



Food and Agriculture
Organization of the
United Nations

FAO
FISHERIES AND
AQUACULTURE
PROCEEDINGS

ISSN 2070-6103

65

International Symposium on Fisheries Sustainability

STRENGTHENING THE SCIENCE-POLICY NEXUS



FAO HEADQUARTERS
18–21 NOVEMBER 2019
ROME, ITALY

International Symposium on Fisheries Sustainability

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Required citation:

FAO. 2020. *Proceedings of the International Symposium on Fisheries Sustainability: strengthening the science-policy nexus*. FAO Headquarters, 18–21 November 2019. FAO Fisheries and Aquaculture Proceedings No. 65. Rome.
<https://doi.org/10.4060/ca9165en>

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ISSN 2070-6103 [Print]

ISSN 2707-5532 [Online]

ISBN 978-92-5-132654-1

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To all the fishers and fish workers who work continuously to provide nutritious and healthy food around the world, even under exceptionally difficult circumstances, such as the ones seen during the COVID-19 global pandemic.





Preparation of this document

This technical report has been prepared and edited by Mr Manuel Barange, Symposium Convenor, Ms Vera Agostini, Chair of the Local Organizing Committee, and Diana Fernandez de la Reguera, Symposium coordinator.

Contributing authors to the report include Ms Vera Agostini, Ms Molly Ahern, Mr Manuel Barange, Ms Nicole Franz, Mr Nicolás Gutiérrez, Ms Amber HimesCornell, Mr Audun Lem, Mr Marc Taconet and Mr Yimin Ye, all of them FAO Session leads; the members of the advisory board, keynote speakers, chairs and panelists and rapporteurs; Mr Ben Siegelman, coordinator of the Symposium learning initiative; and Ms Diana Fernández de la Reguera, project manager/climate change specialist. A complete list of the contributing authors is included in Annex F. The graphic design of this publication is by Ms Chorouk Benkabbour, communication specialist.

For each thematic session of the Symposium, the document includes: i. the description of the session; ii. the narrative of the plenary discussions; and iii. the key messages and recommended actions. In addition, the document summarizes the main cross-cutting messages and recommendations emanating from speakers, panelists and participants across the various Symposium sessions. The document also includes a section on the learning initiative of the Symposium and a number of annexes (contributing authors to this report, speakers, chairs and panelists, abstracts of the keynote lectures of the sessions, a summary of the side events and the fisheries innovation forum and agenda of the Symposium).



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Foreword

The *International Symposium on Fisheries Sustainability: strengthening the science-policy nexus* was held to support the development of a new vision for more sustainable and socially just fisheries, and more resilient to the challenges of the twenty-first century. The event managed to gather an incredibly diverse group of participants from different sectors and regions around the world. Moreover, a set of recommendations emerged from the sessions' discussions, that will help improve the sustainability of capture fisheries and progress towards the different targets and objectives of the Sustainable Development Goals.

Although the main objective of this symposium was to help develop a new long-term vision for fisheries, the outcomes are also pertinent when dealing with unexpected short-term crisis, such as the recent COVID-19 pandemic. This crisis is impacting capture fisheries in many direct and indirect ways, affecting fishers, fish dependent communities, and vulnerable communities that rely on fish and fish products for nutrition and livelihoods. Many of the solutions for this crisis are consistent with the proposed actions to secure the longer-term sustainability of the sector. Our first response to the current crisis must be to make sure that fish is available and affordable, as this can make a significant difference in terms of food and nutrition security of people around the world.

One of the lessons of this pandemic is the need to address the social and economic inequalities within countries and across countries in order to secure the implementation and achievements of the Sustainable Development Goals (SDGs) across the world. Therefore, as the health crisis subsides, impoverished households will need to be supported with options that ensure access to food, promote sustainable long-term growth and secure poverty reduction measures. We need to build resilient and sustainable food systems that leave no one behind.

Sustainable capture fisheries have a crucial role in nutrition, food and livelihood security. The recommendations of the Symposium, supporting and promoting access to fish and fish products to address malnutrition and hunger, empowering fishing communities, strengthening participatory approaches and building capacity among all stakeholders, promoting decent work and socio-economic measures to reduce poverty and inequality, and addressing climate impacts, are especially relevant now.

Lastly, I would like to dedicate these proceedings to all the fishers and fish workers who work continuously to provide nutritious and healthy food around the world, even under exceptionally difficult circumstances, such as the ones seen during the COVID-19 global pandemics.



Manuel Barange
Director FAO Fisheries and Aquaculture Department
Symposium Convenor

Acknowledgements

This symposium would not have been able to address its ambitious objectives if not for the attendance and active participation of nearly 1 000 individuals from academia, the private sector, government, international organizations, civil society and non-governmental organizations and the 107 exceptionally diverse and gender balanced speakers and panelists from a wide range of regions and sectors. Together they provided a strong representation of all fishery stakeholders from around 100 countries, providing an invaluable source of knowledge and expertise upon which the outcomes of the Symposium rely on. Also, special thanks are due to FAO and all the partners that with their support made the event possible.

The Symposium was organized under the guidance of Dr Manuel Barange, Director of the FAO Fisheries and Aquaculture Department and Symposium Convenor, and Dr Vera Agostini, Deputy-Director of the FAO Fisheries and Aquaculture Department and Chair of the local organizing committee, as well as the coordination of Diana Fernández de la Reguera, consultant of the FAO Fisheries and Aquaculture Department.

The technical content of the symposium, including the topics and questions in each of the sessions was prepared under the coordination of the sessions leads (Dr Vera Agostini, Ms Molly Ahern, Dr Manuel Barange, Ms Nicole Franz, Dr Nicolás Gutiérrez, Dr Amber Himes-Cornell, Dr Audun Lem, Mr Marc Taconet and Dr Yimin Ye) with the technical support of the international advisory board members. Our most sincere thanks for providing their knowledge and expertise to help shape the development of a new vision for fisheries for the twenty-first century.

Special thanks are also due to the work of the local organizing committee and the staff of the Fisheries and Aquaculture Department in contributing to the success of this event, in particular Mr Silvio Alejandro Catalano, coordinator of the innovation forum, Ms Marianne Guyonnet, coordinator of publications, Mr Luca Limongelli, coordinator of IT, Mr Benjamin Siegelman, coordinator of the learning initiative, Ms Kimberly Sullivan, coordinator of the communication strategy, Dr Rumiana Uzunova, coordinator of meetings and liaison and Mr Weiwei Wang, coordinator of side events.

The fisheries innovation forum and side events provided additional expertise and knowledge in support to the objectives of the Symposium and we would like to extend our gratitude to all the entities that contributed to the success of these events.

Finally, we would like to extend our recognition to the Bureau of the FAO Committee on Fisheries (COFI), the Fisheries and Aquaculture Department, FAO Regional Offices and partnering Regional Fisheries Management Organizations for their involvement in the Symposium and their tireless effort in supporting fisheries sustainability around the world.

Abbreviations and acronyms

CBD	Convention on Biological Diversity
CCRF	Code of Conduct for Responsible Fisheries
CFS	Committee on World Food Security
COFI	Committee on Fisheries
EBM	Ecosystem Based Model
EAF	Ecosystem approach to fisheries
EDF	Environmental defense fund
FAIR	Findable, Accessible, Interoperable and Reusable
FCA	Fishery cooperative associations
FIP	Fishery improvement project
GDP	Gross Domestic Product
GFCM	General Fisheries Commission for the Mediterranean
HCR	Harvest control rule
HLPE	High Level Panel of Experts
HRBA	Human rights based approach
ICES	International Council for the Exploration of the Sea
ICT	Information and communication technology
IHH	Illuminating hidden harvests
ILO	International Labour Organization
IMO	International Maritime Organization
IT	Information technology
IUU	Illegal, unreported and unregulated fishing
LCA	Life cycle assessment
LIFDC	Low Income Food Deficit Country
MPA	Marine protected area
MSC	Marine Stewardship Council
MSY	Maximum sustainable yield
NFI	National Fisheries Institute
NOAA	National Oceanic and Atmospheric Administration
OECD	Organization for Economic Co-operation and Development
PICES	North Pacific Marine Science Organization
RFMO	Regional Fisheries Management Organization
SDG	Sustainable Development Goal
SIDS	Small Island Developing States
SSF	Small-scale fisheries
SOFIA	State of World Fisheries and Aquaculture
TURF	Territorial use rights for fisheries

USGS	United States Geological Survey
UNCLOS	United Nations Convention on the Law of the Sea
UNFSA	United Nations Fish Stocks Agreement
WCS	Wildlife Conservation Society
WHO	World Health Organization
WTO	World Trade Organization
WWF	World Wide Fund for Nature





International Symposium on Fisheries Sustainability

STRENGTHENING THE SCIENCE-POLICY NEXUS



18-21 NOVEMBER 2019 **ROME, ITALY**

Working for **#ZeroHunger**

Executive summary

The *International Symposium on Fisheries Sustainability: strengthening the science-policy nexus* took place at FAO Headquarters, Rome, Italy, from 18–21 of November 2019. It gathered around 1 000 participants from academia, the private sector, government, international organizations, civil society and non-governmental organizations, from around 100 countries.

The Symposium was held to address the need for a new vision for capture fisheries, outlining how the sector needs to transform in response to the complex and rapidly changing challenges facing society. It was structured in eight thematic sessions, in which a number of strategic questions were addressed. A total of 107 exceptionally diverse and gender balanced speakers and panelists from a wide range of regions and sectors, contributed to building this new vision through the discussions held in the different sessions.

The Symposium included an innovation forum, as well as a number of different side events, promoting sustainable fisheries and marine-derived products from different perspectives. It was an occasion to showcase best-practices and innovative blue growth approaches.

To improve the design of future events, increase participant engagement during the Symposium, and maximize outcomes, the attendees' priorities for fisheries sustainability, as well as their experiences during the symposium were assessed through a mixed-methods study. The quantitative and qualitative data of this study contributed to identifying lessons learned, and helped identify widely supported messages that could contribute to this shared vision for sustainable fisheries.

The outcomes of the Symposium include a comprehensive booklet with background information, session description and contents and main challenges addressed by each session, prepared ahead of the meeting in coordination of the advisory board members and the session leads; a dedicated section in the 2020 *FAO State of World Fisheries and Aquaculture* Report with the main key messages of the sessions; an information paper for the 34th FAO Committee on Fisheries summarizing the main results of the Symposium and this document, which acts as the proceedings for the meeting.

While each session developed specific key messages, presented in each section of these Proceedings, a number of emerging cross-cutting messages and recommendations that are relevant for both inland and marine capture fisheries were considered and highlighted here:

- There is a strong need to integrate fisheries into broader planning and governance frameworks that bring multiple sectors together and facilitate the implementation of evidence-based assessment and management.
- The development of joint integrated biodiversity and food security objectives is required to ensure that aquatic foods can reach those that need it most now, and in the future, reducing undesirable impacts and food waste and addressing malnutrition and hunger.
- Capacity building, in particular aimed at data collection and analysis and improving countries ability to better assess and monitor their fisheries continue to be needed.
- Communication on fisheries issues needs to be largely improved. In particular, there is a need to change the narrative on fisheries, putting the emphasis on its uniqueness and importance as food production system, and leveraging it as vehicle to empower fisherfolk.
- Livelihoods, well-being and decent work must be considered more explicitly in fisheries management, including by increased stakeholder involvement and secured rights and access.
- Gender equality and equity with support to the younger generations must be improved. Proactive mechanisms for this include elevating the role of women in decision making; engagement of youth; focused capacity building actions; gender statistics; sex- and age- disaggregated data.
- Reducing and eliminating harmful practices that may lead to overcapacity, overfishing, and/or IUU fishing are important means for sustainability.
- Political will should be sought and capacity to improve implementation of existing policy frameworks should be strengthened. Policy innovations in the sector are required to address emerging challenges such as climate change, and the increasing demand of fish and fish products.

Finally, the aim of these proceedings is to synthesize the debates, key messages and recommended actions that emerged from the different sessions of the Symposium. These recommendations represent a collective set of views on how to drive sustainability forward, to inform and to be taken into consideration by all stakeholders when relevant.

Introduction

SYMPOSIUM OVERVIEW

Marine and Inland fisheries are crucial to meet the goal of a world without hunger and malnutrition. In 2018, the sector produced 179 million tonnes of fish for direct human consumption, a 7-fold increase from 1950, of which 97 million tonnes came from capture fisheries. As a result, a global record-high per capita consumption of 20.5 kg was reached in 2018. Moreover, fish is especially important for the nutrition of many Low Income Food Deficit Countries (LIFDCs) in Oceania, Asia and Africa. We have never relied on the sector as much as we do today.

However, capture fisheries is the only major food production industry that relies on the natural cycles of wild populations, and the impacts of a rapidly changing world on the sector are becoming more and more relevant. Among the many factors involved we note population growth, a degrading environment and a number of anthropogenic impacts, including climate change. As a result of these challenges, the fraction of marine fish stocks fished within biologically sustainable levels continues to decline, especially in least developed regions, and the percentage of stocks fished at biologically unsustainable levels increased from 10 percent in 1974 to 33.1 percent in 2015. In addition, knowledge of the sustainability status of inland fisheries, which are increasingly affected by the demand for fresh water, is limited.

The fisheries sector is at an important crossroad and needs transformation on the basis of a new vision for the twenty-first century – a vision that better reflects the way society perceives and uses capture fisheries in the context of the 2030 Agenda for Sustainable Development and the United Nations Decade of Ocean Science for Sustainable Development (2021–2030).

OBJECTIVES

The Symposium aimed to identify pathways to *strengthen the science and policy interplay in fisheries production, management and trade, based on solid sustainability principles, for improved outcomes in practice.*

The debates, key messages and recommended actions that emerged from the Symposium were steppingstones for the development of a new vision for the sustainability of capture fisheries – both marine and inland – in the twenty-first century. In addition, the outcomes of the symposium were expected to contribute to:

- a) Promote strategies for synergistic and supportive actions and policies at multiple scales to support sustainable fisheries while meeting international commitments.
- b) Reinforce commitments to the FAO Code of Conduct for Responsible Fisheries and its associated instruments, and lead to new FAO partnerships.
- c) Assist countries as they debate and consider a new COFI Sub-Committee on Fisheries at the 34th FAO Committee on Fisheries meeting.
- d) Support the planning process of the UN Decade of Ocean Science for Sustainable Development (2021–2030) to join efforts, in moving towards an Ocean We Need for the Future We Want.

- e) Provide input to the high-level policy statement on the role, value and sustainability status of global and regional fisheries in the twenty-first century. It may be open for endorsement during the 25th anniversary celebrations of the Code of Conduct for Responsible Fisheries, to take place during the 34th FAO Committee on Fisheries meeting.

These outcomes are also expected to support to address some of the targets and objectives set in different conventions and international agreements. In particular, the symposium addressed critical issues related to the following Sustainable Development Goals within the Agenda 2030 for Sustainable Development: SDG1 – No poverty, SDG2 – Zero hunger, SDG3 – Good health and well-being, SDG4 – Quality education, SDG5 – Gender equality, SDG8 – Decent work and economic growth, SDG9 – Industry, innovation and infrastructure, SDG10 – Reduced inequalities, SDG11 – Sustainable cities and communities, SDG12 – Responsible production and consumption, SDG13 – Climate action, SDG14 – Life below water, SDG15 – Life on land and SDG16 – Peace and justice.



INTERNATIONAL ADVISORY COMMITTEE AND SESSION LEADS

The following experts, in alphabetic order, are members of the International Advisory Committee and provided input to the technical and scientific contents of the different sessions of the Symposium in collaboration with the Session leads.

Name	Position and affiliation
Dr Vera Agostini	Lead of Session 2. Chair Local Organizing Committee. Deputy Director, FAO Fisheries and Aquaculture Department. Italy
Ms Molly Ahern	Lead of Session 3. FAO Fisheries and Aquaculture Department, Italy
Prof Manuel Barange	Lead of Session 6. FAO Symposium Convenor. Director, FAO Fisheries and Aquaculture Department, Italy
Dr Claudia S. Beltran Turriago	Fisheries value chain consultant, El Salvador
Prof Anthony Charles	School of the Environment & School of Business, Saint Mary's University, Canada
Dr Sloans Kalumba Chimatiro	Fisheries and aquaculture consultant, Malawi
Prof Kevern Cochrane	Department of Ichthyology and Fisheries Science, Rhodes University, South Africa
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Prof Christopher Costello	Donald Bren School of Environmental Science and Management, University of California, Santa Barbara, United States of America
Dr Lifeng Cui	China National Fisheries Technology Extension Center, China Society of Fisheries, China
Prof Charlotte de Fontaubert	The World Bank, United States of America
Ms Nicole Franz	Lead of Session 4. FAO Fisheries and Aquaculture Department, Italy
Prof Elizabeth Fulton	Commonwealth Scientific and Industrial Research Organization, Australia
Dr Nicolas Gutierrez	Lead of Session 1. FAO Fisheries and Aquaculture Department, Italy
Prof Ray Hilborn	School of Aquatic and Fishery Sciences, University of Washington, United States of America
Dr Amber Himes-Cornell	Lead of Session 8. FAO Fisheries and Aquaculture Department, Italy
Prof Simon Jennings	International Council for the Exploration of the Sea, Denmark
Dr Audun Lem	Lead of Session 5. FAO Fisheries and Aquaculture Department, Italy
Mr Tony Long	Global Fishing Watch, United States of America
Ms Editrudith Lukanga	World Forum of Fish Harvesters & Fish Workers, Tanzania
Dr Abigail Lynch	U.S. Geological Survey's National Climate Adaptation Science Center, United States of America
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Mr Alastair Macfarlane	Ministry for Primary Industry, New Zealand
Dr Sangeeta Mangubhai	Wildlife Conservation Society, Fiji
Dr Ana Parma	Centro Nacional Patagónico (CONICET), Argentina
Dr Ernesto Penas Lado	International fisheries policy consultant, Spain
Mr Marc Taconet	Lead of Session 7. FAO Fisheries and Aquaculture Department, Italy
Dr Shakuntala Thilsted	WorldFish, Malaysia
Dr Vivienne Solis	CoopeSolidAR R.L., Costa Rica
Prof Rashid Sumaila	Institute for the Oceans and Fisheries, University of British Columbia, Canada
Prof Atsushi Sunami	Ocean Policy Research Institute, The Sasakawa Peace Foundation, Japan
Dr Meryl J. Williams	Gender in Aquaculture and Fisheries Section, Asian Fisheries Society, Malaysia
Dr Yimin Ye	Lead of Session 1. FAO Fisheries and Aquaculture Department, Italy

PARTNERS

The International Symposium on Fisheries Sustainability was organized with the technical and economic support of FAO and the following partners:

- Conxemar
- Environmental Defense Fund (EDF)
- European Commission
- International Council for the Exploration of the Sea (ICES)
- Marine Stewardship Council (MSC)
- Minderoo Foundation
- National Fisheries Institute (NFI)
- National Oceanic and Atmospheric Administration (NOAA)
- North Pacific Marine Science Organization (PICES)
- Rare
- Sasakawa Peace Foundation
- UN Decade of Ocean Science for Sustainable Development
- United States Geological Survey (USGS)
- Wildlife Conservation Society (WCS)
- WorldFish
- World Wide Fund for Nature (WWF)

STRUCTURE AND CONTENTS

The International Symposium on Fisheries Sustainability was structured around a series of plenary discussions on eight different themes. Each session had two keynote lectures, and two panels of five panelists each. Keynote lecturers synthesized the state of knowledge and highlighted prominent topics in each panel. Panelists provided statements based on a set of leading questions. Attendees of the Symposium had the opportunity to answer similar questions in real time through an online polling system and to formulate other questions during the Q/A period. Session 9 consisted of the summary of the main conclusions and key messages from the different sessions.

The sessions' themes were as follows:

- Session 1 The status of global and regional fisheries sustainability and its implications for policy and management
- Session 2 Sustainable fisheries: linking biodiversity conservation and food security
- Session 3 Fish in food security and nutrition: from tide to table
- Session 4 Securing sustainable fisheries livelihoods
- Session 5 The economics of fisheries
- Session 6 Fisheries management in the face of a changing climate
- Session 7 Fisheries information systems and new technologies
- Session 8 Policy opportunities for fisheries in the twenty-first century
- Session 9 Summary of the Sessions

FISHERIES INNOVATION FORUM

As part of FAO's International Symposium on Fisheries Sustainability, an innovation forum related to fisheries sustainability and marine-derived products was hosted. The display included ocean-sourced Blue fashion, the use of fish skin for medical uses, algae packaging, the creation of biodegradable plastics from fish waste, blockchain technology and drones utilizing artificial intelligence, among others. In addition, there were artwork displays from different artists that aim to promote ocean conservation through art. The innovation forum offered an opportunity to all visitors to exchange knowledge and to network with partners and fellow participants directly involved in fisheries sustainability.

SIDE EVENTS

As part of the Symposium and the innovation forum, there were a number of side events that are listed below and summarized in Annex D:

- **Blue innovation – emerging technologies and trends in fisheries sustainability** (organized by FAO Fisheries and Aquaculture Department)
- **Innovative regional initiatives as an important vehicle to achieve sustainable marine living resources and the conservation of marine ecosystems** (organized by the FAO General Fisheries Commission for the Mediterranean – GFCM)
- **Minderoo Foundation reception** (organized by Minderoo Foundation)
- **The future of food production from the ocean** (organized by the High Level Panel for a Sustainable Ocean Economy)
- **Global Atlas of AIS-based Fishing Activity** (organized by FAO, Fundación AZTI - Tecnalia, Seychelles Fishing Authority and Global Fishing Watch)
- **Educating children on sustainable management of our marine resources and overall welfare of the sea** (organized by FAO, Ms Publia Cruciani and Saint George's British International School Rome)





SUMMARIES OF THE SESSIONS



Session 1. The status of global and regional fisheries sustainability and its implications for policy and management

SESSION DESCRIPTION

Fisheries sustainability has been measured using several indicators, including trends in abundance of exploited fish populations, trends in fishing pressure, production of yield in relation to the maximum potential and, more indirectly, by the effectiveness of the management system and the impacts of fishing on ecosystem structure. *FAO report on the Status of Fisheries and Aquaculture - SOFIA* (FAO, 2018) suggests that there has been a gradual increase in the percentage of overfished stocks, rising from 10 percent in 1974 to 33 percent in 2015. This is based on the abundance of stocks relative to a maximum sustainable yield (MSY) target. However, looking more closely at those stocks of the world with formal, quantitative stock assessments reveals that fishing pressure in the last 20 years has been declining (on average across the stocks) and abundance increasing in recent years. For these stocks, fish stock abundance is now, on average, above MSY and fishing pressure below MSY. In general, in regions where there is research, assessment and management plans, which are typical contexts of developed regions, fisheries are improving. However, there are also some regions of the world with excessive fishing pressure and poor biological status.

Therefore, the major challenge is to bring scientific assessment, fisheries management and stock rebuilding to those places where fishing pressure remains too high. In most of Asia, and some parts of Central and South America and Africa, where fisheries are particularly important for food security and livelihoods, scientific assessment of fish stock status is lacking, and fisheries management measures are considered to be relatively ineffective. This situation is in part due to a combination of shortage of data, limited technical capacity, and weaker governance. Inland and small-scale fisheries are particularly poorly understood and largely unmanaged. There is an urgent need to improve data, scientific assessment and bring intensive management to those fisheries in order to move them towards global sustainability.

PANEL 1.1 THE STATE OF THE STOCKS AT GLOBAL AND REGIONAL LEVELS – WHERE ARE WE AND WHERE SHOULD WE BE HEADING?

Global demand for fish and the consequent increasing intensity of fishing activity are the key factors for the increase in overfished stocks. These two factors can indirectly contribute to changing the ecosystem structure and function on a long-term basis, making it difficult to reverse the trend. In addition, climate change, pollution and habitat degradation can also affect stock abundance and productivity. Poor quality of data, weak analytical and technical capacity, and lack of transparency and public access to information limits the understanding of the state of the stocks in many regions. Although about 50 percent of the global marine catch is subjected to quantitative

stock assessments, the other 50 percent, mostly targeted by small-scale and inland fisheries, is largely not being monitored and their status is mostly unknown. Moreover, the unassessed stocks of the world largely come from developing regions with low management intensity and, based upon the relationship seen in the assessed stocks between management intensity and stock status, it is expected for these regions to have poorer stock status.

Inland fisheries have primarily been ignored; improving stock status monitoring for these fisheries is sorely needed. Unlike the marine realm, inland fisheries are affected by water extraction, fragmentation, and habitat loss. Therefore, better information not only on catch and fishing effort, but also in terms of water quality and habitat functioning is critical to better understand the state of inland fisheries.

Many of the stock assessment approaches applied today are very complex and data demanding. In order to reduce the proportion of unassessed stocks around the globe, it is needed to focus mostly on simpler but rigorous stock assessment methods requiring less detailed data and less technical expertise. Packaging assessment methodologies in user friendly formats as well as integrating local knowledge and experts' judgment into stock assessments are also important, as is to provide local people with appropriate training and support to perform data collection tasks and apply these assessment methods.

In conclusion, developing cost-efficient data gathering, and assessment approaches is important, as the technical capacity is currently missing in large parts of the world, particularly in those where fisheries are not performing at optimal levels.

PANEL 1.2 ACHIEVING SUSTAINABLE FISHERIES MANAGEMENT: A DEVELOPING WORLD PERSPECTIVE

The ability of fishery management systems to maintain fishing pressure at levels that can sustain productive fisheries depends on the availability of information, the capacity to adjust harvest in response to changes in stock abundance, and the ability to implement and enforce regulations. However, management systems that have proved effective in many large-scale industrial fisheries will not work in small-scale fisheries and/or in regions with limited resources and weak governance.

