and
– 77 hours in any seven-day period.

Hours of rest may be divided into no more than two periods, one of which shall be at least six hours in length, and the interval between consecutive periods of rest shall not exceed 14 hours.

Activity

Indicator: Days at sea
The standardized fishing time spent actively fishing.
Methodology for the calculation
Single variable indicator – *directly obtained from variable*
Because it is difficult to assign an independent benchmark value, it is best to assess the trend against previous years or against similar fleet segments to give an indication of performance.
Deliberate omissions
Conventionally, the time spent running to and from fishing grounds is excluded, amongst other measures (FAO, 1969), however specific conventions for the calculation are applied depending on the required outputs and this cannot be easily generalized.

Indicator: Duration of fishing trip

Any continuous period of 24 hours (or part thereof) during which a vessel is at sea during the interview period with a minimum reporting of one day.

Methodology for the calculation

Single variable indicator – *directly obtained from variable*

Performance benchmark

Because it is difficult to assign an independent benchmark value, it is best to assess the trend against previous years or against similar fleet segments to give an indication of performance.

Indicator: Volume of landings (kg)

The total volume of catch landed.

Single variable indicator – *directly obtained from variable*

Performance benchmark

Because it is difficult to assign an independent benchmark value, it is best to assess the trend against previous years or against similar fleet segments to give an indication of performance.

Indicator: Self-consumption

Quantity of landings per trip not sold but used by the fishers for their own consumption or their families' consumption, including sharing of catch for crew remuneration.

Methodology for the calculation

Single variable indicator – *directly obtained from variable*

Performance benchmark

Because it is difficult to assign an independent benchmark value, it is best to assess the trend against previous years or against similar fleet segments to give an indication of performance.

Variable costs

Indicator: Personnel costs

Remuneration of crews.

Methodology for the calculation

Single variable indicator – *directly obtained from variable* when a fixed salary is paid. When share system is utilized this is calculated based on this (Part G, Chapter 5).

Performance benchmark

When present, the minimum wage for the sector, a comparable sector or the national minimum legal wage can be used as a benchmark value. Moreover, the trend can be assessed against previous years or against similar fleet segments to give an indication of performance.

Note on unpaid labour:

In the case where the owner(s) make up the only crew for a vessel then the remuneration and profit may be, in practical terms, merged. Although you would be calculating a figurative value, we still suggest you calculate the remuneration for the owner(s) so that there is no "unpaid" or unaccounted remuneration and the personnel costs include everyone on the vessel. For a specific analysis – if you need to separate out these cases – then you can keep the owner(s) remuneration "unpaid".

Indicator: Energy costs
Cost of consumed fuel and lubricants for the vessel.
Methodology for the calculation
Single variable indicator – *directly obtained from variable*
Performance benchmark
Because it is difficult to assign an independent benchmark value, it is best to assess the trend against previous years or against similar fleet segments to give an indication of performance.

Indicator: Energy consumption
Type and volume consumed (in litres) for fuel and lubricants used on the vessel.
Methodology for the calculation
Single variable indicator – *directly obtained from variable*
Performance benchmark
Because it is difficult to assign an independent benchmark value, it is best to assess the trend against previous years or against similar fleet segments to give an indication of performance.

Indicator: Other operational costs
All the purchased consumable inputs related directly or indirectly to fishing effort. Included are the bait, food to be consumed during the fishing trip, costs for delivery of any of these consumables, and components of any assets (gear or vessel) that are not related to maintenance and are consumed within the given year.
Methodology for the calculation
Single variable indicator – *directly obtained from variable*
Performance benchmark
Because it is difficult to assign an independent benchmark value, it is best to assess the trend against previous years or against similar fleet segments to give an indication of performance.
Deliberate omissions

Purchased consumables that are not consumed within the given year.

Indicator: Commercial costs
All the costs related to selling the production resulting from the activity of the vessel.
Methodology for the calculation
Single variable indicator – *directly obtained from variable*
Performance benchmark
Because it is difficult to assign an independent benchmark value, it is best to assess the trend against previous years or against similar fleet segments to give an indication of performance.

Indicator: Repair and maintenance costs
Costs for maintenance and repair to the vessel and gears – including both routine and extraordinary maintenance/repairs.
Methodology for the calculation
Single variable indicator – *directly obtained from variable*
Performance benchmark
Because it is difficult to assign an independent benchmark value, it is best to assess the trend against previous years or against similar fleet segments to give an indication of performance.

Indicator: Fixed costs

The costs not directly connected with operational activities (effort and catch/landings). Fixed costs do not change in relation to the level of activity of the vessel (they remain the same whether there is one trip per year or 200 trips per year).

Methodology for the calculation

Single variable indicator – *directly obtained from variable*

Performance benchmark

Because it is difficult to assign an independent benchmark value, it is best to assess the trend against previous years or against similar fleet segments to give an indication of performance.

Investments

Indicator: Investments

Value of the vessels at the end of the previous calendar year, plus any improvements to existing vessel/gear during the survey period.

Methodology for the calculation

The value of the vessel is calculated through the PIM model (Capital costs on page 65) while the improvements are calculated as a single variable indicator – *directly obtained from variable*

Performance benchmark

Because it is difficult to assign an independent benchmark value, it is best to assess the trend against previous years or against similar fleet segments to give an indication of performance.

Deliberate omissions

The value of the vessel, unless it was actually sold during the survey period, is only an estimate of what its value would be were it to be sold on the market.

Economic

Indicator: Revenues

Value of production measured as the sale of landed fishery products and income generated from the use of the vessel in other, non-commercial fishing activities.

Methodology for the calculation

Income from landings plus other income

Performance benchmark

Benchmarked against other fleet segments and/or years.

Deliberate omissions

Income from direct subsidies and fishing rights.

Indicator: Gross cash flow (GCF)

Significance: it represents the total amount of cash that the business generates each year. It can be considered as the main indicator for the feasibility of the survival of fishing companies or establishments in the short term.

When calculated as a percentage of revenue, it indicates the normal profitability of the operations and is of most interest to fishers because it represents the share of income they are left with at the end of the year.

A high ratio indicates that the sector has a low-cost operating model and reflects efficiency in turning inputs into outputs. A low ratio can indicate a low margin of security, i.e. a higher risk that declines in production, or increases in costs, may result in a net loss.

Methodology for the calculation

Revenues – (energy costs + personnel costs + repair and maintenance costs + other operational costs + commercial costs + fixed costs)

Performance benchmark
It can be calculated both in absolute terms and as a percentage of revenue. And, once data from previous years are available, you can assess the trend against previous years using three performance classes:

Change (year *i*)/(year *i – 1: y – 2*)	
Stp >= 105%	Improved
95% <= stp < 105%	Stable
Stp <= 95%	Deterioration

Indicator: Gross value added (GVA)
Net output of a sector after deducting intermediate inputs from all outputs.
Significance: it is a measure of the contribution to GDP made by an individual producer, industry or sector.
It also shows the percentage of revenues directed to remuneration, profit, opportunity cost and depreciation.
Methodology for the calculation
Revenues – (energy + repair and maintenance cost + other operational costs + commercial costs + fixed costs)
Performance benchmark
It can be calculated both in absolute terms and as a percentage of revenue. And, once data from previous years are available, you can assess the trend against previous years using three performance classes:

Change (year *i*)/(year *i – 1: y – 2*)	
Stp >= 105%	Improved
95% <= stp < 105%	Stable
Stp <= 95%	Deterioration

Indicator: Capital productivity (return on fixed tangible assets, ROFTA, %)
Measurement of the profits in relation to capital invested.
Significance: it is defined as a percentage of the return of the investment divided by the cost of the investment.
Methodology for the calculation
[(economic profit + opportunity cost of capital)/tangible asset value)] × 100
Performance benchmark
The higher the return, the more efficient the sector is in utilizing its asset base.
Deliberate omissions
Data on intangible assets (e.g. fishing rights).

