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Duke UNIVERSITY

WorldFish

Illuminating Hidden Harvests

The contributions of small-scale fisheries to sustainable development

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Foreword

Several countries in the world are implementing the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines), an international policy instrument that sets out to enable states and actors alike to secure greater benefits from small-scale fisheries on a sustainable basis. The anticipated benefits include sustainable livelihoods and resource sustainability. Certainly, such endeavours require the availability of accurate data and information. Hence, it was necessary to conduct a thorough study aimed at generating and gathering this information with regard to the contributions of the small-scale fisheries subsector.

Indeed, I am glad that the effort has finally paid off. We have in place a comprehensive report entitled *Illuminating Hidden Harvests: the contributions of small-scale fisheries to sustainable development* (hereinafter referred to as IHH), a revised and expanded version of the 2012 World Bank, FAO and WorldFish publication, *Hidden Harvest: the global contribution of capture fisheries.* The IHH report has been produced jointly by FAO, Duke University and WorldFish, with contributions covering 58 countries and territories, and involving about 800 individual researchers, government officials and consultants. The report highlights key information on the role of small-scale fisheries in the areas of food security and nutrition, sustainable livelihoods, poverty eradication and healthy ecosystems. It also examines gender equality as well as the nature and scope of governance in small-scale fisheries, allowing for more effective decision-making by policymakers and empowerment of small-scale fisheries actors and their communities.

As expressed in the SSF Guidelines, small-scale fisheries are complex socioecological systems requiring holistic management approaches. Thus, at the government level, we need to begin the process of transformational change through: building on the IHH study's multidisciplinary and multisource approaches, including the use of multiple indicators; improving data collection methods by disaggregating data adapted to the multidimensional nature of small-scale fisheries; harmonizing data analysis and creating integrated information systems; and through multidisciplinary capacity building and partnerships, applying participatory and innovative approaches – including traditional, local knowledge, expert insights, and sustainable allocation of funds – to support continuous updating of the key indicators and tracking progress towards securing sustainable small-scale fisheries and achieving the SDGs.

As we continue to implement the SSF Guidelines, let us embrace the aforementioned transformational change process to enable effective, collective, inclusive and participatory governance for sustainable development of the subsector.

Emmanuel Magese Bulayi
Director of Fisheries

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Small-scale fisheries are special for many people. Foremost, of course, for the nearly 500 million people who depend, entirely or at least partially, on engagement in these fisheries for their livelihoods. This concerns not only fishery or household socioeconomics and contributions to food security and nutrition, but entire socioecological systems of aquatic resources, culture, gender, governance, and ultimately human well-being. The important global study *Illuminating Hidden Harvests: the contributions of small-scale fisheries to sustainable development* addresses these and more complex dimensions of small-scale fisheries.

The IHH study can inform the implementation of the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines) and facilitate the achievement of the Sustainable Development Goals (SDGs), thanks to the combined efforts of FAO, Duke University and WorldFish with the support of resource users, researchers and practitioners. However, the new insights into small-scale fisheries also call for further investigation. My perspective comes from nearly two decades of managing small-scale fisheries in the Caribbean followed by another two as an interdisciplinary applied researcher with an interest in small-scale fisheries globally.

Like many an excellent study, the IHH study generates new questions, hypotheses and propositions. At the heart of these is a need for better-informed decision-making on small-scale fisheries at multiple levels of governance. How do we achieve this? The IHH study is necessary, but not sufficient. More national and local actors must actively engage in the collection, analysis, interpretation and use of small-scale fisheries data and information. With monitoring, evaluation and learning, small-scale fisheries can become more adaptive and resilient. This study provides a strong foundation to be built upon regarding small-scale fisheries data, information, knowledge, trends and linkages that are meaningful to diverse audiences.

Paragraph 11.1 of the SSF Guidelines advises: "States should establish systems of collecting fisheries data, including bioecological, social, cultural and economic data relevant for decision-making on sustainable management of small-scale fisheries with a view to ensuring sustainability of ecosystems, including fish stocks, in a transparent manner." After deepening our understanding of such data, Chapter 9 of the IHH report also offers guidance on the way forward. Building upon and delving deeper into the country-level data is an obvious start for applied research. The report also demonstrates the need to understand the multidimensional and intersectoral links within and between small-scale fisheries, aiming for a truly comprehensive understanding of key aspects such as gender and governance. This knowledge can facilitate greater inclusiveness, participation and innovation in action research beyond "business as usual" for small-scale fisheries institutional learning. Applied research should also be guided accordingly.

The IHH report reminds us that active small-scale fisheries institutions and partnerships are essential for the capacity building and coproduction of knowledge that contributes to and sustains development. This is not mere theory, but real-world transdisciplinary problem-solving and creation of opportunities for millions who depend on small-scale fisheries. There will be challenges along the way forward, but this report has shown that data limitations can be creatively overcome by using a combination of diverse knowledge sources and types to illuminate the contributions of small-scale fisheries globally, as reflected by the SSF Guidelines and in support of achieving the SDGs.

Patrick McConney

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The present IHH report highlights the true nature of small-scale fisheries, which are far more than just an economic subsector, but a livelihood and cultural system that remains undervalued and neglected.

Small-scale fisheries communities and Indigenous Peoples play a major role in the food system and in other areas, such as coastal management, local economies, environmental protection, and sustainable use of marine and aquatic resources. Above all, they guarantee food security for a huge number of people. However, their role is still overlooked, and many governments fail to see the diverse benefits provided by small-scale fisheries from an economic, cultural, social or nutritional point of view. The lack of such recognition can lead to an inability to address the negative impact that certain policies, economic investments and conservation measures have on the rights of small-scale fishers, by excluding them from decision-making processes that directly affect their lives and livelihoods.

Governments must ensure equal and balanced participation in decision-making processes in all areas affecting small-scale fisheries – including policy formulation, pre- and post-harvest activities, and the management of territories and resources. Small-scale fishers themselves must be at the centre of decision-making processes related to fisheries resources. By giving these groups an active role in the decision-making and management process and by supporting capacity development for small-scale fisheries organizations, the contributions and positive impact of small-scale fisheries activities will fully emerge and be amplified.

We, the International Planning Committee for Food Sovereignty (IPC) members of the Advisory Group of the Global Strategic Framework in support of the implementation of the SSF Guidelines (SSF-GSF), welcome the efforts to value small-scale fishers and fishworkers; but much remains to be done, not only in quantitative but also qualitative terms. We strongly support the final recommendations of the IHH report, especially the call for governments and the international community to recognize the role of small-scale fisheries and the knowledge of traditional communities. In fact, traditional fishing methods and inland fishing still fall under the radar of current data collection methods, and local traditional knowledge is still belittled. Data collection and analysis mechanisms should go beyond the economic and quantitative definition of small-scale fisheries and encompass more the qualitative aspects, such as their collective knowledge, territorial cultures, and local traditions and practices. Finally, to ensure a comprehensive understanding of the social and political context in which small-scale fisheries populations struggle, it is important to ensure that the data collection process also captures the impact of certain policies and measures on the human rights of small-scale fishers and Indigenous Peoples. It must also take into account the ancestral customs and traditions of these groups as well as their struggle for the preservation, conservation and ownership of the lands and territories where they are settled, which must guarantee minimum conditions for their development and continued contribution to their food sovereignty.

We, therefore, remain available to support FAO, governments and other government institutions in improving their data collection methods, and to encourage active involvement from small-scale fishers and fishworkers in the research processes that concern them. This should not be limited to data collection activities but should also guarantee that the processes are participatory and transparent, thus ensuring that the purposes of the data collection and the final outcome are shared among the small-scale fisheries populations involved.

Advisory Group of the Global Strategic Framework in support of the implementation

of the SSF Guidelines / International Planning Committee on Food Sovereignty

Abbreviations and acronyms

ASF	animal source food
ASFIS	Aquatic Sciences and Fisheries Information System
BNP	Big Numbers Project
CAOPA	African Confederation of Artisanal Fisheries Professional Organizations
CBD	Convention on Biological Diversity
CCRF	Code of Conduct for Responsible Fisheries
CCS	country and territory case studies
CSO	civil society organization
DHA	docosahexaenoic acid
DHS	demographic and health survey
EEZ	exclusive economic zone
EPA	eicosapentaenoic acid
FCS	food consumption score
FPIC	free, prior and informed consent
GDP	gross domestic product
GT	gross tonnage
GVA	gross value added
HIES	household income and expenditure survey
hp	horsepower
ICSF	International Collective in Support of Fishworkers
IHH	Illuminating Hidden Harvests
ILO	International Labour Organization
ISCO	International Standard Classification of Occupations
ISIC	International Standard Industrial Classification of all Economic Activities

LDC	least developed country
LFS	labour force survey
LMB	Lower Mekong Basin
LME	Large marine ecosystem
LSMS-ISA	Living Standards Measurement Study – Integrated Surveys on Agriculture
MPA	marine protected area
nei	not elsewhere included
NGO	non-governmental organization
OECD	Organisation for Economic Co-operation and Development
PPP	purchasing power parity
RFMO	regional fisheries management organization
RNI	recommended nutrient intake
SAU	Sea Around Us
SDGs	Sustainable Development Goals
SES	social-ecological system
SIDS	Small Island Developing State(s)
SSF Guidelines	Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication
TAC	total allowable catch
TAG	Technical Advisory Group
TURFs	Territorial use rights in fisheries
UN	United Nations
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples
UNPFII	United Nations Permanent Forum on Indigenous Issues
VIF	variance inflation factor
WTO	World Trade Organization

Executive summary

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Introduction

Small-scale fisheries account for at least 40 percent of the global catch from capture fisheries and provide employment across the value chain for an estimated 60.2 million people, about 90 percent of the total number employed in fisheries globally. The economic value of these fisheries, however, is only a part of their importance: for example, nearly 53 million additional people were estimated to be engaged in subsistence activities in 2016. Rightly considered from a holistic and integrated perspective, small-scale fisheries define the livelihoods, nutrition and culture of a substantial and diverse segment of humankind.

This study, *Illuminating Hidden Harvests: the contributions of small-scale fisheries to sustainable development* (hereinafter Illuminating Hidden Harvests, or IHH), uncovers the contributions and impacts of small-scale fisheries through a multidisciplinary approach to data collection and analysis. The study provides information that quantifies and improves understanding of the crucial role of small-scale fisheries in the areas of food security and nutrition, sustainable livelihoods, poverty eradication and healthy ecosystems. It also examines gender equality as well as the nature and scope of governance in small-scale fisheries, and how this differs between different countries and fishery units.

The IHH study was carried out in support of the implementation of the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines), themselves developed in recognition of the plight of small-scale fishers, fishworkers and associated communities. The SSF Guidelines provide advice and direction for the enhancement of responsible and sustainable small-scale fisheries, through the development and implementation of participatory, ecosystem-friendly policies, strategies and legal frameworks.

Similarly, the Sustainable Development Goals (SDGs) present a holistic framework for work towards achieving the development objectives set out in Agenda 2030. The 17 SDGs are necessarily interconnected, in recognition of the links between poverty, inequality, climate change, environmental degradation, peace and justice. In many countries achieving the SDGs will not be feasible without ensuring a sustainable future for small-scale fisheries.

The purpose of this report, therefore, is to contribute to a more holistic understanding of what small-scale fisheries are, their importance, and why they are essential to efforts to achieve the SDGs. By using this knowledge wisely within a human rights-based approach in line with the SSF Guidelines, and by empowering small-scale fishers and fishworkers, a more inclusive, equitable, sustainable and resilient small-scale scale fisheries subsector can be achieved. Realizing this goal would benefit hundreds of thousands in fishing communities and society at large.

With this in mind, the IHH report is aimed at all those with a stake or an interest in the small-scale fisheries subsector, in particular decision-makers who are concerned with fisheries, poverty eradication, food security and nutrition, and sustainable development more generally. It is also addressed to small-scale fisheries actors themselves and those who support them.

Study design: a tapestry of approaches

The IHH study estimated a set of indicators to illuminate the contributions of inland and marine small-scale fisheries to sustainable development and the challenges faced in maintaining those contributions. The indicators focused on the environmental, economic, gender, food security and nutrition, and governance dimensions of small-scale fisheries. Data to produce the indicators were collected and collated using a tapestry of approaches and sources, including 58 country and territory case studies (CCS); an ad hoc questionnaire sent to FAO Members; and available global, regional and national datasets (e.g. FAO Food Balance Sheets, household income and expenditure surveys). In addition, a tailored methodology for data validation, analysis and extrapolation to the global level was designed and implemented. For important topics for which global, quantitative figures were not relevant or available, a series of thematic studies conducted by experts in these subjects was implemented (Figure 1).

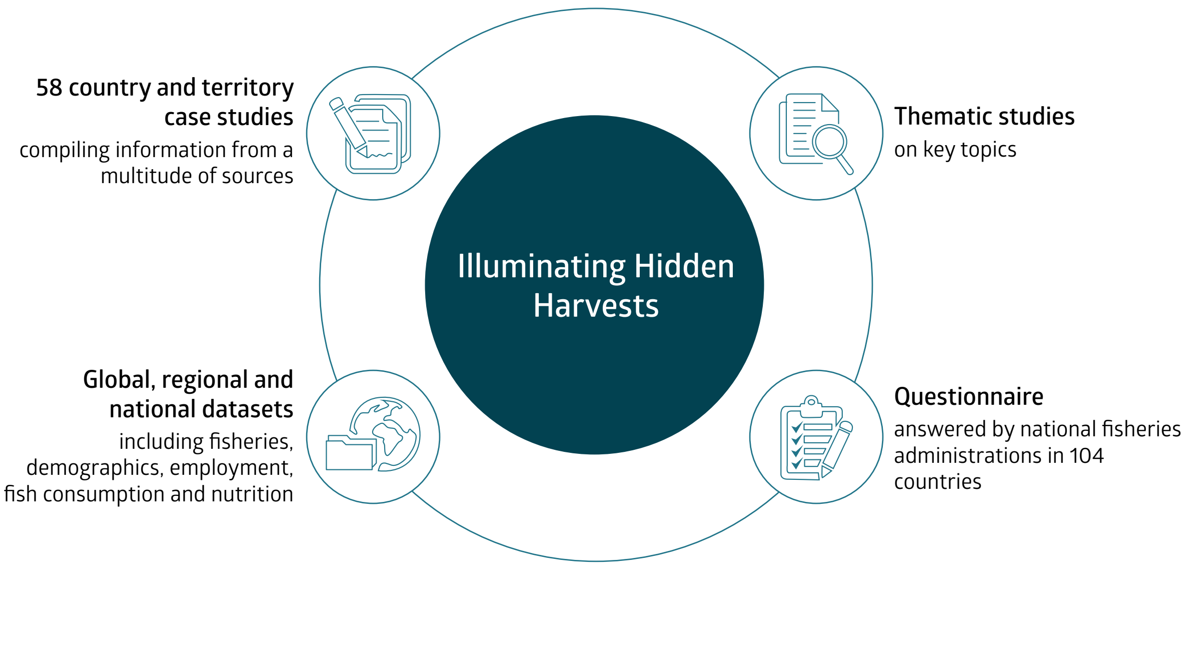
In particular, the CCS constituted the backbone of the IHH effort to build a comprehensive, multidisciplinary dataset covering small-scale fisheries across the world. CCS were conducted by national and international small-scale fisheries experts through the compilation of existing sources of data available at national level. Countries and territories included in the study were selected prioritizing those where the fisheries sector played an important role in terms of production (especially small-scale fisheries), employment and nutrition, according to existing databases.

The 58 countries and territories studied span a range of economic classifications and geographic locations, representing about 69 percent of the world's marine catch, 63 percent of inland catch, 73 percent of marine fishers, and 54 percent of inland fishers (according to FAO FishStat data, average values for 2013-2017).

A detailed methodology was designed with specific protocols and data compilation guidelines to ensure comparability across case studies and robustness of the estimates of IHH indicators. Moreover, compilation of CCS data involved a thorough quality assessment process. The IHH methodology did not prescribe a standard definition of small-scale fisheries due to the global diversity and complexity of the subsector. Instead, CCS experts provided the most common definition (e.g. legal or operational) for small-scale fisheries adopted in their country or territory.