For instance, data-limited assessment methods and simple empirical harvest control rules can perform reasonably well if tailored to the specific characteristics of each fishery yet requiring some level of information and technical capacity which is often lacking in developing countries. In this context, cost-effective, community-based data collection programs that capture basic biological and fishery information as well as local experts' knowledge need to be implemented and institutionalized in order to properly inform management systems.

Strategies for scaling up capacity development in data-limited assessment and management approaches for technically-limited countries and regions are also urgently needed. Such strategies need to include continuous training programs that ensure the institutional buy-in and strengthening needed for adaptive management. Moreover, long-term commitments from governments and funding agencies to sustain enduring engagement processes to build local capacity and foster communities of practice are critical.

Data and technical capacity limitations are commonly compounded with other difficult governance problems, which renders many of the usual harvest controls impractical or unenforceable. These challenges are exacerbated in the context of small-

scale fisheries, where the low value of production and/or landings and the intrinsic nature of the fishery turn monitoring and enforcement difficult and expensive. Moreover, an over-riding problem is often the political difficulty of managing excess fishing effort and access when poverty levels are high and there are few available alternatives to fishing for sustaining livelihoods. The difficulty of reducing excess fishing effort in developing countries is exacerbated by a growing seafood transfer to developed countries, not only through international trade but also through bilateral or private fisheries agreements. Therefore, it is imperative that we find the right mechanisms, incentives and suitable alternatives for the excess fishing capacity, particularly in developing countries where fisheries are critical for food security and livelihoods.

KEY MESSAGES AND RECOMMENDED ACTIONS

- **Promote assessment and monitoring of individual stocks and improve transparency at stock and country level** to better understand the status of fisheries at relevant geographical scales, in line with Sustainable Development Goals (SDGs) 14.4 monitoring initiatives. This will correct the narrative that fisheries are collapsing everywhere and focus the attention and efforts in those regions where overfishing is occurring at large.
- **Encourage the development and implementation of simpler stock assessment methods** that require less-detailed data and less technical expertise to reduce the proportion of unassessed stocks around the globe.
- **Improve the monitoring of inland fisheries.** Despite having a lower overall harvest than marine fisheries, inland fisheries are critically important for local food security and livelihoods and suffer from a broad range of additional threats, such as habitat degradation and water quality problems. Approaches must be developed to evaluate freshwater fisheries along with technical tools to manage inland systems.
- **For inland fisheries it will be particularly important to engage with other sectors** (e.g., hydropower, agriculture) and consider fisheries within an integrated watershed management framework.
- **Mobilize resources and provide financial support for continued capacity development programs** aimed at strengthening countries ability to better assess and monitor their stocks and fisheries, particularly in developing-world, small-scale and inland fisheries. These programs should be institutionalized by government agencies, research institutions and civil society organizations in order to achieve lasting technical capacities.
- **Consider adoption of a new global target for sustainable management that would be more conservative or precautionary in data-limited situations and/or where governance is weaker.** Such targets can be achieved by designing simple, data-limited harvest rules that could be implemented by communities or governments with few resources at their disposal.
- **Focus efforts on collecting biological, fishery, and habitat information, in a cost-efficient and rigorous manner.** For this, capacity development for fishers, managers and scientists in data collection, management and curation is key. Incentives for community-based data collection and management should be provided. Use of available technology to make data collection, management and transfer more efficient should be promoted. Data often exists, the main limitation lays in the capacity to analyze it and use it to inform management.
- **Data-poor not always means information-poor. Develop and implement better mechanisms to incorporate multiples types of available information, including local knowledge and expertise and their integration into assessment and**

management approaches. These information sources are particularly critical in the context of small-scale fisheries and developing and implementing guidelines for integrating qualitative information, experts' judgment and traditional ecological knowledge into management systems is critical.

- Shortage of long-term data series does not justify lack of management. **Collect basic data needed for a particular fishery and capture local knowledge to help to design empirical, simple harvest control rules.** When technical capacity allows, data-limited management strategy evaluations should be used to test and communicate the impact of different management interventions to managers and policy makers.
- **Encourage appropriate communication, knowledge mobilization and education across actors** (fishers, scientists, managers) involved in decision-making to improve transfer of information and buy-in compliance to regulations to achieve effective management systems. It is also important to better communicate with the general public about the importance of fisheries for food security and livelihoods and change the negative narrative about the generalized impacts of the fishing sector on the environment.
- **Promote appropriate communication and awareness about the impact of illegal fishing on overfishing and fish stock recovery.** Mechanisms to improve statistics and reporting in small-scale fisheries is needed for more efficient and transparent management.
- **Encourage mechanisms to improve and reward compliance to management regulations.** These may include market-based programs such as fisheries certification and eco-labelling and improved traceability mechanisms. Such programs have been successful for many industrial fisheries but should be further promoted for small-scale fisheries.
- **International organizations, non-governmental organizations, civil society organizations and academic and research institutions need to better cooperate and expand its outreach to build technical capacity in fisheries and aquaculture to continue to take on the challenge of sustainability of global fisheries.**

Session 2. Sustainable fisheries: linking biodiversity conservation and food security

SESSION DESCRIPTION

Biological diversity and the complex interconnections between species and populations, their functions and the environment, underpin the food and livelihoods upon which our growing population depends, in particular in the case of inland and marine fisheries. However, objectives for biodiversity conservation have often been considered to be in competition with objectives for food security. In recent years, we have seen a growth in the calls from national and international fora to better integrate these objectives, given they all contribute to sustainability. The reality is that while some trade-offs exist, some common ground can also be found. Fundamentally, maintaining biodiversity is essential for keeping the capacity of ecosystems to produce food and other ecosystem goods and services at levels that are resilient to climate change and other stresses. Improving management of wild fisheries will result in more resilient ecosystems with greater biodiversity, which in turn may help sustain those systems in the face of climate perturbations.

The importance of biodiversity conservation in relation to fisheries goals is articulated in guidelines, such as the 1995 FAO Code of Conduct for Responsible Fisheries (CCRF) and the 2003 Ecosystem Approach to Fisheries (EAF). Internationally agreed targets for biodiversity conservation and fisheries have been set under the UN Sustainable Development Goals (SDG) and Convention on Biological Diversity (CBD) Aichi frameworks, which orientate countries' actions to delivering on biodiversity conservation and food provision objectives. National and regional goals often follow these global instruments.

A number of key questions arise when addressing these targets. How can we best assist societies in reconciling food security and biodiversity objectives? How do we ensure we are able to meet the nutritional needs of a growing world population while at the same time ensuring our aquatic ecosystems are not degraded and can support food production into the future? A greater understanding, effective communication, and novel tools to support management of common and/or complementary objectives, as well as mechanisms for shared accountability, are needed. Organizations and individuals working on fisheries and biodiversity conservation are converging on a triple bottom line – ecosystem, social and economic sustainability – but how can we accelerate the achievement of these transformative goals?

This session examined how the sustainability of fisheries and the maintenance of biodiversity are fundamentally interconnected and interdependent, and explored the changing nature of fisheries management within this context.

PANEL 2.1 PLANNING FOR A SUSTAINABLE FUTURE – SUPPORTING THE ADOPTION OF COMPLEMENTARY FOOD SECURITY AND CONSERVATION OBJECTIVES

Over the last 200 years, but particularly the last 20, the human footprint has increased in all Earth's ecosystems, especially in aquatic ecosystems. Observational and modelling data deliver the same message: productive and healthy ecosystems actually supply more food than degraded systems. It is evident from recent data that pushing the system harder and further does not improve food security and it puts the system's integrity at risk of shocks. Finding and maintaining the levels of food production or extraction that do not compromise the integrity or resilience of the ecosystems that support food production is the main challenge. However, while a healthy ecosystem is required for a healthy and prosperous society, the role of human behaviour must be recognised as a key part of the equation, because, for example, people may not respond positively to management actions if they feel no ownership of them.

Today there is a powerful mix of well-established tools for monitoring and managing fisheries, but also new data collection technologies, new analytical methods and new management perspectives that support holistic approaches to fisheries and conservation. Altogether, our predictive skill is increasing, allowing us to provide near-real-time to multi-decadal forecasts with ever more powerful multispecies and ecosystem models. These tools and technologies still have substantial uncertainties associated and vary in the amount of data and resources that are necessary to implement them, but that should not be considered a barrier to their use. Using these approaches more widely and integrating them into fisheries management systems matches well with the crucial role that adaptive management – learning by doing and updating approaches as conditions change or more information becomes available – will play in achieving sustainability as climate shifts ecosystems from one state to another. There are different national and regional capacities to use and implement these technologies, limiting the potential applicability of some tools in some places.

The integration of biodiversity objectives within fisheries management plans has become more prominent in recent years. Nevertheless, finding an adequate balance between biodiversity and food security objectives is still challenging. Challenges include different societies having different mixes of desired and/or required biodiversity and food security outcomes, and different ecosystems responding differently to given rates of fisheries exploitation. A pro-active approach that facilitates the identification of common targets, including biodiversity objectives recognized to be key for the medium to long term sustainability of food production, is crucial in addressing these challenges. When setting aspirational targets, balancing maximum biodiversity protection with MSY may be unrealistic. However, managing human activities towards aspirational targets can still be useful and contribute to balancing biodiversity and food production objectives. Key to successful management will be effective communication, information and knowledge sharing, outreach, cooperation and the ability to be adaptive, as needs and tools will change as the system changes – both the human and natural components – especially with stressors such as climate change.

The targets used in fisheries management and biodiversity conservation and protection need to be carefully examined. To achieve joint objectives in both biodiversity and food security, there are limitations with MSY as a sole target, since trade-offs may occur at lower fishing pressures than those yielding MSY. In general, the maximization of food production without compromising ecosystem integrity and resilience will generally require richer data streams, more complex models, and more precise harvest control rules (HCRs) compared to more risk-averse approaches that

produce somewhat less food. Moreover, MSY cannot be achieved for all species at once. The current prevailing use of single species models in management needs to be integrated with an ecosystem perspective, which also incorporate specific biodiversity objectives – and evolve towards a larger toolbox that includes biological indicators, multispecies and ecosystem models. There are also opportunities to enhance co-building of HCRs and precautionary target reference points. Ecosystem based models (EBM) need to be rigorous to reinforce their credibility, best practice standards (such as skill assessments) need to become standard, acknowledging (and quantifying where possible) sources of uncertainty and using the information generated in frameworks robust to uncertainty.

It should also be recognised that multispecies and ecosystem models come in many forms. In places with data poor fisheries, indicator-based approaches or simpler multispecies or network-based models can be used. All of these approaches, as well as more quantitative ecosystem models, can be also be enhanced by local and traditional knowledge, including on the internal feedbacks between fish assemblages and marine ecosystems. Countries new to ecosystem approaches can benefit from tools developed by and leverage lessons learned by others, rather than re-trace their steps, which will provide a ‘leapfrog’ strategy. Moreover, maturing technologies will reduce costs, increase learning opportunities and help make even more methods available to provide joint solutions.

Although inland capture fisheries are mostly overlooked in regional planning processes, regional action needs to be taken to help reconcile fisheries with biodiversity objectives. The Mekong River case is a good example of such action. To address the three main challenges in this area – which are illegal, unregulated and unreported fishing (IUU), habitat loss (to agriculture, hydropower, flood protection), and climate change – a basin-wide fisheries management and development strategy was adopted by the Mekong member countries to report on joint targets for food security, economic development and biodiversity. However, challenges still exist as enforcement remains ineffective due to the lack of financial incentives.

PANEL 2.2 MAKING IT HAPPEN – IMPLEMENTING JOINT FOOD SECURITY AND CONSERVATION OBJECTIVE

Implementing targeted joint food security and conservation objectives is possible but the right policies and institutional frameworks need to be in place. There is an efficiency frontier for biodiversity and food provision, and it is important to implement policies that promote this frontier to maximize the benefits from both. However, ecosystem constraints may force trade-offs and we need to avoid policies/interventions that reduce food and biodiversity. The final choice will depend on social preferences, which might change over time. Climate change, pollution and other stressors in both inland and marine ecosystems might alter and shift this frontier and will require new policies to address the new challenges.

Achieving efficient joint provision should consider a variety of aspects, including the identification of tools and management systems that ensure adequate biodiversity conservation while addressing food security objectives; maintain long term stewardship; harness local knowledge and ensure that all stakeholders are represented in the process; and provide true engagement and adequate incentives to balance trade-offs.

There are several tools and approaches to fisheries management that have been taken over the years, each of which provides different levels of food or biodiversity. Some approaches such as open access have been clearly shown to be limiting, providing low levels of both food and biodiversity. Single species fishery management provides certain incentives; however, it fails to consider the ecosystem as a whole and therefore

negatively impacts biodiversity. While other management measures, such as inland and marine protected areas, can result in increased local biodiversity and biomass, they can fail to deliver on food security objectives or foster stewardship. Certain spatial planning and co-managing measures or proactive planning such as territorial use rights for fisheries (TURF), cooperatives and concessions, have been successful in achieving joint objectives, by ensuring long term stewardship, making use of local knowledge, integrating stakeholders into decision making processes and providing incentives to balance trade-offs. Integrating spatial measures with ecosystem service market tools will also enhance the achievement of joint objectives.

For small-scale fisheries (SSF), where the sheer number of fishers and diversity of landing sites make the implementation of effective monitoring or control programmes quite challenging, tenure and, in particular, the use of incentives take on an important role when trying to achieve joint biodiversity and food security objectives. In Belize for example, a rights-based approach with TURFs was implemented; this has created an incentive for fishermen to protect these areas, and encourage a sense of increased co-responsibility. This has been combined with a co-management system wherein the fishermen work hand in hand with the management agency to gather and evaluate catch data and make adjustments within the fishing season to HCRs based on what they see and experience in the water. As a result compliance in the local fishery has increased in these co-managed areas, because of the community-based approaches that involve the fishermen in decision making. Other such examples can be found in Chile and the United Kingdom.

Achieving both food and biodiversity objectives in cases where there are large numbers of fishers and limited resources, as in many tropical developing countries, is urgent. In those areas, governance capacity should be fostered with basic education, trust, social capital and stewardship that promote the role of communities and the importance of achieving joint objectives. Also, although stock assessment in tropical regions has developed rapidly in the last decades, it is still challenging due to the incredibly diversity of species contributing to the catch, as well as the variety of fishing gears and non-point sources of fishing. The lack of scientific knowledge and resources should not result in the absence of management measures; multi stakeholder approaches that make use of local knowledge and therefore support stewardship should be implemented in these cases.

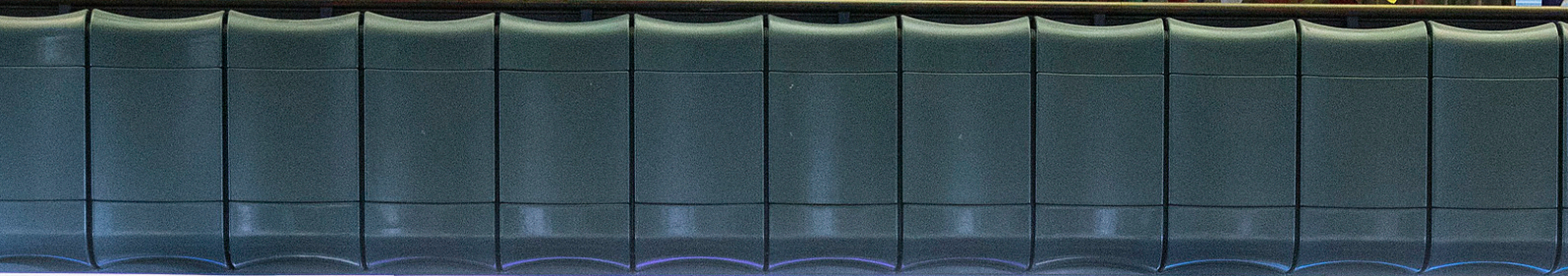
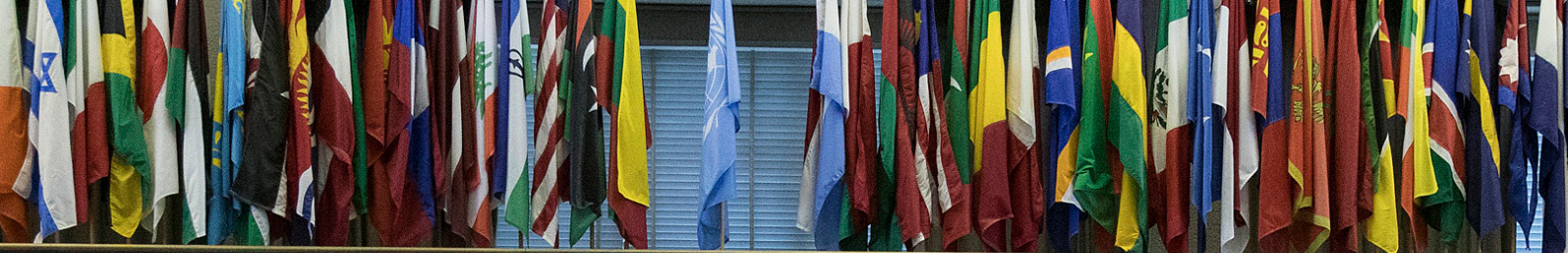
There is growing recognition that gender equality and inclusion are needed for successful sustainable fisheries. Successfully implementing joint biodiversity and food security objectives depends on this. Women and men hold different specific biodiversity knowledge and use it in different ways. The collection of sex-disaggregated data can shed light on gender roles in biodiversity protection and fisheries management, and can help us design interventions that promote equality and inclusion. Approaches that simply try and fill a gender quota, do not result in transformative change, as they do not tackle the underlying root causes of inequality. There is also a need to create the space for different viewpoints and styles of problem solving, to find impactful solutions.

A diverse set of partnerships are needed to succeed in attaining joint biodiversity and food security objectives. Global commitments, such as the SDGs, the Aichi and the post-2020 targets, exist, but most countries lack the capacity to execute them. In addition, sometimes national plans or management that attempt to balance food security and biodiversity objectives leave the responsibility to communities lacking the required relationships, capital and knowledge to implement them. Stronger partnerships could support the achievement of these commitments. These partnerships could provide the confidence to realise that minimizing trade-offs between biodiversity

and food production is not as overwhelming as it may seem and that with clever use of the entire toolbox, pragmatic feasible options exist for managing even the largest and most diverse multispecies fisheries such that they produce good yields while protecting biodiversity and maintaining the resilience of their supporting ecosystems.

KEY MESSAGES AND RECOMMENDED ACTIONS

- **Support the development of joint integrated biodiversity and food security objectives that recognize trade-offs** and are nationally and locally relevant, and supplement aspirational targets for biodiversity and food security. Biodiversity and healthy aquatic systems are essential for responsible fisheries and food security.
- **Engage and influence existing and emerging policy frameworks** (for example, the CBD's post-2020 global biodiversity framework, and the SDGs) **that represent opportunities to design, implement and monitor joint objectives.**
- **Continue developing inclusive integrated management frameworks** that rapidly move to reference points consistent **with sustainability from ecosystem perspectives, enables women participation in decision making, promote stewardship, and secure tenure and participatory management** that effectively translates into action at all scales, as management for both biodiversity and food production is linked.
- **Enhance the ability to monitor and report on ecological, economic and social sustainability** by including information on ecosystems (including people) drawing on a diverse set of knowledge (social, economic and biological sciences, and local and traditional knowledge) disaggregated by gender and by building capacity of SSF communities to contribute to knowledge-gathering, assessment, goal-setting and management.
- **Promote and strengthen diverse, inclusive and accountable partnerships** to effectively manage ecosystems for both biodiversity and foods security.
- **Integrate market-based mechanisms with measures to protect non-market social and ecological values**, that advance sustainability into fisheries management is fundamental.
- **Implementation should build on previous experiences using existing tools that help achieve joint objectives, remain mindful of the specific context** (data availability, management needs, local capacity) and develop and nurture the adoption of science training models (barefoot ecologists') that can deliver the technical capacity needed at the fishing-community level.



Session 3. Fish in food security and nutrition: from tide to table

SESSION DESCRIPTION

People have never consumed as much fish and aquatic foods¹ as they do today: per capita global food fish consumption grew from 9.0 kg in 1961 to 20.5 kg in 2018, at an average rate of about 1.5 percent per year. Since 1961, the average annual growth rate of global apparent food fish consumption has outpaced the one of the population and the one of meat consumption from all terrestrial animals combined (FAO, 2018). Peering below regional and national levels, many coastal and inland populations rely on fish as the primary animal source food of a healthy diet, notably in rural settings and in poor communities with limited alternative sources of essential micronutrients and animal protein. Of the 34 countries where fish contribute more than one-third of the total animal protein supply, 18 are LIFDC, and five are Small Island Developing States (SIDS), where aquatic foods serve as the backbone to healthy diets.

The 2017 High Level Panel of Experts report, a report of the Committee on World Food Security (CFS), reiterated how fish remains one of the best sources of micronutrients, omega-3 fatty acids, and high-quality animal protein, especially in lower-income communities that may lack access to alternative animal foods. Furthermore, post-harvest loss and food safety issues with fish and other aquatic species pose challenges for ensuring availability and access to fish for human consumption.

Fish production systems worldwide are threatened by, and can contribute to, freshwater and marine ecosystem degradation, in turn threatening access to one of the most important animal source foods for a healthy diet in many nutritionally vulnerable areas. Recent reports on healthy diets from sustainable food systems provide new scientific targets for our global nutrition and food systems goals, recognizing that fish play a unique role but that fish should not be separated from other parts of the food system. Yet defining an optimal level of consumption for fish and other animal-source foods has been a challenge, considering varied consumption patterns across countries, the large variability in nutritional content, and the complex impact of fish and other animal foods on both human and environmental health.

Surprisingly, while nutrition stands high on the global political agenda, it only attracts a very small fraction of development aid globally. In a world where an estimated 821 million people – approximately one out every nine – are undernourished and require stable access to high-quality foods, it remains unclear how, where, and in what quantity fish can sustainably fit into the global food system and how marine and freshwater resources are best utilized for food in order to create the most benefits.

This session looked at the most recent research, investments, and policies, to highlight how increasing evidence exists that fish make a crucial contribution to nutrition, how that contribution could be optimized in the future, and possible implications of the realization of fish's crucial role in diets. Looking through the

¹ 'Fish and aquatic foods' includes finfish, crustaceans, mollusks and other aquatic animals, but excludes aquatic mammals, reptiles, seaweeds and other aquatic plants.

specific context of countries facing the burden of malnutrition, where and how can strategic regional, national, and community partnerships improve nutrition? Can fish and other aquatic foods play a primary role in healthy diets, becoming the dominant animal food consumed globally? Finally, the session aimed to discuss how to translate and scale-up a vision of fish as a contributor to food security and nutrition across sectors historically less aligned with fisheries, including aquaculture.

PANEL 3.1 PUTTING FISH ON THE TABLE: EVIDENCE AND OPPORTUNITIES FOR IMPROVED NUTRITION IN LOW-RESOURCE SETTINGS

Fish and other aquatic foods include a diverse array of animals and plants, with unique characteristics and with some being rich sources of highly bioavailable nutrients. Often recognized as a high-quality protein source, our focus on fish needs to expand to include all aquatic foods, which are essential source of micronutrients and fatty acids, and serve as a vital source of nutrients for different population groups. Fish and other aquatic foods have the potential to address issues with hidden hunger – micronutrient deficiencies that exist in undernourished and over-nourished populations – affecting two billion people globally. Consumption of fish in the first 1,000 days of life—from conception to the child’s 2nd birthday in which healthy diets for both women and children are emphasized – is associated with positive outcomes for neurocognitive development, decreased stunting in children, as well as increased fatty acid content of breastmilk, ensuring that micronutrients reach the child after birth. Although there is evidence of positive outcomes associated with fish consumption during the first 1,000 days, our focus should be broadened to fish consumption throughout the life cycle. For example, school feeding programs can be used to promote consumption of fish from local fishers, having positive impact on livelihoods for producers as well as food security and nutrition for schoolchildren.

Nutrient content of fish and aquatic foods vary by species. For example, the contribution from a 50g serving of some small indigenous fish species in Bangladesh can meet the full daily recommended intake of vitamin B12 for pregnant and lactating women, and in Cambodia a similar portion of a very common small fish found in rice fields meets 45 percent of daily iron requirement for women. A nutrient-rich food itself, fish has the potential to increase the bioavailability (or absorption) of nutrients from other foods when consumed together. Small fish species can be easily combined with other foods and can be sold in small, affordable portions. Fish-based products which are culturally acceptable and convenient to prepare and combine in a meal should be developed to promote increased fish consumption and nutrient intake. When whole fish are consumed or processed (including bones, eyes, viscera, etc.), cleaning loss and plate waste is reduced, and the nutritional content is often higher than in muscle tissue. Innovations in fish products are needed to meet the growing demand for convenience foods, while ensuring high nutritional quality and food safety. Examples include fish-based chutneys and fish powders that can be consumed with vegetables or other foods as a spice or as a nutritional additive, take little time to prepare and improve the nutritional content and absorption of nutrients from the meal. In addition, these products have a long shelf life, allowing fish to be preserved in times of plenty and consumed in lean seasons.

The evidence of fish and aquatic foods’ positive impact on diets and nutrition outcomes is strong but needs continued investment and support to build data on the nutrient content and food safety of the vast array of species consumed across different regions. In addition, nutrient and contaminant analysis should broaden its scope to include not only fresh fish, but also processed and prepared fish, to improve understanding aimed at ensuring

nutritious, safe and affordable diets. Data on nutrient profiles, consumption patterns and preferences of aquatic foods can inform research, policies, and action plans, if efficiently collected, analysed, and disseminated through appropriate channels.