Indicator: Economic profit
The difference between outputs or revenue and total (explicit) costs of inputs. Explicit costs include all operational costs, such as wages, energy, repair, depreciation and opportunity costs of capital.
Significance: it is the primary indicator of economic performance and is often used as a proxy of resource rent in fisheries. It provides an indication of the sector’s operating efficiency and, if expressed as a percentage of revenue, it captures the amount of surplus generated per unit of production. Economic profit differs from gross profit in that it includes depreciation and the opportunity costs of capital.
Methodology for the calculation
Economic profit = revenue – (operating costs + annual depreciation + opportunity costs of capital).

Performance benchmark

It can be calculated both in absolute terms and as a percentage of revenue (i.e. economic profit margin). When calculated as a percentage of revenue the performance can be classified as high, reasonable, or weak as demonstrated by this table (STECF, 2015):

>10%	High	Profitability is good and segment is generating a good amount of resource rent
0-10%	Reasonable	Segment is profitable, generating some resource rents
<0%	Weak	Segment is making losses; economic overcapacity

It can also be compared to other fleet segments, other similar sectors and, of course, against the performance of other years.

Indicator: Break-even revenues

Significance: it represents the point at which costs and revenues are equal.

Methodology for the calculation

(Fixed costs + opportunity costs of capital + depreciation)/[1−(personnel costs + energy costs + repair and maintenance costs + other variable costs)/revenue]

Indicator: Short -term performance (STP) (European Commission, 2005)

This is calculated after three years of data collection, but may also be calculated after the second year. It uses GCF as a short-term indicator in fisheries, and points out the feasibility of survival of a fishing company.

Significance: STP is a good short-term indicator in fisheries: positive GCF means that the company is capable of paying for all its operational costs and meeting at least part of its obligations to its creditors (bank). Empirical research shows that companies can survive short-term (one to two-year) losses as long as the cash flow remains positive.

Methodology for the calculation

(GCF in Year i)/(average GCF of (year $i - 1$: y − 2))

GCF 2004/average GCF 2002–2003

Performance benchmark

Three performance classes are distinguished:

Change (year *i*)/(year $i - 1: y - 2$)	
Stp >= 105%	Improved
95% <= stp < 105%	Stable
Stp <= 95%	Deterioration

Indicator: Medium -term indicator (MTI) (European Commission, 2005)

For the medium-term performance, the average realised revenues for the period (year *i*: y $i - 2$) are compared to the required break-even revenue.

Significance: the break-even revenue represents a level of production at which all costs are covered, so that the segment could implement regular replacement investments in the long run. It may be safely assumed that economic results at break-even level usually imply very satisfactory profitability in fiscal terms.

Methodology for the calculation

(average revenue in Year *i*)/(break-even revenue (year $i - 1$: y − 2))

Performance benchmark

Four performance classes are distinguished:

mti >= 105%	Strong	Vessels have no problems meeting all their financial obligations
95% <= mti < 105%	Reasonable	All costs are more or less covered, at low level of profits or losses
85% <= mti < 95%	Weak	Minor losses lead to deterioration of solvability
mti <= 85%	Very Weak	Losses, probably also in fiscal terms, have been incurred in previous years

Indicator: Depreciation costs

The reduction in the value of the capital invested with the passage of time, due in particular to wear and tear.

Methodology for the calculation

Calculated through the PIM model (Capital costs on page 65)

Performance benchmark

The benchmark of costs is not made by considering absolute values, but is measured relative to the other costs of the vessel and against the revenues. This relative value can then be benchmarked against the performance of other years.

Indicator: Opportunity costs

The implicit cost incurred when an alternative action is forgone but a payment is not made.

Methodology for the calculation

Calculated through the PIM model (Capital costs on page 65)

Performance benchmark

The benchmark of costs is not made by considering absolute values, but is measured relative to the other costs of the vessel and against the revenues. This relative value can then be benchmarked against the performance of other years.

Indicator: Debts

Percentage of assets covered by loan.

Methodology for the calculation

Single variable indicator – *directly obtained from variable*

Performance benchmark

It can be measured relative to other fleet segments or years.

Indicator: Subsidies to GVA (%)

Subsidies as a percentage of the GVA. It is a measure of the reliance on subsidies within the sector.

Significance: subsidies are monetary payments received from the government that can be in the form of money or monetary reimbursements for purchases that modify the potential profits by the industry in the short, medium or long term.

Methodology for the calculation

(GVA/revenues) × 100

Performance benchmark

It can be measured relative to other fleet segments or years.

Deliberate omissions

Indirect subsidies.

Socio-economic

Indicator: Remuneration per FTE

Remuneration is among the most important indicators to estimate; it is also the most challenging to estimate.

Significance: it provides the main measure of the contribution to livelihoods for the fishers and, being often paid by crew shares proportional to the income, it is also proportional to the overall economic performance.

Methodology for the calculation

Personnel costs*/FTE

*includes unpaid labour and excludes taxes

Performance benchmark

It is measured in absolute terms and relative to a minimum wage. The minimum wage can be set nationally or within the same or similar sector (average or legal wage).

Deliberate omissions

Benefits, either monetary (bonus) and/or non-monetary (e.g. fish for self-consumption).

Crew share remuneration:

Remuneration made through crew shares is common in fisheries around the world. The system allows for sharing both the risks and profits of fishing activity between the fishers and the owners. Moreover, the system is based on the traditions and culture of fishing communities. Basically, crew shares are calculated in one of two parent forms – as a straight percentage of revenues, or as a percentage of revenues minus activity costs. The first formula was the original form of the calculation and is still found today in fisheries where costs are low compared to revenues. The second formula is applied in fisheries with higher costs. Typically, when remuneration has been collected as a single monetary value it has been the most challenging socio-economic information to collect. But, as we propose here, when the crew share system is in place it is better to collect the formula used in the calculation and combine it with the relevant costs and revenues data to calculate a more accurate value. In this way you are able to side-step the need to collect the sensitive (and often inaccurate) monetary value. In this context, crew remuneration should not be considered as a classic input, but rather as an output of the activity. The use of crew remuneration as an indicator is particularly relevant for small-scale fisheries because the method for the calculation of crew remuneration is based on the common operating practice of using crew shares.

Indicator: Labour productivity (monetary value/FTE)

Output per unit of labour, calculated as GVA (measure of output) by full-time equivalent (FTE) employment (unit of labour input). Expressed in monetary value per full-time equivalent, nominal value.

Significance: it is a measure of productivity as a result of labour inputs that takes into account both the hours worked and the people involved.

Methodology for the calculation

GVA/FTE

Performance benchmark

It can be calculated both in absolute terms and as percentage of revenue. And, once data from previous years are available, you can assess the trend against previous years using three performance classes:

Change (year i)/(year $i - 1: y - 2$)	
Stp >= 105%	Improved
95% <= stp < 105%	Stable
Stp <= 95%	Deterioration

Demographics

Indicator: Age of crew members

Methodology for the calculation

Single variable indicator – *directly obtained from variable*

Performance benchmark

It can be assessed against the average age of the population or against similar sectors (e.g. agriculture).

