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Report of the

EXPERT MEETING ON METHODOLOGIES FOR CONDUCTING FISHING FLEET TECHNO-ECONOMIC PERFORMANCE REVIEWS

Chennai, India, 18–20 September 2018

Cover picture: Trawler in Indian waters (courtesy of BOBP-IGO (2018)

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PREPARATION OF THIS DOCUMENT

This is the Report of the Expert Meeting on Methodologies for Conducting Fishing Fleet Techno-Economic Performance Reviews, which was held at the Raintree Hotel in Chennai, India, on 18-20 September 2018.

The Expert Meeting was co-organized by the Bay of Bengal Programme Inter-Governmental Organisation (BOBP-IGO) and the Food and Agriculture Organization of the United Nations (FAO). The Meeting served to present and discuss methodologies applied for conducting fishing fleet techno-economic performance reviews. The Meeting was attended by fisheries economists from China, European Union, India, Indonesia, Norway, Thailand, United Kingdom and the United States of America. The high quality of the contributions by these experts to the Meeting is acknowledged by the organizers.

The Expert Meeting was made possible with the financial support from FAO's Regular Programme under Strategic Objective 2: Make agriculture, forestry and fisheries more productive and sustainable.

FAO and BOBP-IGO technical assistance to the Expert Meeting and its preparations was provided by Mr Raymon van Anrooy, Mr Yugraj Singh Yadava, Mr E. Vivekanandan, Mr V. Venkatesan and Mr Rajdeep Mukherjee. Formatting and publishing assistance was provided by Ms Estefania Burgos, Ms Marianne Guyonnet and Ms Chorouk Benkabbour of FAO

This report contains a record of the Expert Meeting, including summaries of presentations and discussions, as well as the finalized report prepared by the resource person, Mr Philip Rodgers. The report of the resource person in appendix 3 is reproduced as received.

ABSTRACT

The Expert Meeting on Methodologies for conducting fishing fleet techno-economic performance reviews was held in Chennai, India, 18-20 September 2018. The Meeting was attended by fisheries economists from China, European Union, India, Indonesia, Norway, Thailand, United Kingdom and the United States of America. The Meeting was co-organized by the Bay of Bengal Programme – Intergovernmental Organization (BOBP-IGO) and the Food and Agriculture Organization of the United Nations (FAO).

The Meeting brought together a group of key fisheries economists with experience in fishing fleet reviews to: 1) present and discuss the advantages and disadvantages of various methodologies applied for reviewing the economic and technical performance of fishing fleets, 2) develop and agree on a general sampling/survey methodology for conducting techno-economic performance reviews, which can be applied also in developing countries, and 3) discuss technological innovations that have taken place in the last 10 years that had an impact on the economic and financial performance of fishing fleets.

The Expert Meeting agreed on data and information to be collected in the 2018-19 surveys for the FAO global review of techno-economic performance of fishing fleets and on the financial and economic indicators to be applied in the analysis. The Meeting concluded, amongst others, that the number of countries that collect and analyze socio-economic information on fisheries and analyze the performance of their fishing fleets has increased rapidly over the last decade, particularly in the European Union and the USA. The Meeting recognized that technological advances have increased fishing efficiency tremendously since the last FAO global review of fishing fleets in 2003. Technologies such as GPS and Fishfinders are now widely applied by industrial, small-scale and recreational fisheries, and smart FADs (Fish Aggregating Devices), which are communicating via satellite with the vessels, are changing the fisheries sector. Improvements in vessel fuel efficiency, vessel design, communication, fish processing on-board and bycatch reduction devices also have major positive effects on profitability of the fishing fleets.

CONTENTS

ABBREVIATIONS AND ACRONYMS

AER	Annual Economic Report on the EU fishing fleet
BOBP-IGO	Bay of Bengal Programme Inter-Governmental Organisation
CFP	Common Fisheries Policy of the European Union
DCF	Data Collection Framework - EU-wide framework for the systematic collection of fisheries data.
DG MARE	Directorate-General for Maritime Affairs and Fisheries of EU
DWH	Deepwater Horizon Oil spills
EC	European Commission
EEZ	Exclusive Economic Zone
EU	European Union
FAD	Fish Aggregating Devices
FAO	Food and Agriculture Organization of United Nations
FIAO	Fishing Operations and Technology Branch of FAO
FLCs	Fish landing centers
FTE	Full Time Employment
GDP	Gross Domestic Product
GOM	Gulf of Mexico
GPS	Global Positioning system
GT	Gross Tonnage
GVA	Gross Value Added
HP	Horse Power
JRC	Joint Research Centre, European Union
kW	KiloWatt
LOA	Length Overall of fishing vessels
MMAF	Marine Affairs and Fisheries Research, Government of Indonesia
MSC	Marine Stewardship Council
NARA	National Aquatic Resources Research and Development Agency, Sri Lanka
NMFS-NOAA	National Marine Fisheries Service of the National Oceanic and Atmospheric Administration, United States of America
RFMO	Regional Fisheries Management Organization
RoFTA	Return on Fixed Tangible Assets
RoI	Return on Investment
SDG	Sustainable Development Goals
SEAFDEC	Southeast Asian Fisheries Development Center
SOFIA	State of World Fisheries and Aquaculture (FAO publication)
STECF	Scientific, Technical and Economic Committee for Fisheries of the European Commission
TAC	Total Allowable Catch
USD	United States Dollar
VMS	Vessel Monitoring System

Introduction

1. The marine capture fisheries sector plays in many countries an important role in terms of generating employment and income opportunities as well as earning of foreign exchange. The sector also significantly contributes to meeting the nutritional requirements of the increasing global population. The United Nations' 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs) recognize that the fisheries sector offers many opportunities to reduce hunger and improve nutrition, alleviate poverty, generate economic growth and ensure better use of natural resources. FAO and its member states are therefore making great efforts to achieve SDG 14 "Conserve and sustainably use the oceans, seas and marine resources for sustainable development".

2. In order to safeguard the important role of the capture fisheries sector in the achievement of SDG 14, it is important that fishing operations are environmentally sustainable, socially acceptable and economically viable. The implementation of the 1995 Code of Conduct for Responsible Fisheries and the related International Programmes of Action (e.g. on Illegal, Unreported and Unregulated Fishing, Fishing Capacity, Shark conservation) would be greatly facilitated when the economic and financial performance of the fishing fleets is duly taken into consideration.

3. Therefore, FAO and particularly its Fishing Operations and Technology Branch (FIAO) regularly conduct global studies to analyze the cost structure and economic and financial performance of fishing fleets. The studies form part of the regular monitoring of the economic and financial viability of marine capture fisheries, conducted by FAO in close cooperation with national fisheries research institutions, fisheries administrations and experts in selected countries in Asia, Africa, Latin America and the Caribbean and Europe.

4. The findings of previous studies carried out in 1995 to 1997 and 1999 to 2000 and 2003 to 2005 respectively are reported in FAO Fisheries and Aquaculture Technical Papers 377, 421[1] and 482[2].

5. The findings of these studies showed that in spite of fully and sometimes overexploited fisheries resources , marine capture fisheries was an economically and financially viable undertaking, which generated sufficient revenue to cover the cost of depreciation as well as the opportunity cost of capital and generated funds for reinvestment in addition to employment, income and foreign exchange earnings.

6. Since the last global review study on this topic in 2003, FAO has not conducted any major comparative study on fishing fleet performance. However, many developed countries, including Japan, Norway, the United States of America, and the EU, have continued to carry out their fleet performance measurements in order to regularly monitor the economic and financial feasibility of their fishing sector.

7. Given the fact that various countries, as well as the European Union, have in recent years further developed the methodology to conduct techno-economic performance reviews of fishing fleets, there is a need to review and update the methodology used in the earlier studies. Therefore, it was determined that before the 2018-2019 global review study would start, first the methodology should be reviewed and where necessary updated.

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[1] *Techno-economic performance of marine capture fisheries (FAO Fisheries Technical Paper No. 421) 2001* *http://www.fao.org/docrep/004/Y2786E/Y2786E00.HTM*

[2] *Economic performance and fishing efficiency of marine capture fisheries (FAO Fisheries Technical Paper No. 482), 2005* http://www.fao.org/docrep/008/y6982e/y6982e00.htm

8. FAO found a partner in the Bay of Bengal Programme Inter-Governmental Organisation (BOBP-IGO), which contributed significantly also to previous global review studies on this topic. Together with the BOBP-IGO, FAO conducts the 2018-2019 global review of the techno-economic performance of the main fishing fleets, with the aim to:

i. Monitor the economic and financial feasibility of the main fishing fleets worldwide
ii. Compare differences in economic performance between fleets and over time within fleets.
iii. Identify which technological innovations have impacted the performance of fishing fleets in recent years

9. The global review study outcomes will be published in an FAO Fisheries and Aquaculture Technical Paper in 2019, and will be presented to the 34th session of the FAO Committee on Fisheries in 2020 and to other regional and global forums. It is anticipated, that the trends in techno-economic performance will guide fisheries policy and decision makers, as well as fishers and vessel owners in making investment-related decisions for marine capture fisheries.

10. In this context, an Expert Meeting was held in Chennai, India, in the period 18–20 September 2018 to present and discuss methodologies applied for conducting fishing fleet techno-economic performance reviews.

11. The objectives of the Expert Meeting were to:

i. Bring together a group of fisheries experts with experience in fishing fleet reviews to present and discuss the advantages and disadvantages of various methodologies applied for reviewing the economic and technical performance of fishing fleets.
ii. Develop and agree on a general sampling/survey methodology for conducting techno-economic performance reviews, which can be applied also in developing countries.
iii. Discuss technological innovations that have taken place in the last 10 years that had an impact on the economic and financial performance of fishing fleets.
iv. Identify experts/counterparts in developing countries that could participate in testing the methodology from October 2018 onwards.

12. The agenda of the Expert Meeting and the List of Participants are provided respectively in Appendices 1 and 2.

Opening of the Meeting

13. The Expert Meeting was jointly organized by FAO and BOBP-IGO. Seventeen fisheries experts from FAO Members participated in the Meeting: China (through skype), European Union, India, Indonesia, Norway, Thailand, United Kingdom and United States. FAO and the BOBP-IGO provided the secretariat for the Meeting.

14. The Meeting started with 'Lighting of Lamp' in accordance with the local tradition. Mr Yugraj Singh Yadava, Director of BOBP-IGO, welcomed the participants. He underlined the importance of the Meeting and thanked the participants for travelling long distances to make it to the Meeting. He informed the Meeting that the BOBP-IGO, which started as a field project of FAO in 1979, is an integral part of the fisheries development narrative in the Bay of Bengal region and has contributed to knowledge generation, policy development, technology development and transfer and capacity building. The marine fisheries sector is an important livelihood and commercial activity in the region, which is also home to a large share of the global number of fishers and fishing vessels. He said that the techno-economic performance review study will contribute to improving the understanding of fisheries dynamics in the region within a global context and is expected to lead to valuable policy inputs.

15. Following the welcome remarks, participants introduced themselves and their area of work.

16. Mr Raymon van Anrooy, FAO Fishery Industry Officer, introduced the Agenda and explained the objectives of the Meeting.

Global reviews

17. Mr Van Anrooy presented the Meeting a "Summary of findings of past FAO techno-economic performance reviews of fishing fleets". He said that in 1995-1997, 1999-2000 and 2002-2003, FAO carried out three global review studies on the techno-economic performance of fishing fleets. The reviews included the main fishing fleets and the country coverage of the first two reviews was large. The countries included in the first two surveys landed at that time over 48 percent of the world's marine capture fisheries production. The third review covered 25 percent of the world's capture fisheries production, as its country coverage was reduced. The following countries were included in at least two of the three previous global review studies: (Asia) China, India, Indonesia, South Korea, and Thailand; (Europe) France, Germany, Spain and Norway; (Africa) Senegal; (Latin America and the Caribbean) Argentina, Peru, Trinidad and Tobago, and Antigua and Barbuda.

18. The first review showed that considering the problem of overexploited fisheries resources —in most cases— marine capture fisheries during 1995-1997 was an economically and financially viable activity. Marine capture fisheries generated sufficient revenue to cover the costs of depreciation, opportunity costs to capital and generate funds for reinvestment. It was also understood that there was a need to limit fishing effort, preserve and rehabilitate coastal resources and protect small-scale fishers. The first review study also noted that fisheries subsidies were being reduced.

19. The second review study in 1999-2000 showed that 97 percent of the fleets assessed obtained positive cash flows and fully recovered operational costs. The study revealed operational losses in the Chinese stow net fleet and in bottom fish trawlers in Trinidad and Tobago. Eighty-five percent of the 108 vessel types studied showed net profits. Compared to the first review, France and Spain showed improved profitability and China and Germany reduced profitability. The positive figures were mainly a result of the higher fish prices paid to fishers at the turn of the century. The study further noted that older vessels fishing on overexploited stocks were those that showed reduced profits or losses.

20. All the types of fishing vessels assessed in the third review (2002-2003) had positive cash flows and fully recovered operational costs. Ninety-four percent of the 94 vessel types studied showed net profits. The profitability of the fishing fleets remained largely the same, despite a 9 percent increase in fuel prices and a 5 percent reduction in fish prices. Compared to the second review study of 2 years earlier, Korea, Germany and Argentina showed increased profitability. Positive figures were attributed in some cases to the limitation of fleet capacity by some countries.

21. The three reviews further showed that the labour costs in European fisheries were high compared to those in Asia, Africa and South America, which had a large effect on the operating costs. In addition, the costs of maintenance and repair were relatively larger in Europe. Technology uptake and innovation were important for maintaining profitability for some of the fleets. Subsidies played also a major role in the profitability of some of the world's major fishing fleets. Fishing access rights and quotas allocated under Regional Fisheries Management Organizations (RFMOs) and quotas allocated under bi-lateral fishing agreements (*e.g.* EU with Mauretania) were gaining importance during the period covered by these past reviews.

22. At the end of the presentation, Mr van Anrooy showed various slides from the latest FAO Report on the State of World Fisheries and Aquaculture (SOFIA 2018), to place emphasis on the need for an updated global review of the techno-economic performance of fishing fleets. In this respect, the stable marine capture fisheries production, along with the increasing percentage of stocks that are overfished and the increasing demand for and consumption of fisheries products were mentioned to have impact on the techno-economic performance of the fishing fleets. The effects of these trends on fleet performance are expected to be revealed in the report of the 2018-2019 global review.