Communications promoting consumption, processing, and preparation of aquatic foods should be designed with consideration of cultural norms and values. To promote consumption of nutrient-dense, sustainably produced animal proteins – such as fish – there is need to encourage disruptive technologies in fish and aquatic food value chains to unleash social innovation and financial inclusion for women and the marginalised. There is a need for innovation (social, financial, and institutional), as well as new technologies and products to shift consumer and producer-driven chains to be investor-focused with a shift from terrestrial animal food products to sustainable and healthy aquatic food products. This will require new business models and innovative collaborations across seafood supply chains such as public-private partnerships and strong civil society engagement.

PANEL 3.2 PATHWAYS FOR IMPROVED FISH IN FOOD SYSTEMS: ENVIRONMENT, POLICY AND TECHNOLOGY

In recent years, there has been an increasing interest in the environmental impact of food production as evident by studies on life cycle assessment (LCA) on fisheries production systems, sustainability of different diets and planetary health guidelines. Multidisciplinary teams of scientists are now interested in characterizing the relationship between ecosystem transformation and human health and nutrition outcomes as the World Health Organization (WHO) estimates that one-quarter of the entire burden of disease could be avoided through improved ecosystem management. The EAT-Lancet planetary health guidelines promote consumption of sustainably-produced animal proteins such as fish, however leaving questions around trade-offs between different animal source foods and how fisheries and aquaculture can meet growing demand, especially in nutritionally vulnerable populations. Dietary guidelines targeting different populations in different countries can be adapted based on culture and food supply in order to provide specific recommendations on which types of fish and aquatic foods are beneficial to eat for each population group and which types should be consumed in moderation or avoided (for example, pregnant women should avoid consumption of large pelagics).

Fish catch rates have potential risk to fall in the future due to climate stress, rising ocean temperatures, ocean acidification, coral reef bleaching, less oxygenated water, diversion of water for agriculture, and extreme weather making fishing more dangerous, if improved management is not implemented. This potential decline in fish catch is expected to disproportionately affect equatorial regions – for example, as ocean temperatures rise, fish migrate towards the poles, and reduced oxygenation may result in smaller fish size. These environmental changes may lead to reductions in productivity of important sources of micronutrients, fatty acids and animal protein that many equatorial coastal populations rely on, causing exacerbation of nutrient deficiencies and poor nutrition in these communities. If projections of possible catch movements are correct, nutritional impacts may be felt differently in different countries, with: 1) total fish consumption being largely unaffected in wealthy nations, but possible species or price changes; 2) malnutrition increasing in some countries due to greater dependence on plant-source foods which are not as rich in micronutrients as fish; and 3) reduction in fish causing a decline in nutritious diets and more reliance on nutrient-poor, energy-rich processed foods in other countries.

Fish and aquatic foods have an important role to play in addressing the burden of malnutrition and ensuring that nutritionally vulnerable populations continue to have access to fish in their diets, although it is important to note that nutritional impacts not only differ by country but may be felt differently amongst various communities within countries. Certain communities within countries, certain households within communities, and certain individuals in a household can be more nutritionally vulnerable than others. For example, women of reproductive age, pregnant and lactating women are considered a nutritionally vulnerable group because of their greater micronutrient needs and vulnerability to contaminants, highlighting the importance of various consumer needs and preferences towards species at lower trophic levels such as small pelagics.

Aquaculture has grown to contribute to the increasing demand for fish, and FAO estimates suggest that supply of fish for human consumption from aquaculture has surpassed that from capture fisheries in recent years. Information on consumer preferences and affordability of different fish species can better inform fish production for nutritionally vulnerable populations. For example, incentives for aquaculture to re-align to include low-trophic, low market-value fish species that can boost intake especially in poor, rural communities.

Our current food systems are inadequate to ensure sustainable food security and nutrition for a growing population. Climate pressure may have a disproportional impact on vulnerable groups, exacerbating and possibly even deepening malnutrition, but fisheries management and governance can play a large role in abating malnutrition. To ensure that fish reaches and continues to reach those who are most nutritionally vulnerable, more information is needed on trade-offs between dietary choices, consumer and cultural preferences, and there is a need for a multi-disciplinary approach across the fish value chain in which food losses are assessed and reduced.

KEY MESSAGES AND RECOMMENDED ACTIONS

- **Use best available science to make food policy and nutrition action plans.** Although fish and aquatic foods are rich in micronutrients, fatty acids, and animal protein, variations exist between species. Consumption data focusing at the species level and on the parts that are actually consumed will inform research, policy and action plans as to consumption patterns and consumer preferences.
- **Improve data collection and analysis on of aquatic food consumption and analysis of nutrients and food safety,** including nutrient profiling of various species of fish and aquatic foods, taking parts used (fins, head, viscera, etc.), preparation and processing methods into consideration, as well as waste and loss and nutrient retention along the fish value chain.
- **Ensure aquatic foods are reaching those that need it most,** across diverse communities within regions, and diverse individual needs within households – to ensure that essential micronutrients, fatty acids and animal proteins reach children, women and men – now and in the future.
- **Deploy context-specific messaging through appropriate channels to encourage consumption of diverse nutritious and sustainably produced aquatic foods.** Behaviour change communications have the potential to expand consumption of nutritionally beneficial aquatic foods and products, e.g. seaweed which are currently not consumed in certain population groups.

- **Include aquatic food in food systems policies** given its potential to address **malnutrition in all forms**. Despite being recognized for their ability to address stunting, wasting, undernutrition, and non-communicable diseases, fish and aquatic foods can be better promoted in national food-based dietary guidelines and school feeding programs, specifically adapted to the needs of different groups and regions.
- **Improve utilization and stability of aquatic foods supply by supporting disruptive technologies, social innovations and targeted risks to unleash new networks of supply chain governance capable of empowering women-led businesses and being inclusive and socially just.** Women, who are often involved in the post-harvest sector, have strong potential to develop innovative and culturally-acceptable aquatic food products. These products can potential to decrease food waste and increase the nutritional value and safety of diets by utilising all parts of the fish and can stabilize supply through extended shelf life of affordable, safe, nutritious foods that can be produced in times of plenty and consumed in lean seasons.





Session 4. Securing sustainable fisheries livelihoods

SESSION DESCRIPTION

Fisheries provide livelihoods and incomes for many millions of people working as fishers and harvesters but also in pre- and post-harvest activities such as boat building, net making and fish processing and trade. In particular, the small-scale fisheries sector generates 90 percent of fisheries employment in capture fisheries, which represents more people than all other oceans-based economic activities put together (OECD, 2016), and women constitute about half of the workforce (World Bank, FAO and WorldFish, 2012). Inland rivers, lakes and floodplains support even more men and women fishers, processors and sellers than do marine systems (World Bank, FAO and WorldFish, 2012). It is estimated that over 40 million people are directly engaged in the primary sector of capture fisheries (FAO, 2018). This figure does not account for the large amount of people, in particularly women, involved in post-harvest activities. Indigenous people in coastal communities and living in and around inland water bodies are particularly dependent on fishery resources, for livelihoods security and food security and nutrition.

However, the sustainability of livelihoods in the fisheries sector is increasingly under threat. In addition to overfishing, pollution, habitat destruction and climate change impacts, issues such as loss of cultural identities, competition and access to fish as a resource, as well as to markets where the fish is sold, cause growing inequalities where many fishers and fish workers struggle to make ends meet or are forced to work in unsafe environments. Maintaining and improving livelihoods of those working in small-scale fisheries requires addressing not only fisheries management and governance challenges but also food security and nutrition, poverty and overall socioeconomic development needs of fishers and their communities. This is particularly relevant as small-scale fishers are often economically poor, politically weak, and thus vulnerable to being marginalized from resources and arenas where decisions are made. Addressing these issues is therefore a priority in the context of SDGs and FAO strategic objectives.

Session 4 examined possible pathways to secure sustainable fisheries livelihoods, including with respect to their social, cultural and equity dimensions. The discussions emphasised approaches leading to equitable and sustainable fisheries livelihoods, particularly regarding inclusive fisheries governance and engagement with fishers and fish workers, both women and men.

PANEL 4.1 HOW DO WE SECURE SUSTAINABLE FISHERIES-BASED LIVELIHOODS, INCLUDING THEIR SOCIAL, CULTURAL AND EQUITY DIMENSIONS & PANEL 4.2 INNOVATIVE APPROACHES FOR INCLUSIVE FISHERIES GOVERNANCE COALITIONS, CROSS-SECTORAL COLLABORATION AND ENGAGEMENT WITH FISHERS AND FISH WORKERS – WOMEN AND MEN

A vast number and diversity of people's livelihoods, both for jobs and income, as well as food and nutrition is in some way reliant on fish. In addition to providing direct jobs for more than 40 million people, reaching up to for an estimated 120 million people - both woman and men - when the whole value chain is considered, fisheries are delivering food and nutrition security benefits to four billion consumers globally.

A large percentage of these jobs are coming from small-scale fisheries and associated post-harvesting activities, and recent analysis show that even a small proportion of catches from SSF retained locally can make a major contribution to reducing micronutrient deficiencies in coastal countries, therefore making the sector a very valuable contributor to nutritional security. However, the small-scale fishing sector and its associated post-harvesting activities often lack financial resilience to address short term and long-term needs because they have little or no access to formal credit systems. Evidence to date indicates that the cost of not safeguarding the small-scale fisheries sector, both in terms of securing jobs but also its contribution to food security and nutrition, particularly in vulnerable communities, may be much higher than the investment required to support the sector.

Addressing the question of securing livelihoods in all their dimensions is difficult, as fishery decision-makers often lack the necessary information, in particular socio-economic data, to facilitate their analysis and identify efficient measures. However, in spite of the fragmented information, the values and benefits associated with small-scale fisheries livelihoods are increasingly acknowledged by international policies, conventions and agreements. Already the 1995 Code of Conduct for Responsible Fisheries acknowledges the contribution of small-scale fisheries to employment, income and food security, and seeks to protect the rights of fishers and fish workers in these subsectors to secure livelihoods, including by promoting their preferential access to fishing ground and resources. More recently, there are the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines), and the 17 SDGs that bridge poverty alleviation, food and nutrition security, climate change adaptation, gender equality, equity and environmental stewardship, with SDG 14.b specifically dedicated to small-scale fisheries. These agreements and commitments embrace and span the complexity of fisheries livelihoods, and provide pathways to secure those livelihoods.

The SSF Guidelines deal holistically with the needs of fishers and fish workers and provide guidance on how their rights can be protected, employing a human rights-based approach, for the benefit not only of fishing communities but of all who depend on the sector for food and nutrition. In Honduras and Costa Rica for example, the SSF Guidelines have been used to empower indigenous peoples to defend their rights with regard to fisheries management and access to resources. However, other initiatives that recognise the need for a comprehensive perspective are important. In June 2019, Norway launched a new action plan for sustainable food systems in the context of Norwegian foreign and development policy. The action plan recognizes the role of the ocean for food security and nutrition, arguing that it will not be possible to reach SDG targets 1 and 2 without involving aquatic food, including the small-scale fisheries sector.

Innovation has a role to play in improving livelihoods and in strengthening the environmental, economic and social aspects of fisheries sustainability. There are various examples of the use of information and communication technologies (ICTs), including apps, which support fishers and fish workers, both to adaptively manage fisheries and to connect communities to markets, financial services etc. Social protection can also play an important role in stabilizing livelihoods of vulnerable groups. Also, small-scale fisheries have inherent innovative impulses, which constitute an important ingredient for their continuity. The strength of 'local innovations' should be recognised. However, all innovations, and expectations of local actors to innovate, need to be combined with deeper systemic (political, economic and social) transformations that enable sustainable small-scale fisheries. Deeper systemic change – which may be slow, complex and multi-level – require cross-sectoral collaboration, and cannot be replaced by techno-fixes and new language.

Substantial opportunities for improving the economic, food security and nutrition and wellbeing performance of fisheries livelihoods exist through recognising the often less visible role women play in value chains, and ultimately to work in ways that increase gender equality. The challenge is to move beyond “women fish too” or “women are also part of fishery value chains” to seeing women as equal contributors of roles, skills and knowledge. As an example from a Zambian value chain, local innovation was enabled and at the same time underlying norms and beliefs were challenged– the result was a reduction in waste and loss, and an increase in equality between men and women retailers. An example of the need for change is from Japan where women in coastal communities have been organized and connected to fishery cooperative associations (FCAs) for many years. However, they have not had full-membership rights because of the Japanese practice of “one member per household”, which is traditionally reserved for men. Such local fisheries governance mechanisms need to be changed to have broader and more representative formal memberships, including in particular women and youth, and entrepreneurship and other capacities should be promoted among both women and men.

It is also essential to strengthen the institutional and organizational capacity of women’s networks. Building organizational structures and skills will not only result in women having a stronger voice, ensuring that their concerns and needs are heard, but also to food security and nutrition through better fishery products by improved fish handling, processing and marketing. Better women’s organizational skills also support peer-to-peer learning and improve fisheries governance outcomes. The establishment of the African Women Fish Processors and Traders Network (AWFISHNET) in April 2017 with the support of the African Union is an excellent example showcasing good practice of an inter-governmental organization that encourages collective action and participatory approach with non-state actors, with a focus on women.

More and better information, including gender disaggregated data, is needed and the way it is collected should change to allow for a better understanding of the contributions of capture fisheries and its different sub-sectors – small-scale fisheries, the post-harvest sector and inland fisheries – to livelihoods, gender equality, sustainable use, ecosystem conservation and food security and nutrition. Large-enough, multi-country projects like the Illuminating Hidden Harvests (IHH) study that engage global policy makers, national governments, and international and national researchers, can help create the capacity, methodologies, examples and incentives at the national level to create the required strategies and actions for more holistic data collection and analysis.

As discussions on ‘innovation’, the ‘blue economy’ and ‘blue growth’ become prominent in global and national arenas, it is especially important to keep in mind the role of fisheries, and specifically small-scale fisheries, as major contributors to livelihoods, nutrition, food security, and resource stewardship. Blue economy visions also argue for more effectively designated and enforced aquatic property rights, to create the right climate for investment. But this does not need to imply privatization, as community-based fishery management has been shown to be a viable and effective rights-based alternative, for example in many Pacific Island communities and Canadian Indigenous communities. This speaks as well to the need for the blue economy and blue growth to be concerned with issues of equity and justice.

There is also a need to allocate resources for facilitating the participation of fishers and fish workers to take part in decision making. From a governance perspective, it is important to devolve the decision-making responsibilities to as local a level as possible, as localised management is often more effective and hands on. This should take place within a governance system that respects the rights and knowledge of fishers, fish workers and their communities and within which holistic, integrated and participatory approaches are promoted.

A major threat to sustainable fisheries livelihoods is the common negative perception of the sector: the popular narrative of demise and overexploitation of fisheries stocks points to fishers as part of the “problem”, which overshadows their role as part of the solution – not only to environmental sustainability, but also social and economic improvements. There are many examples of successful bottom-up initiatives by fishing communities and fisher organizations, to act as stewards of fisheries and of aquatic ecosystems. Fishers also contribute to conservation in different ways, such as co-management and other participatory approaches contributing their traditional knowledge and practices. This strong stewardship performance is often overlooked.

The narrative around fisheries needs to be changed into a story that acknowledges the positive contributions of fisheries and fishers to sustainability and recognises the opportunities for food security, nutrition and poverty eradication. This narrative should be based on human dignity and recognise the cultural, social and economic value and relevance of fishing communities to the broader life of the country and society. Fishing is generally a localized activity but provides much larger, even global, benefits and values. There are many examples of successful bottom-up initiatives by fishing communities and fisher organizations, to act as stewards of fisheries and of aquatic ecosystems. Fishers also contribute to conservation in different ways, such as co-management and other participatory approaches contributing their traditional knowledge and practices. This strong stewardship performance is often overlooked.

Let’s build a new fisheries livelihoods narrative for the 25th Anniversary of the Code of Conduct for Responsible Fisheries in 2020 and for the 2022 International Year of Artisanal Fisheries and Aquaculture that celebrates fishing people around the world who engage in stewardship and development activities towards sustainable fisheries livelihoods.

KEY MESSAGES AND RECOMMENDED ACTIONS

- **Fully recognize and support the role of fisheries, in particular small-scale fisheries, in employment and income, culture and food security and nutrition.** Policies that support livelihoods and food security and nutrition, recognizing the social, economic and cultural contributions of fisheries, especially at local and regional levels, are needed.
- **Recognise the role of women and prioritize achieving gender equality across the value chain, including in decision-making.** Collection of sex-disaggregated data standards (extending from sampling design, data collection, to analysis and reporting) can acknowledge the role of women and gender as a social construction that can differently enable or disable outcomes and opportunities for different women and men.
- **Empower fishing communities, strengthen participatory approaches and build capacity.** By developing and supporting inclusive institutions and small-scale fisheries organisations, including those representing the rights of indigenous communities, women and marginalised sectors of societies, local communities can participate in resource planning, development and governance to secure access to resources and markets.
- **Modify data collection systems to include interdisciplinary and disaggregated data** to account for nutrition, well-being, gender, traditional knowledge and other dimensions beyond catch or economic value. Encourage co-production of information with stakeholders to promote trust and collaboration among governments, academia and small-scale fishing communities, leverage technology to improve data accessibility to both fishers and fish workers and build capacity to use information.

- Promote approaches to fisheries development and governance that build on the principles of the SSF Guidelines and on a human rights-based approach (HRBA), participation and a holistic and people perspective for governance and development.
- Ensure that actors along the value chain, in particular women and small-scale producers and processors, have the capacity to seize opportunities, have access to benefits and engage fully in sustainable and equitable food systems.
- Change the rhetoric around small-scale fisheries. Encourage recognitions of the role of small-scale fisheries in livelihoods, food and nutrition to millions of people globally and use the occasion of the International Year of Artisanal Fisheries and Aquaculture in 2022 to raise the profile of fisheries livelihoods.



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Session 5. The economics of fisheries

SESSION DESCRIPTION

The full contribution of the fisheries and aquaculture sector to the economy is often not adequately documented, especially in its wider and indirect impacts and benefits. Such knowledge gaps lead to sub-optimal planning and decisions by policy-makers, national authorities responsible for implementing them, and investors, among other key stakeholders, thereby causing misallocation of resources and perhaps inaccurate definition of priorities. The lack of sufficient economic and socio-economic data, especially on the contribution of women and the small-scale sector, can prevent the sector from making the necessary transformational changes to allow it to reach its full potential as a generator of long-term economic and social benefits, which also include nutritional improvements in diets. This is particularly the case for inland capture fisheries, where data is frequently missing or at least underestimated.

Understanding the contribution of the fisheries and aquaculture sector to the economy is fundamental for achieving inclusive economic growth and development. Fisheries and aquaculture value chains extend across all sectors of the economy, amounting to much more than the value of the product extracted from the water or processed subsequently. These value chains are often long, complex and difficult to measure empirically; yet they constitute the full contribution of the sector to national economies through physical capital, revenue and employment, amongst others. In addition, the improvements in nutrition derived from fish consumption diets should be accounted for.

This session focused on how the sector can reach its full potential as a long-term contributor of sustainable economic benefits. It examined the sector's economic and social contribution to the national economy. Economic evaluation of fisheries cannot ignore the importance of good governance to ensure that current returns do not compromise future gains, and that overcapacity and overfishing put stocks under pressure. Equally, a stable and transparent trading environment is necessary to allow trade flows and provide positive externalities. Greater awareness of the role of fisheries in national economies can assist policymakers in enacting effective and appropriate policies. This could enable the sector to reach its long-term potential as a generator of sustainable economic and social benefits in addition to its direct contribution to food security in terms of sustainable harvests.

PANEL 5.1 ECONOMICS IN FISHERIES POLICY

The concept of economics in fisheries can be controversial as it interacts with resource access, policy making, ethics, equity, wealth distribution, property rights, and subsidies, among others. To improve the economic efficiency in fisheries management it is central to start by addressing "who owns the fish?" Is it the fishers, the local communities dependent on the fisheries activities or society in general? At local/community levels, the lack of clear property rights might lead to overfishing. When communities get property rights they can organize efficiently and invest for the long term. This

requires clear boundaries, site specific rules, participatory rule making, capacity building, local resource monitoring, local courts for conflict resolution with a system of sanctions. At the national level, a suite of tools is available including requirements related to regulations on technology or harvesting methods, prohibition of harmful fishing gears, mesh size control, a system of closed seasons, performance regulations (fisheries license), non-tradable fishing quota among others. Fisheries outside national jurisdiction require specific treaties and management mechanisms.

Fisheries do not take place in a vacuum but within an economy, which is fast moving. Other competing sectors move forward needing resources of both financial and human nature. Hence the importance through market-based fisheries management systems to improve the returns for the fishers who want to remain in the sector and, concurrently, improve the returns to society of having a fishing industry. Taking into account that the population of fishers is ageing and leaving the sector, both in developed and in developing countries, coupled with difficulties in recruitment of youngsters, policy makers need to help align fishing capacity to available resources to secure an economically sustainable future. Such trends represent recruitment challenges, but also an opportunity to reform the sector. It is important to be innovative.

Economic data inventories are generally limited, and international agencies, in particular FAO, can play a key role in this regard. Moreover, women are not counted in fishing statistics and their knowledge is not incorporated in the diagnoses, hence decisions taken can not be optimal. Despite the lack of data, economic facts and considerations in fisheries management decisions (including through market mechanisms) needs to be strengthened in order to help managers evaluate competing interests.

The sector is rather unique and there are problems of accounting. There is no common accepted methodology to assess the contribution of fisheries to Gross Domestic Product (GDP) as several services related to fisheries are not considered, as for example the health benefits derived from increased fish consumption. Moreover, the economic value of fisheries goes beyond the value of the landings and it is important to collect information along the value chain, also taking into consideration the value before the production takes place (e.g. vessel production, nets, etc.). In addition, aquaculture is not always reported together with fisheries, but with the agriculture sector. A better understanding of the contribution of the sector will improve also its image. In this context, the optimal economic objective should be to secure the greatest amount of welfare by integrating social, ecological and economical assessments through co-viability tools. Integrated ecological-economic assessments should be easy to interpret and provide decision makers with the information needed to identify efficient measures, and that in turn requires to use a wider definition of what economic contributions provide, including not only the people directly and indirectly involved in the sector but the consumers and the benefits generated.

Seafood is one of the most highly traded groups of food products as wild fish abundance is determined by geography and ecosystems and not by the location of consumers and markets. In addition, for aquaculture products, to some extent many developed countries have chosen not to develop this sector as producers, but else to rely on the production elsewhere, commonly on developing countries, leading to a significant north south trade, with its consequent generation of income and employment for the producer.

Fish and fishery products are classified as industrial products in the World Trade Organization (WTO), leading to lower formal trade barriers in form of tariffs than is the case for agriculture products. However, non-tariff barriers are a concern. Some of these are obviously legitimate, particularly in relation to food safety issues. On

the other hand, there is no doubt that such measures can also be misused to protect domestic producers, and it is sometimes hard to distinguish legitimate concerns from measures introduced for other reasons. The good news in this is that the wave of anti-dumping cases, in which foreign imports have been added a protectionist tariff by domestic governments, has largely abated, as it leads to changes in trade patterns, but no lasting price increase for the domestic producers they were intended to benefit. Trade barriers due to environmental, and increasingly also humanitarian and social concerns are a more relevant issue, and are likely to become more important. If IUU fishing and other concerns become even more important, it is likely that we will see more trade issues related to these. The experience from anti-dumping cases suggest that also such measures will be relatively ineffective beyond changing trade patterns, particularly since the developed countries share of trade is steadily decreasing.

A particularly important issue in the case of fishing is the use of subsidies. Although in some cases, subsidies can be associated with increase in production, benefiting some specific stakeholders, the overall benefit to the society, particularly in terms of economic allocation and sustainability is not positive. In that sense, new rules are required to be in line with SDG 14.6 which includes the removal of subsidies to fisheries that contribute to overcapacity and overfishing, and eliminate subsidies that contribute to IUU fishing, and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the WTO fisheries subsidies negotiation. In general, subsidies can lead to a number of allocation problems with negative and unintended consequences. In particular, fisheries subsidies can lead to overcapacity and overfishing, and in some cases, they can be an ineffective tool when intended to benefit poor and vulnerable groups. For such purposes, a number of countries have found that other targeted social support programmes are more effective and with less negative consequence for the resources.

PANEL 5.2 THE SOCIAL DIMENSION OF THE CONTRIBUTION OF FISHERIES AND AQUACULTURE TO THE ECONOMY

The fisheries sector is a massive contributor towards achieving the SDGs through investments in infrastructure, in production, processing and value-addition including in least developed countries where other sectors see little or no investment. However, given the presence of over-capacity and overfishing, economic benefits are often dissipated. Management reforms are therefore needed to make the sector more sustainable, however, attention must be paid to the socio-economic impacts or consequences of these reforms and the need for relevant compensating mechanisms in order to enable all involved stakeholders to escape poverty, generate economic benefits and increase the acceptance and commitment of stakeholders to implement those reforms.

Given that fisheries sustainability implies medium and long-term issues and challenges, its road map should be based on national rules, state policies, international agreements and guidelines, but having enough flexibility to adapt and respond to new objectives and priorities established by successive governments. The generation of employment under conditions of decent work, safety at sea, fair income, gender equality and equity should be defined as a top goal. However, the status of many hired fish workers in the sector can be fragile and unclear, with fish workers not always having a contract and a clear legal status, and working conditions that meet the legal requirements not always present. This is not only the case in developing countries; unlawful working conditions have also been found in developed countries.

Also, invisible unpaid or underpaid auxiliary work allows fishing activities by men to continue even when the activity is not profitable (e.g., mending nets, net making, administration, selling); women's or group minority contribution to the workforce can bring problems when unpaid or not-registered work take place, creating hidden inputs making a transparent price structure difficult. The adoption and implementation of national rules and international instruments, jointly with the commitment of the private sector, are key elements to enhance social responsibility in fisheries and aquaculture value chains.