It is also meaningful to assess the trend over the years.

Indicator: Literacy level of crew members
Methodology for the calculation
Single variable indicator – *directly obtained from variable*
Performance benchmark
It can be assessed against the minimum legal literacy level of the country or against the average literacy rate of the population or against similar sectors (e.g. agriculture). It is also meaningful to assess the trend over the years.

Indicator: Nationality of crew members
Methodology for the calculation
Single variable indicator – *directly obtained from variable*
Performance benchmark
It can be assessed against similar sectors (e.g. agriculture). It is also meaningful to assess the trend over the years.

Indicator: Household size of crew members
Methodology for the calculation
Single variable indicator – *directly obtained from variable*
Significance: It provides an indication of the total number of people who rely on the sector.
Performance benchmark
It can be assessed against the average size in the country or in similar sectors (e.g.agriculture). It is also meaningful to assess the trend over the years.

Indicator: Number of household members engaged in fishing
Methodology for the calculation
Single variable indicator – *directly obtained from variable*
Significance: It provides an indication of the total number of people who rely on the sector.
Performance benchmark
Because it is difficult to assign an independent benchmark value, it is best to assess the trend against previous years, or against similar fleet segments to give an indication of performance.

Indicator: Number of household members engaged in gleaning
The number of household members involved in gleaning or harvesting activities (e.g. clam gleaning) activity which may not necessarily be related to that of the survey unit.
Methodology for the calculation
Single variable indicator – *directly obtained from variable*
Performance benchmark
Because it is difficult to assign an independent benchmark value, it is best to assess the trend against previous years or against similar fleet segments to give an indication of performance.

Indicator: Number of family members engaged in onshore activities
Methodology for the calculation
Single variable indicator – *directly obtained from variable*
Significance: It provides an indication of the total number of people who rely on the sector.
Performance benchmark
Because it is difficult to assign an independent benchmark value, it is best to assess the trend against previous years or against similar fleet segments to give an indication of performance.

Indicator: Age of the family

Methodology for the calculation

Single variable indicator – *directly obtained from variable*

Performance benchmark

It can be assessed against the average age of the population or against similar sectors (e.g. agriculture).

It is also meaningful to assess the trend over the years.

Indicator: Literacy level of the family

Methodology for the calculation

Single variable indicator – *directly obtained from variable*

Performance benchmark

It can be assessed against the minimum legal literacy level of the country or against the average literacy rate of the population or against similar sectors (e.g. agriculture). It is also meaningful to assess the trend over the years.

Indicator: Proportion of total household income from fishing activity

Methodology for the calculation

Single variable indicator – *directly obtained from variable*

Significance: It provides an indication of the importance of the sector for livelihoods.

Performance benchmark

Because it is difficult to assign an independent benchmark value, it is best to assess the trend against previous years or against similar fleet segments to give an indication of performance.

Technical indicators

Indicator: Capacity utilization (CU)

The ratio of actual to potential output. The most accurate calculation is made through econometric methods, for example with data-envelopment analysis. The more practical (but less accurate) calculation is calculated here as actual sea days to potential sea days.

Significance: It represents the degree to which the vessel is fully utilized. From an input-based perspective, this may relate to the ratio of the sea days to the number of days the boat could potentially be at sea under normal working conditions (Ward *et al.*, 2004).

Methodology for the calculation

Days at sea/maximum days at sea*

**based on the average activity of the top 10 percent of the most active vessels in that particular fleet segment.*

Performance benchmark

It can be measured relative to other fleet segments or years.

Deliberate omissions

Non-customary and non-usual operating procedures.

Captain and crew skills that are components of CU (Kirkley *et al.*, 1999).

Indicator: Inactivity level (IL)

The proportion of the total fleet population that is inactive (i.e. with no fishing activity during the survey period).

Methodology for the calculation

Number of inactive vessels in fleet/total fleet

Performance benchmark

It can be measured relative to other fleet segments or years.

Environmental indicator

Indicator: Fuel efficiency of seafood landing

Landing per tonne of fuel consumed. It is an environmental indicator that measures the efficiency of harvesting in terms of fuel consumption.

Methodology for the calculation

Landings (tonnes)/fuel consumption (tonnes)

Performance benchmark

It can be assessed against other fleet segments or years or in cross-sectoral comparisons relative to the average age of the population or against similar sectors (e.g. agriculture). It is also meaningful to assess the trend over the years.

9. Example of data presentation and utilization

The following example shows, in a practical way, how to analyse and interpret results and use them to provide advice to the sector and to policy makers. Please note that because the indicators selected and the analysis performed depend on the context and desired insights, they need to be customized for each analysis.

Beyond the hypothetical example presented here, three documents may be used as references to follow the way in which this methodology has been applied in selected countries, the manner in which results were presented and the policy advice that was formulated. These three documents are: A subregional analysis of the socio-economic situation of the Eastern Mediterranean fisheries (FAO, 2016); Socio-economic analysis of Egyptian fisheries: options for improvement (FAO, 2014); and socio-economic analysis of the Lebanese fishing fleet (FAO, 2013).

Context

Country	Utopia
Direct contribution of fishing sector to GDP	1%
Unemployment rate	18%
Income level	Lower-middle income
Population below poverty line	26%
Legislation/management controls	Input control (vessels have to be licensed; no further licences to be allocated) no output control (no spatial/temporal limits)
Subsidies	Direct subsidies on fuel
Minimum legal wage	$333 per month*
Overall status of stocks	10/11 commercially important stocks listed as overexploited

* *currency presented in US$ for the purpose of example*

Description

In 2015, the fishing fleet of Utopia comprised 780 vessels, 600 of which were active; 2 360 FTE crew were employed while a total of 3 120 people were engaged. Across all segments, crew were paid according to a crew share system. There were four fleet segments: small-scale fleet <6 m; small-scale fleet 6–12 m; bottom trawlers 12–18 m; bottom trawlers 18–24 m. Trawlers were the mainstay of the fleet of Utopia both in terms of activity, capacity and employment.

Small-scale vessels used, on average, four different static gear types throughout the year; the most used gears were the fixed net and longlines. The average fishing trip lasted less than 24 hours. Normally, the owner was also a crew member and this situation is particularly relevant for the vessels <6 m.

For the trawl fleet segment (18–24 m) the average fishing trip lasted one week and targeted deep-water species that were frozen at sea. The small trawl segment (12–18 m) had short fishing trips lasting less than 36 hours and targeted shallow-water species.

The total costs for all the segments was $80.5 million and this included capital costs of $80.5 million. Three of the four segments generated profits, while the segment of trawlers 12–18 m, generated negative profits. The entire sector generated a net profit of $3.3 million. The trawl segments were 91 percent of the total costs for the sector. The two bottom trawler segments accounted for 75 percent of the fleet in terms of number of vessels; 89 percent of the total revenue generated; and 80 percent of FTE engaged crew.

Employment and remuneration

Across the fleet an average of 3.9 people, FTE, were employed per vessel and this varied between the segments from 1.6 people in the small-scale fleet (<6 m) to 6.0 people in the bottom trawler (18–24 m) segment.

The small-scale fleet (6–12m) and bottom trawlers (12–18m) employed similar numbers with an average of 3.8 and 3.3 per vessel, respectively.