Country Presentations

United States of America

23. Mr Andrew Kitts, Economist, Office of Science & Technology, National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), made a presentation on "USA -Methodologies applied for conducting economic and financial fleet performance reviews". He said that a comprehensive program of cost/earnings data collection through the National Marine Fisheries Service began in 2001. As of 2017, there were nineteen data collection programs covering 75 fisheries. Data on revenue is collected from 69 fisheries, operating cost data from 55 fisheries, and fixed cost data from 52 fisheries. Survey vehicles include mail, telephone, in-person interviews, web-based surveys, and through add-ons to existing logbook and observer programs. Some surveys are mandatory while the rest are voluntary. Most surveys sample the population of vessels, but a few also census the fleet. There is a mix of continuous and periodic surveys.

24. In analyses, cost data are combined with other data sources, such as vessel registration (vessel characteristics), fishing permit applications (fishery endorsements, ownership), fishing logbooks (trip activity), sales to fish buyers (revenue and quantity) and observer programs (sample of detailed trip activity). Cost data are used in a variety of ways: financial and economic profit profiles, economic impacts, cost/benefit analyses, damage assessments, and in bio-economic models.

25. Two fisheries were selected that exemplify methods used in the USA for creating financial profiles: the Gulf of Mexico (GOM) shrimp fishery and the West Coast (WC) groundfish trawl catcher vessel fleet. Annually, a survey is mailed to one-third of the GOM shrimp fishery. Fishermen who receive a survey are required to reply. Non-compliance results in the forfeiture of fishing permits. The population is stratified by state and by sampling without replacement and fishermen are surveyed every three years. Annual level operating costs are entered on the survey form. Financial profiles are prepared for four non-mutually exclusive components of the GOM shrimp fleet. Average values are given for: (1) commercial vessels with GOM shrimp permits (includes vessels active in other fisheries), (2) active and inactive commercial GOM shrimp vessels (may not have a permit), (3) active GOM shrimp vessels, and (4) inactive GOM shrimp vessels. Financial profiles for the GOM shrimp fishery include balance sheets, cash flow statements, income statements, where Profit = net revenue from operations - financing costs + non-operational income (government and Deep Water Horizon disaster relieve related payments), average shrimp and fuel prices, fuel efficiency, and non-cash cost estimates (owner's time and depreciation). Two other financial indicators are given: economic return (net revenue from operations/value of vessel assets) and return on equity (profit/owner equity in the vessel).

26. For the West Coast groundfish trawl fleet, a mandatory survey is sent to all catcher vessels in the catch share program. Annual level operating costs are entered on the survey form. Catcher vessel financial profiles provide average fuel use, speed, crew size, and revenues from various sources. Average values for each cost item collected are also given. Commonly used crew share systems are described. Mean and median rates for revenues and costs are given day-wise and by the metric ton. Two types of net revenue are also provided: 1) variable cost net revenue (revenue – variable costs) and 2) total cost net revenue (revenue – variable – fixed costs). Since WC groundfish trawl catcher vessels participate in multiple fisheries, fixed costs are disaggregated according to four methods: 1) weight of shoreside landings and at-sea deliveries, 2) value of shoreside landings and at-sea deliveries, 3) days at sea and 4) combination of the other three methods ("mixed method").

27. In the USA, a working group of fisheries economists was formed in 2018 to review methods and terminologies for measuring fishing business returns. Detailed recommendations are being devised for financial and economic profit statements. Methods for measuring particular components, such as the cost of capital and opportunity costs of labour and intangible assets, are being developed.

28. The discussion that followed the presentation included clarification on terminology applied, such as overheads, motherships and active versus inactive vessels. The collection of trip data, insurance,

cash flow calculations, quota sales and the equity for owners were also discussed. Questions were raised about the coverage of training costs and safety at sea equipment costs, as well as subsidies and where these would be included in the analysis. The reasons for decommissioning of boats and the inclusion of inactive/idling boats were discussed and the modification of vessels to carry out other fisheries. It was found that the economic profit is a good measure and that it would be good to also calculate the resource rent.

European Union

29. Ms Natacha Carvalho, Fisheries Economist, D.2 Water and Marine Resources at the Joint Research Centre (JRC), European Union (EU), made a presentation on "European Union – Methodologies applied for conducting economic and financial fleet performance reviews". She started with explaining that fisheries management in the EU falls under the remit of the EU Common Fisheries Policy (CFP), implemented by the Directorate-General for Maritime Affairs and Fisheries (DG MARE). The CFP explicitly requires the European Commission (EC) to 'take into account the best available scientific, technical and economic advice' when drafting legislative proposals for the European Parliament and the Council. The provision of advice under the CFP is dependent on the availability of high-quality data. For this, an EU-wide framework for the systematic collection of fisheries data (Data Collection Framework [DCF]), was introduced in 2002, co-financed by the EC, and the Scientific, Technical and Economic Committee for Fisheries (STECF), the EC's scientific advisory committee providing independent advice on matters relating to fisheries and aquaculture.

30. Under the DCF, EU member states have established national programmes for the collection of data on their fishing, aquaculture and fish processing sectors according to guidelines and harmonized methodologies set out in EU legislation. Member states are required to provide detailed information on how they intend to collect and process data in multi-annual work plans[3] and to report annually on their achievements; which are reviewed by the STECF before being endorsed by the EC.

31. Most of the fleet capacity and fishing activity data are collected under the EU Control Regulation[4]. The EU Fleet Register contains technical characteristics and history (length, GT, kW, licensed gear, age, ownership, modifications, etc.) of all fishing vessels flying the flag of a member state. In addition, the Control Regulation requires the following: fishing logbook for all vessels over 10 m Length Over All (LOA); electronic logbook and landing declarations for vessels over 12 m LOA; sales notes for vessels under 10 m LOA; catch statistics on species subjected to Total Allowable Catch (TACs) or quotas; and the vessel monitoring system (VMS) for vessels over 15 m LOA.

32. Socio-economic data are collected through surveys, usually web-based or face-to-face questionnaires and generally complemented with financial statements from accounting networks. Where required, fishing activity data for vessels under 10 m LOA are also collected through surveys.

33. The sampling frame for the annual surveys is the target population, which is the fleet on 31 December on the EU Fleet Register plus all vessels having reported any fishing activity during the year. The sampling unit is the vessel, not the firm. Inactive vessels (vessels with no reported fishing activity in a given year) are also surveyed to obtain data on capital value and in-year investments.

34. The DCF data call on the EU fishing fleet is an annual exercise, issued by DG MARE, requesting member states to submit transversal (capacity, landings and effort) and socio-economic (income, costs, employment, capital value and investment) data collected on their fishing fleet. The member states report data aggregated by fleet-segment - a combination of the main fishing technique category and vessel length group - and raised to the population (national fleet). These data are submitted

[3] COMMISSION IMPLEMENTING DECISION (EU) 2016/1701 of 19 August 2016.
[4] COUNCIL REGULATION (EC) No 1224/2009 of 20 November 2009.

to the EC's Joint Research Centre (JRC), which reviews and assembles them for further analyses by STECF expert working groups to produce the Annual Economic Report on the EU fishing fleet (AER).

35. The AER provides the most comprehensive overview of the economic performance of EU fishing fleets and includes a detailed structural overview and assessment of each EU member state's fishing fleet, together with regional analyses by sea basin and relevant RFMOs.

36. The two-year time lag in economic data availability presents a major challenge in keeping the exercise up-to-date and relevant for policy-makers and the industry. To address this, estimates of the economic performance of the EU fleet for the current and next year (t and t+1) are performed using 'nowcasting' techniques based on the latest available data, such as fish and fuel prices, total allowable catches (TACs), etc.

37. The main indicators estimated include: average wage per FTE, revenue, Gross Value Added (GVA), GVA to revenue (%), labour productivity (GVA/FTE), break-even revenue, gross profit, gross profit margin, net profit, net profit margin, Return on Investments (RoI) and Return on Fixed Tangible Assets (RoFTA), fuel efficiency and intensity, average fuel and fish prices, etc.

38. The AER has become the most important economic reference publication for policy decision-making in fisheries management under the CFP. DG MARE uses the AER and corresponding datasets for Impact Assessments (IA) of fisheries policies and management plans; negotiating and setting of TACs and quotas; monitoring the balance between fleet capacity and fishing opportunities; evaluating EU-funded programmes in fisheries and structural policies, *i.e.* context indicators used in the EU Maritime and Fisheries Fund (EMFF) operational programmes, evaluation of EU funded programmes, etc.

39. In conclusion, Ms Carvalho informed the Meeting that the EU Commission has an open data policy: all reports and aggregated data are made available on the STECF and JRC websites and online data dissemination tools[5].

40. The discussion on the presentation noted that raw data remain at the Member State level and that the JRC only receives the aggregated fleet data. The sanctions for non-reporting were referred to and survey methods applied were discussed. Reference was made to common guidelines documents and the role of the STECF. Questions were raised on the incorporation of other non-EU countries in the system and the categories used for data collection, as well as on discards/landing obligations, the definition of small-scale fishing vessels, access agreements with countries in Africa and effort measurement categories used.

India

41. Mr R Narayana Kumara, Principal Scientist, Central Marine Fisheries Research Institute, India made a presentation on "Methodologies applied for conducting economic and financial fleet performance reviews in India".

42. He emphasized that the assessment of the economic performance of fishing operations is very important as it serves many purposes. Such an assessment provides guidance to investors (for resource allocation), to funding agencies for the provision of loans and grants (financial worthiness) and for the Government in formulating the fishery management policies and welfare programmes.

43. The Central Marine Fisheries Research Institute (ICAR) has conducted various studies to analyze the economic performance of different fishing fleets across the maritime states over the last few decades, taking in consideration the objectives of fishers' welfare and the fishing industry at large. The sampling procedures included the selection of landing centres at the first stage. This was done with the

[5] Please see https://stecf.jrc.ec.europa.eu/reports/economic; https://datacollection.jrc.ec.europa.eu/data-dissemination. Additional information on the EU Data Collection Framework and process can be found at https://datacollection.jrc.ec.europa.eu

help of the Fishery Resources Assessment Division of the Institute, who has the list of the marine fish landing centres (FLCs) across the country. Based on this, the FLCs are divided by numbers of mechanized, motorized and non-mechanized crafts. At the second stage, ten sample days are systematically selected in a month for data collection from the selected FLCs. At the third stage, ten sample units are selected for collection of cost and earnings data every month, using trained enumerators.

44. Two types of schedules are prepared for data collection. The first schedule is for collecting the fixed costs (including investment) and the second one is for collecting operating or variable costs and earnings (revenue) per trip. In the first schedule on fixed cost, the details of initial investment in fishing vessels and equipment (including the year of purchase, their economic life and annual maintenance expenses) and the general fishing pattern followed is collected. The second schedule is used to collect information on the operating expenses incurred per fishing trip on fuel, wage labour, ice, salt, auction charges, marketing charges, transportation and other related costs.

45. From the data collected, the indicators to assess the economic and financial performance are worked out, including: net operating income, annual net profit/loss, gross value added, operating ratio, fixed ratio, profitability ratio, input-output ratio, labour productivity, break-even harvest and break-even prices. The financial feasibility of the fishing operations is calculated using indicators such as: payback period, the rate of return to investment (without time value of money), net present value, benefit-cost ratio and internal rate of return (using time value of money). Standard assumptions are applied for financial feasibility analysis. Based on the results of these key indicators, recommendations are made for the benefit of researchers, policymakers and administrators in support of guiding the sector towards sustainable exploitation of the resources in an economically viable manner.

46. The discussions following the presentation included questions on how the total value of Indian fisheries was calculated, its contribution to the GDP and growth opportunities for the sector. The purpose of the economic and financial research and how the government uses the information was discussed as well. Other items discussed included: the value of estimating post-harvest losses, the access to subsidies in the sector, and whether fishing gears would be included as fixed or operational costs in the analyses.

China

47. Mr Liming Song, Professor, College of Marine Sciences, Shanghai Ocean University, China made a (Skype) presentation on"Methodologies applied for conducting economic and financial fleet performance reviews in China". He said that in order to update and validate the findings of the earlier studies, understanding the technological innovations in fisheries and their impact on fleet performance, Shanghai Ocean University would conduct a marine capture fisheries sampling survey covering the age structure of the fleet, operational characteristics, innovations in gear and equipment, financial and economic characteristics and subsidies.

48. The operational characteristics include the length of the vessel, tonnage, propulsion and engine power, on-board facilities for processing and storage of catch, fishing gear and deck equipment, crew numbers and composition, ownership of the fishing unit and sharing, operational expenses and income, and operation of the fishing unit. The financial and economic characteristics that will be covered in the study include: investment costs (vessel construction, engine, equipment, etc.), operating costs (fuel, wages, harbour fees, ice, repair/maintenance, etc.), revenues (from sale of fish), species caught, landed, discarded at sea, depreciation and interest on loans. Information on subsidies is to be provided on the availability of capital subsidies for acquisition of fishing vessels and gear, the availability of tax exemptions on fuel, import and purchase of fishing inputs and with regard to business taxes, and financial compensation for reduction of fishing effort, such as scrapping of fishing vessels, etc. The study would also document the innovations in gear and equipment including trends in hull/vessel design and dimensions, gear technology, engines/power units/machinery, navigation and communication technologies.

49. Mr Song informed the Meeting that fleets covered in the sampling survey include the industrial demersal fish trawling fleet, semi-industrial squid jigging fleet, semi-industrial purse seine fleet, gillnetters, and drift net fleet. Sampling survey areas would be Shandong Province, Jiangsu Province, Zhejiang Province, Fujian Province, and Guangdong Province. The study would inform the implementation of the National Plan of Marine Capture Fisheries.

50. Following the presentation, some discussion took place on the level of fish production in China, and particularly on the distinction between landings of fish from coastal waters and those from the high seas fishing fleets. Given the large share in global fisheries production, it was considered essential that China participates in this global review study.

Norway

51. Mr Terje Vassdal, Professor Emeritus, PhD. School of Business and Economics, University of Tromsø - The Arctic University of Norway, Norway, made a presentation on "Methodologies applied for conducting economic and financial fleet performance reviews in Norway". He said that Norway has a comprehensive system in place for collecting data from fishing and harvesting of wild marine resources. The present legal authority is given in the "Law on Managing Wild Live Marine Resources" (*Lov om forvalting av viltlevande marine ressursar,*) from 2008. This law mandates Norwegian fishing and hunting vessels the duty to provide the Government with information about their operations, electronically report their positions and catches, report landings and final contract notes between fishermen (seller) and buyers. All fishing vessels must be registered, including a detailed description of their physical properties (year of building, motor, length, depth, breadth, tonnage, building materials, etc.). In addition, all licenses and permits related to every vessel are registered, both permanent permits given by the authorities and licences/permits acquired through commercial transactions. Only active fishermen can own fishing vessels and related licenses/permits. The laws also contain conditions for exemptions to the main rules. Processing companies own a large part of the bigger demersal trawler fleet. Descendants of formerly active fishermen sometimes also own large vessels in the pelagic fisheries sector.