Although it is a fact that many small-scale fisheries communities around the world are characterized by significant levels of poverty, this does not mean that all small-scale fishers are poor or that small-scale fisheries in general are unprofitable. To the contrary, many economic studies of fishing operations have shown that depending on the target species, seasons or climate conditions, fishing can be very profitable, although good incomes are not always reflected in the welfare of families. This may necessitate improved organizational structures, capacity building in business administration, proper administration of money by fisherfolk and crews, better handling and conservation of the product, reduction in losses and waste, overall increased value added, and improved access to both domestic and international markets. More attention and awareness of the importance of the sector by the national administration, could lead to improved social support systems for the fishers and their families. In general, policy makers should strive to design better employment conditions to achieve a more equitable distribution of the economic benefits derived from fisheries for skippers and crew.

The contribution of women in the value chain is significant although seldom fully recognized. The sector should therefore strive to achieve equal pay and improve the inclusion and participation of women at all levels. It is important to provide opportunities for vocational and professional training; dedicated support services, and the promotion of productive projects aimed to women, mixed or family groups, taking into account the national or regional context, their culture, specificities and needs.

Also, there is a growing awareness by retailers and consumers about their potential role in improving fisheries sustainability, particularly in developed countries, through the sourcing and consumption of fish and fishery products that are certified as being sustainably produced. Certification schemes have the potential to lead to better harvesting practices; however, imposes costs on producers which only rarely are able to recover these through higher prices. These schemes have become a cost of doing business and a requirement for access to many markets. This has further implications for the need for traceability in the value chain. Although the focus of certification so far has been mainly on environmental sustainability, the emphasis on social sustainability, human rights and decent work is now clearly increasing.

It is important to recognize that fisheries sustainability is not just a matter of regulations, monitoring and surveillance, but also about independent and associated fishers and crew's responsible behavior. Appropriate technical training on regulations, responsible fishing and climate change among others, as well as capacity building, effective dialogue and awareness of producers and communities regarding their responsibility in fisheries sustainability, could be the key to achieve better results on management and co-management strategies.

In order to address the challenges described above, it is important to invest in the collection of data and information on the sector, scientific analysis and technological innovation. Information that should be collected and analyzed includes the strengths and needs of the value chain actors, the access to social security systems, statistics

of employment by gender, the possibilities of diversification inside and outside the fisheries sector, access to dedicated support services, community association, entrepreneurial capacity, barriers to development in isolated and indigenous communities. Some large-scale fisheries are already investing in overall governance of fisheries – from the scientific process to collaboration with stakeholders and managers, while in small-scale fisheries the need for improvements and investments is acute, including by guaranteeing the involvement of small-scale fishers and representatives from vulnerable groups in these activities.

KEY MESSAGES AND RECOMMENDED ACTIONS

- **Include economic considerations in the policy debate.** Fishing is an economic activity and the efficient and effective allocation and utilization of scarce economic resources should be part of the policy discussion also in the fisheries sector. The labour of women's or group minority contribution to the workforce can bring problems when unpaid or not-registered work take place, creating hidden inputs making a transparent price structure difficult.
- **Improve collection and analysis of economic data.** Whereas figures for trade in goods are relatively simple to document, data **on the full economic impact of the sector** are often incomplete or partial, especially on the contribution of women and the small-scale fisheries in the sector, creating difficulties for policy-makers to make informed decisions. Economic activity created or derived from the sector should be better accounted for in the GDPs and appropriately attributed.
- **Include economic considerations in policy trade-offs.** Introducing market-based instruments leads to higher financial efficiency and increased profitability for operators, but reduces the number of jobs, necessitating the **introduction of social-support systems/flanking measures** during the transition period in combination with value-chain development strategies where these instruments are used.
- **Respond to changing age structure.** The increasing average age of fishers in both developed and developing countries together with new technological innovations provide a need for sectoral restructuring and improved opportunities for young and well-qualified people, leading to improved economic returns.
- **Promote trust across value-chain relationships.** Fisheries management does not take place in isolation and requires building awareness through participation in sustainability at all levels of the supply chain, including consumers and fishers.
- **Define and allocate property rights.** To improve the economic performance of fisheries, property rights must be well defined and allocated. Local circumstances, culture and tradition will decide the nature of these property rights, whether these are individual or community held, as well as the time horizon.
- **Recognize the role of women and disadvantaged groups in the value chain by achieving equal pay and improving the inclusion and participation at all levels.** Make sure that human capital is being fully utilized. Mainstream inclusive policies to increase the role, well-being and working conditions of women and disadvantaged groups in the sector, including at the decision-making levels.
- **Improve access to credit, finance and insurance.** Operators need better access to finance for sectoral development and profitability especially in the small-scale sector, women entrepreneurs and operators from disadvantaged groups. In this regard, financial education is crucial for producers to build a bank history as clients of the financial system, and simultaneously, in order that the financial sector recognizes them as credit subjects.

- **Reduce waste and increase utilization by developing new products and markets,** through reducing post-harvest losses and fully utilizing the entire catch, including for new and innovative non-food uses of by-products as increased value added is important.
- **Reduce and eliminate harmful subsidies** that may lead to overcapacity and overfishing, harming the long-term environmental sustainability of the resource as well as distorting markets.
- **Promote social responsibility in the fisheries value-chain.** Working together through public-private partnerships, international collaboration with the International Labour Organization (ILO), International Maritime Organization (IMO) and others, the international community must support the industry in implementing social responsibility in fisheries and aquaculture value-chains.



Session 6. Fisheries management in the face of a changing climate

SESSION DESCRIPTION

The multi-decadal trend of climate warming has significant implications for ocean heat content and circulation, as well as for the hydrological cycle and water resources. The fisheries sector is one of the most vulnerable to climate change owing to the climate change impacts on fish resources and to the fact that fisherfolk communities relying on them live in areas that are at the forefront of susceptibility to ecosystem changes and extreme events.

There is overall agreement and increasing evidence that climate change is indeed reshaping marine and inland fisheries resources and the communities that rely on them. Climate change is causing significant changes in ocean currents, sea and lake levels, rainfall, river flows, and acidification and thermal structure of the water column, as well as changes in the severity and frequency of storms; and is expected to continue doing so and, most likely, with an increasing impact. Whereas climate change almost always presents additional stressors that can put food production and livelihoods at risk, in some instances, opportunities are also emerging. Despite the high level of uncertainty with regard to climate change impacts, adaptation and mitigation options are available and represent opportunities to change management practices and approaches. Importantly, adequate adaptation responses are critical to meet food security and livelihood needs; failure to do so is likely to exacerbate the effects of climate change.

Based on growing scientific and empirical evidence, the session examined (i) innovative adaptation of management systems, and (ii) interventions to minimize impacts and maximize opportunities. Discussions were framed by a set of questions relating to adjustment of current management approaches at different scales, under conditions of high uncertainty and addressing adaptation strategies for dependent communities.

PANEL 6.1 INNOVATIVE TECHNICAL ADAPTATIONS OF MANAGEMENT SYSTEMS TO CLIMATE CHANGE & PANEL 6.2 INTERVENTIONS TO MINIMIZE IMPACTS AND MAXIMIZE OPPORTUNITIES

Addressing changes in fish productivity and distribution

Forecasting climate change impacts is a daunting task; however, substantial progress has been made, generating an overview of the multiple pathways through which climate change can influence fisheries in the future. The impacts on fisheries resources are the result of an interaction between a number of effects, both natural and anthropogenic. While understanding the effect of separate stressors (overfishing, pollution, climate change) allows for more targeted actions, implementing effective integrated fisheries management has considerably higher value for long-term sustainability than trying to disentangle the effects of such stressors. This is particularly true in the case of inland

fisheries whose spatial and ecological segregation affording limited possibilities for species to move/escape from environmental change makes them highly vulnerable. Building ecological resilience of aquatic production systems, whether marine or inland, can rely on the existing tools for fisheries management.

There are two broad categories of ecological processes affecting fisheries resources that are being driven by climate change. These are (1) changes in biological productivity of fisheries resources and (2) changes in their geographical distribution, including the increasingly reported occurrence and spread of non-indigenous or invasive species. Whilst some of the latter sustain profitable fisheries (e.g. sea snail in the Black Sea), others substantially challenge traditional fisheries and the species they rely on. Whatever the scenario, there is a pressing need to create medium to long-term objectives for World fisheries that address both conservation and fisheries management targets in order to avoid maladaptation.

So far, greater attention has been given to climate change-driven variations in productivity resulting from increased temperatures, in both local fisheries (e.g. increase in Chilean jack mackerel, decrease in southern red snapper) and globally. Despite management often being focused on maximizing yield, a number of fisheries are currently not producing and are likely not to produce at maximum sustainable levels in the near future if no action is taken. For example, recruitment of young individuals to the fishable stock is the major determinant of stock productivity and sustainable fishery yields, however there is still limited understanding of how it is affected by environmental factors. The reality is that there are few fisheries for which the impact on recruitment can be predicted with any certainty. This calls for an increase in the effectiveness of management interventions to deal with uncertainty, the mainstreaming of climate considerations in management approaches and an increase of precautionary levels in management in order to buffer the effects of climate change. Suggested ways of addressing uncertainty include the consideration of environmental parameters in stock assessment models and the mitigation of higher inter-annual variability in productivity by applying more conservative catch limits and/or effective adaptive management measures. In addition, reference points for fisheries management could be reassessed, to address both past changes in productivity and projected future changes and their uncertainties. Monitoring should ideally be done via fishery-independent methods; however, given the fact that the fishing industry is at the forefront of change, use of real-time fisheries-dependent data is becoming increasingly relevant.

Other types of adaptation to varying productivity include diversification of fisheries practices and fish use. Previously unexploited resources (e.g. mesopelagic fish) could sustain new fisheries with due consideration to sustainable harvesting levels and the ecosystem impacts of fishing. The development of additional fish products for human consumption could provide similar economic returns from reduced catch levels e.g. from traditionally non-consumed species, species that are processed into fishmeal or processed products with an added value. Value-addition can include changes in timing, as for example in Tanzania where fish is processed and conserved for sale in the off-season to avoid discontinuity in revenues.

Along the same lines, particularly relevant adaptation measures for small-scale fisheries include the opening or enhancement of local markets to fish products that are traditionally either exported (e.g. tuna in the Pacific) or considered of low value (e.g. low trophic level and short-lived species). However, because of their trophic position, the development of low trophic level fisheries requires a precautionary approach with due attention paid to ecosystems as a whole so not to disrupt food webs.

Overall, the diversification of markets requires education and awareness raising of consumers, and the fishing industry should instigate a fundamental shift towards

selling whatever is caught rather than trying to meet consumer preferences. This would improve food security and resilience by reducing reliance on imported fish products through locally sourced fish products and allowing adaptation to anticipated changes by introducing flexibility in consumer choices and taste.

Adjustments in markets and consumption patterns are also relevant adaptation measures to shifts in fish distribution resulting from changing environmental conditions. These have received less attention so far. Yet, climate change impacts on resource distribution may be easier to understand and predict than impacts on productivity, particularly with regard to temperature for resources that are already close to their upper thermal tolerance, allowing for long-term planning and responses. Adaptation solutions include the inclusion of spatial planning in fisheries management and spatial information in stock assessment, in order to inform plausible scenarios and adequate responses, such as shifting of fishing effort or fish processing infrastructure.

Furthermore, shifts in occurrence of resources across national jurisdictions requires sharing of resources and the development of transboundary management. The implications are potentially complex, especially when international cooperation is weak and/or regulatory frameworks are not harmonized, leading to ineffective management. Displacement of fish biomass also potentially questions the existing allocation of fishing rights between countries, with traditional management areas, including static marine protected areas (MPAs), likely to become obsolete and requiring an adaptive revision of their boundaries to adjust to moving fish stocks. The protection of climate refuges, as done in Minnesota for the cisco (salmonid fish), can be a good solution particularly for inland waters.

However, the ability to shift fishing effort (and when appropriate processing facilities) depends on the adaptive capacity of individual fishery sectors and is less feasible for small-scale fisheries for which product diversification is a more realistic option. Overall, equity issues are and will be generated worldwide, as some countries have better management potential than others and some are likely to benefit from the changes (receiving additional fish biomass) whilst others will be affected negatively. In this context, new types of international cooperation are required to reduce incentives for poor management, based on fair trade-offs and ethics and supported by participatory decision-making on the allocation of resources.

Broadening the scope of fisheries management

Climate change is challenging fisheries production and management on a number of fronts and a change in approach deviating from the assumption of stationarity (e.g. relatively stable environmental carrying capacity, yields and species composition) is needed. Resilience needs to be built into the whole management system and supply chain, from more precautionary and resilient harvest control rules (HCRs) and management strategies adaptable to changing conditions, to integrated multiscale approaches that recognize global production as part of a bigger system, with biological, logistic and social diversity and complexity. The call for broadening the scope of fisheries management is not new as it was embedded in early policy instruments such as the Code of Conduct for Responsible Fisheries and the ecosystem approach to fisheries. However, implementation has lagged behind in many parts of the world. The session showcased ongoing efforts to implement such approaches and their relevance to coping with the effects of climate change.

There is growing evidence that fish, as a food source for humans, has an overall lower carbon footprint than most land-based foods and therefore it is likely that meeting food demand whilst mitigating against climate change will increasingly rely on

fish. Given the foreseen changes in fisheries distribution and productivity, sustainable fish production would benefit from a shift in fisheries management from traditional single-stock approaches to multi-species approaches, with an increased focus on what aquatic ecosystems can realistically produce on a sustainable basis. There are cases of such shifts in management practices; for example, in the Bering Sea a rapid transformation of the management system has led to the implementation of Ecosystem-Based Fisheries management, informed by integrated and practical scientific advice and based on a participatory decision-making system involving multiple stakeholders. Similarly, in the Southern Pacific tuna fisheries proactive management was put in place with precautionary target reference points, adaptive spatial management and increased ecosystem based co-management.

Broadening the scope of fisheries management entails integrated thinking across the entire supply chain, including considerations of pathogens and disease outbreaks. Inclusiveness in terms of minority stakeholder group participation (e.g. indigenous people, women and youth) substantially increases the chances of successful and constructive change with a high degree of social cohesion to foster adaptation by creating opportunities to learn and innovate rapidly.

While local communities often show a strong capacity to adapt their fishing practices and livelihoods to changing conditions, more rapid changes in institutional arrangements are needed, as well as the development of sector-specific policies when these are missing (e.g. seaweed production sector in Tanzania). Overall, both decision-making for and buy-in to policies need to occur faster. This entails a major decentralization and effective co-management, whether for adaptation to changes that have already occurred or in anticipation of the ones to come. The ability to be proactive rather than reactive and anticipate change will help ease the transition to a new future and the formulation of strategies that are robust to unpredictable conditions will be critical. An example is given by the development of innovative parametric insurance products for small-scale fishers in Grenada and St Lucia to help cope with losses in the face of changes in storminess patterns.

Equity principles apply in sharing resources and allocating fishing rights in international fisheries co-operation, but they should also be guiding principles of policies to recognize the importance of gender equality, as well as ensure that attributes of social resilience are present in the system (social capital, financial reserves, learning networks across communities).

KEY MESSAGES AND RECOMMENDED ACTIONS

- Global problem with local solutions. **Urgently implement transformative adaptation.** Fishers are adapting; institutions and policies need to step-up and be at the forefront of providing adaptation guidelines and frameworks. Learn from the examples of successful adaptation.
- Be proactive. **Respond to climate change by improving fisheries management through the implementation of cross-sectoral, holistic and precautionary approaches** that attain robustness to variability rather than stability.
- **Develop spatial management mechanisms** able to adapt to the fast pace of climate change, accounting for shifts in species distributions, as well as changes in seasonality of ecological processes and incorporating effective communication between stakeholders.

- Climate change will almost always result in unequal distribution of benefits and losses. This requires **negotiating trade-offs and build on climate justice and equity considerations** when taking decisions on allocation of and access to fisheries resources. Drawing on ethics is one valuable option.
- **Diversify supply chains by adding value to new or currently undervalued resources.** Promote market diversification to avoid weak links that result in low resilience to changes and shocks. Educate consumers.
- **Design adaptation solutions that account for gender and youth differences** in terms of vulnerability and build on the specific skills and positive role women and youth can play.
- To do the new you need to drop the old. **Invest in innovation to modify fishing,** modern insurance alternatives, early warning systems, communication and the use of industry real-time data.





Session 7. Fisheries information systems and new technologies

SESSION DESCRIPTION

Reliable, timely and detailed statistics play an essential role in supporting sound policymaking and providing information on the performance of the fishery sector and its sustainability that is essential for effective management (FAO, 1995). While most countries have a system in place for the collection of at least partial fisheries statistics, inadequate collection frameworks and data gaps are still widely encountered, holding back many countries from properly assessing and tracking the status of their fisheries resources and designing and implementing effective fisheries management policies and schemes (FAO, 2018). As a matter of fact, the fisheries sector has generally been a late adopter of innovative information technologies, while there is an urgent need to improve availability, quality and use of fishery data, statistics and information particularly in developing countries (FAO, 2018).

As our global environment evolves with increasingly complex societal challenges (increased demand for fish, competition for resources, climate change, etc.), the demand for data and information also evolves. New information technologies have the potential to change the way we generate, interpret and communicate fishery sustainability issues. Fisheries data are rapidly becoming a public commodity, opening opportunities to many non-state actors to provide innovative services, and to state actors to make the most of the available technologies. Additionally, the emergence of new technologies such as blockchain, big data, artificial intelligence and deep learning is likely to significantly affect the established data value chain and to disrupt the sector's management in the short to medium term.

Major challenges remain, however, to fruitfully put these innovations to the benefit of the sector and contribute to efforts to implement Agenda 2030 – these include copyrights, privacy and confidentiality boundaries, comprehensiveness and risks for biases, capacity to integrate sources and analytical services, among others. These issues are particularly complex in the context of small-scale fisheries, where information is even more fragmented and incomplete and the need to integrate sources is more acute.

This session outlined the effectiveness of current data collection and fisheries information systems, the central set of issues which need to be addressed, and the new and proven technologies that may be applied to improve marine and inland fisheries. It also fostered discussions on a future-oriented global vision, exploring which emerging technologies can be scaled and adopted, what their future role might be in support of management of fisheries and ocean conservation, and highlighting the role that the public sector at national, regional and global levels should play in this arena.

PANEL 7.1 THE FUNDAMENTALS – WHAT CENTRAL SET OF ISSUES NEED TO BE ADDRESSED FOR FISHERIES DATA/INFORMATION TO BE A PUBLIC COMMODITY SUPPORTING THE SECTOR'S NEEDS

As described in Session 4 small-scale fisheries play a critical role in food security, poverty eradication, equitable development and sustainable resource utilization. However, their economic contribution remains largely invisible and they receive limited government support. As such, most small-scale fisheries are considered to be not well managed and

approaches have largely failed to address fishing effort, manage a range of conflicts, account for climate change and socio-economic needs, or to incorporate meaningful co-management structures.

Along with the lack of recognition and support, the data available for small-scale fisheries continues to be particularly deficient, and therefore this panel focused on addressing this sector. Issues of scale and the complexity of small-scale fisheries are not the only factors determining the lack of data. Many of the existing systems in place are cumbersome to implement and unsustainable in the long term, with over-customization hindering scalability, and unengaging in terms of the end-user experience. It is clear that a more collaborative form of governance is required for small-scale fisheries and now, more than ever, there is a need for comprehensive, affordable, scalable, customizable and interoperable Fisheries Information Systems that support decisions in a range of aspects while engaging a multitude of stakeholders, especially small-scale fishers themselves.

However, in the more recent period, the range of ICTs available to collect small-scale fisheries data is evolving rapidly (e.g., the use of mobile apps, satellite and radio trackers, cloud based systems, the internet of things, and data visualization kits). A number of successful ICT initiatives emerged for the sector, including community-catch monitoring programmes, self-reporting and e-logbooks, and tracking for improved safety-at-sea. Many of these solutions aim at improving achieving traceability within supply chains to drive local or regional market access or facilitate digital payments or tracking progress within fishery improvement projects (FIPs). These ICT initiatives have started to contribute to the improved well-being of fisher communities globally and if implemented in an inclusive way have the potential to further advance the small-scale fisheries sector in particular and to contribute to the FAO Guidelines for Securing Sustainable Small-Scale Fisheries.

Lessons learned tell that for small-scale fisheries, user engagement in the concept of data collection – particularly using ICTs – is as important, if not more important, than the implementation of data collection systems itself. Taking account of digital literacy and access for all, as well as acknowledging the importance of ICT initiatives to enable fishermen and women to raise their voice and build confidence in the concept of the collection and sharing of data are critical issues to improve the collection of data in this sector.

Key challenges related to data quality, data ownership and data use in fisheries management include skepticism in the possible impact of ICTs and data and in the unethical use and monetization of big data; the suspicion in the security of cloud based systems, the maintenance, scalability and over-customization of applications; and their sustainability. Addressing these challenges implies collaboration with local, regional and global organizations. Many existing initiatives connect with local organizations, but none have so far gained support from global fishing organizations advocating for the recognition of small-scale fishers and policy reform. Greater focus is also needed in terms of interoperability, standards and linkages with Government Fisheries Information Management Systems, and particularly in the light of emerging technologies such as Artificial Intelligence and distributed databases or blockchain-supported financial transactions: a deep reflection on the utilization of ICT for fisheries, the Key Data Elements embedded in these systems, their robustness for stock assessment work, or even supply chain traceability audits and automated digital payments, is needed to enable a timely shared learning experience and extract emerging lessons within a community of practice.

PANEL 7.2 A VISION FOR THE FUTURE – WHAT TECHNOLOGIES MUST BE SCALED AND ADOPTED, AND WHAT DO EMERGING TECHNOLOGIES NEED TO ADDRESS?

Information technology (IT) is a swiftly innovating industry, and beyond a five-year time frame it is difficult to predict what IT will look like and how far it will transform our monitoring and management processes. However, it is clear that the world moves away from information systems to information networks, that data are increasingly used to drive real time decisions instead of producing annual reports, and that singular domains like fisheries or shipping will not anymore be considered in data silos, but instead that we will be adapting our behavior to what is observed.

The development of artificial intelligence and big data will be central to the radical changes in information systems in the next 5–10 years. Artificial intelligence will be empowered by the availability of a huge amount of heterogeneous data produced, in large part by sensing technologies whose variety, distribution and purpose are growing exponentially, from satellites, buoys, terrestrial and underwater vehicles, and citizens. Furthermore, the scope for the integration of these technologies is stronger and more functional than ever before as technologies increasingly interoperate with and complement one another, they open up new possibilities.

The exploitation of these data will also be enabled by the radical evolution of processing technologies (e.g., e-Infrastructures, edge computing, exascale computing, quantum computing) and communication networks, including mobile networks (e.g. 5G, 6G), coupled with new software approaches and paradigms, that offer the potential to address challenges such as food security, adaptation and resilience to climate changes and ecosystem management.

A considerable part of the generated data will be publicly available. Uniform and transparent usage of data across domains, organizations, and challenges are increasingly becoming the norm, and will be facilitated by the convergence by data providers towards common standards and by intelligent IT solutions.

There is a clear trend towards increasing the use of artificial intelligence everywhere, facilitating accessibility and use, but also supporting data sharing, collaboration and inclusiveness. Algorithms, models and, especially new forms of reasoning based on a variety of approaches (e.g. machine learning and deep learning) resulting from the current large investments in artificial intelligence, will empower systems that will be able to learn, inform, predict and decide. Augmented intelligence will span across a large variety of functionalities, from smarter retrieval and access of multimedia information to sophisticated “what-if” predictions, also in contexts where not many data, skills and resources are available to automatic discovery of phenomena and virtual reality collaboration environments powered by intelligent recommender systems.

However, innovation in data driven technologies poses a number of risks that must be appropriately addressed. Risks include notably:

- Trust and transparency will be mandatory properties in the resulting complex scenario of connected intelligent information systems (supporting decision-makers and taking decision by themselves). The outcomes of today’s research on FAIR (Findable-Accessible-Interoperable-Reusable) data management, block chain, traceability, and artificial intelligence will provide solutions contributing to address these important questions, and the research community cannot do this in isolation.
- Ethical questions relate to the risk of concentrating power in the hands of few. Addressing aspects like the data chosen for training a deep learning algorithm, the ownership of the knowledge resources empowering the augmented intelligence

and the access to the chosen data and computational model are key to guarantee that everyone can participate and that no one is left behind.

- The divide between Information and knowledge. Beyond the improvements in facilitating the collection and sharing of data, bridging the gap between information and knowledge will be key to ensuring countries have the capacity to transform data into knowledge.

This forward scenario will need clear governance and policy decisions. To make it happen the global community addressing fishery sustainability will have to identify appropriate new regulations, guidelines and best practices for Information Systems. The development of Voluntary Guidelines on Data/Information Systems Governance could be a way forward.

KEY MESSAGES AND RECOMMENDED ACTIONS

- **Integrate data collection and supply chains.** There is a strong need for developing countries to focus technical and human resource investments in the capacity to compile, manage and analyse data in fully integrated systems that encompass the complete value chain. Data systems need improvements to provide analytical services and synoptic results having the capability to better communicate the wider picture to decision-makers.
- **Promote online structures delivering analytic services** and invest in **remote sensing technologies, internet accessibility and sensors** as ways to generate new, real time, and inclusive knowledge.
- **Identify key simple and easy to collect data** as a way to expand the information on which to make fisheries management decisions.
- **Tackle institutional and regulatory barriers** preventing the implementation of effective fisheries information systems and data sharing, and consider open-data policies governed by principles that are secure and transparent.
- **Build trusted knowledge from data.** Develop well-defined, transparent and inclusive processes to facilitate communication at the science-policy interface in order to ensure that trusted sources of data and information (including indigenous ones) produce credible, relevant, legitimate and responsibly interpreted information, openly accessible, at all scales.
- **Reduce the digital divide.** Ensure awareness of new available technologies, invest in mobile data collection and the use of remote sensing technologies, involve fisherfolk communities, including women and youth, and empower them with services (including analytics) to improve their livelihood and facilitate ownership.
- **Support capacity building in the data supply chain**, i.e. data collection, data management and data analysis. The necessary support from Governments and funding organizations/sponsors in the data supply chain can be best ensured by focusing data collection and analyses on socio-economic aspects and the value of the sector to the economy and livelihoods.
- **Develop international policy guidelines on how to develop and equitably utilize emerging technologies and ensure FAIR principles (Findable-Accessible-Interoperable-Reusable).** FAO should also lead or contribute to data standards and their expansion to adapt to new forms of recording fishery activities and domains in needs such as small-scale, recreational, aquaculture.
- **By supporting strengthened governance and increased partnerships among data and technology providers**, the public sector can help achieve comprehensive, neutral and sharable data feeds from local applications to global statistics and trends monitoring. While fulfilling this role, the public sector will have to ensure that inherent biases of private interests do not distort an objective assessment of the sector's reality.