The average remuneration per FTE was $8 451 annually, which is equivalent to $45.9 per day. The highest earnings were generated by the segment bottom trawlers (18 – 24 m) with remuneration per FTE of $12 083 annually; the second highest was for the small-scale fleet (6–12 m) of $7 500; then bottom trawlers (12– 8 m) with $5 900 and finally the small-scale fleet (< 6 m) with $4 000 per FTE. As noted above, for the small-scale vessels, the owner is also a crew member and the remuneration should be summed up to the profit for the vessel for a better representation of the owners' earnings.

For the whole fleet the average remuneration is 2.1 times the minimum wage. The segment bottom trawlers (18–24 m) had an average remuneration 3.0 times the minimum wage, followed by the segment small-scale fleet (6–12 m) at 1.9 times; bottom trawlers (12–18 m) at 1.5 times and finally the small-scale fleet (< 6 m) segment with 1.0 times the minimum wage. As evidenced by the comparison of earnings to minimum wage, employment in the fishing sector offers a competitive wage, even in the case of the smallest vessels.

Activity

The total effort of the entire fleet was 106 000 days at sea and on average 177 days were spent at sea annually, per vessel. The segment bottom trawlers (12–18 m) was the most active and operated, on average, 200 days per year. The other trawler segment (18–24 m) was less active with 133 sea days (on average). The small-scale fleet (6–12 m) spent an average of 180 days at sea and, finally, the small-scale fleet (<6 m) spent an average of 160 days at sea.

The capacity utilization (CU) was ranked in the following order:

1. Bottom trawlers (12–18 m): days at sea = 0.95
2. Bottom trawlers (18– 24 m): days at sea = 0.85
3. Small-scale fleet (< 6 m): days at sea = 0.80
4. Small-scale fleet (6–12 m): days at sea = 0.60

The calculation is based on the total number of potential days for each segment. This means that although the days are higher for the SSF segment 6-12 m, the potential number of days are also higher and so the CU is a lower value. Inversely, the SSF segment under 6 m is performing better for CU because this segment is closer to the maximum number of days.

This demonstrates that the small-scale vessels in both segments are operating far below their potential, while both of the trawl segments are operating close to their full potential, as calculated by CU. The inactivity level was 23 percent for the entire fleet, but was highest for the small-scale segment. For the small-scale (<6 m) fleet, two-thirds of the vessels were inactive, while for the small-scale (6–12 m) fleet the inactivity level was 17 percent. In this case, CU and inactivity level are inversely proportional to each other.

Cost structure

Fishing fleet segments are characterized by cost structures that impact the overall economic performance of the vessels and, in addition to the targeted species, characterize the fishery. An analysis of cost structure often helps in identifying potential inefficiencies in the fleet (FAO, 2016).

The comparison of the breakdown of costs showed that labour and energy were in general the primary costs associated with fishing, although their proportion varied between segments. Together, labour and energy costs account for 60 percent of the total costs for the fleet. Labour represented the main cost item for both the small-scale segments, while energy costs were the main cost item for the trawlers. This was particularly the case for the bottom trawlers (12–18 m) segment where energy accounted for 39 percent of the costs. It is worth noting that although fuel was subsidized in Utopia, energy costs still made up a large share of the costs.

Economic performance

GCF is a good short-term indicator in fisheries. Positive GCF means that the vessel is capable of paying for all of its operational costs. Net profit can be viewed as a measure of the return to the vessel owner's equity. The total GVA by the sector is the GCF plus wages paid to labour (crew share). The GVA is the value of landings minus the cost paid to other (supplying) industries. The ROFTA indicates how profitable a sector is relative to its total assets. The higher the return, the more efficient is the sector in utilising its asset base.

The GCF was positive for all segments of the fleet, while economic profit was also positive for all but one segment (bottom trawlers, 12–18 m), which showed negative profits. The annual value, on average for one vessel, was $12 142 for GCF and the economic profit was $5 542. The GVA was $45 383. In terms of GCF, the highest value was $22 500, generated per year by both the segments bottom trawlers (18–24 m) and small-scale fleet (6–12 m) owing to streamlined cost structures. Although they have very different revenues, they generated the same GCF in the end.

The GVA is the GCF plus personnel costs; owing to higher labour costs in the large trawler fleet this was the highest amongst the four segments (at nearly two times the average value) while the small-scale fleet 6–12 m was ranked second (just above the average value). Both the smallest LOA class of the small-scale and trawl segments had values far below average. In terms of economic profit, the small-scale 6–12 m showed the highest value with $18 100 while bottom trawlers showed a negative value at –$2 000. The best performance for ROFTA was found in the small-scale fleet segments, and, in particular, small-scale 6–12 m had the highest return on investment at 32 percent. The small-scale segments were the more fuel-efficient segments. The highest efficiency value was the small-scale <6 m segment with 0.6 tonnes of production per one tonne of fuel.

Recommendations

From the analysis of the socio-economic data in this example, the main area for management attention is the trawlers 12–18 m segment. The overall lack of regulations and the operation of too many vessels in this segment (half of the total fleet) generated poor economic performance in this segment and limited the capacity of the small-scale segments.

The small-scale 6–12 m segment had significantly better performance than the trawlers 12–18 m, generating, for example, GCF five times higher and FTE remuneration 27 percent higher. Moreover, the small-scale 6–12 m segment employs more people per vessel.

We recommend spatial and temporal limitations for the trawlers 12–18 m and supporting the conversion of the trawl gear into passive gear types. For example, the trawlers could be excluded from fishing within five nautical miles of the shore to allow greater access for the small-scale segments. Further, temporal limitations, such as no trawling activity during the weekend could also be introduced. The government could also offer economic incentives for the conversion of trawl gear to passive gear and this would be further reinforced by reducing or removing fuel subsidies. In this way, the total fleet size would not be increased; there would simply be a shift in the fleet capacity from trawlers to small-scale.

In light of the high unemployment rate in the country, the move towards more activity in the small-scale segments would help increase employment in coastal communities which are often remotely situated and, consequently, economic opportunities may be limited.

After the preparation of an initial management plan in which the activities of the various fleet segments in Utopia have been separated temporally and/or spatially, detailed managements plans for every fishery could be developed. In this respect the following summary table could represent some recommendations for management in order to apply the EAF in Utopia:

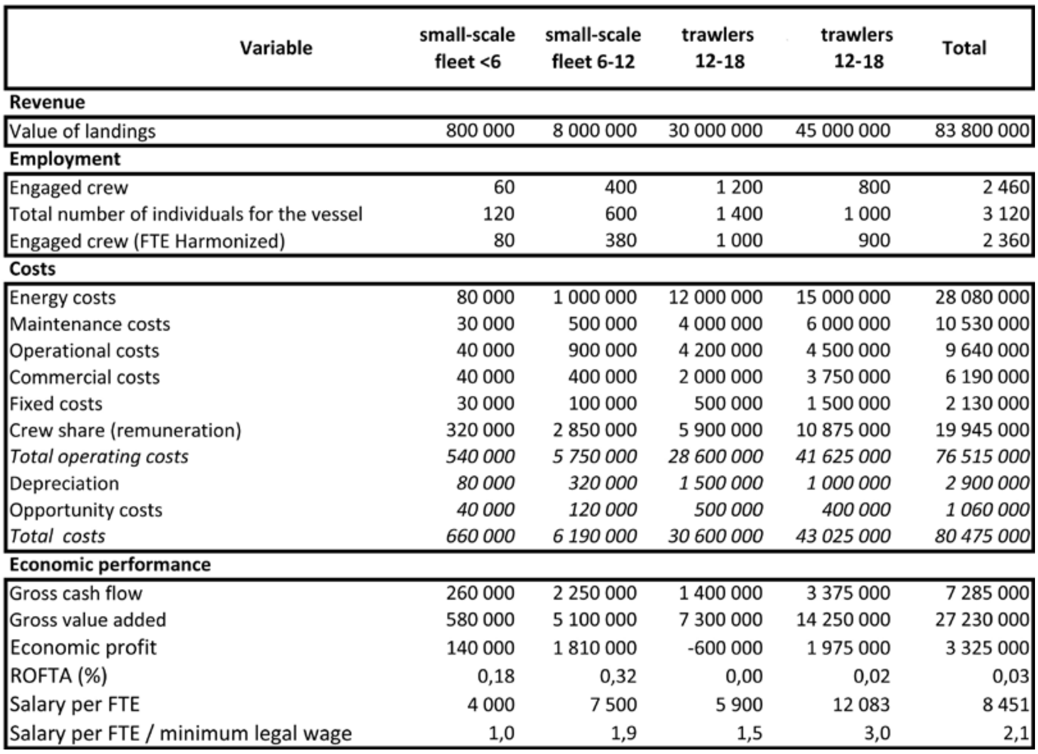
Recommendations – fleet structure	**Priority**
Incentivize conversion of trawl into small-scale	*High*