52. Statistics for the number of fishermen in Norway exist and date back almost 100 years. The total number of fishermen peaked at about 120 000 around 1940. The present number is only about 10 000. For analytical purposes, the population is split into two groups according to the time used for fishing. The groups are fishermen whose main income source is fishing and fishermen having income from fisheries as a secondary occupation. Both groups have bene reducing in numbers. Presently, the number of fishermen with fishing as primary occupation is about 9000 and this is around 80 percent of the total number of registered fishermen.

53. Statistics for the number of vessels also go back almost 100 years. The number of vessels peaked at about 41 000 in 1960. The number of vessels now registered is around 6 000 vessels. The greatest reduction in the number of vessels took place in the category of vessels of less than 10 m LOA. Many of these small vessels were open undecked vessels. Modern small vessels between 10 and 15 m LOA are still popular and this category has been stable at about 2 000 -2 500 for the last 20 years. The category of the largest vessels (larger than 28 m) declined slightly during the last 20 years from over 300 to about 250 in 2018. There is no indication of further decline in the number of largest vessels.

54. The average age of vessels is now about 27.6 years, an increase from 17.8 in 1980. The increase over the years has been steady. The situation for different length groups is largely different. For vessels larger than 28 m LOA, the average age is now 19.6 years, whereas for vessels 15 – 21 m the average age is 36.6 years. All other vessel length groups have now average ages between 27 and 30 years. Not surprisingly, the largest vessels take the majority of the catch. About 90 percent of the total landings originate from vessels larger than 21 m LOA. For herring, as an example, more than half of the landed fish comes from vessels larger than 28 m and the rest is landed by vessels between 21 and 28 m. For shrimp landings originating from the Norwegian Exclusive Economic Zone (EEZ), the largest volumes are landed by vessels of 11 to 15 m.

55. The total fish landings by Norwegian vessels, including catches from outside the Norwegian EEZ, have been remarkably stable the last 20 years at around 2.5 million tons. For this period, the catch of herring showed variations with a factor of three and cod catches varied with a factor two. Catches of other species have seen relatively large variations as well, but the variation for individual species seems to be surprisingly uncorrelated. This observation may explain the stability in total landings of fish by the Norwegian fleets.

56. Not all species are equally valuable. When studying the value of total landings, much more variation is observed than when looking at the total volume of fish landed. Landings of cod, one of the most valuable species per kg, have been increasing since 2009, and this is the main reason for the increase in total fisheries value during the last 4-5 years. The general increase in the price level for many fisheries products may further add to the positive trends in the value of total landings. After the 2017 fishing season the quotas for cod were reduced. It is yet unclear now how this will affect the total fisheries value in 2018 and 2019.

57. Gear types in use for the Norwegian fisheries are handline, longline, Danish seine, purse seine, bottom trawl and pelagic trawl. Purse seine and trawl are by far the two most important gear types with a combined catch of 70 – 80 percent of the total volume landed. In cod fisheries it is not allowed to use purse seines. Here gillnets, Danish seines and demersal trawls are the three gear types with the largest landings. Handlines, operating from the smallest vessels close to the coast, produce about 5 percent of the cod landings.

58. In 2003, the Norwegian Directorate for Fisheries decided to change the format of data collection on fishing vessels. Before 2003, vessel owners filled in a form with information relevant for the purpose of the analysis. Over time, the discrepancy between what vessel owners, as registered business entities, had to report to tax authorities, Statistic Norway and others, and what the Directorate of Fisheries wanted from them, became increasingly large. The Directorate of Fisheries decided to simplify its reporting formats and from 2003 agreed to normal financial accounting information, with some extra information for fuel, bait, etc. For the profit and loss account, the changes were minor with the exception for the item "Depreciations". The balance sheets from 2003 use only book values. This makes comparison before and after 2003 difficult. Standard terminology used by financial analysists is applied. Profitability measures in fisheries are now comparable with any other commercial sector in Norway.

59. Operating revenue of the Norwegian fishing fleet has increased to about 50 percent during the last 4 years. More than 50 percent of the operating revenue belongs to vessels > 28 m. Operating profit for 2016 was the largest reported within the last 20 years. Aggregate (net) profits were negative in 2000, 2003 and 2008 and positive in all the other years. Large variations are observed in aggregate (net) profits from year to year. The average return on assets is about 5-6 percent, but with large variations across vessel types and categories.

60. Mr Vassdal informed the Meeting that the Norwegian fleets specific data required for the FAO review on the techno-economic performance of the fishing fleet are already available in databases belonging to the Norwegian Directorate of Fisheries and Statistics Norway. Much of the information requested is already collected and published in aggregate form annually. The detailed statistics are published in Norwegian language only and summaries are available in English language. Adjustment of existing information into the format for this specific FAO review study would be possible without too much additional effort.

61. After the presentation, participants discussed various issues, including the use of TACs for different fisheries, whether fishers comply with reporting requirements, discard issues, how economic profit is calculated, the pricing mechanism for quotas, the economic sustainability of fisheries in the Norwegian EEZ, MSC certification, immigrant workers in the fisheries sector and various indicators for measuring profitability of the fishing fleets.

Indonesia

62. Ms Umi Muawanah, Researcher, Research Centre for Marine and Fisheries Socio-Economics, Agency for Marine Affairs and Fisheries Research, Government of Indonesia made a presentation on "Methodologies applied for conducting economic and financial fleet performance reviews in Indonesia".

63. She said that the total number of marine fishing vessels is about 500 000 in 2018. Although the fishery sector' contribution to national GDP was only about 3-3.5 per cent, the fishery sector provides about 54 percent of the animal protein required for the population and provides employment to about 4 million fishers, who are directly depending on the fishery sector for their income.

64. The logbook program for vessels was launched in 2010 and is still being implemented. However, the completion rate of logbook information is still very low with only some 5 percent. In many cases, the fishers fill up the form when they have already landed their catches, because it is difficult to fill up the form when they are on-board. Therefore, the quality of data in terms of accuracy is rather low.

65. The Government of Indonesia does not have a regular program for the collection of cost/earnings data of fishing vessels. However, the National Statistic Books depicts the aggregated technical data of the fisheries sector, such as total fleet sizes and vessel sizes. Information for the National Statistic Books originates from yearly sampling and data records obtained from fishing ports throughout Indonesia. To date, the existing socio-economic data have been collected by research conducted under various projects, such as FAO's REBYC II project, CSIRO and the Global techno-economic fleet reviews that FAO conducted in the years 1999 and 2004.

66. Ms Umi further mentioned that several types of general fishing fleet related data are available and their sources can be summarized as; (i) General vessels information which can be found in the fishing permits and includes information on length, weight (GT), horsepower of the engines; (ii) Logbooks data on total catch and catch composition; location of fishing grounds; fishing zones; home port and port of landing; and (iii) Socio-economic data obtained through research programmes, which are most likely to include cost and revenue data for financial analysis of small-scale, medium and large scale vessels. The coverage depends heavily on the scope of research and the research questions. In summary, there is no regular socio-economic data collection system in place, which could be used for the purpose of the present study.

67. Following the presentation, it was discussed how fishing effort is being measured, the status of some stocks, the number of ports in the country, and household data collection systems used. It was mentioned that licencing is of key importance to find out more about the fisheries and fishing vessels used and that budget should be allocated to conduct the necessary surveys in Indonesia.

Thailand

68. Mr Suthipong Thanasansakorn, Marine Engineering Section Head, Training and Research Supporting Division, SEAFDEC made a presentation on "Methodologies applied for conducting economic and financial fleet performance reviews by the South East Asian Fisheries Development Centre" with a focus on Thailand.

69. Explaining the context of his presentation, Mr Thanasansakorn said that in the Southeast Asian countries, the major concern, in respect of fisheries, is poverty and human well-being. In terms of fishing operation, the fuel cost has the largest share in the operating costs, which in turn determines the income of the fishers. Therefore, technological intervention is aimed at optimizing energy use through engine management, better construction of fishing vessels, and appropriate fishing operations. Towards this SEAFDEC is carrying out a project to improve fuel efficiency and possible use of alternative energy sources. Apart from contributing to the bottom-line of fishing operation, the project would also contribute to the reduction of carbon emission from the fisheries. Further, safety at sea for fishers is

also a major concern and the project is also aiming at awareness building on the safety at sea for fisher through improved living and working conditions on board.

70. The presentation delineated the step toward systematically evaluating the potential impact of fuel optimization practices in fisheries, including their suitability and relative contribution to fuel conservation and describes the outcome of an extensive energy audit of the Thai single-boat trawl fleet. The methodology that was applied was based on fishing vessel energy audit protocols designed for the Australian fishing industry and further modified following completion of a pilot energy audit study in the Thai single-boat trawl fleet in 2014. The energy audit protocol consisted of three key levels. The Level 1 audit involved interviewing a total of 150 fishing vessel owners/operators about the operation of their trawler and fishing gear, including operational, duty cycles, catches, revenues and expenditure details. During the Level 2 audit, six trawlers were selected for further evaluation, including at sea measurement of fuel consumption over a six-month period. At Level 3 of the audit an evaluation was conducted, a variety of fuel-saving options were identified and a first-order estimate of their suitability and fuel impact on the entire trawl fleet was calculated. The payback period for many potential options presented was estimated to be less than one year.

71. The data collection included information from 150 trawlers operating in the Gulf of Thailand and the Andaman Sea. The vessels were classified into three categories – small, medium and large and 50 samples were collected for each category. The small trawlers included vessels less than 14 meters (m), with a displacement of less than 20 gross tonnages (GT), and engine capacity of 70 to 150 HP. The medium category included vessels between 14 and 18 m, with displacement ranging between 20 and 60 GT and an engine capacity of 150-275 HP. The large category included vessels from 18 to 24 m, having a displacement of 60-150 GT and an engine capacity of 280-480 HP. All trawlers were over 10 years of age and most (78%) were over 20 years of age. All were constructed from hardwood. Service speed was typically between 6-8 knots, and the duration of fishing trips were typically 1-day trips for the small vessels, 6 to 7 days or more for the medium sized vessels, and 10-14 days for the large vessels.

72. The study found that investment costs (including wooden hull construction, main engine, fishing equipment, etc.) ranged from 30-45 000 USD for small vessels; 70-100 000 USD for medium vessels and 150-200 000 for the large vessels. The operating costs (including fuel, wages, labour cost, ice, and daily maintenance) per fishing trip for small, medium and large trawlers were on average USD 4 000, USD 8 000 and USD 12 000 respectively and annual maintenance cost for the same categories were USD 3 500, USD 5 000 and USD 10 000 respectively. On an average the fishing vessels made a monthly profit of USD 2 000 (small vessels), USD 6 000 (medium vessels) and USD 9 000 (large vessels).

Sri Lanka

73. Mr Oscar Amarasinghe, Professor, Department of Agricultural Economics, Faculty of Agriculture, University of Ruhuna, Sri Lanka shared his presentation on fisheries in Sri Lanka. The Meeting was informed that since the late 1930s, experiments have been conducted by the Sri Lankan State to introduce suitable mechanized crafts into Sri Lankan fisheries. The results of the various experiments led to the introduction of three main types of vessels:

i. Mechanized crafts with outboard engines (the most commonly used craft is the 17-23 feet fiberglass reinforced plastic –FRP- vessels);
ii. One-Day Operating Craft (ODOC) with inboard engines (these vessels are 28 – 34 feet in length or and up to 3.5 tonnes in weight; and
iii. Multi-Day Operating Craft with inboard engines and ice compartments (MDOC) (these vessels are 3.5 - 5.5 tonnes ‘Tank Boats’ and their length is more than 34 feet).

74. Of the crafts mentioned above, the FRP boats, which were introduced in the early 1970s operate mainly in coastal waters along with traditional crafts and beach seines. The 3.5-ton one-day operating craft is meant to fish in off-shore waters, beyond 40 km from the coastline. However, this boat was not

equipped with facilities to ice the fish catch and, therefore, the fishermen had to confine their fishing activities to one-day fishing trips. By the late 1980's, fishermen started introducing an ice compartment to the existing fleet of day-boats and subsequently the modified boats were generally replaced by the multi-day boats with ice compartments and cabins for the crew. Some of the vessels operated today are over 45 feet LOA and are powered by engines of more than 100 HP. They are generally equipped with high-frequency radios and GPS.

75. Along with the mechanized craft, the nylon gill net was introduced into Sri Lankan fisheries in the early 1960s. The nylon nets replaced all traditional hemp and cotton nets. With the introduction of the nylon nets, gill netting became a popular technique of fishing, which led to a considerable increase in catches. The five-fold increase in fish production from the 1950s until today is the combined result of both the introduction of the nylon nets and the mechanized crafts. Apart from gillnet fishing, techniques such as long-lining, trolling, bottom set nets and lines, and purse-seining were also introduced and many of these techniques have become quite popular today.

76. While no regular collection of cost and earning data on fishing operation is collected, various studies carried out by different researcher showed that the return to labour was lowest in traditional crafts (LKR 134), while it was highest for the MDOC (LKR 877.42). Return to labour for the MDOC was lower than expected, because the multi-day fishing trip was taken as the total labour time employed in fishing operations, although this included a considerable amount of non-fishing labour time (to reach distant fishing grounds and also resting time). The FRP boats too reported a high return to labour (LKR 830.25).

77. The Meeting was informed that the National Aquatic Resources Research and Development Agency (NARA) in Sri Lanka instituted a study on the cost and earning of fishing vessels in 2016. For the purpose of the study, information on more recent fishing trips was obtained through interviews with fishing crew and from observation. The annual costs and revenues of the fishing craft were extrapolated via multiplying the trip values by the average number of fishing trips that were completed by a fishing craft within a year. The questionnaire included questions relating to the fixed cost of the craft, such as numerical values of fishing gear, hull, engine and other assets and annual recurrent costs, such as insurance premiums, license fees and repair costs. The operational cost data related to the respective fishing trip were collected and categorized into major cost groups: labour, fuel, food and beverage, ice/salt and other. The production and revenue data of the trip included: fish catch by species and respective market prices. A straight-line depreciation method was applied to calculate the annual depreciation.

78. The results from the NARA study showed that there is a tradeoff between vessels length and profitability for multi-day fishing vessels. The profitability declines beyond 38 meters of length. However, revenue increased with the increase in length and there is a tendency now to increase the length of the fishing vessels.