Session 8. Policy opportunities for fisheries in the twenty-first century

SESSION DESCRIPTION

The fisheries and aquaculture sectors in both marine and inland aquatic spaces play a significant role in the blue economy and have a long-standing presence that serves a wide range of objectives. They are key food-producing sectors, providers of livelihoods, and sources of social and cultural values, despite traditionally having relatively less economic and political power and priority than other sectors. There is now broad agreement that the governance frameworks for oceans and seas need to be reinforced to secure ocean-based goods and services for future generations and to develop a truly sustainable, just and inclusive blue economy. The expectation of increasing demands on the blue economy in the context of a growing human population and climate change has also led to calls to ensure the foundation of that economy – our oceans, seas, lakes and rivers – are used sustainably. Recognition of the many services provided by marine and inland aquatic spaces is now gaining a prominent presence in the agenda of high level political leaders. All of this implies the need for improved fishery policy measures.

The international legal framework for managing the fisheries sector sustainably is now well established, both in areas under national jurisdiction and the high seas, due to United Nations Convention on the Law of the Sea (UNCLOS) and the United Nations Fish Stocks Agreement (UNFSA). The Code of Conduct for Responsible Fisheries has also had a strong positive influence on cooperation and coordination at regional and global levels. The 53 Regional Fisheries Bodies around the globe and other competent organizations and frameworks, are strengthening the international oceans governance mechanisms covering the fisheries of the world.

Session 8 focused on the policy opportunities for improving fisheries management in the twenty-first century. The key note speakers and panelists were charged with reflecting on the main policy failures and successes, needed policy innovations, which international legal frameworks need to be strengthened, trade-offs that need to be considered, how fisheries policies can be better supported, and how the blue economy can best contribute to securing livelihoods and food security.

PANEL 8.1 BEYOND THE CODE OF CONDUCT: POLICY OPPORTUNITIES FOR FISHERIES MANAGEMENT IN THE TWENTY-FIRST CENTURY

There are a number of key policy failures that have plagued fisheries management and are hindering the ability to deliver SDG 14. Examples include a lack of political consensus; the persistence of IUU fishing; the widespread lack of transparency across the fishing industry, which contributes to IUU fishing, corruption; and the loss of revenue and fish stocks to coastal states and inland fisheries. In addition to the above, challenges such as increased pollution on land and sea, including by marine litter, as well as competition over ocean and freshwater space are also hindering the implementation of efficient policies. However, there are also policy successes, including the development and implementation of international policy instruments (e.g., CCRF, SSF Guidelines, and for Flag State Performance, for Catch Documentation, on the Marking of Fishing



Gear, Voluntary Guidelines on the Responsible Governance of Tenure and accession and implementation of the Port State Measures Agreement).

Although there has been a trend of increasingly responsible fisheries management actions, there is a need for greater political will, the capacity to implement policies well, coordination among resource use sectors, and better communication to improve public perception of fisheries. Particular policy innovations are needed that actively improve livelihoods and well-being of SIDS and their small-scale fisheries food systems in particular. There is also a strong need to develop practical schemes for monitoring, evaluation, social learning and adaptation that can easily be implemented in developing countries, especially SIDS. In this vein, there is a need for all stakeholders in small-scale fisheries systems to co-design and co-implement fisheries management policies with policy makers.

Small-scale fishers face many complex problems; therefore, policies governing them need to keenly recognize their importance to local economies. A key challenge for policy makers is conflicting policy goals where small-scale and industrial fisheries co-exist. There is a great need to recognize the multiple benefits of small-scale fisheries, including job creation, revenue generation and food security, while also acknowledging the role of industrial fishing interests. To this end, particularly in areas shared with other major coastal economic activities such as tourism, it is important to have appropriate recognition and designation of fisheries tenure and rights. Finite fisheries resources should be managed through a system of fisheries tenure and user rights that appropriately reflects the different contexts in which they occur, with particular attention to existing and traditional tenure systems. Such management regimes should be designed to make fishing capacity commensurate with and adaptable to available fishing opportunities.

If global society wants to deliver social, economic and environmental sustainability, gender equality needs to be improved. Proposed mechanisms to improve gender equality include elevating the role of women in decision making so that their views can be heard and considered; enhancing capacity building in coastal communities to enable knowledge from women to be recognized and supported; collecting sex-disaggregated data; and encouraging gender balanced participation in fisheries management activities.

Landside, inland fisheries policies need to be improved in order to maintain good water quality, healthy ecosystems, effectively protect native and endangered species, and fundamentally ensure that fishing rights and livelihoods are secured. Inland fisheries issues have only recently entered into broader land and water dialogs, and inland fisheries management must broaden beyond its current focus on managing access and on providing technical regulations. Broader environmental policies – that focus on flood protection, irrigation and water allocation, navigation or hydropower generation – need to better consider the ensuing impacts on water quality, habitat coherence, freshwater availability, and climate change that are essential for inland fisheries. Likewise, addressing downstream impacts of terrestrial activities on coastal habitats and conditions, land-based pollution and addressing the problem of marine litter and plastic are crucial for improving the environmental status of the ocean.

A top priority for both developed and less developed states is understanding and dealing with the impacts of climate change and climate variability. Political flexibility will be needed, which, in turn, necessitates compelling analysis and credible options to overcome resistance to change. Fishers play a significant role in this by helping climate scientists test to reconcile their hypotheses and models with ‘experiential knowledge’ that fishers have accumulated when encountering both slow ecosystem changes and sudden, emergent, place-based and local weather and climate situations. In particular, fisheries managers must explicitly recognize that scientific knowledge is not the only type of knowledge relevant to the science-policy nexus. There are other types of

knowledge — local, indigenous, social, political, moral, religious and institutional knowledge — which are also valid, exchanged and co-created.

Sustainable and just blue economy will not be achieved unless spatial plans are coherently and fairly developed, and based on an ecosystem approach that ensures appropriate space both for traditional aquatic uses and for natural processes. Such plans also need to be climate smart and forecast future trends, innovations and ocean use with environmental, economic and social sustainability as the central pillars of the plans. Given this, there is an increasing role for adaptive policies that build in rationale and mechanisms for automatic policy change in the face of possible evolutions. This will necessarily require an integrated approach to management, as well as cross-country cooperation and coordination between different types of multilateral bodies, such as Regional Fisheries Management Organizations (RFMOs) and regional sea conventions and others. RFMOs must have a stronger capacity to collect data, ensure that stocks are not overfished, and enforce compliance.

It is particularly important, where relevant, to end cycles of unsustainable investment patterns and give the welfare of future generations more weight in our economic and moral decisions of today. In order to achieve the state of the ocean we want future generations to inherit, countries should be encouraged to prohibit investment by both public and private banks in unsustainable activities and to encourage countries to reallocate public funds and investments away from support that encourages over-capacity, over-fishing and other unsustainable fishing practices, and instead, to provide incentives and guidelines, such as the Sustainable Blue Economy Finance Principles, to support sustainable activities. This must be done in a manner that respects the range of SDGs being pursued in the ocean, including poverty, food security, gender equality and equity considerations. There is currently a lack of transparency across much of the seafood supply chain, which is impeding effective resource management and enforcement while also increasing the risk that distant water fleets will engage in IUU fishing. Part of the solution is to reinforce transparency across the seafood supply chain as the social license for the fishing industry in the twenty-first century, including ensuring that investments and activities are reflective of the limits fisheries resources have. This includes addressing the power imbalance in fishery access agreements between coastal states and flag states. Greater transparency will enhance equity for coastal nations.

Furthermore, given the many trade-offs on the environmental-economic-social axes of the SDGs, the global community cannot view fisheries policy through a purely sectoral lens. In order to make progress beyond SDG 14 “Life below water” and towards the many other SDGs that are relevant to capture fisheries and fisheries stakeholders (i.e., SDG 1 – Reduce poverty, SDG 2 – Food security, SDG 3 – Good health, SDG 5 – Gender equality, SDG 8 – Decent work and economic growth, SDG 10 – Reduced inequalities, SDG 11 – Sustainable cities and communities, SDG 13 – Climate Change), we need to ensure the blue economy is truly equitable and sustainable, and is accompanied by climate resilience of our ocean. Furthermore, to have a positive impact on society and achieve a sustainable future where food security and the livelihoods of fishermen and women and of coastal communities are ensured, fisheries policy must be incorporated into the broader policy arena. To achieve this it would be necessary to go beyond a sectoral approach to adopt a more integrated and cross-cutting ocean agenda taking into consideration the complexity of challenges affecting fisheries and the oceans. Fisheries needs to partner with other sectors (e.g., energy, tourism, military) to collectively address joint challenges and meet broader goals and objectives in order to achieve its own goals and defend its interests. This is important in view of the complexity of challenges affecting fisheries and the oceans. In particular, biodiversity conservation is a key policy arena where sustainable fisheries interests and knowledge need to be present and taken into consideration.

Lastly, there is a need for good governance practices that ensure that fisheries policies are designed in consultation with all interested parties, including civil society representatives and coastal communities, with support and buy-in from different branches of government. This will require the availability of sound data and scientific advice, greater transparency and making use of adaptive policy mechanisms. Governments will need to develop fair, transparent and inclusive governance, coordinating efforts across different branches of government, independent scientific bodies and stakeholders in all sectors and civil society.

A key question is where and how the needed substantive fisheries policy debates will take place. The global community cannot continue managing fisheries with a business as usual attitude. The new vision for fisheries management must take into account lessons learned from local and regional initiatives that involve multiple sectors and that properly incorporate the needs and values of small-scale fishers, stressing the continued importance of small-scale fisheries in developing countries, the role of climate change, and issues of transgenerational justice. Public support needs to be re-aligned with the objective of enabling the development of sustainable, inclusive, just and resilient fisheries as an important part of a strong and sustainable blue economy. We need to take back the fisheries agenda, and be much more forceful in implementing it so that we can improve the record of fisheries successes.

KEY MESSAGES AND RECOMMENDED ACTIONS

- **Integrate fisheries into broader planning and governance frameworks that bring multiple sectors together.** Fisheries management cannot act in isolation, and should be working alongside other more visible and economically valuable sectors.
- **Continue and intensify efforts to eradicate IUU fishing.** In particular, all flag, port, coastal and market states need to ratify and implement the Port State Measures Agreement.
- **Strengthen political will and capacity to improve implementation of existing policy frameworks,** and support policy innovation for emerging challenges.
- **Ensure that fishery policy and management decisions are inclusive,** promoting scientific evidence and the recognition of local/traditional knowledge.
- **Improve public and governmental perception of fisheries** to justify investment and respond to criticism, thus increasing ownership of the fisheries agenda.
- **Increase accountability and transparency of fishing activities and build greater trust in the capacity and transparency of the fishery sector** to be part of the solution
- **Improve cohesion between fisheries and biodiversity conservation objectives.**
- **Ensure livelihoods, well-being and decent work are fundamental goals in fisheries governance and management,** involving stakeholder, and securing rights and access, while reconciling food security and supply objectives with conservation.
- **Ensure that efforts to develop the blue economy are based on sustainable and equitable development** and incorporate the rights of those whose livelihoods depend on the sea now and for future generations of fishers.
- **Improve gender equality, support to younger generations and capacity building in fishers' communities.** Proactive mechanisms for this include elevating the role of women in decision making; engagement of youth; capacity building in fisher communities to support their capacity to manage; sex- and age- disaggregated data is a requirement for this.



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Session 9. Overall Symposium conclusions and overarching actions

The remarkable diverse group of experts and participants that attended the Symposium contributed to rich and detailed discussions (see Sessions summaries 1–8). From these discussions, a number of cross-cutting messages and recommendations emerged to improve sustainability in the sector and contribute to this new vision for sustainable fisheries in the twenty-first century.

The messages included a wide range of topics (e.g. food and nutrition security; gender equality and equity; capacity development; communication and evidence-based information sharing; data and information; technology; integration across sectors; biodiversity; livelihoods and social sustainability; and partnerships). They are also in agreement with the analysis of the responses from the attendees carried out within the Symposium learning initiative (see Annex A), therefore representing a shared vision among speakers, panelists and attendees. These main emergent cross-cutting messages and recommendations for marine and inland fisheries are listed below:

- There is a strong need to **integrate fisheries into broader planning and governance frameworks** that bring multiple sectors together, and facilitate the implementation of **evidence-based assessment and management**, using a variety of information sources, including **traditional, local, indigenous and women's knowledge**, and promoting **participation of fisherfolk** in all steps of the process. For inland fisheries, it is particularly relevant to engage with other sectors and consider fisheries within an **integrated watershed management framework**.
- The development of **joint integrated biodiversity and food security objectives** is required to help **ensure that aquatic foods can reach those that need it most now and in the future**, namely marginalized and vulnerable groups, **reducing undesirable impacts and food waste and addressing malnutrition and hunger**. This will require strengthening implementation of the Ecosystem Approach to Fisheries, including through promoting **diverse, inclusive and accountable partnerships to effectively manage ecosystems** for both biodiversity and food security.
- **Capacity building**, in particular aimed at **data collection and analysis** and improving **countries ability to better assess and monitor their fisheries** continue to be needed. Capacity building programmes should aim to **involve fishers and fish workers, increase transparency, reduce the digital divide and include new technologies**, improve the collection and analysis of data from all aspects of fisheries, in particular **economic aspects, gender and small-scale fisheries**, and encompass all elements of the value chain.
- **Communication on fisheries issues** needs to be largely improved. This includes communication between fishers, scientists, managers and decision-makers, but also to the wider public. There is a need to **ensure the narrative on fisheries** is focused on emphasizing the importance of the fisheries sector as a food production system, and used to empower fisherfolk, women and vulnerable communities in the sector.
- **Livelihoods, well-being and decent work** must be considered more explicitly in fisheries management, including by increased **stakeholder involvement**

and secured rights and access. A meaningful balance in the allocation of space and resources between fisheries and other objectives should be sought, in a manner that respects traditional fishery tenure while reconciling food security/supply objectives with conservation.

- **Gender equality and equity** with support to the **younger generations** must be improved. Proactive mechanisms for this include elevating the role of women in decision making, engaging youth, implementing focused capacity building actions, and collecting gender statistics, including sex- and age-disaggregated data.
- **Reducing and eliminating harmful practices** that may lead to overcapacity, overfishing, and/or IUU fishing are important means to help achieve sustainability. However, socio-economic measures that include **improved access to credit, finance and insurance**, especially in the small-scale sector, as well as the **integration of market-based mechanisms** with measures to protect non-market, social and ecological value, are also key for the sustainability of the sector.
- Political will should be sought and capacity to **improve implementation of existing policy frameworks** should be strengthened. **Policy innovations** in the sector are required to **address emerging challenges** such as climate change and the increasing demand of fish and fish products, and to improve the involvement of fishers and fish workers (including women) in the development and implementation of policies.



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ANNEXES



ANNEX A. Symposium learning initiative

DESCRIPTION

In order to adaptively design Symposium events, learn from outcomes, and increase participant engagement, attendee experiences and priorities were assessed. Mixed methods research was implemented combining quantitative and qualitative techniques including online focus groups, pre- and post-Symposium surveys, and participant observation and semi-structured interviews conducted during the event. Methods were designed to understand who attended the Symposium, what their goals were for the event, how they assessed their experience, and what their priorities are for fisheries sustainability. Participatory methods were chosen in order to increase attendee engagement at the Symposium and to inform design of the week's events. Analysis methods to derive patterns included emergent and a priori coding, as well as statistical analysis of survey and demographic data.

KEY FINDINGS

- The regional, sectoral, and gender diversity of Symposium attendees and speakers was exceptional, setting the stage for a broad and representative coalition of fisheries professionals.
- Event design helped engage participants by focusing on the goals that drove attendance: Learning, networking, sharing experiences, and contributing to event outputs.
- Gender inequalities may have influenced the dynamics of the event; in light of this, facilitating opportunities for networking may reduce barriers to gender equality in fisheries science and policy, while simultaneously enhancing the experience of all attendees is suggested for future events.
- Attendees rated their experience highly, but felt interaction was lacking. To improve this, they suggested smaller panel groups and more time for Q/A and discussion.
- Some evidence suggested that the use of WhatsApp groups and online focus groups helped enhance engagement efforts, and should be considered in the design of future events.
- Participants found in-session Livepolling to be a helpful and engaging addition, but noted that this strategy will be more effective with improved design and accessibility.
- There was broad agreement of cross-cutting themes to guide fisheries sustainability. These included adaptive management; social support and livelihoods sustainability; gender and women's inclusion; science and policy communication; food and nutrition security; capacity development; participation of fishers and fish workers; participation of the value chain industry; and data-based decision making and information systems.
- Survey results signal that data-based management and support for fisheries livelihoods were themes with particularly strong appeal to a broad group of attendees. Respondents highlighted these two issues above others in a series survey

questions relating to priorities in fisheries sustainability. Respondents envision adaptive management that responds to data variability, uses technology and capacity building to improve data uncertainty, and integrates local, traditional, and indigenous knowledge- including women's knowledge. They endorsed supporting fisheries livelihoods through co-management, fisher participation, gender equality efforts, and social support mechanisms.

- Attendees seek improvements in fisheries policy and implementation (see Table 4, below). They suggest that low political will can be improved through better communication of science and policy to the general public, fish-dependent people, and decision makers.

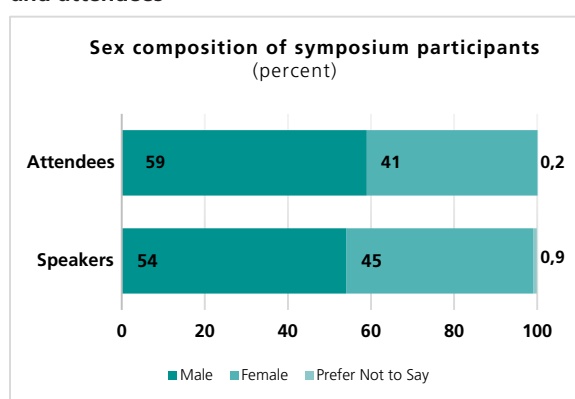
METHODS OF DATA COLLECTION AND ANALYSIS

Formal data collection efforts began in September 2019 and lasted through the Symposium. A mixed-method approach integrating quantitative and qualitative data proceeded through sequential steps, allowing for triangulation of data using different data types and input stimuli. Expression of Interest forms yielded demographic data, and qualitative analysis of written responses indicated attendees' key goals for the Symposium. Survey questions were developed through input from FAO session leads, and tested during nine regionally-based and randomly selected online focus groups. Survey questions were revised based on focus group input, and a Pre-Symposium Survey was sent to all individuals who had confirmed their attendance to the event. The survey solicited attendee's goals for the event and their broad priorities for fisheries management, with session-specific questions. During the Symposium itself, participant observation and ethnographic interviews were employed to collect qualitative data that provided depth and explanatory power to survey results, and Livestorm questions were used as an audience engagement tool. Finally, Post-Symposium surveys were sent to all attendees after the event. This survey was designed to elicit participants' evaluations of the event and explore their vision for fisheries sustainability. Survey questions were co-designed by FAO session leads, and were designed to test the results of previous data collection efforts. This allowed for the final survey to triangulate data collected earlier in the process.

OVERVIEW OF SYMPOSIUM PARTICIPANTS

There were 688 registered attendees participated in the Symposium, 107 of whom were speakers during the event. As Figure 1 and Table 1 indicate, the event achieved an unusual degree of gender parity, particularly amongst speakers, as well as a wide distribution

FIGURE 1.
Sex disaggregation of Symposium speakers and attendees



Source: Adapted from the learning initiative of the Symposium study (Ben Siegelman, 2020).

TABLE 1.
Sectoral representation of speakers and attendees

Sector	Attendees (percent)	Speakers (percent)
Academia	26	28
CSO/NGO Representatives	26	20
Research Institution (non-Academic)	14	17
Fisheries Sector	14	9
National Government and Intergovernmental Employees	6	9
Development Agencies	2	6
Private Sector	6	5
UN Agencies and Bodies	3	4
Regional Economic Bodies	1	1
Other	1	0

of sectoral participation. Though European attendees were a disproportionately large demographic- likely due to proximity and ease of travel- this disparity was well compensated for in the regional distribution of invited speakers (Table 2).

TABLE 2.

Regional representation of Symposium attendees and speakers, respectively

FAO Region	Attendees (percent)	Speakers (percent)
Europe & Central Asia	50	22
North America	12	28
Asia & the Pacific	15	25
Africa	12	13
Latin America & The Caribbean	8	12
Near East & North Africa	3	0

Demographic analysis, paired with data gathered in surveys, revealed important ways in which gender inequalities may have influenced the dynamics of the event. Women, though better represented amongst speakers than in previous fisheries conferences, were still underrepresented both on stage and in the audience. Female attendees were also notably younger than their male counterparts, with 55 percent of female participants under the age of 40 while only 30 percent of male attendees fell in this age group. The relative youth of female participants is particularly relevant when taking into account the importance of professional networks: 60 percent of women reported knowing only 0-5 fellow attendees. In fact, chi-square tests of independence showed that both women and under-40 attendees were statistically more likely to have small networks at the event. This makes sense for younger professionals who have had less time to build professional networks in their career, but it represents troubling implications for women in fisheries science and policy. This evidence suggests that small professional networks and lower social capital may be one mechanism of continued gender inequality in fisheries science and policy, particularly for women in the first decades of their career. This finding is of particular importance given attendees' emphasis on networking as a major goal of the Symposium, described below.

EXPERIENCES OF THE SYMPOSIUM

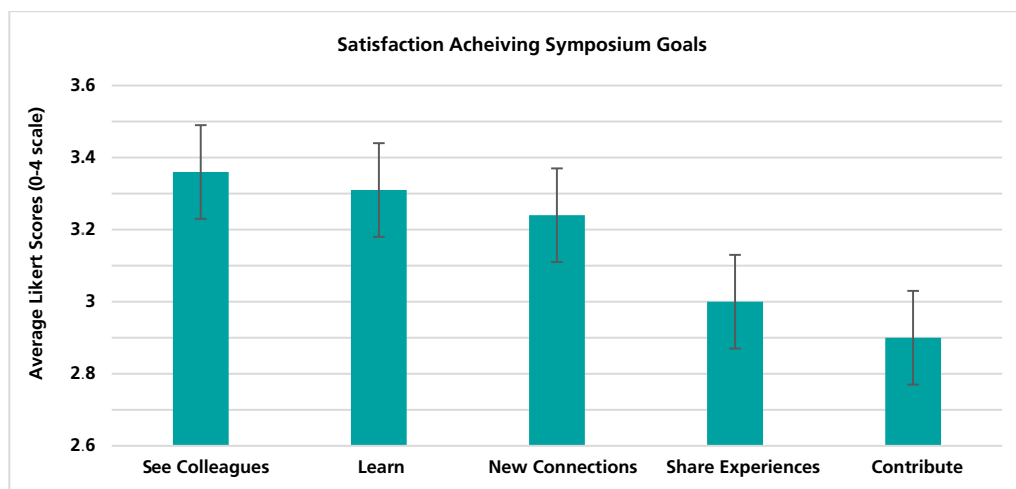
Research revealed that attendees shared five major goals for the Symposium: learning from sessions, contributing to Symposium outputs, extending their network, seeing colleagues, and sharing knowledge with peers. Before the Symposium, participants expressed particular interest in learning from the sessions on stock assessment, as well as the session on climate change adaptation. These findings proved consistent with later outcomes, discussed below, showing that response to data uncertainty is a consensus priority for fisheries sustainability.

Participants' evaluations of the Symposium revealed the event's strengths and pointed to opportunities for improvement. As Figure 2 indicates, satisfaction levels were high, with all answers expressing positive experiences. Attendees were particularly satisfied with their ability to learn and network during the Symposium, and indicated that they found the content of sessions engaging, relevant, and effective. They were happy with the diversity represented in speakers and panelists, though many expressed the view that fishers were underrepresented as Symposium participants.

Attendees were less satisfied with their ability to share experience and contribute to Symposium outputs. This seems related to respondents' calls for more audience engagement. Respondents expressed interest in more interaction between panelists, as

FIGURE 2.

Average Likert scale scores reflecting attendee satisfaction with their ability to achieve each goal, respectively. Evaluations are scored on a 0–4 scale, with 4 = “Very Satisfied”
Margins of error reflect a 95 percent confidence level



Source: Adapted from the learning initiative of the Symposium study (Ben Siegelman, 2020).

well as between speakers and audience, and suggested these might be achieved through smaller panel groups that could more deeply engage with audience questions. It should be noted, however, that this may have reduced the diversity of views represented in the panels. During the Symposium sessions, Livepolls presented and displayed to the audience in real time sought to improve levels of engagement. This was well-received and used by roughly two-thirds of attendees. However, participants noted that the strategy would be more effective with changes to design and implementation. Respondents indicated attention should be paid to accessibility, display quality, panel chair preparation, and panelist response. Nonetheless, this was considered a successful experiment, at once “amazing, informative, and fun.”