Recommendations – technical measures	**Priority**
Develop some spatial and temporal closures to limit conflicts between trawl and small-scale fishery	*High*
Introduce a minimum distance of five nautical miles to fish from the shore for trawlers (spatial zoning)	*High*
Introduce limit for no fishing on weekends for trawlers	*High*

Recommendations - financial aspects	**Priority**
The Utopian fisheries have to be less dependent on the fuel subsidies	*High*
Reduce the high risk for remuneration resulting from dependence on fuel subsidies	*Medium*
Introduce incentives for conversion from trawl to small-scale gears	*High*

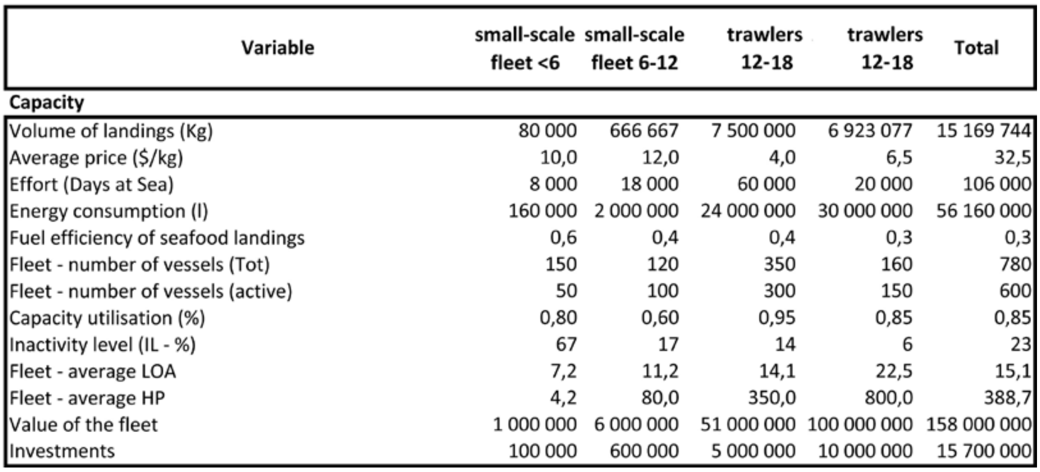
Indicator tables

General 1



Variable	small-scale fleet <6	small-scale fleet 6-12	trawlers 12-18	trawlers 12-18	Total
Revenue					
Value of landings	800 000	8 000 000	30 000 000	45 000 000	83 800 000
Employment					
Engaged crew	60	400	1 200	800	2 460
Total number of individuals for the vessel	120	600	1 400	1 000	3 120
Engaged crew (FTE Harmonized)	80	380	1 000	900	2 360
Costs					
Energy costs	80 000	1 000 000	12 000 000	15 000 000	28 080 000
Maintenance costs	30 000	500 000	4 000 000	6 000 000	10 530 000
Operational costs	40 000	900 000	4 200 000	4 500 000	9 640 000
Commercial costs	40 000	400 000	2 000 000	3 750 000	6 190 000
Fixed costs	30 000	100 000	500 000	1 500 000	2 130 000
Crew share (remuneration)	320 000	2 850 000	5 900 000	10 875 000	19 945 000
Total operating costs	*540 000*	*5 750 000*	*28 600 000*	*41 625 000*	*76 515 000*
Depreciation	*80 000*	*320 000*	*1 500 000*	*1 000 000*	*2 900 000*
Opportunity costs	*40 000*	*120 000*	*500 000*	*400 000*	*1 060 000*
Total costs	*660 000*	*6 190 000*	*30 600 000*	*43 025 000*	*80 475 000*
Economic performance					
Gross cash flow	260 000	2 250 000	1 400 000	3 375 000	7 285 000
Gross value added	580 000	5 100 000	7 300 000	14 250 000	27 230 000
Economic profit	140 000	1 810 000	-600 000	1 975 000	3 325 000
ROFTA (%)	0,18	0,32	0,00	0,02	0,03
Salary per FTE	4 000	7 500	5 900	12 083	8 451
Salary per FTE / minimum legal wage	1,0	1,9	1,5	3,0	2,1

General 2



Variable	small-scale fleet <6	small-scale fleet 6-12	trawlers 12-18	trawlers 12-18	Total
Capacity					
Volume of landings (Kg)	80 000	666 667	7 500 000	6 923 077	15 169 744
Average price ($/kg)	10,0	12,0	4,0	6,5	32,5
Effort (Days at Sea)	8 000	18 000	60 000	20 000	106 000
Energy consumption (l)	160 000	2 000 000	24 000 000	30 000 000	56 160 000
Fuel efficiency of seafood landings	0,6	0,4	0,4	0,3	0,3
Fleet - number of vessels (Tot)	150	120	350	160	780
Fleet - number of vessels (active)	50	100	300	150	600
Capacity utilisation (%)	0,80	0,60	0,95	0,85	0,85
Inactivity level (IL - %)	67	17	14	6	23
Fleet - average LOA	7,2	11,2	14,1	22,5	15,1
Fleet - average HP	4,2	80,0	350,0	800,0	388,7
Value of the fleet	1 000 000	6 000 000	51 000 000	100 000 000	158 000 000
Investments	100 000	600 000	5 000 000	10 000 000	15 700 000