The IHH study is the most comprehensive, systematic research effort to date to focus exclusively on small-scale fisheries. Nevertheless, it still had to contend with the intrinsic limitations in data availability and information for the subsector. As a result, for some small-scale fisheries, particularly in inland waters, data remained unavailable or hidden.

Figure 1 The tapestry of approaches used in the IHH study



Key findings of the chapters

The key findings of the report's chapters, encompassing production and environmental interactions, livelihoods and economic value, gender, governance, nutrition, and other important features and properties of small-scale fisheries, are summarized below, ending with detailed suggestions on future directions and actions. A snapshot of the key findings is presented in Figure 2.

Chapter 3. The challenge of defining small-scale fisheries: determining scale of operation by identifying general fisheries characteristics

Small-scale fisheries exhibit a range of characteristics related to their scale of operation, which itself occurs along a continuum from foot fishers to semi-industrial vessels. Although there is no generally agreed cutoff between small-scale and large-scale designations, most countries have their own operational definitions. National definitions of small-scale fisheries are typically based on a limited set of quantitative metrics, such as vessel size and power, gear type, or area of operation. Such limited quantitative characterizations may in some cases exclude legitimate small-scale fishers or enable larger-scale vessels to be included as part of the small-scale fleet. This can lead to disputes and conflict, as well as dissatisfaction and non-compliance with fisheries regulations.

At the global scale, FAO and several global and regional instruments, policies and strategies specifically address small-scale fisheries. Identifying the scale of a fishery is therefore often useful and even necessary, at both policy and operational levels.

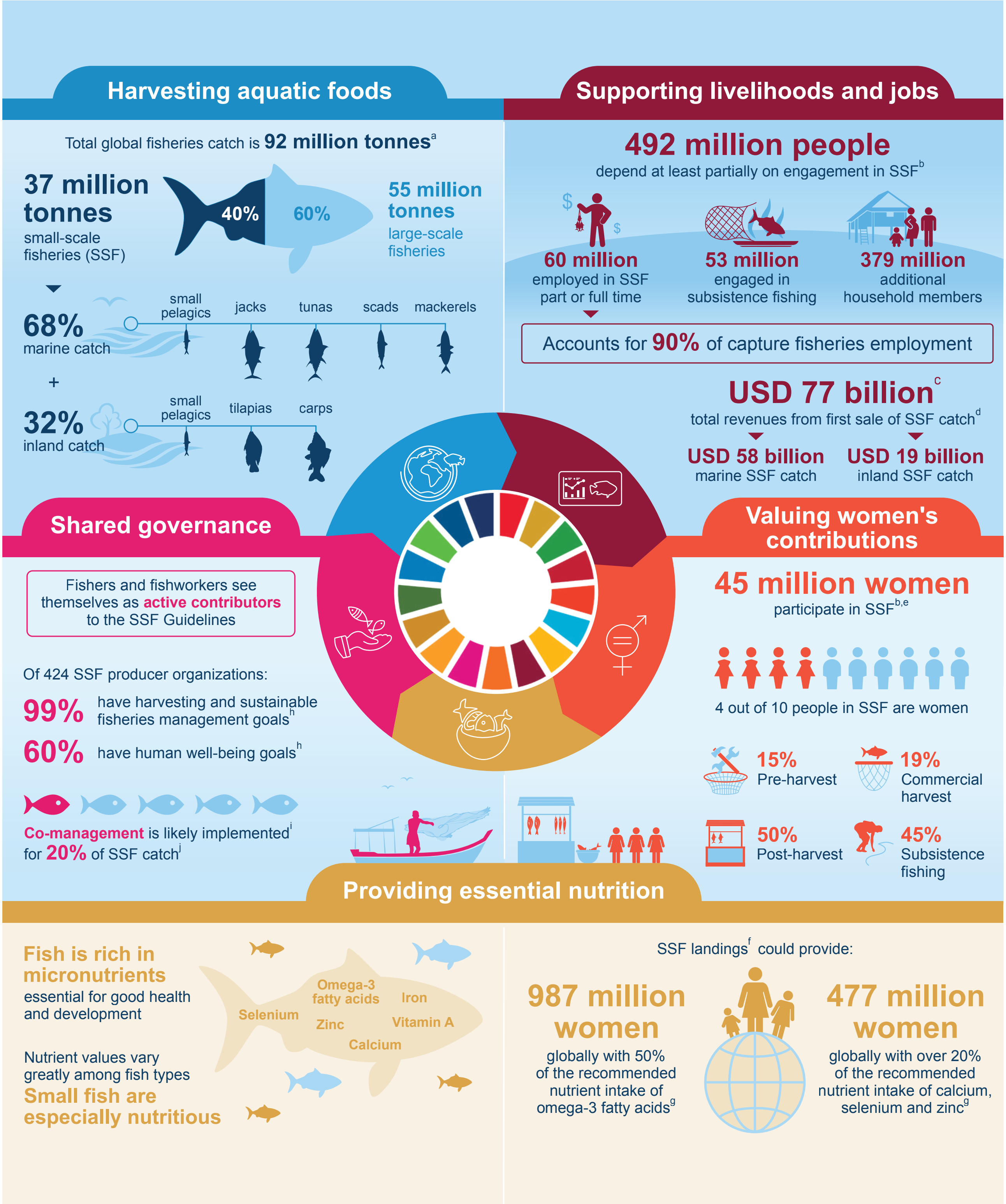
For the IHH study, a method was developed to characterize the scale of fisheries that allowed for comparison between individual CCS and across the whole IHH dataset. This involved an approach that addressed the complexity of small-scale fisheries in a systematic, objective manner, using a number of different criteria to provide a diversified description of each fishery. Building on previous related work, the study utilized a scoring matrix, or "characterization matrix", based on the type of data likely to be routinely collected for statistical or fishery management reporting purposes, but also including relevant qualitative information to enable a more holistic characterization of a fishery.

The characterization matrix consists of separate matrices for marine and inland fisheries. The unit of assessment is a "fishery unit", which, for the purposes of the IHH study, was considered to constitute a relatively homogenous type of fishing activity in terms of the characteristics relevant for grouping fisheries. The matrix applies a range of characteristics related to such fishery units (e.g. vessel and gear types, harvesting operations, degree of organization, and preservation and disposal of catch). Characteristics are separated into four types across a range of scales from small to large, and a score is provided for each depending on where it fits in this range. The aggregation of the scores from all the categories provides an overall picture that facilitates differentiation between larger-scale and smaller-scale fisheries.

Key chapter findings and messages:

- Globally and regionally, small-scale fisheries exhibit a range of characteristics that place them along a continuum with respect to their scale of operation. There are no fixed, universal boundaries that set these fisheries apart from large-scale fisheries, making it difficult for them to be identified and categorized.
- There are international and regional instruments, policies and strategies, including those of FAO, that specifically address small-scale fisheries. This infers the need for a working definition of these fisheries, particularly to ensure that fisheries management, conservation, trade and market measures support – or at least do not hinder – the social and economic development of the small-scale fisheries subsector.
- From a policy and operational perspective, the term small-scale fisheries encompasses diverse characteristics: a small-scale scale fishery in one country may be considered large-scale in another, making it difficult to standardize the application of basic quantitative metrics at the regional or global level. This diversity in how small-scale fisheries are defined has hitherto restricted the ability to objectively compare small-scale fisheries between nations or regions.
- The IHH study resolves this issue by using a matrix approach that scores fisheries with respect to the scale of their operation across multiple characteristics, to better understand the nature of the fisheries found in the 58 CCS.
- As there are no prescribed scoring cutoffs that can be used to separate small-scale fisheries from large-scale fisheries, data from the matrix do not point to a unique, universal definition of small-scale fisheries. However, the matrix provides a standardized approach that can be applied to any fishery to determine where it lies along the continuum of small-scale to large-scale fishing operations, with higher-scoring fishery units sharing many if not all of the characteristics of large-scale fisheries. Furthermore, by scoring each of the fishery characteristics using value ranges drawn from a variety of sources (e.g. from official censuses to expert elicitation), this matrix approach is also suitable for data-limited fisheries.

Figure 2 Key findings of the IHH study



Notes: **a** Average in 2013–2017 extrapolated from 58 IHH country and territory case studies. **b** Extrapolation from 78 national household-based surveys for 2016, including full- and part-time employment along the value chain (numbers rounded). **c** Extrapolated from 58 IHH country and territory case studies. **d** From first sale of SSF catch (2013–2017). **e** Supported by knowledge and insights of 28 gender advisors. **f** Landings include only fish retained by fishers for consumption, sale or trade, whereas catch includes all fish caught. **g** Based on predictive nutrient modelling by the IHH team and partners. **h** Based on global IHH survey of 717 SSF organizations. **i** Based on perceived high participation of fishers, which is used as a proxy for implementation. **j** Based on governance data on marine and inland catch for 58 countries and territories, representing about 55% of the global catch.

Chapter 4. Production and environmental interactions of small-scale fisheries

A substantial part of current and future production by capture fisheries comes from small-scale fisheries, but the full extent of this contribution is only poorly understood because the catch from these fisheries is often missed in national data collection systems – owing to the low priority commonly given to these activities, coupled with limited budgets and capacity for monitoring and reporting. The available data are therefore frequently incomplete, inadequately disaggregated or inaccessible (e.g. found only in paper format).

The inland fisheries subsector consists almost entirely of small-scale fisheries, which are often seasonal, sparse, and found in remote locations. This means that sampling and monitoring can be particularly costly and time-consuming. As a result, inland fish catches and their socioeconomic contributions are especially under-reported, often with no accurate estimates of fishing effort, all of which make the subsector particularly vulnerable to neglect. Similar problems also apply to many marine small-scale fisheries, with the challenges in both environments being greatest in smaller-scale, non-vessel-based fisheries.

A primary goal of the IHH study was therefore to develop more comprehensive and reliable global estimates of the catch of small-scale fisheries, as well as of the interactions of these fisheries with the environment. This chapter addresses the following questions:

- What are the contributions of small-scale fisheries to the global catch?
- What are the interactions of small-scale fisheries with ecosystems?
- What are the impacts of climate change on small-scale fisheries?

As described above, the global estimates of small-scale fisheries catch were based on globally representative samples (both in terms of regional coverage and of total catch volumes) obtained from the 58 CCS, extrapolated to provide global estimates. The reliability of the catch estimates from the CCS were checked through triangulation with the responses to the ad hoc questionnaire and data from the FAO FishStat global capture production database (FAO, 2020a).The information on environmental interactions and the impacts of climate change also reported here were obtained from broad reviews of the scientific literature.

Key chapter findings and messages:

Small-scale fisheries production: global figures and regional patterns

- Globally, small-scale fisheries are a significant component of capture fisheries, providing an estimated 36.9 million tonnes of catch per year, with marine small-scale fisheries catch (25.1 million tonnes) more than double that of inland small-scale fisheries (11.8 million tonnes). This corresponds to around 40 percent of total global capture fisheries production. When looking at aggregated (small-scale and large-scale fisheries together) catches, both CCS data and FAO FishStat capture production data show similar figures for inland and marine fisheries (less than 5 percent difference). However, as the FAO FishStat data are not disaggregated by scale of operation, it is not possible to determine any potential differences between the two data sources for the small-scale and large-scale fisheries subsectors.
- Asia was the region with the largest contribution of small-scale fisheries catch during 2013–2017, accounting for 64 percent (23.4 million tonnes) of the global total, while Oceania was the region with the least absolute contribution, at 0.4 million tonnes.
- The range of total small-scale fisheries catch per capita varied across regions, from 52.6 kg/person/year in Oceania, down to 3.4 kg/person/year in Europe. When looking only at the inland subsector, the catch per capita for least developed countries was significantly higher (4.5 kg/person/year) than that of other developing and developed countries or areas (1.0 and 0.4 kg/person/year, respectively).

Coverage and granularity of small-scale fisheries production

- Total catch values, and particularly those for the inland subsector, are likely underestimated mostly due to limited availability of information on unreported or unmonitored catch for the more remote, smaller-scale fisheries (e.g. foot fishers and gleaners in small freshwater bodies and freshwater, brackish and coastal wetlands). The lack of systematic collection of reliable and comprehensive catch data and ancillary information in many small-scale fisheries hinders fisheries assessment and management, as well as a proper understanding of the contribution of small-scale fisheries to sustainable development.
- Although this study was able to achieve considerable taxonomic granularity in catch species composition, a substantial proportion of small-scale fisheries catch were not recorded at the individual species level (40 percent and 62 percent of the catch data obtained from CCS for marine and inland fisheries, respectively, were not associated to individual species), thus constraining the assessment and management of these fisheries. The most common functional groups found in marine small-scale fisheries catches were herring, sardine and anchovy and miscellaneous pelagic species (20 percent and 19 percent, respectively); for inland small-scale fisheries, the most common groups were miscellaneous freshwater fish and cyprinids (63 percent and 15 percent, respectively).

Nature and scale of small-scale fisheries operations

- Harvest efficiencies (calculated as the annual total catch of a given country divided by total number of fishers and/or total kW of the motorized small-scale fisheries fleet) in both marine and inland small-scale fisheries were much higher for the motorized portion of the fleet, as expected. The harvest efficiencies (tonnes/fisher/year) of all fishery types (non-vessel, non-motorized and motorized) showed marked regional differences, being consistently higher for Europe and the Americas, with an overall maximum of 11.6 tonnes/fisher/year in the case of motorized vessels in Europe.
- Small-scale fisheries vary in their technological and operational scale and complexity, both within and between marine and inland subsectors. In fact, while fisheries operating at the lowest scale account for less than 1 percent of the total marine small-scale fisheries catch with available operational information, these fisheries represent 12.9 percent of the inland small-scale fisheries catch. Moreover, the variation in technological and operational scale of small-scale fisheries challenges the definition of a cutoff between small-scale and large-scale subsectors.

Environmental considerations of small-scale fisheries

- While there are examples where actors in small-scale fisheries attempt to minimize or mitigate fishing impacts on the environment, by virtue of the numbers of people engaged, certain interactions of these fisheries with the environment can result in effects that are detrimental to vulnerable species and critical habitats. Data collection efforts should focus on improving the understanding of the environmental impacts of small-scale fisheries on aquatic environments in order to design and implement mitigation measures, while sustaining fishery yields and livelihoods.
- Small-scale fisheries are among the most vulnerable food production systems to the impacts of climate change, as seen in case studies and anecdotal evidence from the literature. However, data and evidence on such impacts on small-scale fisheries are not systematically collected through standardized frameworks. This information is critical to develop and implement well-informed adaptive strategies to promote climate-resilient small-scale fisheries.

Chapter 5. Small-scale fisheries contributions to economic value and livelihoods

The serious economic plight of many small-scale fishers and fishing communities has been acknowledged since at least the middle of the last century. In the early 1970s, FAO wrote that "the people engaged in these activities and their families continue, with few exceptions, to live at the margin of subsistence and human dignity'' (FAO, 1974, cited in Béné, 2003).

At much the same time, while poverty was described as being a global characteristic of traditional fishing communities, it was also acknowledged that those fisheries made important contributions to national economies. This dichotomy remains and, as noted in the SSF Guidelines, "Despite their importance, many small-scale fishing communities continue to be marginalized, and their contribution to food security and nutrition, poverty eradication, equitable development and sustainable resource utilization – which benefits both them and others – is not fully realized".

For the same reasons that catch in the small-scale subsector is frequently under-reported, the contributions of small-scale fisheries to local and national economies are also often overlooked. Responding to these weaknesses, this chapter aims to improve understanding of the importance of small-scale fisheries by addressing the following questions:

- What is the scale of the economic benefits generated by small-scale fisheries?
- What is the total employment and number of livelihoods dependent on small-scale fisheries, and what is the role of these fisheries in employment at the subnational level?
- How much of small-scale fisheries catch is exported?

Data from the 58 CCS were extrapolated to derive a new global estimate of the landed economic value of small-scale fisheries production. Household-level data (referred to in the section above on study design) were used to make assessments of the contribution of small-scale fisheries to employment and livelihoods. The standardized estimates of the percentages of small-scale fisheries catches that were commercially exported were derived from the CCS data.