Two other factors seemed to improve participants’ sense of engagement. Ethnographic study revealed that nearly 30 percent of attendees self-organized WhatsApp and other social media groups to communicate with each other during sessions. This allowed participants to react in real-time, share thoughts with others in the room, and build stronger working relationships. Tellingly, those who participated in these parallel smartphone conversations during sessions expressed higher satisfaction with their opportunities to learn and to network. In addition, those attendees who took part in online Focus Groups before the Symposium reported higher satisfaction levels regarding their ability to contribute to the Symposium and share their own experiences—two goals that received lower scores amongst the general population. These findings suggest possible strategies for audience engagement in future events, though it must be noted that these results are inconclusive and can only at best show correlation between variables.

A SHARED VISION FOR FISHERIES SUSTAINABILITY

Mixed methods analysis indicated a set of cross-cutting themes that the majority of attendees saw as guiding principles for fisheries sustainability. The most agreed-upon themes, those with over 50 percent support in survey results, are indicated in Table 3. The themes and actions listed in survey questions were derived from the key messages of Symposium sessions themselves after a systematic coding process, and survey responses indicate those with particularly high approval. Though this finding should not be taken as a de facto mandate for the future of fisheries science and policy, it can

be understood to reflect the areas of general agreement, and the high degree to which the Symposium's key messages reflect broader priorities. Table 3 lists those themes and actions which had greater than 50% endorsement amongst survey respondents.

TABLE 3.

The percent of respondents who endorsed cross-cutting themes and recommended actions as priorities for fisheries sustainability. A 4 percent margin of error reflects a 95 percent confidence level.

Which of the following themes should be guiding principles for the future of fisheries sustainability?	percent
Participation of fishers and fish-dependent people	65.35
Adaptive management	62.87
Social support and livelihoods sustainability	58.91
Data-based decision making and information systems	58.91
Communication of science and policy	56.44
Food and nutrition security	55.94
Gender, women's inclusion and empowerment	54.46
Capacity development	51.98
Participation of the fisheries value chain industry	51.49
Which suggested actions from the Symposium are necessary for the future of fisheries sustainability?	
Improve transparency in fisheries management systems and evaluations	62.38
Make management decisions based on both scientific evidence and local/traditional knowledge	58.91
Integrate ecosystem sustainability measures into fisheries management frameworks	58.42
Implement adaptive management designed to address climate uncertainties and newly available data	56.93
Integrate local, traditional, and indigenous knowledges into formal data collection, monitoring, and reporting	55.45
Eliminate harmful subsidies	54.46
Enhance communication tools to facilitate dialogue between sectors and stakeholders	54.46
Overcome institutional barriers to facilitate effective information systems and data-sharing	53.47

This list of cross-cutting themes points to some of the topics that Symposium attendees most clearly agreed on. Data-driven management was a pillar of the Symposium, and this emphasis was backed by survey results. Attendees saw a need for adaptive management that responds to data variability and uncertainty. In particular, survey respondents supported data collection evidencing the contributions of small-scale fisheries, estimating the impacts of the value-added and fish transformation sectors, and using traceability to limit IUU fishing. Participants saw fisher and fish-worker involvement as crucial to these efforts, and supported the integration of scientific practices with local, traditional, and Indigenous knowledge, including women's knowledge.

Attendees also largely agreed on the importance of supporting fisheries livelihoods and social sustainability. Again, fisher and fish-dependent participation was a key point of consensus. Survey respondents supported achieving this through participatory governance including co-management, participatory data collection, social support mechanisms, and capacity development for vulnerable groups. Gender equality was singled out as a vital component of these efforts. The broad emphasis on supporting fisheries livelihoods and social sustainability was one of the most consistent themes of both the Symposium key messages and the survey results.

Finally, communication in the science-policy nexus was a key priority for Symposium attendees. Survey data revealed that most attendees rely not only on the SDGs, but also on the Code of Conduct for Responsible Fisheries and the Voluntary Guidelines for Securing Small-Scale Fisheries (SSF Guidelines). It is interesting to note

that more than half of respondents intend to use the SSF Guidelines in their future work, further evidencing the aforementioned emphasis on fisheries livelihoods. Yet despite this heavy engagement with existing policy frameworks, some 90 percent of respondents indicated that current fisheries policy or implementation is insufficient at global and national scales, while nearly 60 percent claimed that both policy and implementation are lacking (Table 4). Lack of political will to implement sustainable management was seen as a major cause of this shortcoming, with 55.9% ($\pm 5\%$) of respondents listing this as a major cause of implementation failure. To improve this, respondents overwhelmingly agreed that both fisheries science and policy must be better communicated to the general public, to fishers and fish-dependent people, and to decision makers.

TABLE 4.

Respondent views on the sufficiency of current fisheries policy and implementation.

A 4% margin of error reflects a 95% confidence level

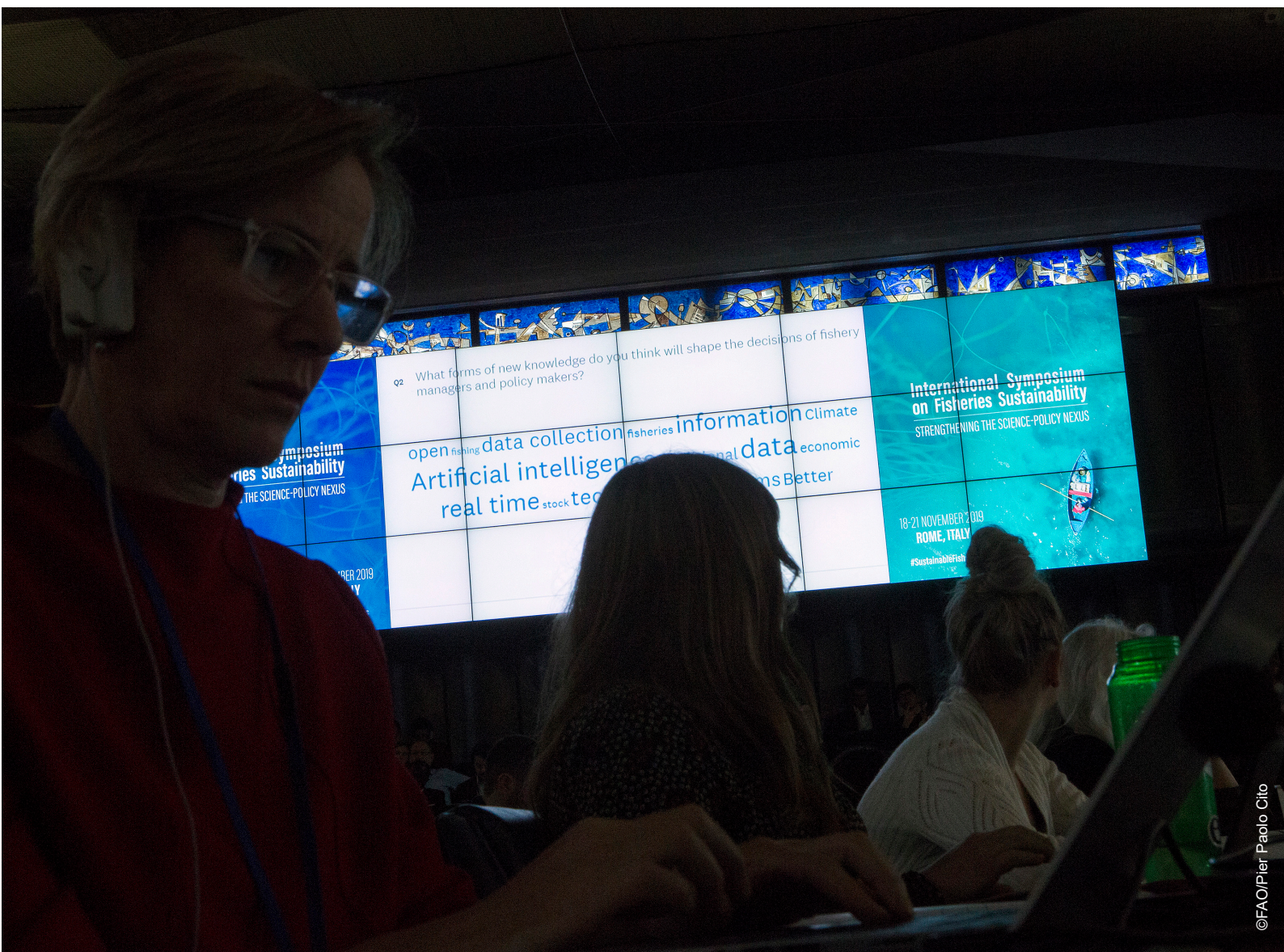
Do you believe current fisheries policy and implementation are sufficient for fisheries sustainability?		
	At the Global Scale (percent)	At the National and Regional Scales (percent)
Existing global fisheries policies and implementation are both sufficient	3.47	1.49
Existing fisheries policies are sufficient, but implementation is weak	33.66	26.24
Implementation is sufficient, but we need innovations in fisheries policy	5.45	5.45
We need major improvements in both fisheries policy and implementation	57.43	66.83

CONCLUSIONS

The 2019 International Symposium on Fisheries Sustainability proved to be an exceptionally diverse gathering of fisheries professionals from a wide range of regions, sectors, and age groups. This diversity was reflected and even enhanced amongst invited speakers and panelists, a factor that attendees appreciated alongside meaningful improvements in gender equality. With these demographic factors in mind, it is fair to understand the gathering as reflective of a broad and representative coalition of fisheries professionals. This makes their experiences and inputs all the more important, as this event represented a rare opportunity to understand driving priorities for a vision of sustainable fisheries.

Data collection clarified the goals that drove attendance, revealed the surprising use of social media groups to enhance engagement, and evidenced the important relationships between networking and gender equality. Symposium evaluations revealed high satisfaction levels with all components of the event, while suggesting opportunities for improving interaction and audience engagement. Finally, survey results indicated an agreed-upon list of cross-cutting themes to guide sustainability efforts, identified the tools and actions seen as highest priority, and highlighted the particular importance of data-based management and social support for fisheries livelihoods as key priorities widely shared by attendees. Though survey questions chosen necessarily limited the range of possible answers, the question design process adhered to Symposium key messages themselves, benefited from the guidance of FAO session leads, and were designed according to focus group feedback. This process ensures that the fisheries priorities identified represent as much as possible those aspects of the Symposium's vision that speak to the shared interests of the wide range of fisheries professionals and expertise who attended the event.

This aspect of the Symposium has also shown the utility of mixed-methods research for studying events. Symposia and conferences provide unique opportunities for institutional learning. They reveal the values and priorities held across expert populations, as well as the social processes so important for effective collaboration. Studying events systematically allows us to capture and learn from these moments, and the data collected holds lessons for more effective and productive convenings. Finally, the conscientious design of these studies can improve the engagement and satisfaction of participants themselves, fortifying the cooperation and collaboration required for sustainable policy and implementation.



ANNEX B. Keynote speakers and panelists

OFFICIAL OPENING

Keynotes	Mr Dongyu Qu, FAO Director-General, Italy
	His Excellency Peter Thomson, UN Secretary-General's Special Envoy for the Oceans
	The Right Honourable Michael Pintard, Minister for Agriculture and Marine Resources, Bahamas
	His Excellency Harald Tom Nesvik, Minister of Fisheries and Seafood, Norway
	His Excellency Ricardo Serrão Santos, Minister for the Sea of Portugal, Portugal
	Her Excellency Mona Mehrez, Deputy Minister of Agriculture, Egypt
	Ms Rebecca Jayne Argo, Fisherwoman, Alaska
Video message	His Excellency Tijjani Muhammad Bande, President of the UN General Assembly
Opening keynote	Prof Manuel Barange, Director, FAO Fisheries and Aquaculture Department, Italy
Chair	Ms Yasmina Bouziane, Director, FAO Office for Corporate Communication, Italy

SESSIONS

Session 1. The status of global and regional fisheries sustainability and its implications for policy and management	
Keynotes	Mr Ray Hilborn, University of Washington (UW), United States of America
	Ms Ana M. Parma, National Patagonian Center (CENPAT - CONICET), Argentina
Chair	Mr Ichiro Nomura, Japan International Cooperation Agency (JICA), Indonesia
Panelists	Mr David Agnew, Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), Australia
	Ms Graça Bauleth D'Almeida, Ministry of Fisheries and Marine Resources, Namibia
	Mr Paul de Bruyn, Indian Ocean Tuna Commission (IOTC), Seychelles
	Ms Patricia Macarena Cepeda, Industrial Fishing Association (ASIPES), Chile
	Mr Steven J. Cooke, Carleton University (CU), Canada
	Ms Maria del Carmen Fernández Llana, Spanish Institute of Oceanography (IEO), Spain
	Ms Elizabeth Logerwell, National Oceanic and Atmospheric Administration (NOAA), United States of America
	Mr Elayaperumal Vivekanandan, Bay of Bengal Programme International Organization (BOBP), India
	Mr Duto Nugroho Suhardjo, Agency for Marine and Fisheries Research and Development, Indonesia
	Ms Oluyemisi Oloruntuyi, Marine Stewardship Council (MSC), United Kingdom of Great Britain and Northern Ireland

Session 2. Sustainable fisheries: linking biodiversity conservation and food security	
Keynotes	Mr Christopher Costello, University of California Santa Barbara (UCSB), United States of America
	Ms Elizabeth Fulton, Commonwealth Scientific and Industrial Research Organization (CSIRO), Australia
Chair	Ms Renée Sauvé, Directorate of Fisheries and Oceans (DFO), Canada
Panelists	Mr Leandro Castello, Virginia Tech University (VT), United States of America
	Mr Rod M. Fujita, Environmental Defense Fund (EDF), United States of America
	Mr Stefan Gelcich, Pontificia Universidad Católica, Chile
	Mr Simon Jennings, International Council for the Exploration of the Sea (ICES), Denmark
	Mr Michel Kaiser, Heriot-Watt University (HW), United Kingdom of Great Britain and Northern Ireland
	Ms Sangeeta Mangubhai, Wildlife Conservation Society (WCS), Fiji
	Ms Nyawira Muthiga, Wildlife Conservation Society (WCS), Kenya
	Ms Yunne-Jai Shin, Institut de Recherche pour le Développement (IRD), France
	Mr Nam So, Mekong River Commission (MRC), Cambodia
	Ms Beverly Wade, Fisheries Department, Belize
Session 3. Fish in food security and nutrition: from tide to table	
Keynotes	Mr Christopher Deweir Golden, Harvard T.H. Chan School of Public Health (HSPH), United States of America
	Ms Shakuntala Haraksingh Thilsted, WorldFish, Malaysia
Chair	Ms Fiorenza Micheli, Stanford University, United States of America
Panelists	Mr Carlos Raúl Castillo Rojas, Ministry of Production, Peru
	Ms Boitshepo D. Giyose, African Union Development Agency (AUDA-NEPAD), South Africa
	Mr Xianshi Jin, Yellow Sea Fisheries Research Institute (YSFRI), China
	Mr Ahmed Khan, African Development Bank (AFDB), Côte d'Ivoire
	Ms Joyce Kinabo, Sokoine University of Agriculture (SUA), Tanzania
	Ms Mimako Kobayashi, World Bank (WB), United States of America
	Ms Anna Lartey, Food and Agriculture Organization of the United Nations (FAO), Italy
	Mr David Little, University of Stirling, United Kingdom of Great Britain and Northern Ireland
	Mr Sveinn Margeirsson, International consultant, Iceland
	Ms Friederike Ziegler, Research Institute of Sweden (RISE), Sweden
Session 4. Securing sustainable fisheries livelihoods	
Keynotes	Ms Philippa Cohen, WorldFish, Malaysia
	Mr Mitchell Lay, Caribbean Network of Fisherfolk Organisations (CNFO) and Gulf and Caribbean Fisheries Institute (GCFI), Belize
Chair	Ms Ratana Chuenpagdee, Memorial University (MUN), Canada
Panelists	Mr Edward Allison, University of Washington (UW), United States of America
	Mr Xavier Basurto, Duke University, United States of America
	Mr Anthony Charles, Saint Mary's University (SMU), Canada
	Ms Courtney Cox, Rare, United States of America
	Mr Naseegh Jaffer, World Forum of Fisher Peoples (WFFP) and IPC Fisheries Working Group, South Africa
	Ms Unni Kløvstad, Ministry of Foreign Affairs, Norway
	Ms Editrudith Lukanga, World Forum of Fish Harvesters and Fish Workers (WFF) and IPC Fisheries Working Group, Tanzania
	Mr Sebastian Mathew, International Collective in Support of Fishworkers (ICSF), India
	Ms Kumi Soejima, National Fisheries University, Japan
	Ms Vivienne Solis Rivera, CoopeSoliDar R.L, Costa Rica

Session 5. The economics of fisheries	
Keynotes	Ms Claudia Beltrán, International consultant, El Salvador
	Mr Carl Christian Schmidt, Nordic Marine Think Tank, Denmark
Chairs	Mr Rashid Sumaila, University of British Columbia (UBC), Canada
	Mr Zhengyong Yang, Shanghai Ocean University, China
Panelists	Mr Mario Aguilar, Grocio Enfoques Oceanicos, Mexico
	Mr Frank Asche, University of Florida (UFL), United States of America
	Ms Elisa Calvo, International consultant, Argentina
	Mr Griffin Carpenter, New Economics Foundation (NEF), United Kingdom of Great Britain and Northern Ireland
	Ms Jingjie Chu, World Bank (WB), United States of America
	Mr Francisco Javier Garat Perez, International Coalition of Fisheries Associations (ICFA) and Spanish Fishing Confederation (CEPESCA), Spain
	Ms Marie Christine Monfort, International Organization for Women in the Seafood Industry (WSI), France
	Ms Katrina Nakamura, The Sustainability Incubator, United States of America
	Ms Ruangrai Tokrisna, Kasetsart University (KU), Thailand
	Mr Nobuyuki Yagi, University of Tokyo, Japan
Session 6. Fisheries management in the face of a changing climate	
Keynotes	Mr Steven Gaines, Bren School of Environmental Science & Management, University of California, Santa Barbara, California, United States of America
	Ms Éva Plagányi, CSIRO Oceans & Atmosphere, Australia
Chair	Ms Hazel Oxenford, University of West Indies (UWI), Barbados
Panelists	Mr Miguel Bernal, General Fisheries Commission for the Mediterranean (GFCM), Italy
	Mr Merrick Burden, Environmental Defense Fund (EDF), United States of America
	Ms Kirstin Holsman, National Oceanic and Atmospheric Administration (NOAA), United States of America
	Ms Abigail Lynch, United States Geological Survey (USGS), United States of America
	Ms Flower Msuya, Zanzibar Seaweed Cluster Initiative (ZaSCI), Tanzania
	Mr Ernesto Penas Lado, International fisheries policy consultant, Spain
	Mr John Pinnegar, Centre for Environment, Fisheries & Aquaculture Science (CEFAS), United Kingdom of Great Britain and Northern Ireland
	Mr Shyam S. Salim, Central Marine Fisheries Research Institute (ICAR), India
	Mr Andrew Smith, Secretariat of the Pacific Community (SPC), New Caledonia
	Mr Carl van der Lingen, Department of Agriculture, Forestry and Fisheries, South Africa
Session 7. Fisheries information systems and new technologies	
Keynotes	Ms Donatella Castelli, CRN-ISTI, Italy
	Mr Serge Raemaekers, Abalobi, South Africa
Chair	Mr Francisco Werner, National Oceanic and Atmospheric Administration (NOAA), United States of America
Panelists	Mr Douglas Beard, United States Geological Survey (USGS), United States of America
	Mr Emmanuel Chassot, Seychelles Fishing Authority, Seychelles
	Mr Alfred Lee Cook, World Wide Fund for Nature (WWF), New Zealand
	Mr Lifeng Cui, China National Fisheries Technology Extension Center and China Society of Fisheries, China
	Ms Sara Iverson, Ocean Tracking Network (OTN), Canada
	Mr Anthony Long, Global Fishing Watch, United Kingdom of Great Britain and Northern Ireland
	Ms Jeannette Mateo Perez, Fisheries Resources at the Dominican Council for Fisheries and Aquaculture (CODOPESCA), Dominican Republic
	Mr Nyoman Radiarta, Institute for Marine Research and Observation (IMRO), Indonesia
	Ms Suzette Soomai, Department of Fisheries and Oceans Canada (DFO), Canada
	Ms Lida Teneva, California Ocean Science Trust, United States of America

Session 8. Policy opportunities for Fisheries in the twenty-first century	
Keynotes	Mr John Kurien, Azim Premji University, India
	Ms Lori Ridgeway, International consultant, Canada
Chair	Mr Atsushi Sunami, Ocean Policy Research Institute, Sasakawa Peace Foundation (OPRI – SPF), Japan
Panelists	Ms Samantha Burgess, World Wide Fund for Nature (WWF), Belgium
	Mr Michael Copeland, Lucky Star Operations, Oceana Group Ltd, South Africa
	Ms Claire Delpeuch, Organization for Economic Co-operation and Development (OECD), France
	Mr Hamady Diop, African Union Development Agency (AUDA-NEPAD), South Africa
	Mr Sergey Leontiev, Russian Federal Research Institute of Fisheries and Oceanography (VNIRO), Russia
	Ms Pamela Mace, Ministry for Primary Industries, New Zealand
	Mr Patrick McConney, University of West Indies (UWI), Barbados
	Mr Yi Tang, Shanghai Ocean University (SHOU), China
	Ms Veronika Veits, Directorate-General for Maritime Affairs and Fisheries of the European Commission, Belgium
	Ms Sally Yozell, Stimson Center, United States of America
Session 9. Summary of the sessions	
Keynotes	Ms Vera N. Agostini, Deputy Director, FAO Fisheries and Aquaculture Department, Italy
Chair	Prof Manuel Barange, Director, FAO Fisheries and Aquaculture Department, Italy

CLOSING CEREMONY

Keynotes	Ms Maria Helena Semedo, Deputy Director-General, FAO Climate & Natural Resources, Italy
	Mr Sidy Mouctar Dicko, Chair of the Committee on Fisheries (COFI), Guinea
	His Excellency Thanawat Tiensin, Permanent Representative of the Kingdom of Thailand to FAO, IFAD & WFP and Chair of the Committee on World Food Security (CSF), Thailand
	Mr Árni Matthías Mathiesen, Assistant Director General, FAO Fisheries and Aquaculture Department, Italy
Chair	Prof Manuel Barange, Director, FAO Fisheries and Aquaculture Department, Italy



ANNEX C. Abstracts

SESSION 1. THE STATUS OF GLOBAL AND REGIONAL FISHERIES SUSTAINABILITY AND ITS IMPLICATIONS FOR POLICY AND MANAGEMENT

Panel 1.1 The state of the stocks at global and regional levels – where are we and where should we be heading?

Keynote presentation: Assessing the sustainability of global fisheries

Mr Ray Hilborn, School of Aquatic and Fishery Sciences, University of Washington, United States of America

Sustainability is widely agreed to have three components: social, economic and environmental. The “Brundtland” definition is perhaps the most widely accepted: “A development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs.” A more specific definition (Matson, Clark, Anderson): “inclusive human well-being does not decline.” In the world of fisheries, sustainability has been measured most commonly by the abundance of exploited fish populations, but also by fishing pressure, the production of yield in relation to potential, by the management system and by the impacts of fishing on the ecosystem structure. The abundance and fishing pressure of fisheries has been measured by publically available scientific assessment for fish stocks that constitute half of the global marine fish production (Ricard *et al.* 2012). For the other half of world fisheries, assessment of abundance and fishing pressure is at the most evaluated by expert judgement using various indicators. For monitored stocks, FAO (2018) suggests that there has been a gradual increase in the percentage of stocks overfished rising from 10 percent in 1974 to 33 percent in 2015. This is based solely on the abundance of stocks relative to a MSY target.

When we look more closely at the assessed stocks of the world, we find fishing pressure in the last 20 years has on average been declining and abundance increasing, and fish stock abundance is now, on average, above MSY targets and fishing pressure below MSY targets. It is estimated that 3-5 percent of potential yield is now lost by excess fishing pressure on these assessed stocks. In general, in regions where there is research, assessment and management plans fisheries are performing better than where there is less of these elements. We see a positive trend in many parts of the world where there has been increasing fisheries management and declining fishing pressure. However, we do see some regions of the world with continued excessive fishing pressure – the Mediterranean and Black Sea and demersal species in NW Africa stand out as having poor biological status.

The unassessed stocks of the world largely come from developing regions with low management intensity and, based upon the relationship we have seen in the assessed stocks between management intensity and stock status, we would expect to see these low management regions to have poor stock status. FAO SOFIA does not suggest this for all regions, and for some regions there appears to be a conflict in information. For instance, Pacific Ocean Western Central and Indian Ocean Eastern both show no more than average fraction overfished in FAO (2018), yet have very low management intensity.

The major challenge is to bring scientific assessment, fisheries management and stock rebuilding to the places in the world where fishing pressure remains too high. Most of Asia, Africa and Central America do not have scientific assessment of fish stock status and have relatively ineffective fisheries management measures, but they are also places where fisheries are particularly important for food security and employment. Inland and small-scale fisheries are particularly poorly understood.

There is no systematic analysis of the social and economic sustainability of global fisheries but the data that are available suggest that environmental, social and economic performance are not necessarily highly correlated: some fisheries continue to provide major social benefits while having relatively low biological status.