Comparison of methodologies used for conducting fleet performance reviews and Presentation of a draft methodology for conducting the global review

79. Mr P. E. Rodgers, Professor, University of Lincoln, United Kingdom, made two presentations: The first dealt with the comparison of methodologies used for fleet performance review in various parts of the World and the second presented a draft methodology for the proposed global survey. The proposed methodology is made available in Appendix 3. The methodology paper comprises four sections: The first section describes what benefits economic analysis can provide to fishery managers and other stakeholders. The second section considers the data needed to be able to complete an economic analysis. The section is structured so that maximum information can be gleaned from existing approaches to data collection and to consider the benefits that might be derived from a minimal increase in the resources allocated to collecting data. The third section focusses on the technical aspects of the development of fisheries. In this section Mr Rodgers examines ways of collecting the economic and financial data and information needed by fishery managers to make informed decisions related to the

management of the fishing fleets. The fourth section considers the mathematical methods that contribute to the estimation of critical variables.

80. Mr Rodgers proposed that labour productivity could be a good candidate indicator for measuring the performance of the fisheries sector. While inferences can be drawn from having only minimal data available, it is clear that the more complete the data are the better the understanding of the economic position of fishing fleets can be. It is, nevertheless, possible to gain a useful picture from minimal data. In situations where revenue and labour data are available, the labour productivity may provide a useful insight into the sector's performance. This can provide a foundation for the future building of the datasets as more resources become available.

81. Following the two presentations by Mr Rodger, the Meeting participants recommended that the total factor productivity could be a better measure although it is more data intensive to collect this information. The Meeting also reviewed the draft methodology and variables identified (Table 1 in Appendix 3) and arrived at an agreed methodology, which is made available in Appendix 4.

Technological innovation in fisheries

82. Mr Van Anrooy (FAO) provided a summary overview of major technological innovations with an impact on fishing fleet performance, based on a draft discussion paper with the same title prepared for the global review study. Since the most recent FAO global review of the techno-economic performance of the main fishing fleets in 2002/3003 many new technologies and other innovations have been explored to increase the performance of the fleets. In the last 15 years, cost reductions and energy savings have been the key drivers for technological developments in fishing vessels, gear and fishing operations. Other technological innovations in fishing focused on increasing fishing efficiency, reducing environmental or ecological impacts of fishing, improving fish handling and product quality, improving safety at sea and working conditions of the fishers on board of vessels, or a combination of these.

83. In his presentation, Mr Van Anrooy identified 5 areas of technological innovations that have had an impact on fleet performance and listed a range of technologies and developments, including:

i. Cost reductions and energy savings in capture fisheries (including the increase in use of cheaper fuels, increase in use of 4-stroke and modern 2-stroke outboard engines, improvements in engine efficiency, propulsion system improvements, vessel hull design [bulbous bow shape] improvements, reduction in the use of wooden fishing vessels, and the use of larger vessels [to stay longer at sea] and transshipment vessels).
ii. Increasing fishing efficiency (including the widespread use of GPS, Fish finders, seabed mapping technology, Fish Aggregating Devices (FADs), biodegradable and collapsible traps, LED light use in night fishing, and multi-purpose fishing vessels)
iii. Reducing the environmental/ecological impact of capture fisheries (including the increased application of Bycatch Reduction Devices (BRDs), Turtle Excluder Devices (TEDs), developments with Electric Pulse Trawls and the increased use of circle hooks)
iv. Improving fish handling, product quality and food safety (including improvements in rapid and more animal welfare compatible methods for the killing of fish, such as electric stunning and bleeding of tuna, computerized weighing/scaling/grading, traceability systems starting on-board and better quality control systems)
v. Improving safety at sea and working conditions of fishers (including increased use of Automatic Identification Systems (AIS) and Vessel Monitoring Systems (VMS), entry into force and implementation of a range of binding and voluntary fisheries and labour related international and regional instruments [PSMA, Global Record, e-logbooks, regional vessel registries, IUU vessel lists, STCW-F 1995, ILO Work in Fishing Convention, Cape Town Agreement], increase in the development of vertically integrated value chains [fishing multinationals], improvements in life jackets and life rafts, and increasing use of solar panels and mobile- and satellite phones).

84. The presentation concluded that innovation is continuing rapidly in communication, processing and engine' fuel efficiency improvements. It was noted that many more technical innovations have been made in the last decade, but uptake by fishers and distribution throughout the world is often limited.

85. Mr Yugraj Singh Yadava made a presentation on "Technological innovations in small-scale fishing fleets in the BOBP-IGO member states". In his presentation, Mr Yadava said that Bangladesh, India, Maldives and Sri Lanka are the member countries of the BOBP-IGO. Fisheries play an important role in all the four member countries. However, the nature of fisheries varies. A major change that has been observed in India, Maldives and Sri Lanka is the replacement of wood with fibreglass (FRP) for the construction of fishing vessels. The presentation was limited to Maldives and Bangladesh as fisheries in the other two BOBP-IGO member countries were already discussed.

86. In the Maldives, where pole and line tuna fishing is in vogue, mechanization of fishing vessels started in 1970 and gathered momentum in 1974. Over 1300 *Masdhonis* were mechanised by the end of 1984 and sails and paddles were completely replaced by diesel engines by 1990. Currently, most new fishing vessels have fibreglass hulls. Use of fibreglass facilitated an increase in the size of the vessels and to improve the comfort for crew and facilities on-board. Currently, fishing vessels are generally 15 to 37 meters in length and their engine capacity varies from 500 to 1 000 HP. The fishing vessels are also having on-board insulated storage facilities.

87. In Bangladesh, there are mainly two types of fishing vessels as per the national classification. These are industrial trawlers (> 24 meters in length) and artisanal fishing vessels (< 24 meters). The artisanal fishing vessels include gillnetters; set bag netters, longliners and trammel netters. Industrial trawlers were initially focused on shrimp trawling. Now many of these vessels are also carrying out mid-water trawling. In the artisanal sector, the construction material is wood and the availability of suitable wood is a major challenge.

Field Visit

88. A field visit was made to Devaneri, a fishing village and fishing landing centre, located south of Chennai. The participants obtained a first-hand experience of small-scale fisheries and the fishing technology in use in India. They also interacted with the fishermen about the trends in catches, fishing gear, challenges and prospect of fisheries.

Identification of Experts for the Global Study

89. The Expert Meeting agreed on the candidate countries to conduct the global study. The List of countries is given in Appendix 5. It was also decided that the FAO and BOBP-IGO will work together to identify experts in other major fishing nations, which were not represented in the Meeting.

Conclusion & Recommendations

Conclusion

90. The Meeting brought together a group of key fisheries economists with experience in fishing fleet reviews to: 1) present and discuss the advantages and disadvantages of various methodologies applied for reviewing the economic and technical performance of fishing fleets, 2) develop and agree on a general sampling/survey methodology for conducting techno-economic performance reviews, which can be applied also in developing countries, and 3) discuss technological innovations that have taken place in the last 10 years that had an impact on the economic and financial performance of fishing fleets. The main conclusions and recommendations from the Expert Meeting are the following:

i. Techno-economic fishing fleet performance reviews provide important information for fisheries authorities, investors, financial institutions and development partners involved in fisheries.

ii. The number of countries that collect and analyse socio-economic information on fisheries and analyse the performance of their fishing fleets, has increased rapidly over the last decade, particularly in the European Union and the USA.

iii. Technological advances have increased fishing efficiency tremendously since the last FAO global review of fishing fleets in 2003. Technologies such as GPS and Fish finders are now widely applied by industrial, small-scale and recreational fisheries, and smart FADs (Fish Aggregating Devices), which are communicating via satellite with the vessels, are changing the fisheries sector. Improvements in vessel fuel efficiency, vessel design, communication, fish processing onboard and bycatch reduction devices also have major positive effects on the profitability of the fishing fleets.

iv. The Expert Meeting agreed on data to be collected in surveys for the global review of the techno-economic performance of fishing fleets and financial and economic indicators to be applied in the analysis.

v. The Expert Meeting also agreed to include in the global review the main fisheries of approximately 18-20 countries representing a substantial part of the global marine capture fisheries landings.

Recommendations

91. Recommendations from the Expert Meeting towards Governments and FAO included the following:

i. Governments should increase their efforts to ensure that fisheries socio-economic data and information are collected and shared, particularly to monitor the economic and financial feasibility of their fishing fleets.

ii. Governments should look into the previous global techno-economic fleet performance reports of 1990s and early 2000s to compare the current performance levels with those of the same fisheries previously.

iii. FAO should continue to carry out global review studies on fishing fleet performance every 5 years, covering major fishing fleets.

iv. Harmonization of methodologies for surveying economic performance of the fishing fleets is important to enable comparison between fleets. The harmonization should also consider the terminology used and indicators applied for performance review.

v. Governments, when carrying out techno-economic fleet performance reviews, should consider capturing also information on investments in safety at sea, environmentally sustainable gears and technologies, and the impact of innovations in technologies on greenhouse gas (GHG) emissions.

vi. Governments are invited to use the information collected during the global techno-economic performance review process of fishing fleets in support of the implementation of the International Plan of Action for the Management of Fishing Capacity (IPOA-Capacity), which was adopted by the FAO Committee on Fisheries in 1999.

Appendix 1

Agenda

Date & Time	***Venue/Activity***
18/09/18	
0900–0915	***Registration of participants***
0915–0945	1.Opening of the Meeting Welcome words: Mr Yugraj Singh Yadava, Director, BOBP-IGO Introduction of participants
0945–1000	2. Objectives of the Meeting and adoption of the agenda (Mr Raymon van Anrooy, FAO)
1000–1015	3. Summary of findings of past FAO techno-economic performance reviews of fishing fleets (Mr Raymon van Anrooy)
1015–1045	*Coffee break,+ Group Picture*
1045–1145	4. USA -Methodologies applied for conducting economic and financial fleet performance reviews (Mr Andrew Kitts with NOAA NMFS Office of Science and Technology)
1145–1245	5. European Union - Methodologies applied for conducting economic and financial fleet performance reviews (Ms Natacha Carvalho, EU DG Mare)
1245–1415	*Lunch break*
1415–1515	6.India -Methodologies applied for conducting economic and financial fleet performance reviews (Mr R Narayana Kumar, CMFRI)
1515–2030	Field Trip/Meeting dinner
19/09/18	
0830–0845	7.Summary of the previous day discussions (Mr Raymon van Anrooy)
0845 – 0930	8. China - Methodologies applied for conducting economic and financial fleet performance reviews (Mr Liming Song, Shanghai Ocean University)
0930 –1030	9. Norway - Methodologies applied for conducting economic and financial fleet performance reviews (Mr Terje Vassdal, University of Tromsø)
1030 – 1100	*Coffee break*
1100 – 1130	10. Indonesia - Methodologies applied for conducting economic and financial fleet performance reviews (Ms Umi Muawanah, Agency for Marine Affairs and Fisheries Research)

1130 – 1200	11. Thailand - Methodologies applied for conducting economic and financial fleet performance reviews (Mr Suthipong Thanasansakorn, SEAFDEC)
1200 – 1230	12. Discussion
1230–1400	*Lunch break*
1400 – 1500	13. Comparison of methodologies used for conducting fleet performance reviews (Mr Philip Rodgers, University of Lincoln)
1500 – 1600	14. Presentation and discussion of a draft methodology for conducting the F AO Global review of techno-economic performance of fishing fleets (Mr Philip Rodgers)
1600 – 1700	15. Discussion
20/09/18	
0830–0845	16. Summary of the previous day discussions (Raymon van Anrooy)
0845–0915	17. Overview of major technological innovations with an impact on fishing fleet performance (Mr Raymon van Anrooy)
0915–1000	18. Technological innovations in small-scale fishing fleets in the BOBP-IGO member states (BOBP-IGO)
1000–1015	*Coffee break*
1015–1130	19. Discussion on technological innovations that have had and will likely have an impact on fishing fleet performance
1130–1230	20. Identification of experts and partner agencies to involve in the global review and desk/previous studies that should be consulted
1230–1400	*Lunch break*
1400–1500	21. Presentation of the updated draft methodology followed by discussion
1500–1530	22. Conclusions and recommendation for follow-up activities
1530–1545	23. Closure of the Meeting by BOBP-IGO
1545–1600	*Refreshments & Close of the Meeting*

Appendix 2

List of Participants

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Appendix 3:

Methodologies for Conducting Fishing Fleet Techno-Economic Performance Reviews

P.E. Rodgers

Abstract

The Food and Agriculture Organization of the United Nations (FAO) wishes to examine methods available to enable comparative assessment of the techno-economic performance of fishing fleets around the world. This represents something of a challenge given the diversity of locations, products and levels of economic development within which fisheries operate.

This paper considers methods of collecting, collating and publishing data to provide useful indicators on the diverse fisheries of the world for fishery managers and other stakeholders. After brief consideration of the state-of-the-art around the world, it sets out the objective, considers the problems and limitations and offers a perspective on the data that are needed. It discusses useful indicators that may be derived from the simplest to the most complex available data. It is concluded that some useful information on the techno-economic performance of fisheries can be obtained from minimal data on catch value and numbers of fishers and that more detailed data offers the possibility of providing a significant level of understanding of the performance of sectors and sub-sectors of fleets.

Keywords: Techno-economic Performance, Fisheries Data Collection

JEL Classification: Q01, Q22

Introduction and Background

The UN FAO wishes to examine methods available to enable comparative assessment of the techno-economic performance of fishing fleets around the world. This represents something of a challenge given the diversity of locations, products and levels of economic development within which fisheries operate.

The approach taken leads to this paper being elaborated in several sections. The first section describes what economic analysis, from its simplest to most complex forms, can provide for fishery managers and other stakeholders.

The second section then considers the data needed to be able to complete the analysis found possible in the first section. The section is structured so that a maximum of information can be gleaned from existing approaches to data collection and to consider the benefits that might be derived from a minimal increase in the resources allocated to collecting data. It is relatively easy to construct an ideal set of data designed to inform analysis, and ultimately fishery managers and other stakeholders. However, several constraints exist which must be recognized and accommodated if a feasible approach to the basic problem of comparative assessment of the techno-economic performance of fishing fleets around the world is to be achieved. On one hand, in some parts of the world the opportunity exists of tweaking already sophisticated data collection systems and analysis. On the other hand, such as in failed states and war situations obtaining even the most elementary data will be a monumental achievement.

The third section focusses on the technical aspects of the development of fisheries and examines ways of collecting the data needed to provide the information for fishery managers to make decisions informed by the economics and finances of their fleets.