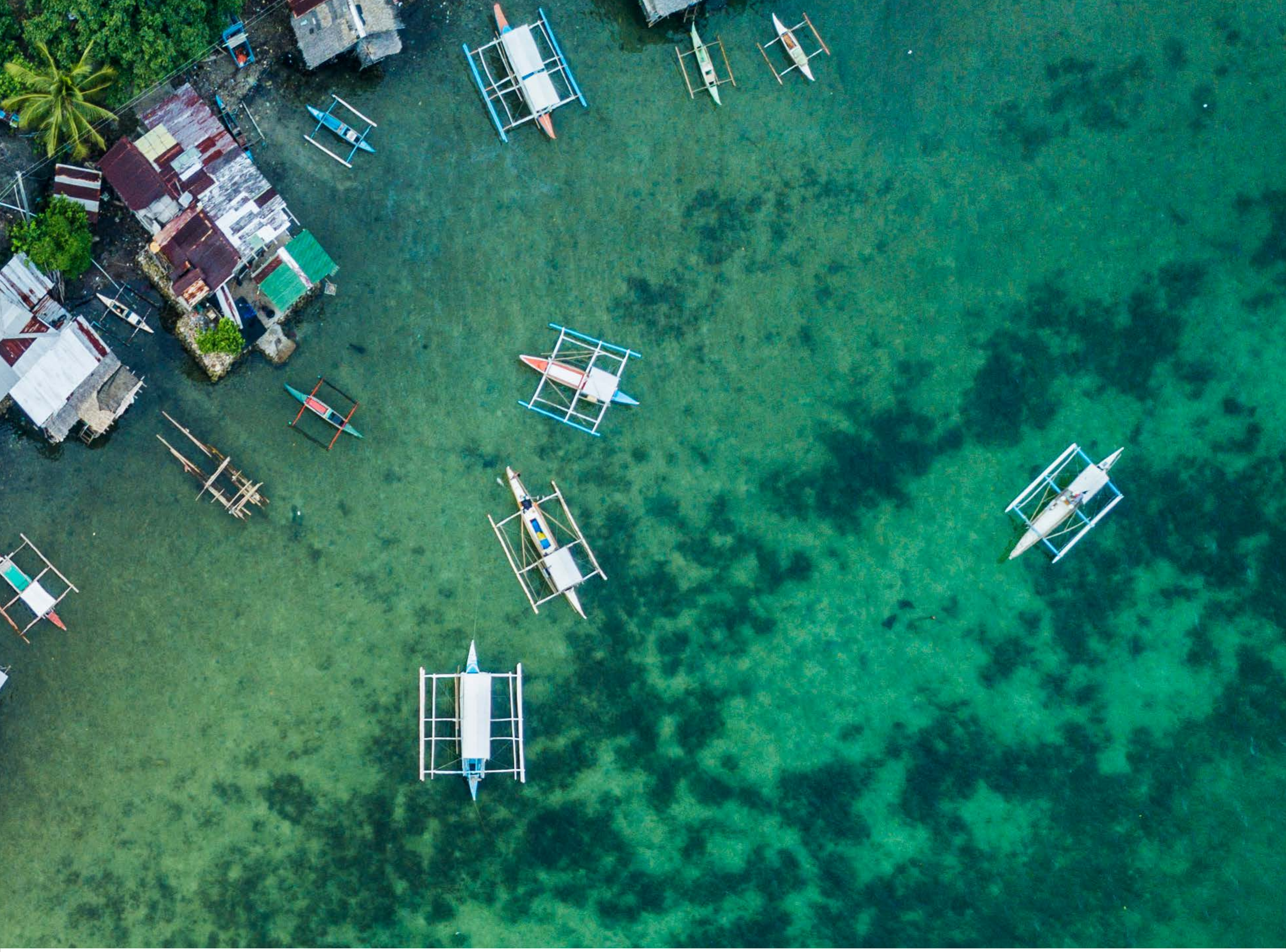
Key chapters findings and messages:

Economic value of small-scale fisheries production

- Extrapolating from 58 CCS, the average annual landed economic value of the global small-scale fisheries catch during 2013–2017 was estimated to be almost USD 77.2 billion in nominal terms, including more than USD 58.1 billion from marine small-scale fisheries and over USD 19.0 billion from inland small-scale fisheries. This estimate is approximately 49 percent higher than the figure obtained in the initial Hidden Harvest study in 2012, though different sources and methods were used.
- The estimated total revenues from the harvesting segment of small-scale fisheries are comparable to the total revenues generated by some of the largest industries in the ocean economy.
- In comparison with large-scale fisheries, for the 58 CCS (representing 68 percent of the global catch reported in FAO FishStat (FAO, 2020c), small-scale fisheries generated 44 percent of the total landed economic value of the catch. This share reflects the significant portion of catch value generated by small-scale fisheries in many countries worldwide.

Small-scale fisheries livelihoods: employment, subsistence, and additional livelihoods dependent upon fisheries

- Estimates extrapolated from 78 national household-based surveys show that 60.2 million people were employed part or full time along the small-scale fisheries value chain in 2016 (compared to 7.3 million people estimated for large-scale fisheries). This confirms that small-scale fisheries account for almost 90 percent of global fisheries employment.
- Of these, an estimated 27.5 million were employed part or full time in the harvesting segment of the value chain (14.6 million in inland and 12.9 million in marine small-scale fisheries).
- Women account for 35 percent of the total employment along the small-scale fisheries value chain (20.9 million).
- Women represent roughly one-half (49.8 percent) of the people employed part or full time in the post-harvest segment of the small-scale fisheries value chain.
- The total employment along small-scale fisheries value chains in 2016 was equivalent to 1.9 percent of the globally employed population, or 1 out of every 50 jobs worldwide, and equivalent to 6.7 percent of agricultural employment (i.e. crop, livestock, forestry and fisheries). Marine small-scale fisheries are likely the subsector with the largest employment in the ocean economy.
- Additionally, an estimated 52.8 million people were engaged in small-scale fisheries harvesting or processing for subsistence at least once a year: 36 million (68.1 percent) in inland fisheries and 16.8 million (31.9 percent) in marine fisheries. Of these, 23.8 million were women (45.2 percent).
- Together, these estimates show that 113.0 million people were either employed in small-scale fisheries along the value chain or engaged in harvesting or processing for subsistence in 2016.
- These 113.0 million people have an estimated 378.7 million additional household members. Therefore, considering all of those employed in small-scale



fisheries along the value chain, plus those engaged in subsistence activities[1] and their dependents, the number of those whose livelihoods are at least partially dependent upon small-scale fisheries is 491.7 million people.

- These 491.7 million people represent almost 6.6 percent of the world population as of 2016 and 13.2 percent of the population in the 45 least developed countries. Under the current methodology, which is based on national surveys, there are likely still more people unaccounted for who are dependent on small-scale fisheries.

Role of small-scale fisheries in exports of fish and fish products

- International trade was a significant feature of small-scale fisheries in the CCS (inclusive of informal trade), across all regions. According to estimates for 22 countries studied, representing 48 percent of global marine capture fisheries production, on average almost 26 percent of the marine small-scale fisheries catch by volume was exported during the period 2013–2017.
- According to estimates for nine countries studied, representing 25 percent of global inland capture fisheries production, on average just over 16 percent of the inland small-scale fisheries catch was exported in the period 2013–2017.

Chapter 6. Towards gender inclusivity and equality in small-scale fisheries

This chapter considers the gender aspect of small-scale fisheries, in particular the contributions from women to the subsector. Small-scale fisheries cannot be understood without considering gender, and to consider gender requires confronting the absence of women in the already limited data available for these fisheries. There is a persistent gender data gap because fisheries, as with many other sectors, are caught in a gender-blind feedback cycle that reinforces the perpetuation of sexist data (i.e. involving information that mostly concerns men). This exacerbates the marginalization of women and presents a limited view of the contributions of small-scale fisheries to economies, food security and nutrition, and sustainable development.

[1] Assuming this engagement is sufficiently frequent to provide some dependence upon fisheries for livelihoods.

The chapter aims to contribute to a better understanding of these issues by addressing the following questions:

- What are the gender-related gaps and barriers that persist in the collection and analysis of small-scale fisheries data?
- How is gender addressed in the different dimensions of small-scale fisheries?

This chapter is informed by qualitative and quantitative data from three main sources: the 58 CCS, estimates extrapolated from 78 national household based surveys and input from 28 IHH gender advisors.

Key chapter findings and messages:

- An estimated 44.7 million women worldwide participate in small-scale fisheries value chains or engage in subsistence activities, which translates into 39.6 percent of the total people active in the subsector. Women represent 15.4 percent of total employment in the pre-harvest segment of the small-scale fisheries value chain (e.g. gear fabrication and repair, bait and ice provisioning, boat-building), 18.7 percent in the harvesting segment (including vessel-based and non-vessel-based activities), 49.8 percent in the post-harvest segment (e.g. processing, transporting, trading, selling) and 45.2 percent of the total actors engaged in small-scale fisheries subsistence activities.
- Women participate in small-scale fisheries most commonly through informal and unpaid activities, limiting their social protections and security. While this participation can be partially highlighted through estimates of engagement in subsistence activities, much of it continues to be systematically excluded from official fisheries data collection and analysis, and thus women's contributions are insufficiently considered in fisheries decision-making.
- Women are over-represented in intertidal, low-gear, invertebrate fisheries due to limitations in access to gear and fishing habitats. These fisheries are less likely to be defined as fishing, and thus may not be monitored, resulting in underestimations of catch, social importance and environmental impact.
- Women in many contexts have less access to small-scale fisheries, but also stand to significantly benefit from that access, with broad societal implications for food security and nutrition and poverty alleviation.
- Women continue to be under-represented in small-scale fisheries governance systems, and those who do participate are typically only able to engage in limited ways. Barriers include gender-blind small-scale fisheries policy, and lack of capacity to implement existing policy.
- The IHH study illustrates that gender-disaggregated fisheries data are still rare, especially in official national-level fisheries statistics. Gender disaggregation should be the minimum requirement for all monitoring and research that informs fisheries policies and programmes. Gender-blind data or biased data collection methodologies overlook women in fisheries, obscuring the full contributions of small-scale fisheries towards the realization of the SDGs and towards achieving gender-inclusive fisheries policies and practices, as called for by the SSF Guidelines.

Chapter 7. Contributions of small-scale fisheries to food security and nutrition

The global and regional consequences of global food insecurity and malnutrition are profound. For example, an estimated 22 percent of children under the age of 5 were affected by stunting in 2020 and 6.7 percent from wasting, while 5.7 percent were overweight. For millions globally, including vulnerable people and those beyond the reach of formal markets, aquatic foods from small-scale fisheries represent a crucial and sometimes irreplaceable source of micronutrients and fatty acids important for growth and good health.

Achieving SDG 2 (Zero hunger) will therefore not be possible in many places without sustained or strengthened contributions from aquatic foods, for which small-scale fisheries will have to play a prominent role, as is well recognized in the SSF Guidelines. The nutritional benefits from small-scale fisheries accrue directly and indirectly. Direct nutritional benefits are realized through providing nutrient-rich food to families, while indirect benefits accrue through economic pathways, with small-scale fisheries providing livelihoods for men and women, and thus income to purchase food. A better understanding of the values and functioning of these pathways is central to developing policy actions, programmes and investments that enable a sustainable and equitable future for the small-scale fisheries subsector and the lives it supports.

This chapter focuses on the following questions:

- What is the profile of nutrients important to human health present in small-scale fisheries landings?
- How do small-scale fisheries provide physical and economic access to nutritious food for urban and rural people?
- How do small-scale fisheries contribute to the diets and healthy growth of children in the first 1 000 days of life?
- How can national information systems for fisheries be improved to reflect the nutrition contributions of small-scale fisheries?

Over the last decade, there has been an increase in quantity and quality of available data on the nutritional quality of fish. This chapter leveraged these new data and information to illuminate global, regional and national nutrition contributions from small-scale fisheries. In particular, the limited data available on the nutrient content of different fish species were used to predict the nutrient content of other species or catches using a recently developed modelling approach that links the nutrient profiles of fish to a number of their traits. Results from the CCS, catch predictions, and outputs from these models were also used to assess the nutrients available from small-scale fisheries landings. Other high-quality information from data "bright spots", notably the African Great Lakes region, was used to demonstrate policy directions that could help to optimize nutrition outcomes from small-scale fisheries.

Key chapter findings and messages:

Contributions of small-scale fisheries to nutrition

- The nutrient potential of fish is measured as the sum of the nutrients contained in the catch at the time of landing. In this study the concentrations of iron, zinc, calcium, vitamin A, selenium and omega-3 fatty acids in each functional group of fish were investigated. Understanding nutrient potential provides an important new method to assess the impacts of fisheries policy on nutrition outcomes.
- The analysis used publicly accessible databases and novel methods of predictive modelling to estimate the nutrient potential of global inland and marine fisheries catches.
- While all fish are highly nutritious, the most nutritious species from both inland and marine fisheries are small (< 25 cm body length), pelagic species. For adult women, a 100 g portion of small fish provides on average 26 percent of the recommended nutrient intake (RNI) for calcium and 72 percent of RNI for omega-3 fatty acids, while a 100 g serving of large fish on average provides 12 percent and 51 percent, respectively, for the same nutrients.
- Fish species harvested by large- and small-scale fisheries contain similar quantities of most nutrients, although the average catch from large-scale fisheries contains 25 percent more omega-3 fatty acids than that of small-scale fisheries. This may reflect the relatively high latitude and deep-water focus of large-scale fisheries, where species tend to be richer in omega-3 fatty acids.
- Finfish catches from small-scale fisheries in all regions (but less so in Europe) can play an important role in addressing known nutrient deficiencies. For example, the finfish catch from small-scale fisheries in Africa has the potential to contribute the equivalent of 20 percent of RNI of calcium, selenium, zinc and omega-3 fatty acids to over 50 percent of women (137.0 million) of reproductive age. In Asia, where calcium intakes are estimated to be well below requirements, finfish catch has the potential to contribute the equivalent of 20 percent of RNI of calcium for 25.2 percent of women (271.0 million) of reproductive age.
- CCS from Lake Victoria found that a serving of small indigenous *dagaa* (*Rastrineobola argentea*) contains six times the calcium, twice as much iron, three times more zinc, four times more vitamin A and twice the omega-3 fatty acids as an equivalent serving of the introduced Nile perch (*Lates niloticus*).
- Loss of fish quality and quantity from inadequate handling, processing and storage frequently reduces the contributions of small-scale fisheries to food security and nutrition. The introduction of appropriate food safety standards and education programmes for fishers, fishworkers and households would contribute to improved nutrition and livelihoods.

Small-scale fisheries and physical and economic access to food: new insights in sub-Saharan Africa

- An analysis of World Bank Living Standards Measurement Study data from the African Great Lakes region found that households living close to small-scale fisheries, and engaging in these fisheries, were less likely to be income-poor (down by 9–15 percent); had increased fish consumption (about twice as often per week and up to three times as much); and had higher rates of household food security (up by 12.6 percent).
- Proximity to small-scale fisheries is also associated with lower inequality in fish consumption (i.e. between wealthy and poor households), by an average of 30 percent. Dried fish is more important to the diets of rural households (by a factor of 1.3 to 1.8 compared to urban households) and those living far from fishing grounds.

Small-scale fisheries and fish consumption during the first 1 000 days of life

- The first 1 000 days of life (from conception to 2 years of age) represent a critical window of child development, when children and their mothers require a nutrient-rich diet to ensure proper growth.
- Proximity to small-scale fisheries increases access to fresh fish by a factor of up to 13 and increases dietary diversity in children. Moreover, small-scale fisheries are an important source of nutrient-rich foods for rural children from 6 to 24 months of age, especially in low- and lower-middle-income countries.