Panel 1.2 Achieving sustainable fisheries management: a developing world perspective

Keynote presentation: **Evidence-based fisheries management: what is needed to achieve biological sustainability of global fisheries?** *Ms Ana M. Parma*, Patagonian National Center (CENPAT – CONICET), Argentina

The ability of fishery management systems to maintain fishing pressure at levels that can sustain productive fisheries depends on: (i) the availability of information on resource status and trends relative to desirable levels, (ii) the capacity to adjust harvest controls in response to changes in stock abundance, and (iii) the ability to implement and enforce regulations. The approaches that have proved effective in many large-scale industrial fisheries from developed countries have relied on the use of complex stock assessment methods to determine catch quotas, and a centralized ‘command-and-control’ model to implement them. Such approaches cannot be expected to work in small-scale fisheries and/or in regions with limited economic and technical resources, and weak governance systems.

The quest for suitable alternatives has often focused on the limited information typically available in these situations to underpin management decisions. Many new stock assessment methods and harvest control rules based on simple indicators have been shown to work reasonably well in data-limited situations. However, such technical progress has yet to produce positive on-the-ground impacts at scale. This is because data limitations tend to go hand in hand with resource and technical capacity limitations that hamper all three components of the management system. The design of monitoring programs and suitable harvest control rules, even if they are simple, still requires expertise that is often lacking in developing countries. Data sometimes exist but are not standardized and there is limited capacity to analyze them. In addition, factors such as remoteness of landing sites or budget restrictions, that make it difficult to collect data at the appropriate scale, commonly also lead to weak capacity to enforce regulations. Thus, the entire management strategy for monitoring, assessment and harvest regulation needs to be considered within the practical constraints of each fishery. The over-riding compounding problem is often the political difficulty of managing excess access and effort in the face of poverty and few alternatives for sustaining livelihoods.

Integrated frameworks proposed for achieving sustainable small-scale fisheries go beyond the specific assessment and management tools to emphasize the institutional processes leading to management decisions. These frameworks call for the involvement of the fishing communities in all stages of management (data collection and interpretation, decision-making and enforcement) and contemplate a key role for the agents that provide local technical support, who have to be equipped with appropriate tools, and have good analytical and communication skills.

Such participatory assessment and management approaches have resulted in positive outcomes in many places, but no quick fixes exist and the specific tools that have worked are highly context-dependent. Thus, local successes cannot be scaled up simply by replication. Rather, sustained efforts need to be devoted to building local technical capacity to collect, curate and analyze data, and to identify and fine-tune suitable harvest control rules for each fishery. Different organizations have developed tools to aid in such processes, but sustained support from governments and funding agencies will be needed to maintain long-term engagements with local stakeholders and to foster communities of practice that learn from experience across fisheries. Finally, a critical aspect of ensuring sustainable and productive fisheries will be finding suitable alternatives for the excess fishing capacity.

SESSION 2. SUSTAINABLE FISHERIES: LINKING BIODIVERSITY CONSERVATION AND FOOD SECURITY

Panel 2.1 Planning for a sustainable future – supporting the adoption of complementary food security and conservation objectives

Keynote presentation: **Juggling biodiversity and food security – keeping all the balls in the air.** *Ms Elizabeth Fulton*, CSIRO Oceans and Atmosphere, University of Tasmania, Australia

Global change, particularly expanding population numbers and increasing footprints on all Earth's ecosystems means that buffers surrounding food provision capacity and biodiversity are both dwindling. Historically, food provisioning and biodiversity conservation have been the focus of different groups, sometimes with conflicting objectives. It is now well appreciated that in aquatic systems they are closely tied and for healthy and sustainable futures neither can be neglected. While ecosystem approaches have been discussed and, in some places, attempted much still needs to be done to operationalise and jointly service both biodiversity and food security. The path is made more challenging by two facts. The first is that there will be no single solution, different ecosystems and different nations (with their own desired biodiversity and food security outcomes) will have different options and solutions available. The second is that we are in a period of transition, new data collection technologies, new analytical methods and new management perspectives are beginning to revolutionise approaches to supporting sustainable fisheries, aquaculture and conservation. This is broadening the options for many systems. However, the technologies are not yet mature – eDNA, close kin population estimates, autonomous (and opportunistic) sampling, and blockchain, for example, are all tangible technologies. Similarly, near-real-time and multi-decadal forecast capacity is beginning to extend from environmental variables more directly into natural resources and fish communities (still with substantial uncertainties attached).

The accelerating capacity of artificial intelligence and machine learning (and associated computational and statistical fields) is only beginning to be realised. The capacity of these technologies and forecast tools to deliver at the scales required is still firming up and has some way to go. Moreover, there are currently different national and regional capacities to leverage these technologies, narrowing the options available in some locations. This is being mitigated to some degree by efforts, happening in parallel, to define and test empirical ecosystem thresholds and indicators of structure and function.

Pragmatic and tractable approaches to taking currently available data and shaping up useful ecosystem-based approaches to fisheries management are also beginning to be realised, though the number of implementations is still small. The newness of all of these options means their exact forms and the full list of their associated strengths and weaknesses is not completely clear. However, this is true of all new approaches

and should not be used to defer their thoughtful use; indeed they are beginning to see use and the coming years will (a) allow for wider use as costs of implementation drop; (b) rapid learning on their most effective applications; (c) transitions from older approaches to the use of these new tools (as appropriate); and (d) the development of further tools, which leverage off the current expansion of capacity, but also developments in other fields. Altogether this means a sensible approach to navigating between what is possible now and what may be possible in the future must be negotiated if food provisioning and biodiversity conservation are both to be successfully supported in the near, medium and long term. These tools and technologies should not be considered as only being available to developed economies. Just as mobile telephone technology has allowed for communications networks to leapfrog the need for fixed infrastructure, these new technologies and approaches to assessment and management have the potential to deliver straight to these joint objectives. This is important as each nation faces its own task of defining and implementing its own acceptable combination of biodiversity and food security objectives.

The key to management in this context will be to continue to retain flexibility – to shape the overall system (the ecosystem and users dependent upon it) in the context of local needs and objectives, as well as the current potential production and stressors upon the system. This will involve recognising the ongoing need for flexibility and diversity of approaches – systems evolve, as do objectives and flexibility to modify plans as needs and tools change will be fundamental to success given current rates of change.

Panel 2.2 Making it happen – implementing joint food security and conservation objectives

Keynote presentation: **Incentives for the joint provision of biodiversity and food from the sea.** *Mr Christopher Costello*, University of California Santa Barbara's Environmental Market Solutions Lab (emLab), United States of America

Biodiversity conservation and food security are two of the most widespread objectives of ocean management, yet concerns are mounting about the ocean's current provision of these ecosystem services and its ability to provide them in the coming years. In this discussion I will provide new insights on the global distribution and overlap of these important ecosystem services, and will use these to illuminate the underlying challenges that have led biodiversity, food security, and often both, to be underprovided by existing institutions. Turning then to the question of what to do about it, I will spell out a number of incentive-based mechanisms – from purely local to global, that can align the interests of fishers, communities, regional governments and even international bodies, with the preservation of biodiversity and food security. Some of the solutions are well established in some locales and could be readily applied to other places, while others are novel and will require new research and possibly institutional design. For a non-trivial class of cases, I will conclude that biodiversity and food security already go hand-in-hand; for that important class, the focus of implementation should be on bolstering governance and institutions. Importantly, though, these objectives do not always go hand-in-hand, thus necessitating making difficult trade-offs and putting in place a set of incentives to achieve desired outcomes.

The challenges of jointly providing biodiversity and food security fundamentally arise from differences in objectives (e.g. one country favors food security, another favors biodiversity), incentives (e.g. insecure tenure may disadvantage both objectives and favour rapid and damaging extraction), timing (e.g. short-term vs. long-term views that are perpetuated by governance problems), and uncertainty (e.g. we may not know which components of biodiversity are crucial for food security). Given

these challenges, we cannot rely only on ‘centrally planned’ solutions that attempt to regulate every margin of ocean use – instead we must focus on implementing mechanisms that establish a set of incentives that will give rise to the joint provision of these goods. Effective mechanisms will align the private incentives of fishers, fishing communities and sovereign countries with the provision of global public goods now and into the future. I will discuss existing mechanisms (such as UN processes and technical transfer of information) and less-employed mechanisms (such as payments for ecosystem services and transferable conservation credits) that may be useful in a global conversation about the joint provision of biodiversity and food security.

SESSION 3. FISH IN FOOD SECURITY AND NUTRITION: FROM TIDE TO TABLE

Panel 3.1 Putting fish on the table: evidence and opportunities for improved nutrition in low resource settings

Keynote presentation: **Aquatic foods improve diets and nourish nations.**

Ms Shakuntala Thilsted, WorldFish, Malaysia

The high levels of many nutrients in fish and other aquatic foods – minerals and vitamins, essential fatty acids and animal protein, with high bioavailability – underpin the necessity of having fish on the plate of diverse, nutritious foods for improving diets. For example, fish is a rich source of vitamin B12, only found in animal-source foods, which is essential for multiple functions, e.g. growth, brain function and nervous system maintenance. Dried small fish powder provides a dense source of multiple essential nutrients for young children who eat small quantities. In addition, fish enhances the uptake of micronutrients from plant-source foods on the plate. Nutrient composition of fish species varies widely, typically with small indigenous species from capture fisheries having much greater concentrations of micronutrients than large species from aquaculture. Many small fish species are eaten whole, thus reducing loss in cleaning and as plate waste. Also, they are cooked with vegetables and spices, thus increasing dietary diversity and nutrient contribution. Using a nutrition-sensitive food systems approach, with multiple entry points for increasing the intake of diverse, nutritious and safe aquatic foods in vulnerable population groups, including pregnant and lactating women and young children – the first 1 000 days of life – will enhance the potential of the fisheries sector to improve diets and nourish nations.

Panel 3.2 Pathways for improved fish food systems: environment, policy and technology

Keynote presentation: **Turning the tide: sustainable fish food systems for food security and nutrition.** *Mr Christopher Golden*, Harvard T.H. Chan School of Public Health, United States of America

What is the current role of fish and seafood in providing important micro- and macro-nutrients for populations around the world? How will projected environmental changes, such as rise in sea temperature, affect the contribution of fish to global and regional food and nutrition security? This presentation will focus on answering these questions, as well as look at which populations are expected to be most vulnerable to changes in diet and nutrition associated with potential changes in environment and fish catch. Some have projected a decline in capture fisheries in areas with poor, vulnerable populations dependent on capture fisheries for food and nutrients. Two different intervention pathways for addressing these issues are proposed: 1) environmentally-sensitive fisheries management and marine conservation, and 2) technology improvements in aquaculture to better serve the most nutritionally vulnerable populations. The

centrepiece of these efforts is the introduction of an analytic framework for decision-makers to calculate the health and nutrition implications of various marine management strategies, using case studies from Madagascar, Bangladesh, Cambodia and Kiribati as a backdrop for estimating shifts in disease burden associated with decreased access to seafood in the diet.

SESSION 4. SECURING SUSTAINABLE LIVELIHOODS

Panel 4.1 How do we secure sustainable fisheries-based livelihoods, including their social, cultural and equity dimensions?

Keynote presentation: **Sustain or transform: towards secure and equitable livelihoods in small-scale fisheries.** *Ms Philippa Cohen*, WorldFish, Malaysia

In this session, I will discuss the livelihoods of around 100 million women and men in developing countries, and many millions more that benefit from the food and nutrition they provide. Small-scale fisheries livelihoods are depicted in a multitude of – at times starkly contrasting – ways, including the height of economic inefficiency, a poverty trap, a social security safety net, a provider of irreplaceable nutrient-rich food, and a hidden driver of local and national economies. I briefly summarize contexts where each of these narratives hold truth or contention, and discuss where there may be merit from each narrative for helping to navigate towards secure and equitable livelihoods in a changing world.

A range of policy instruments and investment strategies are in play – including the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication – that are intended to create conditions that will enable improvements within and for small-scale fisheries. Using evidence from global to local research, I present new knowledge and innovations ‘beyond techno fixes’. First, a recent global analysis illustrates the potential for making substantial gains in addressing malnutrition and livelihood security with a shift in policies towards small-scale fisheries. Second, I share a local initiative that addressed gender inequality in fisheries livelihoods and post-harvest losses using an integrated and participatory approach. These examples bring to action the principles laid out in the Guidelines, and demonstrate the expanding horizons of fisheries research, management and governance.

But what is the relevance of small-scale fisheries livelihoods and these innovations in the face of Blue Growth, ‘transformation of the food system’, finite fisheries resources, a climate-changed world and the apparent explosion of aquaculture? Amidst these transformations, are such innovations fit to address food and nutrition security, social and gender equity, and broader human well-being outcomes through small-scale fisheries livelihoods? I present a series of recommendations for management and governance to be more transformative in the way we are thinking about and planning for small-scale fisheries livelihoods, and provide a series of challenges for the research community to find a new role as these transformations are navigated.

Panel 4.2 Innovative approaches for inclusive fisheries governance coalitions, cross-sectoral collaboration and engagement with fishers and fish workers – women and men

Keynote presentation: **Sea through the eyes of fisher folk.** *Mr Mitchel Lay*, Caribbean Network of Fisher Folk Organisations and Gulf and Caribbean Fisheries Institute, Belize

‘Abstract coming – busy fishing!’

SESSION 5. THE ECONOMICS OF FISHERIES

Panel 5.1 Economics in fisheries policy

Keynote presentation: **Fisheries management at a crossroads: how economics can improve fisheries policy decisions.** *Mr Carl Christian Schmidt*, Nordic Marine Think Tank, Denmark

While fisheries economics is a several decades old science, it is still the case that in many countries throughout the world economics is disregarded, or, at best, an unknown factor in fisheries management. Meanwhile, some fisheries have incorporated economic instruments, such as market-based fisheries management models, and we have notable success stories to learn from. However, when introducing market-based economic instruments, fisheries policymakers often face perceived trade-offs between efficient fisheries and various social considerations, thus creating a discussion platform for stakeholders to enter to claim their particular understanding of the objectives of fisheries. For the fisheries policymaker this is challenging and has rendered the public policy discourse on the subject difficult. Combined with poor statistics on economic variables this situation has made fisheries management decisions opaque, and consequently fisheries have often been left economically unsustainable. Many fisheries therefore continue to be in poor economic health, fishers are being left in poverty and, equally worrying, society at large has left large amounts of potential economic benefits untouched.

To improve economic efficiency in fisheries management it is central to start by addressing “who owns the fish?”. Is it the fishers, the local communities dependent on the fisheries’ activities, or do the fisheries’ resources belong to society? And more generally, how do we ensure that the fisheries sector at large, from capture to international trade, contributes to our economic welfare?

On the route to more efficient fisheries management several challenges will arise, including do we have sufficient data on the economics of fisheries, how to improve communication within the sector and whether our governance structures are aligned with economic efficiency requirements. These are just a few areas we need to better understand before fisheries economics will be a successful science and can usefully contribute to a more sustainable fisheries economy.

Panel 5.2 The social dimension of the contribution of fisheries and aquaculture to the economy

Keynote presentation: **The social dimension of the contribution of fisheries and aquaculture to the economy.** *Ms Claudia Beltrán*, El Salvador

Human behavior has a high influence on the success or failure of fisheries sustainability. Problems such as overfishing, illegal fishing or insufficient protection of aquatic ecosystems depend fundamentally on human decisions.

Fisheries management requires an interdisciplinary and intersectoral approach to obtain better tools for decision-making processes. This concept is also included in the Ecosystem approach to fisheries (EAF). Given that fisheries sustainability face medium- and long-term issues and challenges, its road map should be based on state policies, international rules and guidelines, but with enough flexibility to adapt it and respond to the development plans formulated by each government. In any case, for its proper formulation, interdisciplinary scientific information should be used.

From the social perspective, the generation of employment throughout the entire value chain, under conditions of decent work and gender equity, can be a top goal.

For that, it is important to count on accurate and updated statistics, as well as to apply national and international instruments of social responsibility in the fisheries and aquaculture sector. In addition, women's contribution to the value chain is significant, although seldom fully recognized. Women are underrepresented in decision-making processes at governmental and private sector levels, which could mean a significant loss or underuse of women's knowledge and experiences. They have been more active in processing and marketing than in production, administration and direction.

If consumers are aware that the fisheries products they acquire encourage responsible or irresponsible capture practices, and that fisheries sustainability depends on them, they may be more interested in learning about the species, their origin and degree of threat, to put new demands on vendors in favor of sustainable development. In the same way, if merchants are aware that part of their offer does not comply with sustainability rules and buyers' demands, they will be more demanding with their suppliers about sustainability, traceability and quality. The combination of technical training and social work can be more effective than mere intervention from the technical/environmental perspective.

Fisheries sustainability is not just a matter of regulations, monitoring and surveillance, but it is also about fisherfolk's commitment and responsible behavior. Appropriate technical training (about regulations, responsible fishing and climate change), effective dialogue and awareness of fisherfolk and communities regarding their role in achieving fisheries sustainability, could be key to achieving better results in management and co-management strategies.

SESSION 6. FISHERIES MANAGEMENT IN THE FACE OF CLIMATE CHANGE

Panel 6.1 Innovative technical adaptations of management systems to climate change

Keynote presentation: **Management and policy options to reduce rather than exacerbate the fisheries impacts of climate change.** *Mr Steven Gaines*, Bren School of Environmental Science & Management, University of California, Santa Barbara, California, United States of America

Projected climate impacts on fisheries have been widely studied. The looming challenges, however, have received far more attention than the potential solutions. Clearly, the net effects of climate change on global fisheries are negative even under the most optimistic scenarios. The biggest challenge, however, is that many of the negative effects of climate change will likely be enhanced by maladaptive responses of both fishers and the institutions who manage them. We view the future effects of climate change on fisheries falling into three broad categories. First, the productivity of the ocean will change. Some locations will experience enhanced productivity, but declines in productivity from changes in temperature, pH, oxygen concentrations and other physical characteristics will more than offset any benefits. As a result, global productivity is projected to decline, and the magnitude of the declines escalates dramatically with the scope of climate change. Second, in addition to these projected changes in mean productivity, the variability in productivity among years is also projected to grow dramatically. Greater variance in interannual returns creates significant economic and food security challenges. Finally, species are on the move. The moderate projected changes in global productivity mask far more dramatic changes in different places. Some geographies will experience catastrophic declines in fisheries productivity, while others will experience dramatic growth. The geographies of winners and losers is quite predictable with dramatic fisheries losses at low latitudes and dramatic potential fisheries gains at high latitudes.

As challenging as these climate impacts are likely to be, they could each be dramatically exacerbated by maladaptive human responses. Progressive changes in species demographics from climate change can enhance species declines when management adopts policies that assume species are not changing. Second, enhanced interannual variability can have disproportionately negative effects, since the presumption of ecosystem constancy among years ignores the greater impacts of bad years relative to good years. Finally, shifting species distributions to higher latitudes is likely to invoke a wide range of maladaptive human responses. In settings where species are currently well managed otherwise, the prospect of stocks leaving the region reduces all local incentives to continue managing well. In addition, in regions where stocks are entering, the fishery is typically unregulated. Therefore, even the broad range of fisheries that are currently well managed and projected to have high productivity in the future are likely to deteriorate significantly without new innovations.

We address these challenges by asking what management and policy strategies reduce rather than exacerbate these climate impacts. In each of these categories there are significant options that would likely enhance future fisheries in the face of climate change.

Panel 6.2 Interventions to minimize impacts and maximize opportunities

Keynote presentation: **Adapting fisheries management for proactive, climate-ready dependent societies and economies.** *Ms Éva Plagányi*, CSIRO Oceans & Atmosphere, Australia

Climate change impacts on aquatic resources extend beyond fisher livelihoods through value chains to feed over a billion reliant human consumers. Yet research on adaptation strategies to reduce impacts on fishery-dependent societies or prepare for positive changes has lagged behind biophysical considerations. Although there is a long history of fishers and fishing communities adapting to environmental variability, the pace and scale of climate change means a step change in interventions is needed. There is a growing body of evidence demonstrating the inadequacy of contemporary responses to climate events, but also important lessons for reforms. The equilibrium-based underlying theory and use of static management reference points is failing. Changing baselines, assemblages and increasing variability demand a more dynamic approach to efficiently track the optimum balance between conservation and sustainable utilisation.

Dependent fishers almost universally cite the need to reduce variability as a key objective of fisheries management because of the flow-on impacts on livelihoods, logistics and economies. Adapting to increasing variability will entail responding to changes in catch composition, fishing practices and technologies, and expanding diet preferences and markets. Optimal sustainable utilisation and maximum economic returns will most likely only be possible through collaborative approaches between industry, society, government and non-government sectors that consider changes in assemblages rather than individual stocks and collectively build dynamic value chains that are resilient to climate shocks. Management strategies and governing systems that promote inclusive development are advantageous: fisherwomen can play a positive role in the food supply chain, environmental awareness, enhancing community cohesion plus injecting much-needed conflict resolution skills. Well-resourced nations or stocks with reliable monitoring systems are better placed to proactively adjust management responses or fishing location than less well-resourced nations or data-poor stocks, but the latter group typically has more flexibility to focus on assemblages rather than single stocks, and less rigid market institutions.

Successful future fisheries management will hinge on how well human activities are adaptively aligned with unprecedented changes in the future abundance, distribution and seasonality of fish and fisheries resources. Combining diverse knowledge and value-systems can be used to create possible system trajectories and adaptation options as part of planning processes to prioritise and stage actions and identify opportunities and bottlenecks. The importance of good governance and stakeholder buy-in increases further under a changing climate due to complexities such as non-stationary management rules, the need for precautionary approaches, the need for cooperative management of transboundary stocks, and more complex scientific reasoning underpinning the adjustment of human activities. To build resilience and buy-in, reforms are needed to improve stakeholder engagement or co-management. Examples of good practices include embracing multidisciplinary fisheries management groups, acknowledging indigenous customary knowledge and management practices, developing transparent adaptable harvest strategies in close consultation with stakeholders and strengthening approaches through consideration of principles of equity and inclusiveness. Bottom-up impacts of climate change on aquatic systems will reverberate from local scales through to global, underscoring the urgent need for multi-scale practical interventions to sustain not only wild stocks but also the communities, societies and economies that depend on them.

SESSION 7. FISHERIES INFORMATION SYSTEMS AND NEW TECHNOLOGIES

Panel 7.1 The fundamentals – what central set of issues need to be addressed for fisheries data/information to be a public commodity supporting the sector's needs?

Keynote presentation: **How ICTs can answer some of the big data questions about small-scale fisheries.** *Mr Serge Raemaekers, Abalobi, South Africa*

Worldwide it is recognized that small-scale fisheries, encompassing all activities along the value chain, play a critical role in food security, poverty eradication, equitable development and sustainable resource utilization. These fisheries generally require limited capital investment, use traditional fishing gear and vessels, and catch for subsistence and local markets, but increasingly global markets as well. It is estimated that nearly half of the global catch of marine resources comes from small-scale fishers and yet, unlike industrial fisheries, their economic contribution remains largely invisible and they receive limited government support through dedicated research efforts, data collection, policy development or operational subsidies. As such, most small-scale fisheries are considered to be not well managed and approaches have largely failed to control fishing effort, manage a range of conflicts, account for climate change and socio-economic needs, or to incorporate meaningful co-management structures. Investment in robust and long-term data collection systems can be seen as weak, while at the same time suggested systems are often regarded as cumbersome, not customized sufficiently, with limited capacity to keep these systems running beyond a funding cycle. It is clear that a more collaborative form of governance is required for small-scale fisheries and now, more than ever, there is a need for comprehensive, affordable, scalable, customizable and interoperable Fisheries Information Systems that support decisions in a range of aspects while engaging a multitude of stakeholders, especially small-scale fishers themselves.

Information and communication technology for fisheries (ICT4Fisheries) promotes the use of digital technology in the form of internet-based systems, mobile apps or satellite- and radio-based platforms to address social, ecological and economic challenges within fisheries. From maritime safety to accessing market opportunities, information communication technologies (ICTs) have started to

contribute to the improved well-being of fisher communities globally and have the potential to further advance the small-scale fisheries sector in particular. However, as the use of digital technology in fisheries gains traction worldwide, ensuring that ICT4Fisheries are implemented in a participatory, inclusive way that is transformative and contributes towards the implementation of the FAO Guidelines for Securing Sustainable Small-Scale Fisheries is pertinent. This becomes even more relevant in the light of emerging technologies such as artificial intelligence and distributed databases (including blockchain) or blockchain-supported financial transactions. Working in the fisheries digital space, therefore, does demand careful attention to transformative ‘touch and tech’ methodologies that enable the uptake of technology in small-scale fishing communities.

A deep reflection on the utilization of ICT4Fisheries, the key data elements embedded in these systems, their robustness for stock assessment work, or even supply chain traceability audits and automated digital payments, is needed to enable a timely shared learning experience and extract emerging lessons within a community of practice. A review is presented of recent initiatives in Southern Africa, and how the co-design of an e-logbook for small-scale fishers has catalyzed a fully traceable marketplace that has, in turn, stimulated community organization, the adoption of satellite AIS trackers, and community-level fisheries benchmarking and improvement projects. Lessons and challenges related to data quality, data ownership and data use in fisheries management are presented and related to the outcome of a recent gathering in Cape Town bringing ICT4Fisheries practitioners together from 15 different countries, working in a myriad of different fisheries.

Panel 7.2 A vision for the future – what technologies must be scaled and adopted, and what do emerging technologies need to address?

Keynote presentation: **Beyond augmented intelligence (while leaving no one behind).**
Ms Donatella Castelli, CRN-ISTI, Italy.

The talk will provide a broad look on what we can expect from information systems technology based on current trends in ICT and it will speculate on future ones. Implications for human society and insights of how these will accompany and support changes in fishery sustainability will also be discussed.

At the core of the radical change of information systems in the next 5-10 years is certainly the artificial intelligence and big data systems that these systems will embed. This intelligence will be empowered by the availability of a huge amount of heterogeneous data produced in large part by sensing technologies whose variety, distribution and purpose will be growing exponentially, from satellites, buoys, terrestrial and underwater vehicles, to those in the hands of citizens and scientists.