To recognize the varying degrees of difficulty that may be experienced in different locations the approach adopted in this third section is to build from the collection of data (regrettably sometimes by intuitive estimation in the most difficult cases) to a near complete ideal set for the fullest analysis. Thought must be given to the inconvenience inflicted on the fishing enterprises asked to provide data and the reason for collecting it. In the more developed countries the extent of the data sought from fishing enterprises goes beyond that asked of many other enterprises in other sectors of those economies. The justification normally given for this is that the market failure in fisheries requires that they are managed effectively to prevent overfishing and to enable fish stock conservation and sustainability of the fisheries.

The fourth section considers the mathematical methods that may enable the critical variables to be estimated.

Section 1: What information can the techno-economic analysis of fleets provide that will benefit fishery management and economic development?

The underlying concern of governments is to know whether the contribution of fisheries will remain stable or can be expanded to ensure a population that is employed, fed, able to purchase the necessities of life and luxuries, and that will remain peaceable.

To achieve this, fisheries must continue to offer incomes, which compete with other activities in the economies in which they are embedded. Copes (1988) set this out in terms of fisheries as the need to manage so that they are "stable, profitable and unsubsidized".

Stability is a problematic concept in fisheries because the fish stock reserve is subject to considerable natural variation brought about by the weather, competition for space with other species, predation and a host of other factors, among them pollution and climate change. For example, ICES reported that recruitment of North Sea haddock varied by a factor of ten between the years 2004 and 2005 and again between 2013 and 2014, a common variation in haddock and many other fish products (ICES 2017).

Such a degree of instability is a feature rarely if ever seen in other sectors, such as mining non-renewable resources, though farmers will be familiar with it albeit to a lesser degree. It is rare however, to find fisheries and communities that are dependent wholly on a single fisheries product, but there is hardly a locality around the world that enjoys a similar dependency to another. Nevertheless, the dependency on a single or more likely group (however diverse) of fishery products is something that is of concern to providing the economic stability that is desirable.

Copes' comment came before the use of the term "sustainable" became a fashionable cliché, but stability is not to be confused with sustainability. The idea of a fishery being sustainable is questionable in economics and finance, where future flows of income are discounted to a present value by demanding of them a higher nominal return to compensate for the loss of earnings in the meantime before they arrive. The impact of this is seen clearly in the context of non-renewable resources in Pindyck (1977).

Pontecorvo and Schrank (2009) point out that in fisheries it means that the fish stock reserve will eventually be fished to a minimum if the economic return from the fishery is to be maximized. The notion of harvesting more of the fish stock reserve now than is necessary to leave sufficient for the future encompasses the risk that the future may offer other causes for the demise of the fishery.

Profitability is the feature of the finances that drives the activity of putting food on people's plates. It is one of the indicators most readily available once data on the earnings and costs of fishing enterprises becomes available. However, there is an important qualification to this. Often (if not always) it is the practice of accountants to minimize the profitability of fishing enterprises to reduce the tax burden they face. This means that a standard form of presentation is needed if accounts from fishing enterprises in different parts of the world are to be consistent and comparable. A Concerted Action project funded by the EU (Salz and Frost 1997) developed such a consistent approach and it is now used for the EU's Annual Economic Report on the EU Fishing Fleet (Scientific, Technical and Economic Committee for Fisheries (STECF) 2017.

The concept of profitability is difficult, however. Economists determine profit by deducting the opportunity cost of the factors of production, and not the financial costs, from the total revenue. The opportunity cost of a factor is the cost it would attract in its next best use (Davenport 1911). The financial cost is what was paid. The purpose of this distinction is to enable economists to identify what extra society gains by allocating the factors in a particular way. In addition, the opportunity cost of capital is always deducted, because a normal return to capital is regarded as a cost to a business, something not done in the accountancy approach.

The economists' approach serves to ascertain the strength of the incentives, the drivers, in an economic activity. It is the presence of a profit, thus defined, that causes overfishing in the economic sense of dissipating the resource rent and may cause it in the biological sense of reducing the fish stock reserve to a level at which it is unable to provide the maximum sustainable yield.

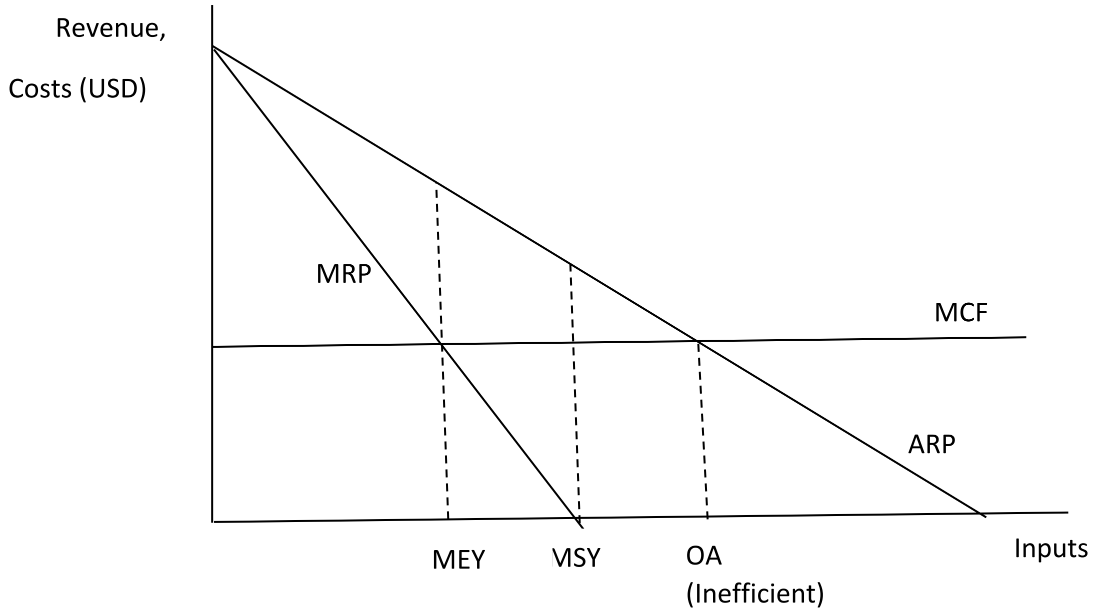

Figure 1: The Effect of Economic and Biological Overfishing on Profitability

Economic overfishing is, thus, fishing at sufficiently high a level to prevent the maximum resource rent being obtained from a fishery. In Figure 1, given the marginal factor cost curve, *MCF*, and average revenue product curve, *ARP*, economic overfishing occurs when the level of inputs is to the right of *MEY*, the level that would produce the maximum economic yield (profit; namely the difference between the *ARP* and *MCF* curves, often described as the dissipation of the resource rent). Clearly economic overfishing will reduce the techno-economic performance of a fleet as the resource rent is dissipated at an increasing rate the greater the extent of the overfishing, but the extent of overfishing will depend not only on the costs faced by a fleet but also by the demand for its product. Competition for the resource leads to lower returns to the inputs and in poorly managed fisheries a fishery will settle at a level of input, *OA*, where there is no more than a normal profit to be made.

Biological overfishing, fishing at a level which is sufficiently high to prevent the fish stock reserve recovering to a level which would be able to support the maximum sustainable yield (MSY) is shown as fishing at a level beyond *MSY* in Figure 1, where the marginal revenue product, *MRP*, becomes negative. Biological overfishing also has an impact on the techno-economic performance of a fleet through its effect on the catch per unit of effort.

The economic approach is more sophisticated than that of marine science. The economic approach breaks down the marine scientists' "fishing effort" into its component parts, most simply into labor and capital, and would allow their use to vary proportionately whereas marine science assumes that the mix of factors employed is fixed. That said it is true that most production functions that have been developed in fisheries follow the use of a single variable index proxying the factors of production (but see Hannesson 1983 and Coppola *et al* 2002). In determining the techno-economic performance of fleets the economists' approach offers more occasion for analysis of the influence of individual factors, among them the level of technology which is the focus of this project.

Subsidization is contentious but fundamental to the question of the techno-economic performance of fleets. The inherent market failure in fisheries is that the fish stock resource has an economic value, which causes it to be harvested for onward sale, but which is costless to the harvester. It is this divorce of costs that causes too much of the factors of production to be allocated to fishing, an economic inefficiency which reduces the net benefit to society. Subsidization adds to the effect of the costlessness of the resource by reducing the cost of capital, and thus in principle will worsen both economic and biological overfishing. However, this is an oversimplification.

The peripheral areas of economies where fishing is generally found frequently offer little in the way of alternative employment (which may render the opportunity cost of labor zero A by-product of subsidization is vessels with more fishing power but often fewer crew, a substitution effect which is often unintended and paradoxical. However, the absence of a counterfactual leaves the effects to be determined by econometrics, which is expensive, particular, and hence, seldom commissioned.

Measuring the techno-economic performance of fishing fleets can say a lot about the above general objectives of fisheries management. A danger with stretching "stability" to "sustainability" is that if it is assumed that employment of labor will somehow remain constant, then a trend uncommon in economics is required. More normally in economic development capital displaces labor – the industrial revolution in Britain between 1750 and 1850 being the archetypal example. Whatever the impact on employment, it is to improvements in techno-economic performance that the fishery must look if wages and profits are to compete with growth and opportunities in other sectors of the economy. If they do not compete then both capital and labor will leave the fishery.

A further indicator of use to fishery managers is the dependency of fleets on fish stock reserves. Some fleets and their localities may be extremely dependent on only a few species. This can be particularly important where the fishery is dependent on a highly migratory fish stock. Such situations occur, for example, down the Indonesian coast and off West Africa. However, even in developed countries such as the Netherlands, fleets may be dependent for their prosperity on only a few fish stocks. The Dutch beam trawl fleet relies primarily on sole and plaice whereas in Italy the fleets characteristically targets at least twelve fish stocks and provide a national harvest of some 40 species. An adjusted Herfindahl Index (Herfindahl 1950) may be used to measure such dependency. Means of calculating this are set out in Rodgers and Bertram (1999). Fleet dependency on certain fish stocks will be affected by techno-economic progress as gears become more selective.

The users of such information are not only fishery managers and policy makers, but also extend to investors requiring information on how they should allocate their portfolios. This demand is complemented by the various public and private funding agencies also seeking knowledge as to whether a lending or investment proposal is viable. Fishery managers will find the information useful in determining whether investment and technological progress is adding to capacity and if the addition is likely to have undesirable consequences for fish stock conservation strategies. For politicians, the importance of the fisheries sector nationally and locally as an employer is fundamental, and governments need information on problems within a fishery requiring their attention.

The indicators needed reflect these objectives and include; profitability, average wage and income, value added, economic rent, the present value of the fishery, return on capital, fuel efficiency, trends in technological efficiency, labor productivity and the age structure of both the fleet and its fishers. Should it be possible to build time series from annual surveys then eventually it will be possible to calculate perhaps the most important of all techno-economic indicators, the percentage rate of technological creep, as fleets become more mechanized and technologically sophisticated. Technological creep is the increasing capacity of vessels of apparently similar characteristics (particularly length, power and fishing time) within a fleet as modern vessels replace older ones. Table 1 sets out the indicators needed, their definitions and contribution to understanding the condition of a fishery.

Table 1: Indicators needed, their definitions and contribution to understanding the condition of a fishery

Indicators Needed (from aggregated data)	Calculation	Why the specific indicator is important?
Revenue	Sum of average prices by species * Output Volume by species	Fundamental. Any two of these variables gives the third
Total earnings	Revenue from fish sales plus income from fishing rights sales, subsidies, grants and other income	
Gross Profit	Total value of landings plus other earnings minus Total gross costs (energy costs and other variable operating costs, crew share and wages, the value of unpaid labour, fishing rights, repairs and maintenance, and other fixed costs)	Fundamental. If profit is less than could have been earned by investing in the next best activity then capital leaks away
Net Profit	Gross profit minus depreciation and interest, and the opportunity cost of capital	Reward for entrepreneurship
Ratio of Net profit to total earnings	Net profit divided by total gross value of landings (before any deductions for costs)	Higher than 10% is good, 7%-8% is a benchmark.
Profit/Cost ratio	Gross profit plus crew share and wages (incl. unpaid labour) divided by total gross costs	A measure of gross profit by ratio 35% is good, 30% is a benchmark
Capital Investment	The total funds invested in the vessel (*i.e.* the total value of assets with a lifetime of greater than 3 years)	Indicates how much capital resource has been allocated to the fleet
Return on Capital	Net profit (plus interest on debt minus depreciation and taxes) divided by the capital investment (defined above)	Yield for investors. Greater than 3.5% will continue to attract re-investment in the fishery
Return on Fixed Tangible Assets	Net profit plus the Opportunity Cost of Capital all divided by the Depreciated Replacement Value of Vessel	Another measure of the return on capital. A desirable result is positive as the cost of capital is taken into account

Indicators Needed (from aggregated data)	Calculation	Why the specific indicator is important?
Return on Investment (ROI)	Net profit divided by total capital invested (Capital Invested = depreciated replacement value of the vessel + estimated value of fishing rights where they are tradeable and have a market value)	Higher than 10% is good, 7%-8% is a benchmark
Average Wage/Income	Sum of all crew shares and wages divided by number of fishers (FTE)	Offers comparison with other employment in an economy
Income (Labour Costs)	Better to use mean wage *i.e.* Total Wages/FTEs	Offers comparison with other wage levels
Employment (Numbers and Mean Wage)	Full-time and part-time. Part-time fishers may be converted to full-time equivalents by dividing their number of hours at sea by 7.5 times 235, assuming a standard day to be 7.5 hours and 235 days per year fished). Where the number of hours fished is not available using 1 FTE = number of Part-Time Fishers divided by 2 is a crude best guess.	Of fundamental socio-economic importance.
Gross Value Added	Gross profits plus crew share and wages (incl. unpaid labour)	It shows the return to the economy for use as future investment and expenditure
Gross Value Added per FTE	Gross value added divided by the number of Full Time Equivalent (FTE) crew	
Gross Labour Productivity	Total earnings divided by the number of fishers (FTE)	Indicates the level of technology employed by a fleet
Fish Stock Status	Not applicable	Undertaken by Marine Biological Institutes; options (overfished, maximally sustainably fished, or underfished) - 5 major target stocks to be covered per country
Fuel Efficiency	Total Fuel Consumption divided by Output Volume	Prey to variations in the fish stock through changes in catch per unit effort
Age Structure of the Fleet	Not applicable	Emerges from the survey, indicates whether the fishery is stable and sustainable

Indicators Needed (from aggregated data)	Calculation	Why the specific indicator is important?
Demographic of Fishers	Not applicable	National level statistics (if available). Indicates whether incomes are keeping pace with other sectors of the economy
Trends in Fish Consumption	Not applicable	From FAO Fish Balance Sheets. Affects the fish stocks exploited, their prices, and the incomes of fishers dependent on them

Note: This list is not exhaustive
Economic Profit assumes a normal return to capital invested i.e. it is the financial (net) profit minus the opportunity cost of capital.