Average per vessel

TOTAL VALUE	AVERAGE PER VESSEL

Variable	small-scale fleet <6	small-scale fleet 6-12	trawlers 12-18	trawlers 12-18	Total
Revenue					
Value of landings	16 000	80 000	100 000	300 000	139 667
Employment					
Engaged crew	1,2	4,0	4,0	5,3	4,1
Total number of individuals for the vessel	2,4	6,0	4,7	6,7	5,2
Engaged crew (FTE Harmonized)	1,6	3,8	3,3	6,0	3,9
Costs					
Energy costs	1 600	10 000	40 000	100 000	46 800
Maintenance costs	600	5 000	13 333	40 000	17 550
Operational costs	800	9 000	14 000	30 000	16 067
Commercial costs	800	4 000	6 667	25 000	10 317
Fixed costs	600	1 000	1 667	10 000	3 550
Crew share (remuneration)	6 400	28 500	19 667	72 500	33 242
Total operating costs	*10 800*	*57 500*	*95 333*	*277 500*	*127 525*
Depreciation	1 600	3 200	5 000	6 667	4 833
Opportunity costs	800	1 200	1 667	2 667	1 767
Total costs	*13 200*	*61 900*	*102 000*	*286 833*	*134 125*
Economic performance					
Gross cash flow	5 200	22 500	4 667	22 500	12 142
Gross value added	11 600	51 000	24 333	95 000	45 383
Salary per crew member	5 333	7 125	4 917	13 594	8 108
Salary per FTE	4 000	7 500	5 900	12 083	8 451
Capacity					
Volume of landings (Kg)	1 600	6 667	25 000	46 154	25 283
Effort (Days at Sea)	160	180	200	133	177
Energy consumption (l)	3 200	20 000	80 000	200 000	93 600
Value of the fleet	20 000	60 000	170 000	666 667	263 333
Investments	2 000	6 000	16 667	66 667	26 167

Average per day

TOTAL VALUE	AVERAGE PER DAY

Variable	small-scale fleet <6	small-scale fleet 6-12	trawlers 12-18	trawlers 12-18	Total
Revenue					
Value of landings	100	444	500	2 250	791
Employment					
Engaged crew	1,2	4,0	4,0	5,3	4,1
Total number of individuals for the vessel	2,4	6,0	4,7	6,7	5,2
Engaged crew (FTE Harmonized)	1,6	3,8	3,3	6,0	3,9
Costs					
Energy costs	10	56	200	750	265
Maintenance costs	4	28	67	300	99
Operational costs	5	50	70	225	91
Commercial costs	5	22	33	188	58
Fixed costs	4	6	8	75	20
Crew share (remuneration)	40	158	98	544	188
Total operating costs	*68*	*319*	*477*	*2 081*	*722*
Depreciation	10	18	25	50	27
Opportunity costs	5	7	8	20	10
Total costs	*83*	*344*	*510*	*2 151*	*759*
Economic performance					
Gross cash flow	33	125	23	169	69
Gross value added	73	283	122	713	257
Economic profit	18	101	-10	99	31
Salary per FTE	25	42	30	91	48
Capacity					
Volume of landings (Kg)	10	37	125	346	143
Energy consumption (l)	20	111	400	1 500	530
Cost structutre					
Labour costs	48%	46%	19%	25%	25%
Energy costs	12%	16%	39%	35%	35%
Other operating costs	21%	31%	35%	37%	35%
Capital costs	18%	7%	7%	3%	5%
Total costs	100%	100%	100%	100%	100%

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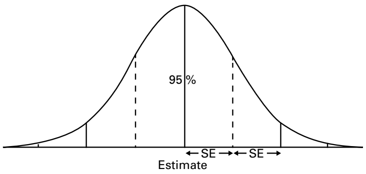
Glossary

Active population	the part of the fleet population that conducted at least one day of fishing activity in the survey period.
Bias	aspects of measurement or sample selection which tend to increase the difference between sample statistics and the population parameters.
Capital costs	capital costs (depreciation and opportunity costs) are intangible costs, without an implied outflow of cash.
Census	a study including (or intending to include) all elements of a population, not just a sample.
Central limit theorem (CLT)	the CLT states that as the sample size (that is, the number of values in each sample) gets large enough, the sampling distribution of the mean is approximately normally distributed. This is true regardless of the shape of the distribution of the individual values in the population. (Levine *et al*., 2008).
Commercial fishing	the harvesting of seafood products, either in whole or in part, for sale, barter or trade. It does not include any sport or recreational fishing activity.
Conditional formatting	Excel enables you to highlight cells with a certain colour, depending on the cell's value.
Data editing	the process of correcting faulty data, in order to allow the production of reliable statistics (NSS. 2016.).
Deckhand	in the hierarchy of the fishers working on board the vessel, the deckhand is the entry-point position (the lowest skilled position).
Fisheries bioeconomics	a field that integrates resource biology and ecology with the economics of fisher behaviour, considering space, time and uncertainty dimensions. (Anderson and Seijo, 2011).
Fishing vessel	any vessel used or intended for use for the purposes of the commercial exploitation of living marine resources, including mother ships and any other vessels directly engaged in such fishing operations (FAO, 1998).
Frame	consists of previously available descriptions of the objects or material related to the physical field in the form of maps, lists, directories, etc., from which sampling units may be constructed and a set of sampling units selected; and also information on communications, transport, etc., which may be of value in improving the design for the choice of sampling units, and in the formation of strata, etc. (Moura, 2016).

Frame population	the set of population units which can be accessed through the frame. The frame also contains sufficient information about the units for their stratification, sampling and contact (Moura, 2016).
Imputation	the process used to determine and assign replacement values to resolve problems of missing, invalid or inconsistent data (Moura, 2016).
Maximum economic yield	the level of catch and associated level of fishing effort that maximises profits in the industry over time and on a sustainable basis.
Mean	the average of a distribution, calculated by adding all the values together and dividing by the number of cases.
Normal distribution  	(NSS). 2016) normal curve. There is a 95 percent chance that the confidence interval which extends to two standard errors on either side of the estimate contains the “true value”. This interval is called the 95 percent confidence interval and is the most commonly used confidence interval.
Population	the total set of elements about which information is wanted and estimates are required.
Precision	a measure of how close an estimator is expected to be to the true value of a parameter. Precision is usually expressed in terms of imprecision and related to the standard error of the estimator. Less precision is reflected by a larger standard error.
Probabilistic sampling	in which elements have known probability of being chosen. Sample units where this is not the case are known as “non-probabilistic”.
Random sample	every element of the population is guaranteed an equal, non-zero chance of being selected.
Remuneration/earnings	defined as “the remuneration in cash and in kind paid to employees…” As a rule, earnings relate to gross earnings. The components of earnings are: • all direct wages and salaries for time worked or work done which are paid in cash; • remuneration for any time not worked which is also paid in cash; • any cash bonuses and gratuities; • any payments made in kind.
Salary/wage	salary is the payment of a fixed daily amount; wage is an amount paid on an hourly basis.
Sampling distribution	the distribution of the point estimates based on sample units of a fixed size from a certain population. It is useful to think of a particular point estimate as being drawn from such a distribution. Understanding the concept of a sampling distribution is central to understanding statistical inference.

Sample elements	selected from a population and, by studying, we hope to understand the nature of the population as a whole.
Sampling error	the calculable probability of drawing a sample whose statistics differ from the population parameters. This is contrasted with "non-sampling error", which is bias built into the design, the sampling frame or the measurement.
Sampling frame	a complete list of the elements in a population.
Small-scale fleet	all vessels under 12 m LOA using one or more static gears.
Soak time	time calculated from the point where each individual unit of gear has been set, to the time when the same unit starts to be removed[5].
Standard deviation	a measure of spread or dispersion from the mean, based on the normal distribution.
Standard error	the standard deviation associated with an estimate is called the standard error. It describes the typical error or uncertainty associated with the estimate.
Standard error	the standard deviation of the values of a given function of the data (parameter), over all possible sample units of the same size.
Stratified random sampling	made up of separate random sample units, drawn from sets which together make up the entire population.
Universe	"The population or universe represents the entire group of units which is the focus of the study. Thus, the population could consist of all the persons in the country, or those in a particular geographical location, or a special ethnic or economic group, depending on the purpose and coverage of the study. A population could also consist of non-human units such as farms, houses or business establishments."[6]
Z-score	the distance of an element from the mean, measured in standard deviation units.