The massive exploitation of these data will be enabled by the radical evolution of processing technologies (e-Infrastructures, edge computing, exascale computing, quantum computing) and communication networks, including mobile networks (e.g. 5G, 6G), that coupled with new software approaches and paradigms, will enable the addressing of problems of a higher order of complexity than we can envision today.

A considerable part of the generated data will be publicly available. Uniform and transparent usage of data across domains, organizations and challenges will become the norm. This process will be facilitated by the convergence by data providers towards common standards and by intelligent IT solutions that will automatically facilitate federation and harmonization when such convergence cannot be easily achieved.

Algorithms, models and, especially, new forms of reasoning based on a variety of approaches (e.g. machine learning and deep learning) resulting from the current large investments in artificial intelligence will empower systems that will be able to learn, inform, predict and decide. Augmented intelligence will span across a large variety of functionalities, from smarter retrieval and access of multimedia information to sophisticated ‘what-if’ predictions also in contexts where not many data, skills and resources are available, to automatic discovery of phenomena and virtual reality collaboration environments powered by intelligent recommender systems.

Trust and transparency will be mandatory properties in the resulting complex scenario of connected intelligent information systems (supporting decision-makers and taking decisions by themselves). The outcomes of today’s research on FAIR data management, blockchain, traceability and artificial intelligence will provide solutions contributing to these important questions, and the research community cannot do this in isolation.

This new scenario will need clear governance and policy decisions to address ethical questions and avoid the risk of concentrating power in the hands of a few. Aspects like the data chosen for training a deep learning algorithm, the ownership of the knowledge resources empowering the augmented intelligence and the access to data and computational model chosen are key to guarantee that everyone can participate and that no one is left behind.

SESSION 8. POLICY OPPORTUNITIES FOR FISHERIES IN THE TWENTY-FIRST CENTURY

Panel 8.1 Beyond the Code of Conduct: policy opportunities for fisheries management in the twenty-first century

Keynote presentation: *Navigating new waters*. Ms Lori Ridgeway, Canada

The context for fisheries policy and management in the future will be very different than in past decades, demanding new and determined conceptual and practical leadership. It will not likely be ‘business as usual’, including control of the fisheries agenda. For example:

- Within fisheries, the Blue Growth framework expands the context for fisheries and aquaculture, and perhaps even the parameters on which even sustainability itself is measured
- The rising importance of the market and market rules as sustainability tools and arbiters of market access for fish products, and resulting livelihoods
- Integrative global goals (e.g. Sustainable Development Goals), arising from global processes, command attention and accountability
- Biodiversity conservation (terrestrial and marine), with its own global goal setting and assessment processes, has become the all-encompassing umbrella (efforts are underway to establish a legally binding regime for conservation of marine biodiversity of areas beyond national jurisdiction)
- A top priority for developed and less developed states is understanding and dealing with the impacts of climate change.

Contextual changes such as these and others mean the fisheries sector may be far less self-determining of its own fate and future than in the past, unless it becomes a committed and active partner with others at all levels. Many other intergovernmental organizations, panels, agencies and NGOs – and subsequently national governments – are developing plans and taking action to implement their legitimate mandates, which will potentially have impacts on options and ability for fisheries policymakers and

managers to set their own agendas and pursue them to successful outcomes from their perspective. There is, for example, an increased risk of conflicting goals, incompatible instruments, data gaps and use of conflicting data and information, and a clash of risk tolerances in cases of inevitable uncertainty.

It goes without saying that this will require coordination, integration and more proactive engagement with others so that fisheries remains in control of its destiny as a viable oceans sector. Are current frameworks, approaches, attitudes and especially governance up to the task? What are key needs for navigating the path forward?

Panel 8.1 Beyond the Code of Conduct: policy opportunities for fisheries management in the twenty-first century (continued)

Keynote presentation: **Fisheries sustainability leaving none behind: three key policy opportunities for the twenty-first century.** *Mr John Kurien, Azim Premji University, India*

This keynote will delve into three key policy opportunities for the twenty-first century.

Fisheries sustainability into the future cannot be ensured without giving a central role to the people involved in small-scale fisheries. They are too many and their activities are too big to ignore. However, the challenge is to highlight fresh perspectives that will give policymakers new reasons to valorise and support small-scale fisheries.

Today there is wider acceptance of an undeniable climate crisis looming large on land and at sea. However, we need to look beyond the ‘scientific facts’ of climate change. We must take into serious consideration the ‘experiential and concrete lived reality’ of fishing communities in dealing with climate events at their respective locales. At the intersection of such collaborative ventures lies a major inclusive policy opportunity for dealing with fisheries sustainability in the context of climate change.

Fish and fisheries are only a small component of the Blue Economy compared to the other realms where debates on futuristic technology, markets and profits prevail over people. However, because of far greater present and future involvement of humans in fisheries, justice and equity perspectives become central concerns. These concerns cannot be exclusively restricted to the rights of humans today. We must also give weight to the welfare of future generations in our present economic and moral decisions.

Pithy advice to policy prescribers and policy implementers, from an Indian sage of yore, provides the end note.

ANNEX D. Fisheries innovation forum and side events

FISHERIES INNOVATION FORUM

18–21 November 2019

FAO Atrium

#SustainableFisheries #FisheriesInnovation

The Fisheries innovation forum was intended to demonstrate dynamic and innovative projects and initiatives contributing to fisheries sustainability from a variety of points of view. These initiatives explored nuanced aspects of fisheries science and management and how they supported fisheries sustainability and biodiversity conservation, poverty alleviation, food security, nutrition and other aspects relevant the UN Sustainable Development Goals.

The innovation forum had on display a wide range of fisheries innovations form around the world. Ranging from ocean-sourced Blue Fashion, the use of fish skin for medical uses, algae packaging, the creation of biodegradable plastics from fish waste, blockchain technology and drones utilizing artificial intelligence, among others.

The entities in alphabetical order that had a display were: Abalobi, Adidas, Atlan Space, Barbara della Rovere, Commonwealth Fashion Council, EDF, EC-DG Mare, EuroUSC, FAO Fisheries and Aquaculture Department, Global Fish Watch, House of Gharats, ICES, Idroni, Intertek, Marinatex, MSC, NFI, Notpla, Ocean Policy Research Institute - Sasakawa Peace Foundation, Rare, Smart Fiber, Shanghai Ocean University, Veramaris, Victorian Foods, WCS and WorldFish.

There were also artwork displays from different artists that aim to promote ocean conservation through art. Fashion designer, Neishaa Gharat displayed a 'Whishing net' for visitors to express their wishes for the ocean on the display. Roman artist Publia Cruciani created an installation from beach debris called 'Ride the storm'. The award-winning photographer Carlo Gianferro exposed a photographic exhibition portraying the life and work of small-scale fishers in the Mediterranean (organized by WWF and FAO).

The Forum offered an opportunity to all visitors to gather inspiration, energy, and knowledge, and a chance to network with fellow participants directly involved and passionate about a new vision for fisheries sustainability in the twenty-first century.



SIDE EVENTS

As part of the Symposium and the innovation forum, there were a number of side events:

❖ **BLUE INNOVATION: EMERGING TECHNOLOGIES AND TRENDS IN FISHERY SUSTAINABILITY**

Organized by FAO Fisheries and Aquaculture Department
18 November 2019 / 10.30–12.00
Sheikh Zayed Centre

New areas of work, such as sustainable Blue Fashion and the medical use of fish skin examine ways to utilize all parts of the fish and promote sustainability. Moreover, these activities provide opportunities to earn additional income for fisheries communities who may face pressures to fish less, thereby requiring alternative income generating opportunities. Creating products made from recycled marine debris, such as sneakers or sunglasses produced from recycled marine plastic, or bioplastic created by fisheries byproducts, marine debris and waste are innovative solutions creating sustainable, quality products while simultaneously working to achieve cleaner beaches and healthier oceans.

Creative uses of algae – utilized in clothing, healthcare products, cosmetic products, and biodegradable water pods are creating new opportunities for young entrepreneurs committed to creating products that are gentler on our planet. In addition, cutting-edge technologies like drones and Artificial Intelligence provide new technology-driven approaches to ensure that the fish we eat is legally caught and that fishing vessels are adhering to laws and regulations.

Most of all, the conversations allowed to think strategically about how fisheries innovation can best provide opportunities to the fisheries, aquaculture and coastal communities, allowing them to benefit from fisheries innovation.

Invited speakers:

Blue fashion (ocean sourced materials: fish leather and algae)

Mr James Ambani, Founder, Victorian Foods, United Kingdom of Great Britain and Northern Ireland

Ms Barbara della Rovere, Founder, BarbaradellaRovere.com, Italy

Mr Daniel Hatton, CEO, Commonwealth Fashion Council, United Kingdom of Great Britain and Northern Ireland

Medical use of fish skin (skin regeneration for burn victims and amputees)

Dr Jeevithan Elango, Associate professor, Shanghai Ocean University, China

Dr Wenhui Wu, Professor, Shanghai Ocean University, China

Cutting edge technologies (creating bioplastics from marine debris and breaking the boundaries of aeronautics with Artificial Intelligence)

Mr Badr Idrissi, CEO, ATLAN Space, Morocco

Ms Lucy Hughes, James Dyson Award winner, University of Sussex, United Kingdom of Great Britain and Northern Ireland

❖ INNOVATIVE APPROACHES AT THE REGIONAL LEVEL AND THEIR CONTRIBUTION TO SUSTAINABLE FISHERIES AND THE CONSERVATION OF MARINE ECOSYSTEMS

Organized by the General Fisheries Commission for the Mediterranean of the FAO (GFCM)

18 November 2019 / 14.00–15.30

Sheikh Zayed Centre

The role of regional oceans governance mechanisms in promoting sustainable ecosystem-based management of marine living resources has taken a prominent role on the international stage in recent years. Although the establishment of regional fisheries management organizations (RFMOs) considerably predates the adoption of the United Nations Fish Stocks Agreement (UNFSA), momentum has gained appreciably since this ground-breaking agreement, which puts the role of RFMOs front and center. Indeed, subsequent to the adoption of the UNFSA several other policy instruments have recognized that RFMOs, as much as other regional mechanisms mandated to ensure the conservation and management of the oceans and their resources, are uniquely poised to promote cooperation and advance policy agendas. In recent years, and most notably as a result of the proclamation of the UN Decade for Ocean Science (2021–2030), RFMOs have been regarded as an essential link between scientists and policy-makers, with some recent initiatives demonstrating that RFMOs are indeed at the forefront of strengthening this science-policy nexus. In this light, building upon the success of its first Forum on Fisheries Science in the Mediterranean and the Black Sea (“Fish Forum”; 10–14 December 2018, FAO headquarters, Rome, Italy), the GFCM is keen to continue bridging gaps between science and policy. It is in this spirit that the GFCM organized a side event to shed light on the vanguard of regional fisheries innovations and to discuss opportunities for further promoting linkages between regional actions and global policies for the sustainability of marine resources. In particular, regional innovations in relation to the following three themes were explored:

- Scientific research towards better fisheries management at the regional level
- Modular monitoring, control and surveillance to fight IUU fishing
- Regional insights towards addressing environmental issues

Invited speakers:

Dr David Agnew, Executive Secretary, Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), Australia

Dr Alejandro Anganuzzi, Global Coordinator, Common Oceans Areas Beyond National Jurisdiction (ABNJ) Tuna Project, FAO, Italy

Dr Miguel Bernal, Fisheries Resources Officer, General Fisheries Commission for the Mediterranean (GFCM), Italy

Dr Natalie Degger, Deputy Project Manager and Training specialist, International Waters Learning Exchange and Resource Network (IW:LEARN), Global Environment Facility (GEF), France

Dr Beth Fulton, Research Group Leader, Commonwealth Scientific and Industrial Research Organization (CSIRO), Australia

Mr Spyros Kouvelis, Moderator, Founder and Programme Director of the Centre for SDGs Governance and Public Law, in a joint initiative of the Cambridge Institute for Sustainability Leadership (CISL) and the European Public Law Organization (EPLO), Greece

Mr David Kroodsmma, Director of Research and Innovation, Global Fishing Watch, United Kingdom of Great Britain and Northern Ireland

Mr Mitchell Lay, Fisher and Program Coordinator, Caribbean Network of Fisher Folk Organizations (CNFO) and Gulf and Caribbean Fisheries Institute (GCFI), Belize

Dr Ana Parma, Principal Researcher, Argentinian Council for Science and Technology (CONICET), Argentina

Dr Abdellah Srouf, Executive Secretary, FAO General Fisheries Commission for the Mediterranean (GFCM), Italy

Dr Francisco Werner, Chief Science Advisor and Director of Science Programs, National Oceanic and Atmospheric Administration (NOAA), United States of America

❖ **MINDEROO FOUNDATION RECEPTION**

Organized by Minderoo Foundation
18 November 2019 / 12.15–13.15
Sheikh Zayed Centre

Minderoo Foundation organized a lunch reception to welcome recipients of the inaugural Minderoo Foundation Bursary to the UN FAO's International Symposium on Fisheries Sustainability. Minderoo Foundation shares FAO's belief that achieving healthy oceans and sustainable fisheries for people and planet requires collaboration between all countries, and supported a bursary to enable a number of additional fisheries experts from around the world to attend this year's meeting in person and share their knowledge and perspectives. The reception was opened by Dr Vera Agostini, Deputy Director of the FAO Fisheries and Aquaculture Department, who welcomed the bursary recipient to FAO and provided an overview of the Symposium and its objectives. There were a series of short presentations from Minderoo and invited fisheries experts on initiatives and challenges for sustainable fisheries, after which attendees were invited to continue the discussion over a buffet lunch. The welcome reception was an opportunity to meet colleagues working on the front line of fisheries in countries as diverse as Bangladesh, Brazil, Egypt, Indonesia and Kenya and to get a firsthand introduction to the goals and thinking behind the Symposium.

Invited speakers:

Dr Vera Agostini, Deputy Director, FAO Fisheries and Aquaculture Department, Italy

Ms Fiona David, Moderator, Research Chair Minderoo Foundation, Australia

Dr David Tickler, Research Lead Minderoo Foundation, Australia

Dr Asha McNeil, Research Lead Minderoo Foundation, Australia

❖ **LAUNCH OF THE BLUE PAPER 1 – THE FUTURE OF FOOD FROM THE SEA**

Organized by the High Level Panel for a Sustainable Ocean Economy
19 November 2019 / 12.30–13.15
Sheikh Zayed Centre

The High Level Panel for a Sustainable Ocean Economy has commissioned a series of "Blue Papers" to explore pressing challenges at the nexus of the ocean and the economy. These Blue Papers aim to summarise the latest science, and state-of-the-art thinking about innovative ocean solutions in technology, policy, governance, and finance realms

that can help to accelerate a move into a more sustainable and prosperous relationship with the ocean. The Blue Papers offer the robust, fact base to inform the work and the final recommendations of the High Level Panel.

The Blue Paper 1 on the future of food from the Sea considers the status and future trends of protein production through fisheries and aquaculture at regional and global scales: the opportunities of ocean-based protein in achieving SDG2 (Zero Hunger); and recommendations for how current barriers might be overcome to transition to more sustainable and abundant food production from the ocean.

The authors for this paper are: Chris Costello, Ling Cao and Stefan Gelcich, Miguel Angel Cisneros, Christopher M. Free, Elsa Galarza, Christopher D. Golden, Gaku Ishimura, Jason Maier, Ilan Macadam-Somer, Tracey Mangin, Michael C. Melnychuk, Masa Miyahara, Carryn de Moor, Roz Naylor, Linda Nøstbakken, Elena Ojea, Erin O'Reilly, Giacomo Chato Osio, Ana Parma, Fabian Pina Amargos, Andrew Plantinga, Albert Tacon, Shakuntala H.Thilsted.

Invited speakers:

Prof Peter Haugan, PhD, Programme Director, Institute of Marine Research, Norway

Dr Chris Costello, Professor, Environmental and Resource Economics, University of California Santa Barbara, United States of America

Dr Stefan Gelcich, Assistant Professor, Pontificia Universidad Catolica de Chile, Chile

Mr Árni Mathiesen, Assistant Director-General, Fisheries and Aquaculture Department, United Nations Food and Agriculture Organization (FAO), Italy

H.E. Mr Harald Tom Nesvik, Norwegian Minister of Fisheries and Seafood, Norway

❖ GLOBAL ATLAS OF AIS-BASED FISHING ACTIVITY

Organized by FAO, Fundación AZTI, Seychelles Fishing Authority and Global Fishing Watch

20 November 2019 / 12.30–13.15

Sheikh Zayed Centre

AIS (Automatic Identification System) offers the ability to create a global, high-resolution map of fishing effort. The FAO, in coordination with Fundación AZTI, Seychelles Fishing Authority and Global Fishing Watch have published the Global Atlas of AIS-based fishing activity to take advantage of this unique dataset to create a more detailed understanding of fishing effort, fill in gaps in knowledge and validate existing datasets. The Atlas describes, in detail, the strengths and limitations of measuring fishing activity from AIS in each FAO region. It compares fishing effort calculated through AIS algorithms with those of VMS and logbooks, and it offers advice over how to interpret AIS-derived fishing effort.

This side event was a presentation about the prospects of AIS and the main findings in the development of the AIS-based Atlas. The discussion focused on the extent to which these data and information could supplement other fisheries data, and the use of AIS based methods for monitoring and analysis for RFMOs, nations, researchers, and NGOs. It also discussed useful applications of effort reconstruction based on AIS and VMS data.

Invited speakers:

Prof Manuel Barange, Director, FAO Fisheries and Aquaculture Department, Italy

Dr Emmanuel Chassot, Seychelles Fishing Authority, Seychelles

Mr David Kroodsma, Global Fishing Watch, United Kingdom of Great Britain and Northern Ireland

Ms Jennifer Gee, Fishery Officer, Statistics and Information Branch, FAO, Italy

Dr Jose A. Fernandes, Fundación AZTI - AZTI Fundazioa, Spain

Mr Marc Taconet, Branch Head, Statistics and Information Branch, FAO, Italy

❖ **EDUCATING CHILDREN ON SUSTAINABLE MANAGEMENT OF OUR
MARINE RESOURCES AND OVERALL WELFARE OF THE SEA**

Organized by artist Publia Cruciani, FAO and Saint George's British International School in Rome

Day 1

Beach of Passoscuro (commune of Fiumicino).

Day 2

20 November / 10.00-14.00

Iran Room Foyer

Through an artistic lens, the workshop aimed to raise children's awareness about the importance of looking after our oceans, recycling waste and reducing plastic use, building on the overall message of sustainability. Artist Publia Cruciani explained how recovered material (otherwise seen as garbage) can be transformed into pieces of art or fun objects, or otherwise find new life.

Children worked on individual or collective projects using the materials they collected during a previous trip to the beach.

Invited speaker:

Ms Publia Cruciani, artist, Italy



ANNEX E. Agenda of the International Symposium on Fisheries Sustainability

Day 0 – Monday 18 of November	
08.00–18.00	Registration of participants
10.00–18.00	Fisheries innovation forum (Atrium)
10.00–18.00	Photo exhibition (Flag room)
10.30–12.00	Side event (Sheikh Zayed Centre): Blue Innovation – emerging technologies and trends in fishery sustainability (organized by the <i>FAO Fisheries and Aquaculture Department</i>)
12.00–14.00	Lunch break
14.00–15.30	Side event (Sheikh Zayed Centre): Innovative approaches at the regional level and their contribution to sustainable fisheries and the conservation of marine ecosystems (organized by <i>GFCM</i>)
15.30–16.00	Coffee break
16.00–18.00	Welcome – Official opening (Plenary Hall)
18.00–20.00	Welcome reception (Cafeteria 8th Floor)
Day 1 – Tuesday 19 November	
Session 1. The status of global and regional fisheries sustainability and its implications for policy and management (Plenary Hall)	
08.30–08.35	Curtain raiser video
08.35–09.35	Panel 1.1. The state of the stocks at global and regional levels – where are we and where should we be heading?
09.35–09.45	Short break
09.45–10.45	Panel 1.2. Achieving sustainable fisheries management: a developing world perspective
10.45–11.15	Coffee break (Tree of Life and Flag Room)
Session 2. Sustainable fisheries. linking biodiversity conservation and food security (Plenary Hall)	
11.15–11.20	Curtain raiser video
11.20–12.20	Panel 2.1. Planning for a sustainable future – supporting the adoption of complementary food security and conservation objectives
12.30–13.15	Side Event (Sheikh Zayed Centre): The Future of Food Production from the Ocean organized by the <i>High Level Panel for a Sustainable Ocean Economy</i>
12.20–14.00	Lunch
14.00–15.00	Panel 2.2. Making it happen – Implementing joint food security and conservation objectives
15.00–15.30	Coffee break (Tree of Life and Flag Room)
Session 3. Fish in food security and nutrition. from tide to table (Plenary Hall)	
15.30–15.35	Curtain raiser video
15.35–16.35	Panel 3.1. Putting fish on the table: evidence and opportunities for improved nutrition
16.35–16.45	Short break
16.45–17.45	Panel 3.2. Pathways for improved fish food systems: environment, policy and technology

Day 2 – Wednesday 20 November	
Session 4. Securing sustainable fisheries livelihoods (Plenary Hall)	
08.30–08.35	Curtain raiser video
08.35–09.35	Panel 4.1. How do we secure sustainable fisheries-based livelihoods, including their social, cultural and equity dimensions?
09.35–09.45	Short break
09.45–10.45	Panel 4.2. Innovative approaches for inclusive fisheries governance coalitions, cross-sectoral collaboration and engagement with fishers and fish workers – women and men
10.45–11.15	Coffee break (Tree of Life and Flag Room)
10.00–13.00	Art workshop for school children (Iran room foyer): Educating children on sustainable management of our marine resources and overall welfare of the sea (organized by FAO, Publia Cruciani and St. George's International School in Rome)
Session 5. The economics of fisheries (Plenary Hall)	
11.15–11.20	Curtain raiser video
11.20–12.20	Panel 5.1. Economics in fisheries policy
12.30–13.15	Side Event (Sheik Zayed Centre): Global Atlas of AIS-based Fishing Activity (organized by FAO, Fundación AZTI, Seychelles Fishing Authority and Global Fishing Watch)
12.20–14.00	Lunch
14.00–15.00	Panel 5.2. The social dimension of the contribution of fisheries and aquaculture to the economy
15.00–15.30	Coffee break (Tree of Life and Flag Room)
Session 6. Fisheries management in the face of a changing climate (Plenary Hall)	
15.30–15.35	Curtain raiser video
15.35–16.35	Panel 6.1. Innovative technical adaptations of management systems to climate change
16.35–16.45	Short break
16.45–17.45	Panel 6.2. Interventions to minimize impacts and maximize opportunities
Day 3 – Thursday 21 November	
Session 7. Fisheries information systems and new technologies (Plenary Hall)	
08.30–08.35	Curtain raiser video
08.35–09.35	Panel 7.1. The fundamentals – what central set of issues need to be addressed for fisheries data/information to be a public commodity supporting the sector's needs?
09.35–09.45	Short break
09.45–10.45	Panel 7.2. A vision for the future – what technologies must be scaled and adopted, and what do emerging technologies need to address?
10.45–11.15	Coffee break (Tree of Life and Flag Room)
11.00–13.30	World Fisheries Day 2019 (Sheikh Zayed Center): Social responsibility in the fisheries value chain (organized by FAO, the Holy See and ILO)
Session 8. Policy opportunities for Fisheries in the Twenty-first century (Plenary Hall)	
11.15–11.20	Curtain raiser video
11.20–12.20	Panel 8.1. Beyond the Code of Conduct: policy opportunities for fisheries management in the twenty-first century
12.20–14.00	Lunch
14.00–15.00	Panel 8.1 (cont'). Beyond the Code of Conduct: policy opportunities for fisheries management in the twenty-first century
15.00–15.30	Coffee break (Tree of Life and Flag Room)
Session 9. Summary of the sessions (Plenary Hall)	
15.30–16.00	Conclusions of sessions
16.00–16.45	Closing ceremony

ANNEX F. Contributing authors

The editors of this report Mr Manuel Barange, Ms Vera Agostini, Ms Diana Fernández de la Reguera and the following experts from FAO and external organizations around the world, have contributed to this report:

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International Symposium on Fisheries Sustainability: strengthening the science-policy nexus

FAO Headquarters

18–21 November 2019

Rome, Italy

The Symposium was held to address the need for a new vision for capture fisheries, outlining how the sector needs to transform in response to the complex and rapidly changing challenges facing society. It was structured in eight thematic sessions, in which a number of strategic questions were addressed. A total of 107 exceptionally diverse and gender balanced speakers and panelists from a wide range of regions and sectors, contributed to building this new vision through the discussions held in the different sessions.

The Symposium included an innovation forum, as well as a number of different side events, promoting sustainable fisheries and marine-derived products from different perspectives. It was an occasion to showcase best-practices and innovative blue growth approaches.

To improve the design of future events, increase participant engagement during the Symposium, and maximize outcomes, the attendees' priorities for fisheries sustainability, as well as their experiences during the symposium were assessed through a mixed-methods study. The quantitative and qualitative data of this study contributed to identifying lessons learned, and helped identify widely supported messages that could contribute to this shared vision for sustainable fisheries.

The outcomes of the Symposium include a comprehensive booklet with background information, session description and contents and main challenges addressed by each session, prepared ahead of the meeting in coordination of the Advisory board members and the session leads; a dedicated section in the 2020 *FAO State of World Fisheries and Aquaculture Report* with the main key messages of the sessions; an information paper for the 34th *FAO Committee on Fisheries* summarizing the main results of the Symposium and this document, which acts as the proceedings for the meeting.

More information also available in the Symposium webpage (<http://www.fao.org/about/meetings/sustainable-fisheries-symposium/en/>).

ISBN 978-92-5-132654-1 ISSN 2070-6103



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CA9165EN/1/05.20