Section 2: What data are needed to enable the indicators discussed in Section 1 to be provided?

From the discussion in Section 1, it is clear that knowledge of the costs and earnings of fleets is essential to being able to determine the techno-economic state and development of fleets. It is more than just a question of the technology employed. Data collected needs to be disaggregated as much as possible and preferably by firm and vessel. This is no easy task, but one problem, the question of converting financial costs (the cost data provided by firms) to opportunity costs, is normally easy to overcome with the simple assumption that the two are congruent. For example, fuel is likely to be sold in its next best use at the same price as it is sold to a fishing vessel, because the fishery represents only a minimal part of the demand for fuel worldwide. This can be applied to almost all costs, but may not be applicable to labor, where if there is unemployment in the locality of the vessel's home port, the opportunity cost of labor may be well below the crew wage or share. The opportunity cost of capital also needs to be determined. Economic theory holds that revenue will exactly equal (opportunity) costs in the long run, another aid to correctly identifying costs.

In the United States, the European Union, and Australasia, among others, fishing firms are required to provide data in detail. Table 2 sets out a minimum desirable level of data collection for situations where there is no detailed fleet data collection in place. An important aspect that emerges from the review of methodologies used is that common definitions are required to provide consistency of analysis and to enable comparisons between countries to be made effectively. Tables 3 to 7 set out requests for more detailed information that will enable a deeper analysis.

Table 2: Data Needed for Techno-economic Evaluation of Fleets' Economic Performance

Category	Item	USD
All figures should be annual amounts		
Earnings (=Revenue)	Total fishing revenue (gross value of landings)	
	Income from sale of fishing rights, licenses, permits and quotas	
	Subsidies and grants	
	Other vessel income (from tourism, charters, etc.)	
Operating Costs	Fuel	
	Lubricants/oil/filters	
	Harbour dues and levies	
	Ice	
	Bait	
	Salt	
	Food, stores and other provisions	
	Fish selling costs (auction commission, etc.)	
	Materials (packaging, boxes)	
	Crew travel	
	Other operating costs	
	Labor share and wages (including social security contributions, life/accident and health insurance)	
Vessel Owner Costs	Fishing licenses, permits and quota	
	Insurance (vessel, employers, equipment)	
	Purchase of fishing rights (quotas)	
	Gear replacements, repairs & maintenance[6]	
	Vessel repairs & maintenance	
	Other fixed costs (accountancy, audit and legal fees, general expenses, subscriptions, etc.)	
	Depreciation (vessel, engine, equipment, and gears that last more than 3 years)	
	Interest	
	Investments	
	Taxes on profits	

[6] Purchase costs of gears that have a life of 3 years or more are reported in the investment items below.

Table 3: Vessel characteristics and other information

Vessel Details	**Year**	
Vessel name		
Registration number		
Home port		
Main fishing area		
Total days at sea		
Number of trips		
Fuel used in year (litres)		

Table 4: Fishing methods employed

Fishing Gears	**% of Time Used**		**% of Time Used**
Pots or creels		Pelagic trawl	
Drift/fixed nets		Purse seine	
Hooks and lines		Seine nets	
Dredge		Beam trawl	
Demersal trawl		Other	
Mid water trawl			

Table 5: Vessel and other equipment values and accountancy practices

20XX	**Vessel Age**	**Cost USD**	**Additions USD**	**Disposals USD**	**Depreciation USD**	**Book Value USD**	**Insured Value USD**
Vessel (ex engine, equipment and gear)							
Engine							
Equipment							
Other							

Table 6: Depreciation method

	%		Straight Line	Reducing Balance	PIM[1]	Other
Vessel						
Engine						
Equipment						
Other						

[1] Perpetual Inventory Method

Table 7: Revenue

Species	Quantity	Value	Main place of landing	Gear used

A minimum set of data would be to complete the green cells in Table 7a. From this the mean price may be calculated because the revenue is the output by volume times the mean price.

Table 7a: Output, Price and Revenue

Country 20XX	Volume of Output (Live weight equivalent)	Price per Tonne (Live weight equivalent) (USD)	Revenue (Local Currency)	Revenue (USD)
Species Product 1				
Species Product 2				
Species Product n				
TOTAL				

If the data suggested in Table 7a for revenue by product are available, then the fish stock reserve dependency of a fleet indicated by an adjusted Herfindahl Index may be calculated.

Table 8 sets out elementary data on labor employed. Again, the green cells represent a minimum.
Table 8: Labor Employed in Fishing

	Full Time (FTE)		Part Time		Total	
			Actual[1]	FTE	Actual[1]	FTE
Fleet 1						
Fleet 2						
Fleet n						
Total						
	Under 20	20-29	30-39	40-49	50-59	Over 60
Male						
Female						

[1] "Actual" means participating in the fishery as a fisher without the time participating being defined. "FTE" means fulltime equivalent and may be worked up from the number of hours spent fishing, assuming 37.5 hours for 235 days a year equals 1 full time equivalent job. Where the number of hours is not available 2 part-time participants should be counted as 1 FTE.

Tables 7 (or 7a) and 8 if completed in detail represent the commencement of finding the data for the more substantial analysis set out in Table 2.

Table 9: Additional Information for FAO to calculate and provide

Other Information
Insurance Value of Vessel (including engine and equipment, but not gear)
Fuel Price (per litre – average price throughout the year)
Opportunity Cost of Capital %
Gross profit margin %
Net profit margin %
Average wage per FTE (USD)/month

Section 3: Methods of collecting data

The techno-economic fishing fleet data may be obtained only by some form of survey. The construction of the survey questionnaire is of primary importance. However, at this point the reality strikes of the likelihood of the data being obtainable and obtained. A few developed countries already have sophisticated systems in place for collecting the necessary data and allocating funding for the collection of the data.

It is not necessary that governments or their agencies take responsibility for the collection of data. There have been many cases where academics have obtained data directly from fishing enterprises for their studies. However, if it is to be collected consistently over time so that time series suitable for econometric and statistical analysis can be constructed, then the government must be the driving force.

Sensitive commercial data are involved and without a legal requirement to provide the data it is understandable that fishing enterprises may question the purpose and use of the data. Suspicion arises from concern that data may be used at some stage in the future to impose constraints on their activity, such as quotas, or that tax authorities may obtain the data. On the other hand, the notion that data may support requests for subsidies may encourage the provision of data by the private sector. A problem here is that data may only be willingly provided where a fleet is performing poorly and may not be forthcoming where a fleet is enjoying a prosperous time.

Once a decision on the resources available for a survey is made, the first question is who will collect the data. The project may be outsourced to (and perhaps funded by) one of its agencies. Otherwise, it will be necessary for a consultancy provider, such as an NGO or university or a private enterprise to take on the task.

The next decision will be whether to survey the whole fleet or to use the method of sampling. Ideally, the whole fleet would be surveyed but this might require legislation. Sampling requires a systematic approach to dimension a matrix of fishing enterprises by, for example, locality, target product, gear, vessel size (length or engine power). Ideally, a minimum of twenty vessels should be included in each cell of the matrix suggesting that the matrix requires as few dimensions as feasible for a sensible fleet sub-sector to be constructed. However, it is only necessary that at least three vessels from independent private enterprises are included in the cells of the matrix to ensure statistical integrity and to preserve the confidentiality of commercially sensitive information.

A legal requirement to provide data will need enforcement but may serve to offer a complete picture of a fleet. It is sometimes possible to tie a requirement to provide data as a condition of a subsidy, such as a grant or loan for a new vessel or for obtaining licenses, permits or quota allocations but again this requires enforcement if it is to be effective.

Perhaps the most important aspect of analyzing the data necessary to illustrate and compare the techno-economic performance is to remember the problem of availability of resources to perform the task. It is relatively easy for governments to pass legislation requiring data to be provided by fishing enterprises from sales notes, log books and accounts. However, this will be to no avail if the infrastructure for receiving the data and processing it into a form coherent internally and with that of other nations is not in place. An infrastructure consistent with the amount of data to be collected is, therefore, essential but will also depend on the chosen means of obtaining the data.

Data on the volume and value of landings and the number of fishers is all that may be extractable where the political situation is unstable, or economic development is limited. As the countries involved are richer and more developed then the infrastructure for collecting data becomes generally more comprehensive. Location of specific fleets and their crew numbers, and the value and location of harvest by species, are next easiest. Vessel characteristics are also relatively easy to obtain once a fleet is identified. It is not uncommon for academics carrying out research independent of government to collect the data they need for studies in this way, though it has the disadvantage of not developing time series. It is important that the sector is not subjected to too many surveys.

Surveys may be conducted face-to-face, by telephone, by e-mail, by post or on-line.

In Australia where responsibility for fisheries is shared between the States (inshore up to 3nm) and the Commonwealth (the remainder of the Exclusive Economic Zone), the *Australian Bureau of Agricultural and Resource Economics and Sciences* (*ABARES*) collects economic data face-to-face for three fisheries on a two- or three-year cycle, with only one or two surveyed each year. In South Australia, a consultancy, EconSearch, runs the survey program that covers around a dozen fisheries. These are surveyed face-to-face every two years, with estimates based on price and cost changes used to provide estimates of the most current year if not in the survey.

Elsewhere in Australia some work is done on a project basis. In Queensland this has been mostly through online surveys owing to the length of the coastline. Early response rates were low but are now around 50%. For some of the more local fisheries surveys have been done face-to-face. A major benefit of on-line surveys is their low cost compared to face-to face interviews.

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) notes that quite a few fisheries claim that consideration of economic information is important for their success (Pascoe 2018).

Fisheries in the Republic of Ireland are surveyed in order to meet the requirements of the European Union Data Collection Framework (DCF). The survey forms are provided on-line and may be completed interactively and returned to the surveying agency, Bord Iascaigh Mhara (The Irish Sea Fisheries Board BIM) by e-mail. Alternatively, the forms can be downloaded for completion and returned by post. The latter has been overwhelmingly preferred by respondents (Jackson 2018). Belgium also uses a web platform for part of its DCF work.

In the United Kingdom, surveying is carried out by the Sea Fish Industry Authority which supplements data on landings collected by the Marine Management Organisation. A team of investigators visits vessel owners and skippers to carry out face-to-face interviews. 400 interviews were conducted in the 2017 survey. The success of this approach has been achieved by building an atmosphere of trust and by enlisting the support of the fishing industry representative organizations (Seafish 2018).

The National Marine Fisheries Service (NMFS) in the USA monitors recreational fishing through telephone surveys, access point surveys, web-based declaration and mail surveys and also uses low-altitude flights for counting fishing boats and shore anglers, combined with on-site interviews (Rocklin *et al* (2014). Telephone interviews are normally computer aided (CATI).

Where the rule of law applies and there is an effective government, it is possible to require fishing enterprises to submit data. This is most effectively achieved by a survey form seeking the information set out in Table 2.

For a variety of reasons, it is not always possible to survey a whole fleet or fleet segment. Vessels may be away from port or there may be insufficient personnel to question every fishing enterprise. Some firms may decline to cooperate, especially if there is no legal requirement to do so. In these circumstances, consideration must be given to a structure for ensuring that something can be said about as many of each of the métiers as possible. The best approach remains to collect data from as many of the population as possible, but when resources are in short supply a structure to the surveying is essential. This is to be achieved by forming the multi-dimensional matrix set out according to vessels characteristics. A thoroughgoing example is to be found in Lawrence *et al* (2018). The precise dimensioning of the matrix is to be determined by the researcher according to the local fleet.

Whatever the local situation the first call is to government. It may be a requirement for vessels to be registered or licensed or to record that they have fishing rights. If this is not the case then a list of fishing vessels, their home ports and owners must be constructed by the researcher. This may be possible only by visiting the harbours and foreshore. It must be remembered that many fishing vessels are pulled up onto the beach, not only in less developed parts of the world like west Africa, but even in developed countries like the UK along the East Coast and English Channel. A further consideration is that the fleet may be away elsewhere fishing according to the seasonal migrations and availability of fish stocks. To complement this, some *ex ante* attempt must be made to determine the importance of the products landed by a fishery. This can be achieved by obtaining government data or those published in FAO catch and commodity statistics. Relying on tonnages alone is likely to be unsatisfactory because of the wide variability in prices per tonne and because of the differing meat yields of fish species.

Section 4: A Simple methodology available for Techno-economic Analysis of Fleets' Economic Performance

Substantial financial analysis is possible from the data collected according to the schedule set out in Table 2. Profitability (in the accountancy sense), gross value added, revenues and costs can be calculated with the collected information of table 2 and the indicators described in Table 1. The development of a database of annual records enables trends to be identified.

Presentation of results depends on the data that it has been possible to collect. Thus, disaggregation is to be considered and will likely be offered by fleet (defined by métier) and then perhaps by locality. The EU's Annual Economic Report provides a useful template in this respect. Data, of course, may be so complex that it is difficult for the reader to extract the important indicators and messages. Again, the EU's Annual Economic Report[7] is a useful example of provision of main indicators and trends for the busy reader.

One of the simplest indicators, not explicitly included in the EU Annual Economic Report, is among the most valuable as regards techno-economic performance. Labor Productivity is quite simply

$$Labor\ Productivity = \frac{Revenue\ from\ Fishing}{Number\ of\ Crew\ (Full\ Time\ Equivalents)} \qquad (1)$$

No subscripts have been applied to Equation (1) but labor productivity may be determined at disaggregated levels, such as by gear or locality, by target species or fishery. This differs slightly from the conventional definition, which divides revenue by hours of labor employed. For comparative purposes between fleets, the equation above would be adequate. If data are available, then the more conventional indicators may be used.

The disadvantage of labor productivity is in its perception. Notably in the minds of the media, but also elsewhere, it is apt to be regarded as a measure of the energy or laziness of the workforce. While there is an element of this, it is not really to be regarded as such.

Labor productivity is actually a measure of the degree of capital intensity (versus labor intensity) of production. Consider the productivity (output) per person of a crew of eight on a trawler compared to the likely productivity of eight people fishing with line and rod from the beach. The labor productivity of the trawler crew will be far higher because of the capital equipment (the vessel and its gear) available to them.

For example, the Sea Fish Industry Authority (Seafish 2017) reports that in 2016 North Sea Beam Trawlers of greater engine power than 300kW produced output per person of £74,800 compared to £34,500 per person for vessels with less than 300kW engine power. This indicates that labor productivity is a function of the capital equipment available to employees.