Illuminating the magnitude and distribution of nutritional benefits from small-scale fisheries

- Strategies are needed to ensure the nutritional benefits from small-scale fisheries and fish products are shared across value chains to include vulnerable groups.
- Initiatives are required to ensure that the benefits to health from fish consumption by infants, children and lactating mothers are widely known and incorporated into practice in order for the nutrition benefits from small-scale fisheries within households to be optimized.

Chapter 8. Global patterns of management and governance of small-scale fisheries: contributions towards the implementation of the SSF Guidelines

Many definitions of governance have been put forward, but the definition used for the purposes of this report can be summarized as "the formal policies in place to manage small-scale fisheries through interaction between governments and the public in particular regarding access to and use of fishing resources …". Governance has been described by the United Nations as being "perhaps the single most important factor in eradicating poverty and promoting development" (United Nations, 1998).

In essence, governance involves the means and processes by which decisions are made and put into practice. Good governance therefore requires the existence of effective and efficient institutions to facilitate those processes. The institutions may be formal, legislated entities or may be informal and based on social relationships. Critically, they should be accepted by society as being legitimate; in turn, society should be engaged in and empowered by them.

In this report, the measures of governance examined are particularly those regarding access to and use of fishing resources; the rights that have been devolved to fishers and that shape incentives for long-term use; and the local norms that give form to informal governance and processes of community development. This chapter therefore addresses the following key research questions:

- What does the policy framework governing small-scale fisheries look like, and how well aligned is it with the SSF Guidelines?
- What are the main management tools used to govern small-scale fisheries, and how much catch is governed through them?
- How is access governed in small-scale fisheries?
- What formal rights do fishers have to manage small-scale fisheries, and how much catch is governed through devolved rights to fishers?

The analyses provided in this chapter were mostly based on three independent sources of data. The first was the IHH governance dataset, which included 976 formal policies provided by the CCS authors, plus the associated catch and other metadata. A second source was data collected through the FAOLEX fisheries legislation database, which was used to verify the policy information obtained in the case studies and also provided complementary information on missing policies where required. The third source was a global database of 717 fishing civil society organizations (CSOs) compiled by Duke University using a snowball sampling approach. In addition, thematic studies on social and cultural identity in small-scale fisheries and on indigenous small-scale fisheries were undertaken by experts in these fields.

Key chapter findings and messages:

The management of small-scale fisheries and governance of tenure

- The analysis of small-scale fisheries in this chapter showed that management rights are formally granted to fishers in nearly 75 percent of countries included in the study, governing more than one-third of the marine (35 percent) and inland catch (39 percent) reported for these countries.
- Co-management policies and the amount of catch governed by them were analysed for 55 percent of the global small-scale fisheries catch. Results show that at the national level, 40 percent of the catch comes from fisheries with formal co-management provisions, but according to experts' perceptions, only half of these involve a high level of fisher participation in co-management arrangements. Co-management is more common at the local level but, nevertheless, while 90 per cent of the catch comes from fisheries with local co-management provisions that are formal, only 40 percent are perceived to involve a high level of fisher participation.
- In order to further strengthen the role of fishers in decision-making processes, more effort is needed to create local enabling conditions for them to be able to exercise their tenure rights. This can be accomplished through local supporting institutions, such as CSOs and decentralized fisheries agencies with clear roles and responsibilities.
- Combining management rights with the rights of exclusion and transferability can also increase fishers' empowerment to manage their fisheries, as long as processes and the outcomes for exclusion and transfers respect the principles of fairness and equity in line with the SSF Guidelines. This fuller form of devolved rights is currently very limited in formal small-scale fisheries laws and regulations, governing less than 5 percent of catch.
- For most fishers, there is often a lack of clear mechanisms for participation in national decision-making processes. The majority of formal small-scale fisheries policies that grant management rights to fishers only have jurisdiction in small geographic areas, not throughout the entire country. As a consequence, fishers' ability to participate in and influence national-level decision-making processes is likely to be limited. Developing national-level spaces for the participation of fishers, their organizations and their supporters could help to address current limitations.
- State policies have often failed to protect indigenous fishers' tenure rights, who have as a result experienced loss of rights to access, harvest and manage resources, thus threatening the survival of their culture and way of life. Attempts to correct colonial legacies have prompted some states to take measures distinguishing indigenous fishers from non-indigenous small-scale fisheries, and to legally recognize indigenous rights to land and water. Although six countries in the IHH dataset reported fisheries laws that acknowledge distinct rights for indigenous fishers, these laws are rarely implemented; yet their existence creates leverage for indigenous fishers.

Factors influencing governance and management effectiveness

- Social and cultural identity plays a vital role in the viability and day-to-day organization of small-scale fisheries, determining who is part of a group and who is not. This influences how management and governance is locally received, shaped or resisted, and ultimately how effective it is. Incorporating social and cultural identity into small-scale fisheries policy research requires complementing quantitative and technical research with qualitative and interpretative studies of how small-scale fisheries work in practice, as well as acknowledging fishers and fishing communities themselves for the valuable insights they can give.

Civil society organizations

- The analysis of the goals of more than 424 producer organizations shows that there is high alignment between the goals of fishers and the goals of the SSF Guidelines, indicating fishers are active contributors to SSF Guidelines implementation and not passive recipients of state action.
- The analysis also shows that most fishers' organizations see high compatibility between sustainable fisheries management and human well-being, as practically all of them expressed goals related to harvesting and sustainable fisheries management, with about 60 percent also expressing goals related to human well-being, labour rights, food security, or to human and environmental health.

Contributions to the SDGs, in particular Target 14.b

- An analysis of coastal preferential access areas for small-scale fisheries showed they are a commonly used spatial tool in all regions of the world for marine fisheries. In a sample of 52 countries, the median coverage of such areas was 3 percent of the exclusive economic zone. While coverage varies between countries, this median shows that preferential access for small-scale fisheries globally is very low. As small-scale fisheries are likely to be the largest employer in the ocean economy, greater attention to securing access to resources for small-scale fisheries through preferential access areas could also be an important mechanism towards achieving SDG 1 (No poverty).

- Licensing is the most commonly used tool in legislation for regulating access to resources for small-scale fishers. While licensing regulations govern about 70 percent of marine and inland small-scale fisheries catch, only almost 45 percent of the catch they govern is paired with devolved rights. Licensing on its own is least likely to empower fishers and fishworkers, and thus their ability to participate in decision-making processes concerning their fisheries is limited. With some less commonly used access strategies such as place of residence or history of use, tenure rights are devolved in more than 95 percent of cases, thereby making them better suited to contribute to SDG Target 14.b ("Provide access for small-scale artisanal fishers to marine resources and markets"). Yet, currently these alternative management approaches govern less than 30 percent of marine and inland small-scale fisheries catch.

Chapter 9. The way forward: turning challenges into opportunities for securing the role of small-scale fisheries in sustainable development

Small-scale fisheries have a very important role to play in fighting hunger and poverty and in sustainable development generally, a role which was recognized by the endorsement of the SSF Guidelines by members of the FAO Committee on Fisheries in 2014. The SSF Guidelines provide an agreed policy framework for realizing the potential of these fisheries and are also a tool for taking action in line with the 17 SDGs of Agenda 2030. The IHH study was undertaken in support of the implementation of these instruments and remains the most comprehensive, systematic data engagement effort to date with a global focus exclusively on small-scale fisheries. It has succeeded in generating new knowledge and information on small-scale fisheries and their contributions to sustainable development. Building on the study and its findings, efforts and actions need to be accelerated in support of small-scale fisheries to achieve the SDGs, which calls for innovative, holistic and multidisciplinary solutions underpinned by principles of fairness, equity and inclusiveness.

Each chapter of this report has included results and key messages on actions and the support needed to achieve the objectives of the SSF Guidelines and the SDGs. This final chapter highlights some of the major steps and actions proposed, as detailed below.

Further explore and build on the CCS data

The richness of information that has been collected through the CCS should be further explored to enhance knowledge and construct indicators that can help monitor the diverse small-scale fisheries dimensions, guiding policymakers in prioritizing key areas of intervention and informing those interventions. Moreover, the comprehensive set of innovative methods used by the IHH study can be replicated and built on in order to acquire enhanced knowledge in the future, at national, regional and global levels.

Reconsider how small-scale fisheries are characterized and defined

There are a number of reasons why it is important to be able to identify small-scale fisheries and distinguish them from their larger-scale neighbours (and often competitors), ranging from local management to implementation of global instruments focused on the subsector. The characterization matrix developed and applied in the IHH study provides a standardized tool that can be readily used for this purpose. Use of the tool at local, national and international levels can show where a fishery lies along the range from small- to large-scale, enabling appropriate management and policy interventions to be made with greater certainty. Scale is a determining characteristic of the subsector, but characterization and understanding must go beyond to also consider the full nature of these fisheries and the benefits they provide across the value chain – such as livelihoods and incomes, nutrition, and cultural values, among others – if those benefits are to be sustained and improved as intended in the SSF Guidelines.

Incorporate the multidimensional contributions of small-scale fisheries across polices and actions

Small-scale fisheries should be conceptualized and governed as multidimensional livelihood portfolios that provide the enabling environment for sustainable development, and not just as an economic activity. Strategies are needed to leverage the full range of benefits of small-scale fisheries and fish products across value chains, particularly for vulnerable groups, including improving intrahousehold distribution of fish. Within these strategies, policies beyond the fisheries sector, in particular with regard to food security and nutrition and local economies, should incorporate the actual and potential contributions of the small-scale fisheries subsector in their goals and actions.

Incorporate nutrition and other livelihood outcomes into management decisions and design

Ensuring that fisheries are sustainable is fundamental to ensuring the sustainability of their benefits, but management and governance need to go further:

namely, adopting policies and implementing management measures that strive towards optimizing the benefits from small-scale fisheries for fishers, fishworkers and their communities, as well as for society at large. These should include, for example, taking into account of the nutrition potential of species and optimizing the contribution of small-scale fisheries to food security and nutrition and human health; ensuring equitable access of women to resources and leadership; and respecting and protecting the sociocultural values of small-scale fishers.

Recognize the needs and benefits of effective participatory approaches, and put them into practice

The knowledge, culture, traditions and practices of small-scale fishing communities are clearly important and must be recognized and supported, including particular attention to Indigenous Peoples, by enabling them to participate effectively in decisions concerning their livelihoods. This will require greater and more equitable participation in all aspects of management of those involved in the small-scale fisheries value chain and will necessitate shifts towards greater institutional diversity, accompanied by changes in power and decision-making authority, at all levels of governance. Fishers and fishworkers in small-scale fisheries – both men and women – and their organizations should be empowered and provided with the space to co-lead in national, regional and international fisheries governance and management decision-making settings.

Improve data and information for promoting SSF Guidelines implementation

The SSF Guidelines provide a clear and comprehensive framework "to support the visibility, recognition and enhancement of the already important role of small-scale fisheries and to contribute to global and national efforts towards the eradication of hunger and poverty" (FAO, 2015, Preface), which will also enhance the contribution of these fisheries to the achievement of the SDGs. To implement the SSF Guidelines there must be continued efforts to fill the knowledge gap and improve the understanding of the nature and contributions of the small-scale fisheries subsector, which will require a substantial shift in how different information systems and sources are integrated and linked, and how small-scale fisheries and their role are defined and monitored.

Build on IHH study approaches and methods to improve data collection and analysis, moving beyond the limitations of "business as usual"

The IHH study developed approaches and collected data in support of SSF Guidelines implementation, the results of which demonstrate the need for monitoring and decision-making systems and processes at country level to be further developed or adapted if the multiple objectives for small-scale fisheries are to be effectively secured. Building on the study's findings and methods, data collection and analyses at all levels should be strengthened, including:

- disaggregating data and information on both small- and large-scale fisheries to allow for governance and management decisions that are adapted to the multidimensional characteristics of small-scale fisheries;
- applying participatory and innovative approaches, including drawing on traditional and local knowledge and expert insight;
- applying multidisciplinary and multisource approaches, encompassing all interlinked dimensions of small-scale fisheries and their contributions, and creating integrated information systems;
- making better use of surveys not specifically directed at fisheries, e.g. household-based surveys and those of the World Bank Living Standards Measurement Study, as well as integrating fisheries-specific modules with such surveys.

Collect information to help recognize the role of women and ensure their visibility and participation

Women play an important role in small-scale fisheries value chains, but their role is often not recognized, and they continue to face challenges based on gender inequality. This needs to be changed by re-evaluating how the subsector is characterized to include the entire value chain, and through concerted broad-based efforts towards gender equality. With regard to data and information, it is important to ensure that data collection activities actively seek and include meaningful gender-disaggregated information to enable decisions that, for example, provide women with equal access to resources and decision-making processes in recognition of their many contributions across the value chain.

Build capacity and partnerships

Capacity building, partnerships and joint efforts by governments, small-scale fishers, fishworkers and organizations, researchers, development agencies and other stakeholders will be required to secure sustainable small-scale fisheries. This includes strengthening the coproduction of knowledge to fully uncover the hidden contributions of small-scale fisheries and to unleash their potential for supporting SSF Guidelines implementation and the achievement of the SDGs.

Taken as a whole, the information obtained from the IHH study and distilled in this report reinforces the reality that small-scale fisheries are much more than just a subsector of the economy: they are the foundation of the livelihoods and culture of an extensive and diverse component of humanity. It is hoped that this study will stimulate and facilitate support and action to move forward in implementation of the SSF Guidelines and related SDGs with increased and renewed commitments and efforts.

1.

Introduction

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1.1 Rationale and context

From roadside drainage channels in South-eastern Asia, to the mega deltas of Africa, South America and Southern Asia, the world's large river and lake systems and the nearshore waters of oceans and seas, diverse fishing and aquatic food-gathering activities provide livelihoods for millions, essential nutrition to billions and contribute substantially to household, local and national economies. Coastal and inland shorelines are the homes to small-scale fishers, fish workers and their communities, and a critical hub for a flow of benefits from aquatic ecosystems to broader populations near and far.

Small-scale fisheries are more than just a subsector of the economy; they define the livelihoods and culture of a substantial and diverse segment of humankind. Inland and marine small-scale fisheries in developing countries employ the vast majority of women and men working in fisheries food systems around the world, spanning activities from pre-harvesting to consumption. These fisheries are frequently complex, intersecting with other sectors such as agriculture and forestry, and with an inherent ability to adapt. Often small-scale fishers and fishworkers, both women and men, have a multigenerational history that is deeply embedded in the subsector. For them, fishing is more than just a job: it is a way of life, shaping their identity and sense of place in the coastal and inland areas they inhabit. Their embedded knowledge about the environment is vital for the development of sustainable governance, making them indispensable to the proper stewardship and management of their local natural resources and ecosystems. The dynamism, agility and multidimensionality of small-scale fisheries uniquely situates them for working towards sustainable development.

The global community has set ambitious development objectives in Agenda 2030[1] and is making laudable national and collective efforts to reach them. At the same time, progress has been slower than planned. Moreover, many obstacles to fighting poverty and meeting food and nutritional needs are set to be amplified by the diverse pressures increasingly weighing upon food systems and the environment. The challenges implicit in finding a sustainable future for humanity – with global population set to swell by 2 billion over the next 30 years (UN, 2019), compounded by the impacts of climate change – frame the scale and complexity of the task ahead. The effects of inaction would be felt disproportionately in developing countries where hunger and poverty are prevalent and persistent. The COVID-19 pandemic has dramatically highlighted the vulnerability of food systems and created unprecedented economic, social, governance and health crises, with particularly severe impacts on marginalized populations.

[1] See: https://sdgs.un.org/goals

The Sustainable Development Goals (SDGs) provide a holistic, agreed framework for addressing these global challenges. The 17 goals are interconnected, recognizing the links between poverty, inequality, climate change, environmental degradation, peace and justice. The SDGs encapsulate shared human values for a fairer, more prosperous, peaceful and sustainable world in which no one is left behind. In many countries, achieving the SDGs will not be feasible without securing a sustainable future for small-scale fisheries. Small-scale fisheries are directly addressed in SDG Target 14.b ("Provide access for small-scale artisanal fishers to marine resources and markets"), but their benefits – food, nutrition, income, and environmental stewardship – represent foundations for many of the SDGs, including for example other targets under SDG 1 (No poverty), SDG 2 (Zero hunger), SDG 5 (Gender equality), SDG 8 (Decent work and economic growth), SDG 10 (Reduced inequalities), SDG 12 (Responsible consumption and production), SDG 13 (Climate action), SDG 14 (Life below water) and SDG 16 (Peace, justice and strong institutions).