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[5] Commission decision of 18 December 2009 adopting a multiannual Community programme for the collection, management and use of data in the fisheries sector for the period 2011–2013 [notified under document C(2009) 10121] (2010/93/EU).

[6] United Nations. 1984. *UN Handbook of household survey. Revised Edition*. Studies in methods. Series F, No. 31, para 4.5. New York, USA, United Nations.

ANNEXE 1

Questionnaire

SOCIO-ECONOMIC QUESTIONNAIRE FOR FISHING SECTOR

Code of the vessel		**Reference period**	
Date of the interview			

01 Source of information	
Owner	☐
Partner	☐
Skipper	☐
Fisher	☐

Ownership	
02 Owner engaged on the vessel	YES ☐ NO ☐
03 Owner engaged in the activity of the vessel on-shore	YES ☐ NO ☐
04 Owner's sole occupation engagement in fishing	YES ☐ NO ☐
05 If NO to (04), is fishing the main source of income for the owner	YES ☐ NO ☐

VARIABLE GROUP	**VARIABLE**	**UNIT**
Effort	06 Number of fishing trips	*Number*
	07 Average duration of a fishing trip (hours)	*Number*
	08 Days at sea	*Number*
	09 Average hours at sea (daily avg on 24-hours basis)	*Number*
	10 Gears used (D=days; H=hours) Gear D H Gear D H Gear D H Gear	D H

VARIABLE GROUP	**VARIABLE**	**UNIT**
Employment	11 Engaged crew per vessel - daily average (including owner)	*Number*
	12 Number of different individuals working on the vessel (including owner)	*Number*
	13 Working hours on-board (daily avg on 24-hours basis)	*Number*
	14 Number of people engaged in onshore activities	*Number*
	15 Number of different individuals engaged in onshore activities	*Number*
	16 Working hours onshore (daily avg on 24-hours basis)	*Number*

VARIABLE GROUP	**VARIABLE**	**UNIT**
Commercial (destination of the first sale)	17 Wholesaler	%
	17 Auction	%
	17 Exporter	%
	17 Processing industry	%
	17 Fishmonger	%
	17 Direct selling to the final customer	%
	17 Direct selling to the restaurant	%
	18 Self consumption	%
	Total	100%

VARIABLE GROUP	VARIABLE	MICRO-VARIABLE	UNIT
Costs	**Energy cost**	19 Fuel type	Diesel □ Petrol □
		20 Fuel costs	*Monetary value*
		21 Fuel consumption (liters)	*Litre*
		22 Lubricant costs	*Monetary value*
		23 Lubricant consumption (liters)	*Litre*
		24 Fuel price (monetary value/l)	*Monetary value/litre*
	Personnel costs	25 Remuneration of crew (including owner)	*Monetary value*
		26 Remuneration of crew (excluding owner)	*Monetary value*
		27 Remuneration based on a fixed amount	YES □ NO □
		If NO, formula used for the calculation of salaries:	
		a) % of revenue	%
		b) [= revenue - fuel]	YES □ NO □
		c) [= revenue - fuel - food]	YES □ NO □
		d) [= revenue - fuel - food - bait]	YES □ NO □
		e) [= revenue - fuel - food - bait - commercial costs]	YES □ NO □
		f) [= revenue - fuel - food - commercial costs]	YES □ NO □
		% that goes to the crew	%
		28 Average daily remuneration of one fisher (the basic fisher)	*Monetary value*
		29 Social security, social costs and pension contributions per fisher	*Monetary value*
		a) Number of crew participating in social security scheme	*Number*
		30 Crewmember insurance per fisher	*Monetary value*
		a) Number of crew covered by insurance	*Number*
	Other operational costs	31 Purchase of food	*Monetary value*
		32 Purchase of bait	*Monetary value*
		33 Purchase of other consumable materials (e.g. battery)	*Monetary value*
		34 Cost for other services required for vessel operations	*Monetary value*
		35 Other operational costs	*Monetary value*
	Commercial costs	36 Fish market commission (as % of the revenues or monetary value)	% or *Monetary value*
		37 Transportation of the fishing production (from vessel to place of selling)	*Monetary value*
		38 Purchase of ice	*Monetary value*
		39 Purchase of boxes and packages	*Monetary value*
		40 Other commercial costs	*Monetary value*
	Repair and maintenance costs	41 Maintenance and repairs to vessel	*Monetary value*
		42 Maintenance and repairs to engine	*Monetary value*
		43 Maintenance and repairs to on-board machineries	*Monetary value*
		44 Maintenance and repairs to gears	*Monetary value*
		45 Other repair and maintenance costs	*Monetary value*

VARIABLE GROUP	VARIABLE	MICRO-VARIABLE	UNIT
Costs	**Fixed costs**	46 Book-keeping	*Monetary value*
		47 Vessel insurance	*Monetary value*
		48 Legal expenses	*Monetary value*
		49 Bank costs	*Monetary value*
		50 Fishing license renewal (vessel)	*Monetary value*
		51 Other fixed costs	*Monetary value*

	VARIABLE	MICRO-VARIABLE	UNIT
	Investments	52 Purchase of engine	*Monetary value*
		53 Purchase of fishing gears	*Monetary value*
		54 Purchase of equipment (mechanical, hydraulic, electrical equipment)	*Monetary value*
		55 Other investments	*Monetary value*
		56 Current market value of vessel (excluding licence)	*Monetary value*
		57 Current market value of vessel (including licence)	*Monetary value*
		58 Current market value of the fishing licence and/or the fishing rights	*Monetary value*

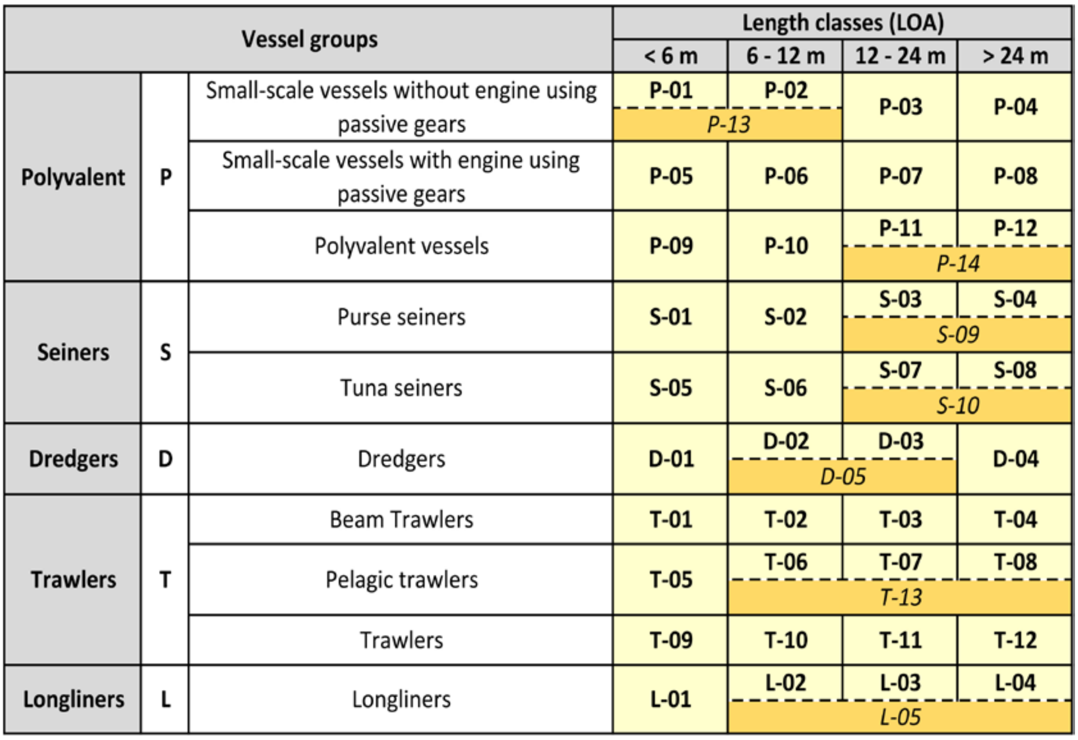
	VARIABLE	MICRO-VARIABLE	UNIT
	Debt and subsidies	59 Were any loans taken in relation to any aspect of the fishery activity?	YES ☐ NO ☐
		60 If YES to 59, specify the source: (a) Bank; b) Company; c) Buyer; d) Other)	
		61 % of the asset covered by the loan	%
		62 Direct monetary subsidies received	*Monetary value*