Similarly, the EU's Annual Economic Report (*op. cit.*) reports productivity per head for the French fleet of €171,000 compared to that of Lithuania €211,000[8]. Since the French economy is more developed than that of Lithuania with a higher gross domestic product per capita this seems a perverse result, but it is easily explained by the contribution of 94% to national fisheries output by value by the Lithuanian distant water fleet whereas only 10% of revenue comes from the French distant water fleet. Distant water vessels have a high capital intensity. France has a fleet comprised mostly of relatively small artisanal vessels.

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[7] https://stecf.jrc.ec.europa.eu/documents/43805/2262384/STECF+18-07+-+AER.pdf

[8] Note that the definition of Labor Productivity used by the EU Annual Economic Report is Gross Value Added divided by Number of Crew.

As a means of comparing the techno-economic performance of fishing fleets the Labor Productivity indicator has considerable virtues. It can be derived from even the most minimal data available, just the value of output and the number of fishers.

This may be applied at the national level but may be aggregated into data from, say, a multinational fishery or disaggregated to compare techno-economic performance between different gear types within a national or local fishery. It is thus extremely versatile. Its drawback is that it must be understood to be a measure of capital intensity versus labor intensity of production and not taken as a measure of the vigor of the workforce. It also suffers from problems with exchange rates if it is to be used for international comparison, and differences in the standard of living across borders.

Calculating an index of labor productivity versus gross domestic product per capita calibrates the indicator within its own economy and a correction may also be made according to purchasing power parity for external comparisons.

It is possible to refine the Labor Productivity variable by replacing revenue by gross value added in the calculation. The drawback of this is that detailed accounts are necessary.

The converse, Capital Productivity, is much less useful and seldom applied in economics but serves primarily to examine the vitality of a workforce for a given level of capital input.

Conclusion and Inferences

Collection of data on the techno-economic performance of fleets provides an opportunity to fishery managers to receive information on the economic contribution of their fisheries to their local economies, as well as the technological state of the fleet and its profitability. This involves collection of data from fishing enterprises on the finances and characteristics of their vessels.

National participants may be asked to provide what information they can obtain and to build towards an ideal presentation. The virtue is that valuable information can still be obtained from minimal data, but the more information available, the more can be gleaned for fishery managers to consider. In other words, the more complete the data the better the understanding of the economic position of fleets. It is, nevertheless, possible to gain a useful picture from minimal data. In situations where revenue and labor data are available, the labor productivity may provide a useful insight in the sector's performance. This can provide a foundation for future building of the datasets as resources become available.

A striking feature of the data considered is the inconsistency, not only in what is being collected (which is to be expected given the differing stages of economic development to be found around the world), but the differences in presentation of the results.

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Appendix 4:

Terms of Reference for the Global Fleet Review

2018 -2019 Global study of Economic Performance and Technological Features of Marine Capture Fisheries

1. Background and context

1.1 Objectives and context

Between 1995 and 1997, 1999/2000 and in 2002/3003, FAO in cooperation with fisheries research institutions and administrations in selected countries in Asia, Africa, Latin America and Europe, carried out studies on the economic and financial viability of the most common fishing craft and gear combinations. These were followed by case studies on the economic performance of small-scale fisheries in 2014-2015.

The findings of the various studies were discussed at some inter-regional workshops, and published in FAO Fisheries Technical papers 377, 421 and 482 (available at http://www.fao.org/docrep/003/W9926E/W9926E00.HTM, http://www.fao.org/docrep/004/Y2786E/Y2786E00.HTM and http://www.fao.org/docrep/008/y6982e/y6982e00.htm), and the small-scale fisheries case studies in Circular 1111 (available at http://www.fao.org/3/a-i5651e.pdf)

The findings showed that - in spite of fully and sometimes over-exploited fisheries resources , marine capture fisheries is an economically and financially viable undertaking which generates sufficient revenue to cover the cost of depreciation as well as the opportunity cost of capital and generates funds for reinvestment in addition to employment, income and foreign exchange earnings. The 2003 study showed that economic and financial performance of the fishing fleet had improved in various countries compared to the earlier study.

Since the last study in 2003, FAO has not conducted any major comparative study on fishing fleet performance. However, many countries and the EU have continued to carry out their fleet performance measurements in order to regularly monitor the economic and financial feasibility of their fishing sector.

The 2018/2019 global review of the techno-economic performance of the main fishing fleets study aims to:

1) Monitor the economic and financial feasibility of the main fishing fleets worldwide
2) Compare differences in economic performance between fleets and over time within fleets.
3) Identify which technological innovations have impacted the performance of fishing fleets in recent years

It is also aimed to expand its scope by covering more countries and focussing on additional issues, such as the role of subsidies in creating or maintaining over-capacities in terms of fishing fleets and fishing effort.

2. Techno-economic and operational characteristics of fishing fleets operating in country of study

2.1 The economically most important semi-industrial and industrial fishing fleets in terms of quantity and value of total catch and of generation of employment and income operating in the country are to be listed. The judgement as to what are the economically most important fishing fleets is to be made and justified by the national expert carrying out the study. Not less than four fleets should be covered in each country.

Each fleet is to be characterised by:
1) the category of fishing vessels, which constitute the fleet,
2) the type of fishing technology and fishing gear used, and
3) the main species caught.

In addition to the economically most important fishing fleets in each country, the following fishing methods are also to be covered by the study if not already covered under the economically most important fishing fleets.

2.2 Approximate number of fishing units constituting each fleet listed and characterised above.

2.3 Description of fishing areas fished by the fleets listed and described above in terms of distance from shore, depth etc. including geographic name of area. Information is to be provided for each fleet separately and on a map and the FAO major fishing area coding system is to be used (see annex 1).

2.4 For each fleet listed and described above, names and location of the major fishing ports and landing sites where catch is landed is to be given. (A format is provided in table 1 in annex 2)

2.5 Species caught, landed, discarded at sea (provide information for each fleet covered by study) are to be given (both scientific and common name)

- Main species targeted by fleet (rank from 1 to maximum 5) (format is provided in table 2 in annex 2)
- Main species commonly caught by fleet (rank from 1 to maximum 5) (format is provided in table 3 in annex 2)
- Main species discarded at sea by fleet (rank from 1 to maximum 5) (format is provided in table 4 in annex 2)

2.6 A short summary overview is to be given of the fisheries legislation and regulations related to

- Fishing operations
- Fishing vessels sizes and numbers
- Fishing gear
- Fishing areas
- Fishing seasons
- Potential catches (species, sizes, and quantities)

The main purpose of this section is to find out which regulations impact fishing operations financially

2.7 Information on age structure of each fleet is to be provided in terms of:
% of number of vessels

- 0 - 5 years
- 5 - 10 years
- 10 - 15 years
- 15 - 20 years
- more than 20 years

(The format is provided in table 5 in annex 2)

2.8 An overview of recent changes and plans for future development of each fleet and its fishing operations is to be given with specific reference to:

- Potential for development of new fishing areas
- Potential for exploitation of new/different resources
- Need for replacement of fishing units over next decade to maintain size of fleet or expand it
- Need to reduce fishing effort and size of fleet

3. Techno-economic and operational characteristics of individual fishing units

For each fleet a typical, average individual fishing unit is to be described in terms of:

3.1 Length of vessel

- Length overall (LOA)
- Length between perpendiculars (LBP)

3.2 Tonnage

- Gross tonnage (GT)
- Gross registered tonnage (GRT)

3.3 Propulsion and Engine Power

- Type of propeller (fixed propeller, controllable pitch propeller)
- Power of main engine in kilowatts (KW)

3.4 On-board facilities for processing and storage of catch

- Volume of fishhold(s) (in cubic meter and in metric tons of fish)
- Freezing capacity (in metric tons of fish)
- Buffer capacity (in metric tons of fish)
- Machinery for processing the catch

3.5 Fishing gear and deck equipment

- Type and quantity/dimensions of fishing gear available with Vessel

- Net drums (number and capacity)
- Fish pumps (capacity)

3.6 Crew size and composition

- Number of crew by category/function

3.7 Ownership of fishing unit and sharing, if any, of operational expenses and income

- Company owned, cooperatively owned, individually owned
- Sharing systems

3.8 Operation of fishing unit

- Fishing days per annum and average duration of fishing trips
- Fishing seasons and off-seasons by month
- Only in case of trawling: single boat operation or pair trawling

(The format for presentation of the survey results on this subject is provided in tables 6, 7 and 8 of annex 3)

4. Financial and economic characteristics of individual fishing units

For each of the fishing units described above, the following financial and economic information is to be provided:

4.1 Investment cost in terms of cost of

- Hull
- Engine and propulsion
- Fishing gear and related deck equipment (e.g. beam/crane systems, bycatch reduction devices, fish aggregation devices) as well as lifesaving equipment
- Navigation and communication equipment, fishing finders/fish detection, AIS/VMS
- Fish freezing, cold storage, ice making, preservation and processing equipment etc.

The format for presentation of the investment costs is provided in Annex 4 table 9. It is important to survey at least 3, but preferably 5 vessel owners/operators per fishing fleet. In the analysis we will use the averages of these vessels.

4.2 Cost of fishing operations in terms of annual cost of

- Fuel, lubricants
- Harbour fees and charges
- Insurance fees
- Licence fees
- Taxes
- Repair and maintenance of fishing vessel and gear
- Replacement of fishing gear and material
- Provisions and stores
- Crew wages/salaries/shares and other crew expenditure

The format for presentation of the costs and earnings per vessel is provided in Annex 4 table 11. It is important to survey at least 3, but preferably 5 vessel owners/operators per fishing fleet. In the analysis we will use the averages of these vessels.

4.3 Revenue

- Volume, composition and value of catch of fishing vessel per annum according to utilisation of catch/final product i.e. frozen, fresh fish, fish meal, canned, otherwise processed (information: on disposition and utilisation: company records and/or assessment based on discussion with key informants)

The format for presentation of the catch composition is provided in Annex 4 table 10.

4.4 Economic and financial performance of fishing vessels

Regarding the calculation of depreciation and interest rates, the methods, which are being followed in different countries, are to be harmonised. In case the depreciation rate is not known, then an estimate is to be applied.

The depreciation of investment could be based on the building costs of vessels of similar sizes (e.g. a uniform annual depreciation regarding the hull should be assumed as 4 % of replacement cost during 25 years and after that period of 2 % annually. The engine should be depreciated at 10 % annually in case of heavy use and 6.7 % in case of light use).

An imputed interest rate should be agreed based on the real interest rate of each country taken from the book value of the vessel.

The indicators for the financial and economic performance of fishing vessels are presented in table 12 of Annex 4. It is not needed to make the calculations yourself, but please feel free to do so. FAO will make the calculations in a spreadsheet and share the results with you for your review.

In order to be able to calculate the profitability of each fleet it is of key importance that tables 9 and 11 of annex 4 are completed for at least 3 (and preferably 5) vessels per fleet.

5. Financial services available to the fisheries sector including institutional credit programmes

The following information is to be provided:

5.1 Access of different categories of fishing vessels/fleets to institutional credit.

5.2 Terms of credit/finance available for acquisition and operation of fishing vessels and gear e.g. amounts available as credit and specific purposes for which loans are available, target groups of loans (individual/co-operatives), repayment periods of loans, interest rates (whether subsidised), equity and collateral requirements, availability of capital subsidies and tax exemptions in conjunction with loans.

The format for presentation of the credit/finance availability is provided in Annex 5 table 13.

6. Subsidies and support to the sector

Information is to be provided on:

6.1 Availability of capital subsidies for acquisition of fishing vessels, engines, equipment and gear both to fishermen and to manufacturers of fishing inputs (percentage of subsidy of capital investments and maximum subsidy amounts)

6.2 Availability of tax exemptions on fuel, import and purchase of fishing inputs (e.g. ice, bait, hooks) and with regard to business taxes (percentage of reduction, maximum amounts etc.)

The format for presentation of the tax exemptions and items that can be obtained at subsidized rates is provided in Annex 5 table 14.

6.3 Financial compensation for reduction of fishing effort such as scrapping of fishing vessels etc.

7. Technological innovations in gears, equipment and vessels that impact fishing vessel economic performance

Under this heading, information on the main technical innovations applied in the fishing fleet since 2000 is to be provided by the institute/consultant who carries out the study.

Please include a description of the main innovations in:
- hull/vessel design and dimensions (e.g. for speed/reduction fuel use, storage space, fish processing, crew accommodation, safety)
- gear technology (e.g. Bycatch reduction devices, hydro acoustic and communicating FADs, pulse trawl, letterbox, winches, cranes)
- navigation and communication technologies
- engines/power units/machinery

Where available, provide an indication of how these innovations (positively) affected the profitability of the fleet.

The format for presentation of the technological innovations is provided in Annex 5 table 15.

8. Summary description of national plans and policies for adjustment of fleet capacities

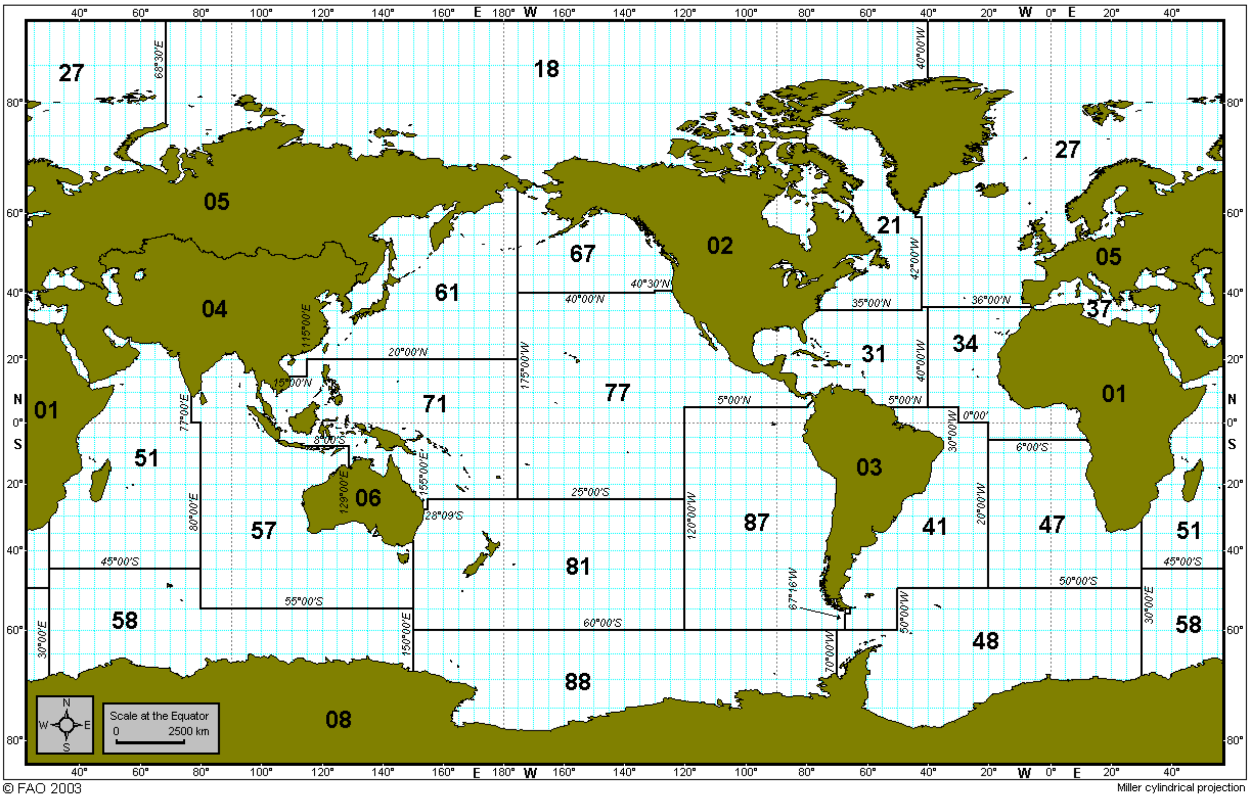
In case there are national and/or regional policies and plans in place or development that aim to limit or reduce the fleet capacity (e.g. National plans of action for the management of fishing capacity) these should be briefly but concisely described here.