In many contexts, working with small-scale fishers and fishworkers is a critical pathway for progress in achieving the SDGs. The Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines; FAO, 2015) build momentum for this, and can also guide the process. The SSF Guidelines are unique in that they are the first international instrument entirely dedicated to small-scale fisheries, reflecting the views of the thousands of small-scale fishers, fishworkers and other stakeholders who contributed to their design (Box 1.1). The Guidelines provide guidance for the development and implementation of participatory, human rights-based and ecosystem-friendly policies, strategies and legal frameworks for the enhancement of responsible and sustainable small-scale fisheries.

Aquatic ecosystems are increasingly coming into focus as critical for the future of food security and human prosperity, particularly among marginalized coastal and inland inhabitants. This has been illustrated in recent initiatives and studies, such as the UN Nutrition discussion paper on the role of aquatic foods in sustainable healthy diets (UN Nutrition, 2021), the Committee on World Food Security (CFS) High Level Panel of Experts report on sustainable fisheries and aquaculture for food security and nutrition (HLPE, 2014), and the Blue Food Assessment (Blue Food Assessment, 2021a). However, the narrative for these ecosystems is complicated, highlighting their current and future importance while at the same asserting their overuse and vulnerability. This complexity points to the fact that building a productive, sustainable and equitable future for aquatic ecosystems and those who depend on them must be shaped by intimate knowledge of how they function and persist, and the processes by which their benefits are acquired and distributed throughout societies.

Given the important role that small-scale fisheries play in aquatic ecosystems as well as related food systems, political will is needed from governments, small-scale fisheries organizations and their development partners, as well as buy-in from other stakeholders. A key to building the case for this support, and assisting in its implementation, is to provide evidence of how small-scale fisheries contribute to societal goals in a way that can be understood by politicians and policymakers and used by small-scale fisheries actors to advocate for much-needed investment in their subsector.

However, data and information on small-scale fisheries are limited and fragmented, so building a picture of this subsector at national or global scales is challenging. Often, the limited nature of government resources leads to a lack of prioritization of small-scale fisheries monitoring and analysis and, as a result, data on large-scale and small-scale fisheries are not disaggregated. The assumption that management can be adequately optimized by studying catch and

BOX 1.1

The Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines)

The SSF Guidelines were developed through a participatory process involving representatives of some 4 000 small-scale fisheries and other stakeholders from over 120 countries. This process afforded these actors the opportunity to share their views and give input on the content of the instrument. The text was reviewed and negotiated by FAO Members before being endorsed by the Thirty-first Session of the Committee on Fisheries in June 2014. The SSF Guidelines thus represent a global consensus on principles and guidance for small-scale fisheries governance and development. They promote a human rights-based approach that encourages governments, fishing communities and others involved in the subsector to work together to secure sustainable small-scale fisheries for the mutual benefit of all.

fishing effort, and that other dimensions of small-scale fisheries are less important, usually underpins data collection programmes of fisheries management agencies and research institutions. The issue is further compounded by a long-standing focus on natural science and on stock assessment approaches to fisheries management. As strongly reflected in the SSF Guidelines, successful governance and management in small-scale fisheries requires attention to a combination of social, cultural, economic and biological aspects. An overall lack of multidisciplinary expertise in fisheries departments (e.g. anthropologists, gender experts, socioeconomists, governance analysts, and food and nutrition experts, in addition to biologists and other natural scientists) makes this a challenge, as well as the fact that some of the most useful data in the context of small-scale fisheries, such as on health, demographics and household expenditures, are housed in other agencies (e.g. ministry of health, central statistics agencies) where, due to weak interinstitutional linkages, they are rarely analysed for fishery outcomes.

Given these challenges, the study *Illuminating Hidden Harvests: the contributions of small-scale fisheries to sustainable development* (hereinafter Illuminating Hidden Harvests, or IHH) set out to find the contributions – positive and negative – that would be elucidated if a multidisciplinary approach to small-scale fisheries data and analysis were adopted, as encouraged in paragraphs 11.1 and 11.9 of the SSF Guidelines (see Box 1.2). As the most comprehensive, systematic global data compilation effort to date with a focus exclusively on small-scale fisheries, the IHH initiative worked with national teams across 58 globally distributed country and territory case studies (CCS) to access and synthesize knowledge and data. The study used predominantly secondary data sources to create previously unavailable syntheses and analyses, with unprecedented resolution across a broad set of geographies. New knowledge is now available on species targeted; the diversity of fleets in terms of their operational, economic and technological characteristics; governance mechanisms; devolution of rights; gender dimensions; and relationships to nutrition and other livelihood-related issues. This information provides a new, unique basis for developing appropriate policies at national, regional and global levels, as well as a platform for future research that highlights the role of small-scale fisheries in sustainable development.

In particular, the IHH study focused on illuminating the multiple, often hidden dimensions of the development contributions of small-scale fisheries. Research was conducted directly with CCS teams on data collection and knowledge synthesis, with a focus on utilizing and building in-country capacity and creating momentum for new conversations focused on improved information gathering and analysis. However, insufficient national investments in data, information collection and curation for small-scale fisheries over the long term clearly emerged. While important information on the development contributions of small-scale fisheries was uncovered, CCS teams often struggled to access data beyond that for valuable and higher-profile fisheries included in national data systems. As a result, in particular data on small-scale fisheries catch proportions were unavailable, or remained hidden from view. Thus, extrapolations were used to arrive at a global aggregate value, but it is recognized that further efforts are needed to fully determine the total small-scale fisheries catch. In order to better understand

Box 1.2

SSF Guidelines paragraphs 11.1 and 11.9

11.1 States should establish systems of collecting fisheries data, including bioecological, social, cultural, and economic data relevant for decision-making on sustainable management of small-scale fisheries with a view to ensuring sustainability of ecosystems, including fish stocks, in a transparent manner. Efforts should be made to also produce gender-disaggregated data in official statistics, as well as data allowing for an improved understanding and visibility of the importance of small-scale fisheries and its different components, including socioeconomic aspects.

11.9 States and other parties should, to the extent possible, ensure that funds are available for small-scale fisheries research, and collaborative and participatory data collection, analyses and research should be encouraged. States and other parties should endeavour to integrate this research knowledge into their decision-making processes. Research organizations and institutions should support capacity development to allow small-scale fishing communities to participate in research and in the utilization of research findings. Research priorities should be agreed upon through a consultative process focusing on the role of small-scale fisheries in sustainable resource utilization, food security and nutrition, poverty eradication, and equitable development, also including DRM and CCA considerations.

this data-limited production system, more efforts and resources are needed to continue engaging with key actors at the country level, building on those represented in the study, to co-develop and promote cost-effective small-scale fisheries data collection and analysis programmes.

In light of the new knowledge on the multiple dimensions of small-scale fisheries, this IHH report is aimed at all those with an interest in the subsector, in particular policymakers who are concerned with fisheries, poverty eradication, food security and nutrition, and sustainable development more generally. The report is also addressed to those who advocate for small-scale fisheries and work in or with the subsector. Its purpose is to improve the understanding of what small-scale fisheries are, why they are important, and how they should be supported as part of efforts to achieve the SDGs. It contributes to improving the knowledge of the subsector, the people it represents, their livelihoods and how they interact with their environment and food systems. By using this knowledge wisely within a human rights-based approach in line with the SSF Guidelines, and by empowering small-scale fishers and fishworkers, a more inclusive, equitable, sustainable and resilient small-scale scale fisheries subsector can be achieved. This can serve as an inspiring example for a prosperous future for people and livelihoods, based on a healthy relationship with the world's aquatic resources and the services they provide.

1.2 Structure of this report

This report is divided into nine chapters. After this introductory chapter, a description of the methodological approach taken by the IHH study follows in **Chapter 2**. **Chapter 3** looks at the characteristics used to determine scale of operation for the wide variety of small-scale fisheries found around the world. The subsequent chapters, detailed below, report on the outcomes of the study's investigation into five key dimensions of small-scale fisheries: environmental, economic, gender, food security and nutrition, and governance.

Chapter 4 – "Production and environmental interactions of small-scale fisheries" – begins with an overview of the approach used to solve challenges associated with small-scale fisheries data access, followed by a detailed account of small-scale fisheries catch as well as a characterization of their operations. The chapter also includes a literature review of the interactions of small-scale fisheries with the environment and the impacts of climate change on small-scale fisheries.

Chapter 5 – "Small-scale fisheries contributions to economic value and livelihoods" – first reviews previous estimates of the contributions of small-scale fisheries to economic value and livelihoods, before synthesizing information on these fisheries' economic benefits in terms of landed economic value. The chapter provides an estimate of participation and livelihood dependency in small-scale fisheries, including both employment and subsistence activities. There is also information on the role of small-scale fisheries in exports of fish and fish products.

Chapter 6 – "Towards gender inclusivity and equality in small-scale fisheries" – discusses women's contributions and gender equality within small-scale fisheries, noting that proper consideration of gender in the subsector requires confronting the persistent absence of women in the already limited data available on small-scale fisheries.

Chapter 7 – "Contributions of small-scale fisheries to food security and nutrition" – provides the first global-scale analysis of the nutrient contributions of small-scale fisheries to diets, with evidence of the importance of fish in the first 1 000 days of life. The chapter explores the nexus between small-scale fisheries livelihoods, poverty, and food security and nutrition, and also briefly considers the issue of food safety.

Chapter 8 – "Global patterns of management and governance of small-scale fisheries: contributions towards the implementation of the SSF Guidelines" – begins with a review of small-scale fisheries policy frameworks. It then presents findings regarding small-scale fisheries governance and management and progress towards SDG Target 14.b, with a focus on devolution of management rights. The chapter also looks at these aspects in the context of indigenous small-scale fisheries, and discusses the importance of cultural and social identity to management and governance.

The report concludes with **Chapter 9** - "The way forward: turning challenges into opportunities for securing the role of small-scale fisheries in sustainable development". This final chapter builds on the previous chapters and on cross-cutting issues in relation to data, analysis, capacity development and the importance of the SSF Guidelines as a policy framework, summarizing the findings and presenting some suggestions on policy directions.

The Annexes detail the study methodology and provide a comparison of the IHH estimates of economic and livelihood contributions with other available data sources.

Required citation for this chapter:

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2.

Illuminating Hidden Harvests (IHH) study approach

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2.1 Design

The Illuminating Hidden Harvests (IHH) initiative was created to improve understanding of the contributions of small-scale fisheries to sustainable development. As a first step, an inception workshop was convened to review the results and impact of the original 2012 Hidden Harvest study (World Bank, 2012) in June 2017, hosted by FAO in Rome, Italy. This gathered about 40 external experts from the fields of social sciences, fisheries, nutrition and sustainable development from around the world, together with relevant FAO staff from the Fisheries and Aquaculture Division, Statistics Division and Food and Nutrition Division.

2.2 Selection of indicators

One of the outputs of the inception workshop was a refined "wish list" of indicators and available datasets on potentially relevant contributions of small-scale fisheries to sustainable development – and the challenges faced in maintaining those contributions. The wish list focused on the three dimensions of sustainable development (social, economic and environmental), while also including food security and nutrition and governance issues around small-scale fisheries.

The indicators were assessed according to data availability and feasibility of operationalization through a systematic scientific literature review (covering the period 2012–2017), scrutiny of relevant technical reports, ad hoc searches and expert queries (FAO, 2017a). The indicators were associated with three types of data: global or regional (e.g. FAO Fisheries and Aquaculture databases), subregional (e.g. national fisheries accounting datasets, household income and expenditure surveys, labour force surveys), and local or context-specific (e.g. local case studies). To best access the richness found in these available data, a tailored methodology for data collection, validation and analysis (hereafter "IHH methodology") was designed and implemented as a foundation for the IHH report (Figure 2.1).

The final list of indicators to be measured was decided during a second expert workshop that took place in May 2018 at the University of Washington with 12 experts from multiple disciplines specializing in small-scale fisheries from around the world. This process solidified the emerging research strategy for the IHH study and helped identify and prioritize resources, methodologies and approaches for data collection efforts on each indicator, as well as criteria for selecting countries for data collection. Table 2.1 provides the final list of the indicators (and their definitions) included in the study for marine and inland small-scale fisheries.[2]

Environmental, economic, social, nutrition and governance experts within the IHH team were identified and organized into thematic clusters to develop and implement tailored methodologies for data collection and analyses around each dimension of sustainable development. Experts in each thematic cluster provided input for data collection on their respective indicators according to their data needs, as well as feedback throughout the data collection process. Gender was considered a cross-cutting theme. Therefore, gender experts provided feedback to all clusters to ensure the data collection process considered a gender perspective, including collecting available gender-disaggregated data and identifying gender data gaps.

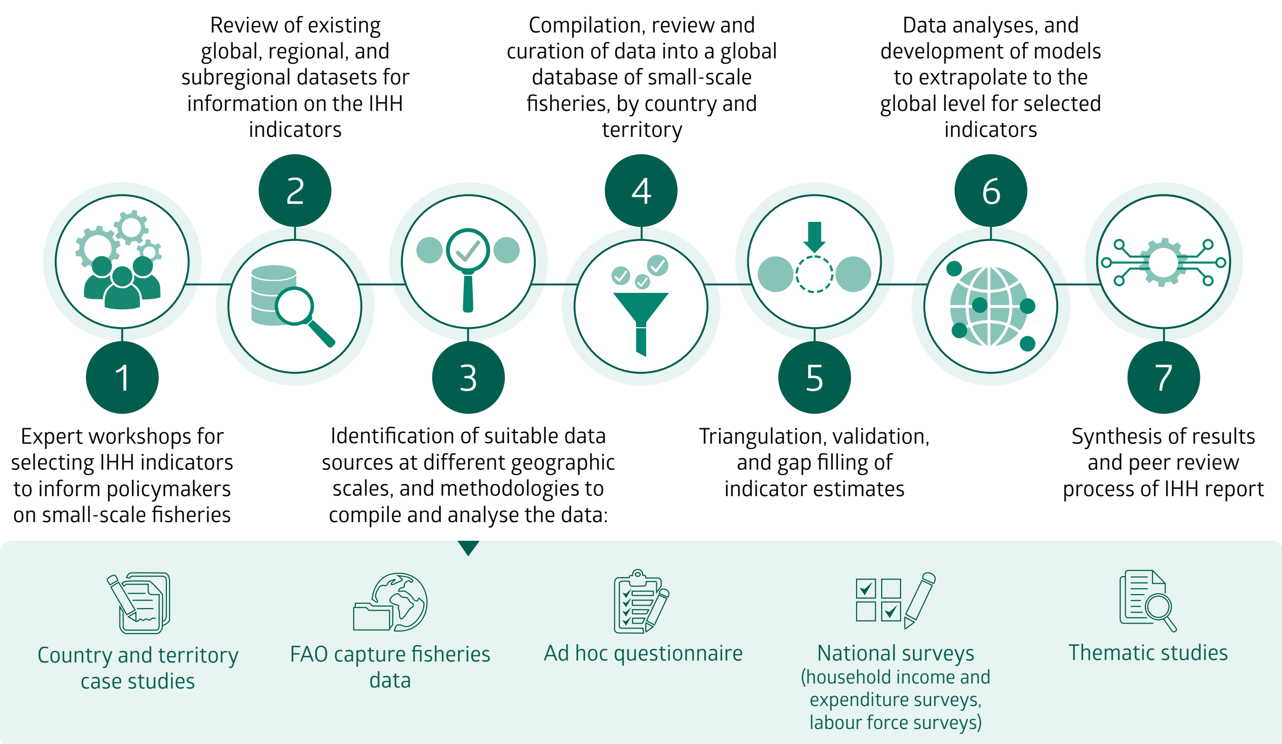
2.3 Data collection

2.3.1 Country and territory case studies

The inception workshop recognized that comprehensive datasets covering global small-scale fisheries holistically as socioecological systems would not be available for all countries across the world. This situation often occurs because small-scale fisheries data and information are overlooked or given low priority for collection in many national fishery information systems (see Chapter 1, Section 1.1). The inception workshop concluded that a lot of information did exist, but was fragmented; therefore an approach was adopted to gather this information in a manner that would enable linking the different dimensions to provide an interconnected and multidimensional perspective. The approach involved using country and territory case studies (CCS) to collect and collate the information and data available at national level for the estimation of key indicators, disaggregated by marine and inland small-scale fisheries. The CCS were conducted by national and international small-scale fisheries experts through the compilation of existing sources of data, with a few exceptions where primary data collection was deemed essential.