VARIABLE GROUP	VARIABLE	UNIT
Income	63 Revenue obtained by using the vessel for activities other than fishing	*Monetary value*
	64 Total quantity of fish landed	Kg
	Quantity of fish landed by group of species:	
	a) demersal	Kg / %
	b) large pelagics	Kg / %
	c) small pelagics	Kg / %
	d) crustacean	Kg / %
	e) molluscs	Kg / %
	65 Total value of fish landed:	*Monetary value*
	Value of fish landed by group of species:	
	a) demersal	*Monetary value / %*
	b) large pelagics	*Monetary value / %*
	c) small pelagics	*Monetary value / %*
	d) crustacean	*Monetary value / %*
	e) molluscs	*Monetary value / %*

VARIABLE GROUP	VARIABLE		Crewmember									
Demographic			1	2	3	4	5	6	7	8	9	10
	66 Year of birth and gender											
Literacy level	67 Literacy level and years in schools											
1=illiterate	68 Nationality											
2= literate but without formal educat	69 Household size											
3=primary education	70 Number of household members engaged in fishing											
4= secondary education	71 Number of household members engaged in gleaning											
5= higher education	72 Number of family members engaged in on-shore activities											
	73 Year of birth of the family members	1										
		2										
		3										
		4										
		5										
		6										
		7										
		8										
		9										
		10										
	74 Literacy level and years in school of the family members	1										
		2										
		3										
		4										
		5										
		6										
		7										
		8										
		9										
		10										
	75 Proportion of total household income from fishing activity											
	If fishing is not 100%, indicate the other activity/ies and proportion											
	76 Membership in collective organisation or group											

ANNEXE 2

GFCM FLEET SEGMENTATION VERSION 2016.2



Vessel groups			Length classes (LOA)			
			< 6 m	6 - 12 m	12 - 24 m	> 24 m
Polyvalent	**P**	Small-scale vessels without engine using passive gears	**P-01**	**P-02**	**P-03**	**P-04**
			P-13			
		Small-scale vessels with engine using passive gears	**P-05**	**P-06**	**P-07**	**P-08**
		Polyvalent vessels	**P-09**	**P-10**	**P-11**	**P-12**
					P-14	
Seiners	**S**	Purse seiners	**S-01**	**S-02**	**S-03**	**S-04**
					S-09	
		Tuna seiners	**S-05**	**S-06**	**S-07**	**S-08**
					S-10	
Dredgers	**D**	Dredgers	**D-01**	**D-02**	**D-03**	**D-04**
				D-05		
Trawlers	**T**	Beam Trawlers	**T-01**	**T-02**	**T-03**	**T-04**
		Pelagic trawlers	**T-05**	**T-06**	**T-07**	**T-08**
				T-13		
		Trawlers	**T-09**	**T-10**	**T-11**	**T-12**
Longliners	**L**	Longliners	**L-01**	**L-02**	**L-03**	**L-04**
				L-05		

ANNEXE 3

ISSCFV – LOA SEGMENTATION (FF1 AND FF2)

FISHERY FLEET – **NUMBER** OF **DECKED** VESSELS / **TOTAL TONNAGE** AND TOTAL **POWER** BY **L.O.A.** (LENGTH OVERALL) AND **TYPE**

FISHSTAT FF-1

Country: ………………………………..

Year: 2015

				VESSEL TYPES									
L.O.A. **(Metres)**	**Code** **N** = Number[1] **GT** = Gross Tonnage[2] **P** = Power Kw[3]		**Total**	**Trawlers** 01	**Purse Seiners** 02	**Seiners others** 03	**Gill Netters** 04	**Trap Setters** 05	**Long Liners** 06	**Liners others** 07	**Multipurpose vessels** 08	**Dredgers** 9.1	**Other fishing vessels** 9.0
Up to 11.9	100	**N**											
		GT											
		P											
12 - 17.9	110	**N**											
		GT											
		P											
18 - 23.9	120	**N**											
		GT											
		P											
24 - 29.9	130	**N**											
		GT											
		P											
30 - 35.9	140	**N**											
		GT											
		P											
36 - 44.9	150	**N**											
		GT											
		P											
45 - 59.9	160	**N**											
		GT											
		P											
60 - 74.9	170	**N**											
		GT											
		P											
75 and over	180	**N**											
		GT											
		P											
TOTAL		**N**											
		GT											
		P											

[1] Total number of vessels

[2] Total Gross Tonnage. (Please indicate if different from GT (i.e. GRT)

[3] Total power. (Please indicate if different from KW, e.g.. HP, CV, etc.)

FISHERY FLEET – NUMBER OF UNDECKED, POWERED AND NOT POWERED VESSELS, BY L.O.A. (LENGTH OVERALL) AND TYPE

FISHSTAT FF-2

COUNTRY: ……………………………………

YEAR: 2015

			VESSEL TYPES									
L.O.A. (Metres)	**Code** **P** = No. Powered **NP** = No. not Powered	**Total**	**Trawlers** 01	**Purse Seiners** 02	**Seiners others** 03	**Gill Netters** 04	**Trap Setters** 05	**Long Liners** 06	**Liners others** 07	**Multipurpose vessels** 08	**Dredgers** 9.1	**Other fishing vessels** 9.0
Up to 5.9	200 **P**											
	NP											
6 - 11.9	210 **P**											
	NP											
12 - 17.9	220 **P**											
	NP											
18 - 23.9	230 **P**											
	NP											
24 - 29.9	240 **P**											
	NP											
30 and over	250 **P**											
	NP											
TOTAL	**P**											
	NP											

NOTES

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The *Handbook for fisheries socio-economic sample survey – principles and practice* provides a practical kit of tested and standardized tools for the collection of the most pertinent data required for a socio-economic assessment of a fishery.

The handbook consists of three parts: an introduction to the theory behind setting up a survey; a comprehensive explanation of the data collection process – including a section on operational steps; and an explanation of how to use indicators to interpret and present the results of a sample survey to stakeholder, and monitor the fishery. It is based on one of the most straightforward sampling schemes available, yet (provided it is correctly applied) guarantees statistically sound and robust fisheries data.

The handbook provides a valuable starting point for countries motivated to establish a self-sufficient and routine socio-economic data collection programme to facilitate the improved planning, monitoring and management of fisheries.

ISBN 978-92-5-109694-9 ISSN 2070-7010

9 789251 096949

I6970EN/1/03.17