9. Description of methodology followed by study

The methodology with the help of which above information is being provided should be described here. Reference should be made to the following methodologies i.e. sample surveys/sample size, total enumeration/reporting, interviews with fishing boat owners/skippers, analysis of fishing company accounts, review/analysis of existing datasets etc.

Annex 1

FAO Fishing areas



01 - Northern Alboran Sea	07 - Gulf of Lions	13 - Gulf of Hammamet	19 - Western Ionian Sea	25 - Cyprus Island
02 - Alboran Island	08 - Corsica Island	14 - Gulf of Gabes	20 - Eastern Ionian Sea	26 - South Levant
03 - Southern Alboran Sea	09 - Ligurian and North Tyrrhenian Sea	15 - Malta Island	21 - Southern Ionian Sea	27 - Levant
04 - Algeria	10 - South and Central Tyrrhenian Sea	16 - South of Sicily	22 - Aegean Sea	28 - Marmara Sea
05 - Balearic Island	11.1 - Sardinia (west) 11.2 - Sardinia (east)	17 - Northern Adriatic	23 - Crete Island	29 - Black Sea
06 - Northern Spain	12 - Northern Tunisia	18 - Southern Adriatic Sea	24 - North Levant	30 - Azov Sea

Annex 2

Table 1: overview of fishing fleets

Fishing fleet Listed by gear name	Number of vessels	Scale[9]	FAO Fishing Area	Main fishing ports
1				
2				
3				
4				
5				

Table 2: Main species targeted by fishing fleet (rank from 1 to maximum 5)

Fleets/Species targeted	1	2	3	4	5
1					
2					
3					
4					
5					

Table 3: Main species commonly caught by fleet (rank from 1 to maximum 5)

Fleets/Species commonly caught	1	2	3	4	5
1					
2					
3					
4					
5					

Table 4: Main species discarded at sea by fleet (rank from 1 to maximum 5)

Fleets/Species discarded at sea	1	2	3	4	5
1					
2					
3					
4					
5					

[9] The scale can be: Industrial, semi-industrial, or artisanal/small-scale.

Table 5: Average age of fishing vessels by fleet in years (in percentages)

Fleets/Average age of vessels in percentages of total fleet size (%)	0-5 years	5-0 years	15-20 years	more than 20 years
1				
2				
3				
4				
5				

Annex 3

Table 6: Basic information of each fishing vessel surveyed

	Vessel 1	Vessel 2	Vessel 3
3.1 Length overall (LOA) or Length between perpendiculars (LBP)			
3.2 Gross tonnage (GT) or Gross registered tonnage (GRT)			
3.3 Total power of main engines in kilowatts (KW)			
3.4 On-board storage facilities (m^3 or metric tons)			
3.5 fishing gear			
3.6 crew size (persons)_			
3.7 ownership (state, shared, chartered, company)			
3.8a Total days fishing at sea			
3.8b Number of fishing trips			
3.8c Fishing season (months)			

Table 7: Fishing methods employed (per vessel[10])

Fishing Gears	**% of Time Used**	**Fishing Gears**	**% of Time Used**
Pots or creels		Pelagic trawl	
Drift/fixed nets		Purse seine	
Hooks and lines		Seine nets	
Dredge		Beam trawl	
Demersal trawl		Other	
Mid water trawl			

Table 8: Labor Employed in Fishing

	Full Time (FTE)	**Part Time**		**Total**	
		Actual	FTE	Actual[1]	FTE
Fleet 1					
Fleet 2					
Fleet 3					
Fleet 4					
Fleet n					
Total					

[10] Please replicate this table for each vessel surveyed

Age distribution of fishers	Under 20	20-29	30-39	40-49	50-59	Over 60
Male						
Female						

Annex 4

Table 9: Vessel and other equipment investment costs and current values and depreciation[11]

2018	Age (years)	Cost of original investment USD	Depreciation rate (%)	Book Value USD	Insured Value USD
Vessel (hull)					
Main engine(s)					
Equipment on deck (e.g. cranes, beams)					
Equipment below deck (e.g. cold storage, ice making, freezers)					
Fishing gears[12] (BRDs, FADs)					
Electronic devices (navigation, fish finding and communication)					
Other					

Table 10: Landing of fish per vessel

Species	Quantity (tons)	Off-vessel Value (USD)	Main place of landing	Gear used
1				
2				
3				
4				
5				

[11] Please replicate this table for each vessel surveyed
[12] Only include equipment and gears in this table that have a life span of at least 3 years.

Table 11: Annual costs and earning per fishing vessel in USD[13].

Category	Item	USD[14]
All figures should be annual amounts		
Earnings (=Revenue)	Total fishing revenue (gross value of landings, if possible split by fish species)	
	Income from sale of fishing rights, licenses, permits and quotas	
	Subsidies and grants	
	Other vessel income (from tourism, charters, etc.)	
Operating Costs	Fuel	
	Lubricants/oil/filters	
	Harbour dues and levies	
	Ice	
	Bait	
	Salt	
	Food, stores and other provisions	
	Fish selling costs (auction commission, etc.)	
	Materials (packaging, boxes)	
	Crew travel	
	Other operating costs	
	Labor share and wages (including social security contributions, life/accident and health insurance)	
Vessel Owner Costs	Fishing license fees, permits and quota	
	Insurance fees (vessel, employers, equipment)	
	Purchase of fishing rights (quotas)	
	Gear replacements, repairs & maintenance[15]	
	Vessel repairs & maintenance	
	Other fixed costs (accountancy, audit and legal fees, general expenses, subscriptions, etc.)	
	Depreciation (vessel, engine, equipment, and gears that last more than 3 years)	
	Interest	
	Investments	
	Taxes on profits	

[13] Please replicate this table for each vessel surveyed
[14] In case another currency is used in the table, then please provide the exchange rate with the US dollar.
[15] Purchase costs of gears that have a life of 3 years or more are reported in the investment items below.

Annex 5

Table 12: Financial, economic, social and technological indicators that may be applied on the aggregate data collected from the fishing fleets, along with their definitions and contribution to understanding the condition of a fishery

Indicators Needed (from aggregated data)	Calculation	Why the specific indicator is important?
Revenue	Sum of average prices by species * Output Volume by species	Fundamental. Any two of these variables gives the third
Total earnings	Revenue from fish sales plus income from fishing rights sales, subsidies, grants and other income	
Gross Profit	Total value of landings plus other earnings minus Total gross costs *(energy costs and other variable operating costs, crew share and wages, the value of unpaid labour, fishing rights, repairs and maintenance, and other fixed costs)*	Fundamental. If profit is less than could have been earned by investing in the next best activity then capital leaks away
Net Profit (also called Net cash flow or net present worth)	Gross profit minus depreciation and interest, and the opportunity cost of capital	Reward for entrepreneurship
Ratio of Net profit to total earnings	Net profit divided by total gross value of landings *(before any deductions for costs)*	Higher than 10% is good, 7%-8% is a benchmark.
Profit/Cost ratio	Gross profit plus crew share and wages (including unpaid labour) divided by total gross costs	A measure of gross profit by ratio 35% is good, 30% is a benchmark
Capital Investment	The total funds invested in the vessel (i.e. the total value of assets with a lifetime of greater than 3 years)	Indicates how much capital resource has been allocated to the fleet
Return on Capital	Net profit (plus interest on debt minus depreciation and taxes) divided by the capital investment (defined above)	Yield for investors. Greater than 3.5% will continue to attract re-investment in the fishery
Return on Fixed Tangible Assets	Net profit plus the Opportunity Cost of Capital all divided by the Depreciated Replacement Value of Vessel	Another measure of the return on capital. A desirable result is positive as the cost of capital is taken into account
Return on Investment (ROI)	Net profit divided by total capital invested *(Capital Invested = depreciated replacement value of the vessel or insured value of vessel + estimated value of fishing rights where they are tradeable and have a market value)*	Higher than 10% is good, 7%-8% is a benchmark
Average Wage/Income	Sum of all crew shares and wages divided by number of fishers (FTE)	Offers comparison with other employment in an economy
Income (Labour Costs)	Better to use mean wage ie Total Wages/FTEs	Offers comparison with other wage levels
Employment (Numbers and Mean Wage)	Full-time and part-time. Part-time fishers may be converted to full-time equivalents by dividing their number of hours at sea by 7.5 times 235, assuming a standard day to be 7.5 hours and	Of fundamental socio-economic importance.

	235 days per year fished). Where the number of hours fished is not available using 1 FTE = number of Part-Time Fishers divided by 2 is a crude best guess.	
Gross Value Added per vessel	Gross profits plus crew share and wages (inc unpaid labour)	It shows the return to the economy for use as future investment and expenditure
Net Value Added per vessel	Gross profits plus crew share and wages after deducting depreciation	
Gross Cash Flow		
Gross Value Added per FTE	Gross value added divided by the number of Full Time Equivalent (FTE) crew	
Gross Labour Productivity	Total earnings divided by the number of fishers (FTE)	Indicates the level of technology employed by a fleet
Fish Stock Status	Not applicable	Undertaken by Marine Biological Institutes; options (overfished, maximally sustainably fished, or underfished) - 5 major target stocks to be covered per country
Fuel Efficiency	Total Fuel Consumption divided by Output Volume	Prey to variations in the fish stock through changes in catch per unit effort
Age Structure of the Fleet	Not applicable	Emerges from the survey, indicates whether the fishery is stable and sustainable
Demographic of Fishers	Not applicable	National level statistics (if available). Indicates whether incomes are keeping pace with other sectors of the economy
Trends in Fish Consumption	Not applicable	From FAO Fish Balance Sheets. Affects the fish stocks exploited, their prices, and the incomes of fishers dependent on them

Note: This list is not exhaustive

Economic Profit assumes a normal return to capital invested i.e. it is the financial (net) profit minus the opportunity cost of capital.

Annex 6

Table 13: Credit availability for the various fishing fleets

	Types of vessels	Types of vessels
Credit provider(s)		
Target groups of credit (individual/companies/ fishing co-operatives)		
Purpose of loans (vessel, engine, equipment, gears)		
Maximum loan size in USD		
Loan period (in years)		
Interest rates %/year (subsidized?)		
Equity and collateral requirements		
Tax exemptions in conjunction with loans		

Table 14: Subsidies and tax exemptions availability for the fishing sector

	Capital subsidies (%)	Maximum subsidy amount USD	Import tax exemption (%)	Duty free purchase locally (Y/N)	Business tax exemption (%)
Vessels					
Engines					
Gears					
Other equipment					
Fuel					
Ice					

Table 15: Technological innovations that have had an impact on the fishing fleet economic performance since 2000

Category	Specific innovations	How these affected economic performance of the fleet
1. Cost reductions and energy savings		
2. Increasing fishing efficiency		
3. Reducing the environmental/ ecological impact		
4. Improving fish handling, product quality and food safety		
5. Improving safety at sea and working conditions of fishers		

Appendix 5

List of countries to be included in the fishing fleet surveys in 2018 – 2019

	Participated in 1995/1997	**Participated in 1999/2000**	**Participated in 2002/2003**	**Proposed for the 2018/2019 surveys**
Asia	India	India	India	**India**
	South Korea	South Korea	South Korea	**South Korea**
	Thailand	Thailand	Thailand	**Thailand**
	Indonesia	Indonesia		**Indonesia**
	China	China		**China**
	Taiwan			**Japan**
	Malaysia			
Europe	France	France	France	**France**
	Germany	Germany	Germany	**Italy**
	Spain	Norway	Norway	**Norway**
		Spain		**Spain**
				Denmark
				United Kingdom
				Russian Federation
				Turkey
Africa	Senegal	Senegal	Senegal	**Senegal**
	Ghana		South Africa	**South Africa**
Caribbean & South America	Peru	Peru	Peru	**Peru**
	Argentina	Argentina	Argentina	**Chile**
		Trinidad and Tobago	Trinidad and Tobago	**Brazil**
		Barbados	Antigua and Barbuda	
		Antigua and Barbuda		
North and Central America				**Mexico**
				USA

Note: Countries not covered in the earlier review studies are shown in the blanc boxes in this table.

The Expert Meeting on Methodologies for conducting fishing fleet techno-economic performance reviews was held in Chennai, India, 18-20 September 2018. The Meeting was attended by fisheries economists from China, European Union, India, Indonesia, Norway, Thailand, United Kingdom and the United States of America. The Meeting was co-organized by the Bay of Bengal Programme – Intergovernmental Organization (BOBP-IGO) and the Food and Agriculture Organization of the United Nations (FAO).

The Meeting brought together a group of key fisheries economists with experience in fishing fleet reviews to: 1) present and discuss the advantages and disadvantages of various methodologies applied for reviewing the economic and technical performance of fishing fleets, 2) develop and agree on a general sampling/survey methodology for conducting techno-economic performance reviews, which can be applied also in developing countries, and 3) discuss technological innovations that have taken place in the last 10 years that had an impact on the economic and financial performance of fishing fleets.

The Expert Meeting agreed on data and information to be collected in the 2018-2019 surveys for the FAO global review of techno-economic performance of fishing fleets and on the financial and economic indicators to be applied in the analysis.

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