Resources for the CCS were allocated prioritizing those countries and territories where the fisheries sector played an important role in terms of production (especially small-scale fisheries), employment and nutrition, according to existing databases including FAO data, the Sea Around Us database (Zeller and Pauly, 2016) and the Global Marine Catch database (Watson, 2017). The particular criteria used in prioritization were: i) absolute contribution to global fisheries production and employment, ii) relative importance of the fisheries sector within a given country (i.e. looking at production and employment per capita), and iii) importance of fish as a source of protein in people's

Figure 2.1 Overall process of the IHH initiative



[2] Additional information on the methods and approaches summarized below can be found in Annex A.

Table 2.1 Indicators for the IHH study and their definitions (see Glossary for detailed definitions)

Indicator	Definition
Social indicators	
Gender and small-scale fisheries	The roles of women and men in relation to the economic, environmental, social and nutrition, and governance dimensions of small-scale fisheries.
Social and cultural identity in small-scale fisheries	The identity of small-scale fishers and communities, as recognized by their diversity and resilience, their cultural heritage, and self-definition and self-determination in fisheries governance.
Indigenous peoples in small-scale fisheries	The state of indigenous small-scale fisheries: their features, values and practices; challenges they face; strategies pursued to better secure sustainable food systems; sustainable resource management opportunities; and policies supporting their shared interests.
Food and nutrition indicators	
Fish supply from domestic small-scale fisheries	The volume of fish available for human consumption from domestic small-scale fisheries over a period for a specific population.
Omega-3 fatty acid contribution from small-scale fisheries	The supply of omega-3 fatty acids from fish over a specific period for a specific population.
Micronutrient contribution from small-scale fisheries	The supply of micronutrients (specifically vitamin A, calcium, iron, zinc and selenium) from fish over a specific period of time for a specific population.
Food safety concerns around small-scale fisheries products	Food safety concerns around small-scale fisheries products (e.g. disease, food contamination).
Distribution of nutritional benefits	The proportion of the supply from fish (or protein and/or micronutrients from fish) available to segments of the population that are vulnerable in terms of income and gender.
Production and environmental indicators	
Catch	Volume of fish (in tonnes) caught by fishing operations and landed, by species level and disaggregated between marine, inland, small- and large-scale fisheries. Catch defined as nominal catch: the live weight equivalent of the landings (i.e. landings on a round, fresh basis; landings on a round, whole basis; or landings on an ex-water weight basis, excluding discards).
The environmental interactions of small-scale fisheries	Interactions, both direct and indirect, occurring across the full spectrum of levels of influence that species and habitats experience when small-scale fishing activities take place.
Impacts of climate change on small-scale fisheries	Challenges related to climate change effects and their related stressors (e.g. sea level rise, warming, acidification, extreme events) affecting small-scale fisheries.
Economic indicators	
Employment	All persons of working age who engage in any activity to produce goods or provide services for pay or profit, including harvesting (e.g. removing or collecting live wild aquatic organisms from oceanic, coastal or inland waters), pre-harvest (e.g. building of ships and floating structures, repair of equipment) and post-harvest activities (e.g. processing and preserving of fish, crustaceans and molluscs; wholesale of fishery products; and retail sale of aquatic products). This includes both part- and full-time employment in order to capture seasonal variation.

Table 2.1 Cont

Indicator	Definition
Subsistence fishing	Also defined as "working for own consumption": individuals of any sex and age who carried out an activity at least once over the previous 12 months to produce fish for their own final use, with no transaction occurring in the marketplace. By definition, subsistence fishing is considered here to include only small-scale fisheries activities.
Dependent livelihoods	Total dependent livelihoods (partial): all members of a household where at least one member is employed in small-scale fisheries or engages in subsistence small-scale fisheries. Total dependent livelihoods (full): total number of household members who are solely dependent upon employment in small-scale fisheries.
Landed economic value	The first sale value of the catch, calculated by multiplying the ex-vessel price by landed catch weight (essentially capturing an average of product quality for the catch).
Price of catch	Ex-vessel prices (USD), i.e. the prices that fishers receive for their catch (per tonne), or the price at which fish are sold when they first enter the seafood supply chain, for commercially exploited fish stocks.
Small-scale fisheries exports	Catch exported (volume and value) per year at the national level, as well as the proportion of small-scale fisheries catch that goes to export at the species level.
Value added from small-scale fisheries	The contribution of one or more small-scale fisheries value chains to the growth of a national economy, calculated by subtracting the value of inputs (intermediate consumption of goods and services produced by agents considered to be operating outside of the value chain, e.g. fuel and food for fishing trips; vessel repair and maintenance costs; insurance; and the cost of handling, processing and selling fish, such as purchasing ice) from the final market value of production (total revenues from the final sale of fish).
Governance indicators	
Policy formality	Formal policies refer to governance arrangements that can be in the form of laws, regulations, policies or plans/strategies. Informal policies are those recognized by customary authorities and usually practiced in customary regimes; they might be recognized by other types of authorities or not.
Access strategies	Governance arrangements with which fishers can formally gain access to fishing grounds (i.e. licences, place of residence, history of use, vessel registration).
Harvesting management measures	Governance arrangements with which fishing authorities manage harvesting by fishers. These include measures addressing gear, spatial arrangements, size, times or seasons, vessels, total allowable catch (TAC), sex of catch.
Devolution rights index	The devolution rights index (DRI) considers three levels of devolution based on rights of i) management, ii) exclusion and iii) transferability: partially devolved, when any one of the above rights is devolved to fishers; mostly devolved, when any two of the above rights are devolved; fully devolved, when all three rights of management, exclusion and transferability are devolved at the same time in a fishery.
Policy focus	Policies are categorized as "general fisheries policies" or "small-scale fisheries-specific policies". General fisheries policies are defined as those that refer to fisheries without explicitly distinguishing between small-scale and large-scale fisheries, between marine and inland, or when they explicitly refer to both (i.e. marine and inland or small-scale and large-scale). Small-scale fisheries-specific policies explicitly make reference to small-scale fisheries in the description of the policy provided by the case study authors or the FAOLEX database.

Table 2.1 Cont

Indicator	Definition
Policy level	The political jurisdiction at which the policy applies. National policies apply over the entire nation, subnational policies apply to a large region or province, and local policies apply to a specific locality.
Policy integration	Whether the policy mentioned other objectives besides production, such as social, economic, environmental or governance.
Preferential access areas	Preferential access areas within national jurisdictions for small-scale fisheries establish some kind of preferential use for small-scale fisheries. They can be the complete exclusion of other types of fishing (e.g. large scale) from the fishing area or just the restriction of certain types of gears used by large scale fisheries (e.g trawls).
Participation	Perceived levels of participation among fishers were categorized as 'no engagement', 'low engagement', 'some engagement', and 'majority of fishers participated in the management of their fishery'. Participation was defined to encompass a broad spectrum of involvement: from fishers being passive recipients of information shared by the government about decisions they plan to make, to government and fishers cooperating as equal partners in decision-making, data collection, monitoring and surveillance and control, to fishers making most decisions and advising government, which then endorses such decisions (Sen and Nielsen, 1996).
Involvement of fishing organizations	Involvement of fishing organizations (either national organizations or national/sub-national offices of international organizations) engaging with fisheries and fisheries management activities.

diet (according to FAO data). Of the list of priority countries and territories, a total of 58 were finally selected (32 for marine and inland fisheries, 6 for inland only, and 20 for marine only), spanning a range of economic classifications and geographic locations. These countries and territories represent (according to FAO FishStat data, average values for 2013-2017) about 69 percent of the world's marine catch, 63 percent of inland catch, 73 percent of marine fishers, and 54 percent of inland fishers (Figure 2.2).

CCS experts were recruited on a rolling basis and case studies were conducted over the course of 3 to 12 months, with all completed by the end of 2019. A detailed IHH methodology was designed with specific protocols and data collection suggestions for CCS experts to follow. The protocols ensured interconnection among the different dimensions of sustainability, comparability across case studies, and robustness of the estimations for the key IHH indicators (see Annex A). Due to time and resource constraints, CCS experts were instructed to focus on readily available sources of information (official statistics, scientific and grey literature, etc). In exceptional cases, to overcome a systematic lack of small-scale fisheries information, the study was able to support very limited primary data collection. The thematic clusters also provided feedback throughout the data collection process to better inform CCS experts.

The IHH methodology did not prescribe a standard definition of small-scale fisheries because of the vast diversity and complexity of the subsector across the various countries. Instead, CCS experts provided the most common definition (e.g. legal or operational) for small-scale fisheries adopted in their country or territory. This allowed flexibility for the experts to determine which fisheries would be covered in the case study and how data would be best organized at the fleet level to suit the country's context (i.e. based on geographic location, ecosystem type, gear or vessel type, or species targeted). While case studies aimed to cover all small-scale fisheries in the country or territory, in many cases the information available did not cover 100 percent of catches, particularly for the inland subsector. To account for this, CCS experts estimated how much of the total national catch for the small-scale fisheries subsector was considered to be represented by the data available and reported within each case study.

The CCS data were compiled and standardized at different levels of aggregation to enable cluster-specific analyses. Each thematic cluster produced global, regional and subregional estimates of their respective indicators for the relevant contributions of small-scale fisheries to sustainable development through a tailored mix of methodologies appropriately selected for each indicator. In addition to CCS, additional datasets (including labour force surveys and household income and expenditure surveys, and the responses to an ad hoc questionnaire dispatched to all FAO Members) were compiled for as many countries as possible to support and validate the estimation of key indicators.

2.3.2 Validation

The compilation of CCS data involved a thorough quality assessment process that included methodology training sessions, iterative feedback, and constant communication between the CCS experts and the IHH Technical Team throughout the case study completion. Preliminary drafts of the CCS went through a screening and revision process by a five-person review team to ensure quality, completeness and clarity on the source and validity of the data, the methodologies, and the data analyses. Final CCS data were checked and corroborated with available global databases and expert consultations via a series of data quality, triangulation, and outlier detection tests (see Table 2.2 for examples on indicator-specific checks). For catch estimates, a validation process was carried out with experts outside the IHH team (internal and external to FAO) comparing IHH catch estimates with the responses to the ad hoc questionnaire and with the FAO capture fisheries database.

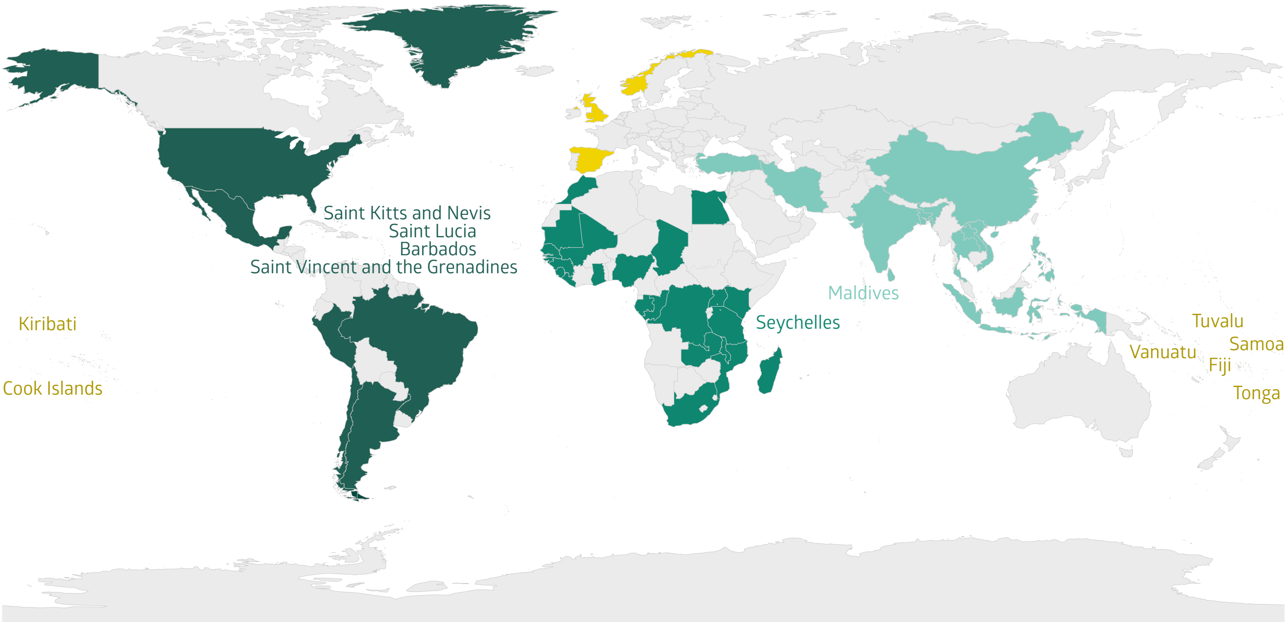
2.3.3 FAO ad hoc questionnaire

For triangulation and corroboration of the CCS, an ad hoc questionnaire was distributed by FAO in December 2018 to all Members for collection of official national-level data on an abridged set of indicators, disaggregated between marine and inland, and small- and large- scale fisheries. Responses to the questionnaire were compiled and standardized throughout 2019. The response rate was 47.8 percent, with 109 responses out of 228 countries and territories (16 countries and territories with regards to inland fisheries only, 22 for marine fisheries only, and 71 for both).

2.3.4 Gap filling and extrapolation of data

To produce global estimates of marine small-scale fisheries catch, CCS data were used as input for estimating non- CCS catch via an extrapolation approach using a set of suitable predictor variables (i.e. IHH estimates of employment and subsistence activities, gross domestic product, and

Figure 2.2 Country and territory case studies conducted in the IHH initiative



Source: United Nations Geospatial. 2020. Map geodata [shapefiles]. New York, USA, United Nations, modified by the authors.

Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. Final boundary between the Sudan and South Sudan has not yet been determined.

Notes: Africa: Chad, Congo, Democratic Republic of the Congo, Egypt, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia (marine only), Madagascar, Malawi, Mali, Mauritania (marine only), Morocco (marine only), Mozambique, Nigeria, Senegal, Seychelles, Sierra Leone (marine only), South Africa, United Republic of Tanzania, Uganda and Zambia; Americas: Argentina, Barbados, Brazil, Chile, Greenland, Mexico, Peru, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines and United States of America (marine only); Asia: Bangladesh, China, India (marine only), Indonesia, Iran (Islamic Republic of), Lao People's Democratic Republic, Maldives, Philippines, Sri Lanka, Thailand, Türkiye and Viet Nam (marine only); Europe: Norway (marine only), Spain, and United Kingdom of Great Britain and Northern Ireland (marine only); Oceania: Cook Islands, Fiji, Kiribati, Samoa, Tonga, Tuvalu and Vanuatu.

region). For inland small-scale fisheries catch estimates, limited availability of suitable predictors, plus the added complexity of inland systems, prevented an extrapolation approach. Therefore, gaps for non-CCS data for inland small-scale fisheries were filled using FAO data.

For other global estimates (e.g. employment, landed economic value), relevant non-CCS datasets necessary for statistical modelling and extrapolation approaches were compiled and used by each cluster according to their needs (see Annex A for more details). It is acknowledged that these other datasets and sources are not without caveats and shortcomings. A more detailed description of these sources and related methods is provided in the thematic chapter sections and in Annex A.

2.4 Thematic studies

To highlight important topics for which global, quantitative figures were not relevant or available, a series of thematic studies conducted by experts in these subjects was integrated into the chapters. The thematic studies provided synthesis of certain key topics, allowing for a grounded and balanced narrative of the multifaceted nature of small-scale fisheries contributions to sustainable development. Experts for these studies were contacted and provided with feedback by IHH team members and additional experts at various stages.

2.5 Technical Advisory Group

A Technical Advisory Group (TAG) was formed in August 2018 consisting of 13 experts on the different aspects of small-scale fisheries from around the globe, including participants from academia, intergovernmental organizations and independent researchers (see Acknowledgements). The role of the TAG was to provide general guidance and technical advice to the different clusters at different junctures of the project, including strategies for analysis of the data compiled through thematic studies and CCS. The results of the cluster analyses and chapter drafts of the IHH report were peer reviewed by IHH team members, TAG members and internal FAO experts prior to the culmination of the final IHH report.

Table 2.2 Data quality and validation checks for key indicators

Indicator	Quality assessment and validation checks
Catch (core indicator for environmental, social/nutrition, and economic dimensions)	• Scrutiny of CCS methodology and data sources to produce catch estimates. • Catch outlier detection protocols. • Triangulation with independent data sources: FAO official statistics (aggregating CCS data from large-scale and small-scale fisheries) and the responses to the ad hoc questionnaire. • Expert review of national and territory level estimates, with experts outside of the IHH team, internal and external to FAO
Ex-vessel price (as input for landed economic value estimations)	• Scrutiny of CCS methodology and data sources to produce catch estimates. • Price outlier detection protocols. • Gap-filling protocols via a four-tiered imputation process according to prices within the same CCS, within the most similar and best available data from neighbouring countries, within countries sharing the same income level, and from data at the global level. • Expert review of national and territory level estimates, with experts outside of the IHH team, internal and external to FAO.
Exports in small-scale fisheries	• Scrutiny of CCS methodology and data sources to produce SSF export estimates from catch utilization data at the species level. • Exported catch outlier detection protocols. • Triangulation with independent data sources: FAO official statistics, and IHH CCS estimates of SSF exports at the country and territory level.
Employment	• Scrutiny of CCS methodology and data sources to produce employment estimates for the harvest sector at country and territory level, including through ILO and NFI statistics colleagues, and TAG members. • Expert review of national and territory level estimates, including gender disaggregation, with internal and external experts to the IHH team. • Triangulation with other data sources: ◦ For employment in the primary sector of fisheries disaggregated by small-/large-scale fisheries: triangulation with IHH CCS and responses to the ad hoc questionnaire. ◦ For employment in the primary sector of total capture fisheries (not disaggregated small-/large-scale fisheries): triangulation with FAO employment data. ◦ For employment in the fisheries postharvest sector: triangulation with IHH CCS and responses to the ad hoc questionnaires, where available (~ 30 countries).
Governance arrangements	• Scrutiny of CCS methodology to exclude arrangements that only pertained to large-scale fisheries, aquaculture, or did not pertain to the harvest of aquatic resources; and those that only pertained to species not included in the IHH study (e.g. seaweeds). • Data screening for internal coherence.

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3.

The challenge of defining small-scale fisheries:

determining scale of operation by identifying general fisheries characteristics

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3.1 Key findings and messages

- Globally and regionally, small-scale fisheries exhibit a range of characteristics that place them along a continuum with respect to their scale of operation. There are no fixed, universal boundaries that set these fisheries apart from large-scale fisheries, making it difficult for them to be identified and categorized.
- There are international and regional instruments, policies and strategies, including those of FAO, that specifically address small-scale fisheries. This infers the need for a working definition of these fisheries, particularly to ensure that fisheries management, conservation, trade and market measures support – or at least do not hinder – the social and economic development of the small-scale fisheries subsector.
- From a policy and operational perspective, the term small-scale fisheries encompasses diverse characteristics: a small-scale scale fishery in one country may be considered large-scale in another, making it difficult to standardize the application of basic quantitative metrics at the regional or global level. This diversity in how small-scale fisheries are defined has hitherto restricted the ability to objectively compare small-scale fisheries between nations or regions.
- The Illuminating Hidden Harvests (IHH) study resolves this issue by using a matrix approach that scores fisheries with respect to the scale of their operation across multiple characteristics, to better understand the nature of the fisheries found in the 58 country and territory case studies.
- As there are no prescribed scoring cutoffs that can be used to separate small-scale fisheries from large-scale fisheries, data from the matrix do not point to a unique, universal definition of small-scale fisheries. However, the matrix provides a standardized approach that can be applied to any fishery to determine where it lies along the continuum of small-scale to large-scale fishing operations, with higher-scoring fishery units sharing many if not all of the characteristics of large-scale fisheries. Furthermore, by scoring each of the fishery characteristics using value ranges drawn from a variety of sources (e.g. from official censuses to expert elicitation), this matrix approach is also suitable for data-limited fisheries.

3.2 Introduction

More than 94 percent of the fishers and fishworkers engaged in capture fisheries globally are employed in small-scale fisheries. In Africa, according to the findings from this IHH study, these fishers and their fisheries make particularly important nutritional contributions to vulnerable and disadvantaged populations, particularly women. The importance of small-scale fisheries runs even deeper, owing to their cultural significance and the community resilience they support.

Despite acknowledgement of the vital role that small-scale fisheries can have in alleviating poverty, food insecurity and malnutrition (as well as addressing other needs), small-scale fishers and fishing communities have frequently been afforded low priority in national and international policies and actions. They face many challenges including competition from large-scale fisheries and other subsectors, inadequate representation in management, and overexploitation of resources, among others (see Chapter 1; Hamilton *et al.,* 2021).

This situation is now changing, as small-scale fisheries (and the many challenges they face) are receiving greater global, regional and national attention, reflected in the agreement on the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines) and the Sustainable Development Goals (SDGs). These instruments are intended to improve the socioeconomic circumstances of small-scale fishers and fishing communities by promoting equitable development, as well as strengthening their role in eradicating poverty and food insecurity. Nevertheless, widespread ignorance and neglect of the role and significance of small-scale fisheries remain serious obstacles to implementing the SSF Guidelines and achieving many of the SDGs. Hence this IHH study aims to increase general awareness and knowledge of the nature of small-scale fisheries, their critical contributions to human well-being and their role in ensuring healthy ecosystems.

3.2.1 Why is there a need to identify and/or define small-scale fisheries?

In order to demonstrate the importance of small-scale fisheries, it is necessary to identify clearly what is meant by their scale of operation and how to differentiate it from the wider fisheries sector. Yet this is no simple task: there is no global definition of what can be considered a small-scale fishery, and the wide heterogeneity of small-scale fisheries around the world complicates any attempt to harmonize the various national definitions and contexts into one universal definition. The issue is further complicated by the varied terminology applied to different parts of both the small-scale subsector (e.g. small-scale, artisanal, subsistence, aboriginal, coastal, nearshore, municipal) and large-scale subsector (e.g. large-scale, commercial, semi-industrial, industrial) (Chuenpagdee *et al.,* 2006; Gillett, 2011; Kittinger, 2013; Smith, 1979; Smith and Basurto, 2019).

Globally and regionally, small-scale fisheries exhibit a range of characteristics that exist along a continuum, rather than an explicit set of fixed measurements. Problems can arise with definitions based on a limited set of quantitative metrics (such as vessel size and power, gear type, or area of operation), or simplistic assumptions that all small-scale fisheries products are consumed locally or in the household, with minimal trade channels. This can lead to disputes and general dissatisfaction concerning fisheries regulations, and may also have serious economic consequences for resources and stakeholders, as well as other undesirable impacts. Furthermore, there is a concern among fisheries stakeholders that trying to formulate a globally standardized definition would obscure or devalue unique cultural, operational or economic characteristics and contexts that contribute to the diversity of small-scale fisheries. Nevertheless, there are several reasons why it is important to have a common understanding of the general nature and characteristics of small-scale fisheries.

Identifying the scale of operation of a fishery is often useful and even necessary, both at the policy level as well as for operational purposes. This can apply to such areas as governance (policy, legislation, access and tenure), economics (taxation, subsidies, welfare, market access) and fisheries management (regulation, licensing, gear and zoning), as well as general awareness (i.e. global understanding of small-scale fisheries and their role).

Efforts to bring greater attention to small-scale fisheries on the regional or global stage, as well as global normative processes (such as subsidies or differential treatment), require that small-scale fisheries be identified so that policies or norms may be applied effectively. Moreover, international and regional instruments, policies and strategies that specifically address small-scale fisheries need a working definition thereof to ensure that fisheries management, conservation, trade and market measures support – or at least not hinder – the social and economic development of the small-scale fisheries subsector. Furthermore, at the operational level, there is frequently a need to differentiate between scales of operation for application of targeted policies or specific regulations.

The 1995 FAO Code of Conduct for Responsible Fisheries (CCRF) recognizes small-scale fisheries as an identifiable subsector that is important enough to warrant specific consideration (FAO, 1995). Although the CCRF does not provide a definition of these fisheries, it does recommend the development of dedicated policy and fisheries management measures to support the rights of small-scale fishers. Small-scale fisheries have also been specifically recognized in other FAO normative processes and instruments. The SSF Guidelines, for instance, notably provide more explicit guidance on a human rights-based approach to providing support to small-scale fisheries. They do not, however, prescribe a standard definition, citing the complexity of the issue (FAO, 2015, para. 2.4). The Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security also contains a general reference to small-scale producers (including fishers) and specifically refers to small-scale fisheries and transboundary issues (FAO, 2012a).

Apart from these FAO instruments, several other international and regional instruments, policies and strategies also address small-scale fisheries. In these, the need for a working definition of these fisheries was identified and either recommended for development, or in some cases actually elaborated for a specific purpose. These purposes cover, for example, ensuring that small-scale fisheries are not adversely affected by conservation measures, such as Aichi Biodiversity Target 11 (CBD, 2010); disciplines on subsidies imposed by the World Trade Organization (WTO, 2021); specific policies for regional economic arrangements, such as those of the European Union (European Parliament Committee on Fisheries, 2012; European Union, 2014; Stobberup *et al.,* 2017) and the Association of Southeast Asian Nations (ASEAN, 2015); and the conservation and management measures of regional fisheries organizations, such as the International Commission for the Conservation of Atlantic Tunas (ICCAT, 2015) and the Indian Ocean Tuna Commission (IOTC, 2019).

There is also recognition of the need to better understand the differences within the fisheries sector for clarity on other aspects of fisheries policies and support programmes, such as trade and development (Kurien, 2005; Short *et al.,* 2021). This is important for proper understanding of the effect of trade and markets on the distribution of fisheries products (and the nutritional consequences of this distribution) at different scales of operation (Bennett *et al.,* 2021), and also with respect to identifying small-scale fisheries for receiving subsidies or addressing constraints on accessing markets and value chains (Von Moltke, 2014; Josupeit, 2016). New policies aimed at promoting the blue economy may also deliberately or unwittingly marginalize or disadvantage small-scale fisheries (Cohen *et al.,* 2019; Short *et al.,* 2021).

In addition to better informing global normative processes that are particular to the small-scale fisheries subsector, a systematic approach to the characterization of fisheries can be very useful for data analysis. The characterization matrix devised for the IHH study provides a common framework to systematically compare and contrast the wide variety of small-scale fisheries found in the 58 country and territory case studies (CCS). The IHH methodology afforded considerable flexibility to CCS authors in defining the set of fisheries to be considered small-scale, mostly based on national legal and operational classifications. Therefore, a standardized approach to classify and characterize fisheries at the global and regional level was needed. The following section gives some background on the challenge of characterizing small-scale fisheries and finding an objective method to situate them along a continuum of operational scale.

3.2.2 The promise – and challenge – of different approaches

There have been a number of attempts to develop frameworks for the characterization of small-scale versus large-scale fisheries (e.g. Berkes *et al.,* 2001; Chuenpagdee *et al.,* 2006; FAO, 2017a; García-Flórez *et al.,* 2014; Gibson and Sumaila, 2017; Guyader *et al.,* 2013; Kesteven, 1973; Kurien, 1996; Smith, 1979; Thompson, 1980; Sumaila, Liu and Tyedmers, 2001; World Bank, 2012). These approaches seem most useful at the national level and are based on the type of data that may be routinely collected for statistical or fisheries management reporting purposes. None, however, are sufficiently flexible for global- or regional-level application. Economics-based methods are too specific to a given fishery or country for more general application, and problems also arise with definitions which are based on a limited set of quantitative metrics (such as vessel size and power, gear type, or area of operation). Purely quantitative characterizations can exclude fishers that should rightfully be considered small-scale, or allow larger-scale vessels to be included in a small-scale fleet (e.g. fishers who use small vessels with very powerful engines, or fisheries that have some large vessels which are unpowered) (Chuenpagdee *et al.,* 2006; Smith and Basurto, 2019). The lack of inclusion of other salient features relating to the fisheries value chain, employment, ownership and social relations (Smith and Basurto, 2019) in the criteria for classification, or the assumption that small-scale fisheries products are not commercially traded, can also result in perceptions of unfair treatment. All of these limitations can lead to disputes and conflict, as well as dissatisfaction and non-compliance with fisheries regulations. They may also result in serious impacts (economic or otherwise) on resources and stakeholders.

Thus the IHH study was tasked with finding an approach that assessed scale without imposing a narrow definition and that also allowed, in line with the SSF Guidelines, for a participatory characterization process. The Guidelines emphasize the need for characterization that is relevant to the national context, but this was a significant challenge in the IHH study, due to the vast diversity of small-scale fisheries in different countries. Therefore a standard definition of small-scale fisheries was not prescribed for the development of the national-level CCS; instead, the study used the definitions adopted by each country.

There was still, however, a need to develop a method for comparison between individual case studies and across the whole IHH dataset that addressed the complexity of small-scale fisheries in a systematic, objective manner. The characterization approaches previously proposed above had the advantage of being based on the type of data that may be routinely collected for statistical or fisheries management reporting purposes. For this study, a scoring matrix was proposed that broadened these approaches to include qualitative information, thus enabling a much more holistic characterization of each fishery (FAO, 2017a).

The approach used in the IHH study is similar to that used by García-Flórez *et al.* (2014) and Gibson (2017), but applies a broader range of operational, economic/organizational and technological characteristics. Further, it is less dependent upon quantitative data, using instead a mixture of quantitative and qualitative descriptions for the attributes in each characteristic. The resulting "characterization matrix" provides a characterization of the fishery units identified in the CCS for the small-scale fisheries subsector at the country level. This systematic approach allows for a comparison of fisheries between countries and regions, facilitating identification of commonalities and differences.

3.3 How the characterization matrix works

The fishing activity characterization matrix consists of two different matrices, one covering all activities in marine fisheries (Table A.3, Annex A) and the other inland fisheries (Table A.4, Annex A). The unit of assessment is a "fishery unit", which constitutes a relatively homogenous group of fishing activity in terms of the characteristics relevant for grouping fisheries (see full definition in the Glossary). The matrix applies a range of metrics, which can be used in combination to establish the extent to which a fishery unit is large- or small-scale.

Each of the characteristics under consideration (encompassing vessel and gear type, harvesting operation, degree of organization, on up to preservation and disposal of catch) is placed on a four-category operational scale, ranging from small to large. A score is provided for each characteristic (for scoring criteria, see example in Box 3.1). Any given fishery unit may have characteristics typically associated with both small-scale and large-scale fisheries, so many will receive lower scores in some categories and higher scores in others. The characterization carries no value judgement on the nature of the fishing operation (i.e. there is no implication of "good" or "bad" activity). But the aggregation of scores from all categories does allow for an objective characterization of the fishery unit, indicating whether it tends towards small-scale or large-scale operation.

By analysing different scores for different fishery units, it is possible to determine if there is a clear cutoff between distinctly small-scale operations and distinctly large-scale operations for the fishery being analysed. In theory, if the matrix is functioning well, it should highlight those fisheries which may be on boundary between small-scale and large-scale (e.g. a small vessel with a high-powered engine and large-scale level of fishing effort), making it possible to assign them their own category.

Furthermore, by incorporating multiple dimensions, the matrix approach seeks to avoid misleading or inappropriate characterizations of fisheries as small-scale or large-scale, which can occur when a single criterion, such as vessel length, is emphasized.

Characteristics were chosen based on the previous approaches described in Section 3.2.2 (Berkes *et al.,* 2001; Chuenpagdee *et al.,* 2006; Kesteven, 1973; Kurien, 1996; Smith, 1979; Thompson, 1980; World Bank, 2012), which are presented in Table 3.1. These characteristics are also harmonized with those listed in the 2004 FAO Advisory Committee on Fisheries Research report (FAO, 2004) and with the description of small-scale fisheries found in the SSF Guidelines (FAO, 2015).

Although some fisheries (less than 3 percent of total fishery units) were not scored due to data or capacity limitations, the characterization matrix results presented in Chapter 5 and Chapter 8 (on economics and governance, respectively) are considered to be representative of the fisheries in the CCS.

Box 3.1

Sample scoring of a fishery unit using the characterization matrix

Marine Characteristics	Score 0	Score 1	Score 2	Score 3
Indicative gear				
Fishing gear	Labour-intensive gear	**Passive gear**	Gear with aggregating devices	Highly active gear
Mechanization	**No mechanization**	Small power winch/hauler powered off engine	Independently powered gear deployment/hauling	Fully mechanized gear deployment/hauling
Vessel				
Size of fishing vessel	No vessel	**< 12 m, < 10 GT**	12 to ≤ 24 m, < 50 GT	> 24 m, > 50 GT
Motorization	No engine	**Outboard/ inboard engine ≤ 100 hp**	Inboard engine > 100 hp to ≤ 400 hp	Inboard engine > 400 hp
Operations				
Fishing trip duration	**< 6 hours**	Day trip (< 24 hours)	>1 day to < 4 days	> 4 days
Fishing location and range	≤ 100 m from shoreline / baseline/ high-water mark	**> 100 m, ≤ 10 km from shoreline / baseline / high-water mark**	> 10 km, ≤ 20 km from shoreline / baseline / high-water mark	> 20 km from shoreline/ baseline
Storage/preservation				
Refrigeration/storage	No (cold) storage	**Icebox (i.e. on deck)**	Ice hold (i.e. below deck)	Refrigerated hold
Employment/labour				
Labour/crew	**Individual and/or family members**	Cooperative group	≤ 2 paid crew members	> 2 paid crew members
Ownership	**Owner/operator**	Leased arrangement	Owner	Corporate business
Time commitment	Occasional	Full-time, but seasonal	**Part-time all year**	Full-time
Use of catch				
Disposal of catch	Household consumption / barter (exchange for payment in goods or services)	Local direct sale at landing site (exchange for monetary payment)	**Sale to traders**	Onboard processing and/ or delivery to processors
Utilization of catch, value addition / preservation	For direct human consumption	**Chilled / locally processed / cured**	Frozen	Frozen/chilled for factory processing (for human consumption or fishmeal)
Integration into economy and/or management system	Informal, non-integrated (no fees required)	**Integrated (registered, untaxed)**	Formal, integrated (licensed fisher, payment of landing fees)	Formal, integrated (licensed, taxed)

In this example (using the marine matrix), a marine fishery unit with the following characteristics receives a score of 11:

- Vessels less than 12 m long with an outboard engine of less than 100 hp
- Use of gillnets and traps (passive gear) with no onboard mechanization
- Fishing for less than 6 hours per day, less than 10 km from shore, all year round
- Catch stored in on-deck iceboxes
- Vessels operated by owner and family members
- Catch landed, chilled, and sold to local traders or locally processed
- Fishers/gear licensed and vessels locally registered, but no landing fees paid on catch

Table 3.1 Various characteristics used to describe scale of operation in inland and marine fisheries

Characteristic	Attributes relevant to scale of operation
Operational	
Fishing trip duration	The duration of a fishing trip is determined by a number of factors related to a vessel's ability to stay away from port/shore. It may also be determined by the ability to store and preserve catch and support the crew. Larger-scale operations tend to have more capacity to fish for longer periods before returning with their catch.
Fishing location and range	The location of fishing grounds is another characteristic that is determined by a vessel's ability to fish away from shore. It is also dependent on the type of gear available, as fishing in deeper waters may require larger gear and additional crew or mechanization to deploy and retrieve it.
Time commitment	Fishing may be a full-time, part-time or occasional occupation. The amount of time that is dedicated to fishing can be a general indication of scale. Occasional fishers tend to be small-scale, as they may have diverse livelihoods, or may only fish full time during a particular fishery season, occupying themselves with farming or off-farm labour outside of the season. However, there are large-scale, commercial exceptions such as high-value fisheries, which have very short fishing seasons.
Labour / crew	The number of crew members can be an indication of scale of operation, especially if the crew are paid wages. There are exceptions, such as unmotorized vessels with large crew sizes which operate on a cooperative basis. The use of mechanization can reduce the need for crew.
Post-harvest preservation of catch	
Utilization of catch, value addition / preservation	There is a wide range of uses of landed fish, and both small- and large-scale fisheries may employ preservation methods. The types of preservation are an indication of whether an operation is small- or large-scale. Large-scale operations tend to process and store fish using chilling or freezing, and require specialized holds and equipment. Small-scale operations may use more traditional preservation techniques. At all scales, some of the catch is sold fresh.
Economic integration	
Integration into economy and/or management system	This characteristic covers the extent to which the state takes an active role or interest in the management or regulation of the sector. The smallest scales of fishing activity tend to be the most informal and dispersed and it is these that the state tends to exert the least control. The level of management or regulatory control is dependent on the financial and human resources available. It tends also to be a reflection of a concentration of economic or food production value, and in some cases number of participants, of a specific fishery.
Disposal of catch	Disposal of catch concerns the degree of consolidation of catch into marketing and trading value chains. Small-scale fisheries products are generally traded quite locally, but in some instances may have extended value chains and wide distribution. Large-scale fisheries may direct some catch to the household, although they tend to sell for income to cover costs of operation. The extent to which fish is traded is a reflection of the volume landed and the regularity of supply. Larger-scale operations tend to be able to sustain trading value chains involving more distant locations, and are less reliant on local disposal. This ability is also strongly linked to the methods of preservation of the catch.
Ownership	The ownership of a fishing operation is a strong indicator of scale, particularly if the owner is a corporate business, which strongly indicates a large-scale operation. Having owners who are also operators indicates a small scale of operation; at intermediate levels of scale, owners hire crew but do not actually fish. Leasing arrangements are variable: for example, small-scale fishing groups may lease their vessel to go fishing and pay rent in cash or catch.

Table 3.1 Cont

Characteristic	Attributes relevant to scale of operation
Size of fishing vessel	Although vessel size isn't necessarily an indicator of operational scale and fishing intensity, it is an important characteristic when paired with variables such as motorization and mechanization. The categories used give a range of sizes which aim to cover the majority of vessels found globally. There are distinct differences in the size ranges used between marine and inland fisheries.
Motorization	Motorization is a common quantitative metric used when considering scale of operation. This characteristic considers the presence of an engine on board, its horsepower (hp) and whether it is outboard or inboard. In the case of multiple engines, only the main one is considered. A higher level of motorization is a strong indicator of the ability to travel greater distances, access fish more quickly, and carry and deploy larger, more efficient gear types (i.e. a larger scale of operation).
Mechanization	The level of mechanization indicates the capacity to deploy and retrieve large gear. Mechanization may also be essential in some small-scale fisheries in developed countries as a means to reduce the number of crew require (as labour costs are high) so it is not an indicator of scale in isolation. In some fisheries, mechanization includes electric attracting lights used in night fishing, and is dependent on the ability to power the unit.
Fishing gear	As with mechanization, the type of gear used by a fishery unit can also be a indicator of its scale of operation. The smallest manual gear types are only economically viable in small-scale fishing operations. There are exceptions, with gear typically used by small-scale fisheries being aggregated into "super-gear" (e.g. multiple joined sections of gillnet, or folding traps that allow hundreds to be carried on board); this is done in some cases to circumvent restrictions on large-scale fishing operations. Highly active gear typically require vessel power and some mechanization, and tend to be employed at larger scales of operation.
Onboard refrigeration / storage	The ability to store catch in increasingly large volumes for longer periods of time can be an indication of a higher scale of operation. This requires additional vessel features, such as storage or bigger holds and even refrigeration. Some small-scale fisheries in developed countries may still have some of these features on board to retain maximum value for specialized, high-value catches. This is not, therefore, an indicator of scale in isolation.

3.3.1 Potential research and real-world applications of the matrix

The characterization matrix can provide unique insights into the composition and activity of small-scale fisheries at the global level. The results of the matrix are presented in subsequent chapters under the following thematic areas:

- **Environment (Chapter 4):** technological (size of vessel, gear, motorization, mechanization, cold storage) and operational scales (duration of fishing trip, location of fishing activity)
- **Governance (Chapter 8):** integration into the economy and ownership

These results show how conceptual definitions for key small-scale fisheries characteristics can be evaluated on a regional and global scale to draw some overarching conclusions. The characteristics applied in the matrix are grouped into operational, economic/organizational and technological themes, which allows for identification of appropriate levers for policy and management interventions that can be more easily operationalized.

For example, regulation of large-scale fishing operations may be under the purview of the national agencies for fisheries, exports or industries, whereas small-scale fisheries are typically regulated by local government authorities (as shown in the findings in Chapter 8). Therefore, having a proper understanding of small-scale fisheries characteristics is key to identifying, as well as allocating, responsibilities to address the unique challenges and opportunities for improvement concerning these fisheries.

The matrix is intended to inform and facilitate a deeper understanding of small-scale fisheries characteristics and to identify areas where practical action can be taken. The aggregated matrix score of a fishery

unit indicates where it lies along the continuum of small-scale to large-scale fishing operations. It can be inferred, for example, that higher-scoring fishery units share many, if not all, of the characteristics of large-scale fisheries. There are no prescribed cutoffs in the total scores in the characterization matrix that identify a hard separation between small and large scales of operation. But certain "operational" cutoffs can, if needed, be decided at local, national or regional level, as long as they are established in a consistent, standardized and transparent manner. Indeed, for the operational purpose of regulation and management of fisheries, some countries already recognize the need for intermediate categories (e.g. "medium-scale fisheries", or "commercial" versus "industrial fisheries").

An example of the sort of results, and subsequent comparisons, that can be derived from the characterization matrix is presented in Box 3.2.

The ability to objectively characterize a small-scale fishery unit through the application of the characterization matrix, at an adequate level of detail in terms of its operational, economic/organizational and technological characteristics, offers clear opportunities for further incorporating these characteristics into fisheries information systems. This can be undertaken at relatively low cost, without need for extensive technical training to assist data collection activities – particularly useful in those countries with low capacity to undertake comprehensive fisheries assessments and surveys. Likewise, by scoring each of the fishery characteristics using value ranges that can be determined using a variety of sources (e.g. from official censuses to expert elicitation), this matrix approach is suitable for data-limited fisheries. Linking the matrix information to other structural and statistical data can improve understanding of the diversity of small-scale fisheries as well as how they evolve with changing scales of operation.

The results of the application of the matrix approach in this IHH study reveal it to be a cost-effective and reliable research tool for exploring the characteristics of small- and large-scale fisheries. It has potential applications in policy development as well as providing a common framework for comparing fishery units between countries and regions. This could facilitate discussions on fishery-related matters where the issue of scale arises, as well as yielding greater clarity and objectivity concerning the scope of management or policy measures that are applied to small- or large-scale fishery units.

Potential applications of the characterization matrix include:

- Improved understanding of the nature of small-scale fleets: for example, by identifying vessels that are, or could be, legally defined as small-scale vessels (e.g. based on length or tonnage) but which are modified in a manner more akin to large-scale fishing operations (e.g. based on gear type, power, or fishing range), and thus requiring different or additional regulations;

- Improved understanding of how certain metrics (e.g. catch, effort or number of fishers) are associated with each fishery characteristic and with overall operational scale: for example, the knowledge that most of the small-scale fisheries catch comes from non-motorized vessels will allow the design of policies that are more suitable and effective;
- Identification and quantification of the key characteristics that will enable determination of an operational cutoff (or the identification of intermediate levels of operational scale) for:
  - Management, legal or regulatory processes: for example, right to fish in a zone reserved for small-scale fisheries, use of certain types of gear in a zone, exemption for closed seasons;
  - Improved focus and application of policies that support or differentiate between small- and large-scale subsectors: for example, identification of fishery units that might be subject to differential treatment or disciplines with respect to incentives or subsidies;
- Objective and transparent clustering of fishery units that target the same stock but do not share the same characteristics and scale of operation (e.g. for monitoring or statistical reporting to regional fisheries bodies).

Box 3.2

Small-scale fisheries catch distribution by gear type and level of mechanization of operations: an application of the characterization matrix

The characterization matrix contains a series of attributes relating to the operational characteristics of small-scale fisheries. These attributes are scored individually from 0 to 3 and then aggregated to form a total score for a particular fishery. This score can be used as a proxy for the true scale of the operation (e.g. fishers collecting clams on the shore would have low scores, while tuna vessels with several crew members using pole-lines would have high scores). Applying the matrix to the CCS fisheries yielded an overall distribution of catch along the operational scale continuum for each characteristic under consideration. Figure A shows the distribution of total catch based on the attribute score for gear type.[a] In the marine subsector, most catches (66 percent) were caught using passive gear, while in the inland subsector catches were more evenly distributed across three categories of both active and passive gear: gillnets and set nets; lift nets and trap ponds; and foraging by hand.

Figure B illustrates the distribution of catch by mechanization of operations, showing a low level of mechanization overall for the majority of catch in both inland and marine fisheries (although more so for inland). The majority of the inland catch (84.2 percent) was associated with no mechanization at all (scoring 0 in the matrix). In the marine subsector, the majority of catch (60 percent) was associated with operations having some level of mechanization, but mostly involving low-level methods (47.6 percent), such as small power winches and haulers. At the same time, a relatively substantial 39.9 percent of marine catch was caught without any mechanization on board. Higher levels of mechanization (i.e. scores 2 and 3), such as fully mechanized gear deployment, accounted for 12.1 percent of marine catch, but virtually none of the inland catch.

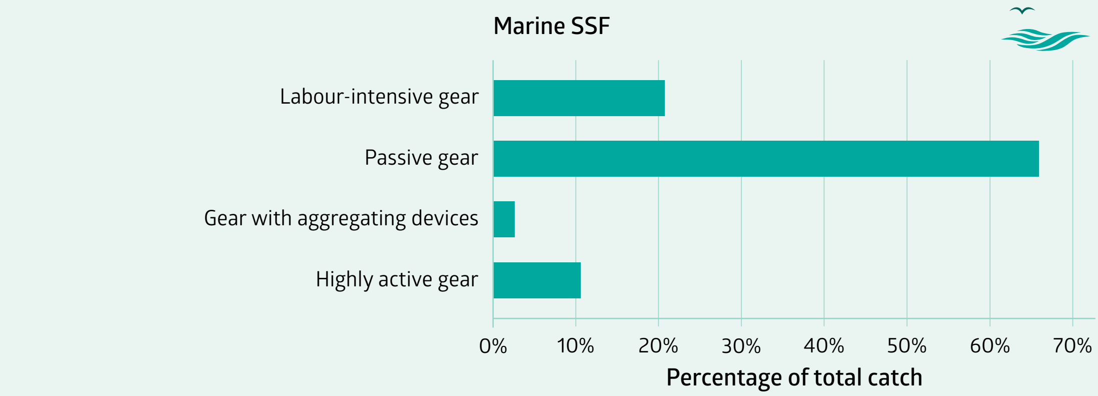
It is evident from these two examples that the majority of catches within the IHH database involve lower categories of operational scale, illustrating the labour-intensive nature of small-scale fisheries. The figures also suggest that marine fisheries appear to require more equipment to begin fishing in a way that yields more substantive catches, whereas in inland waters the entire fishable area is generally much more accessible and requires less equipment.

Notes: **a** In the marine matrix, passive and active gear fall along an operational scale for the characteristic of fishing gear, while in the inland matrix, passive and active gear are treated as two separate fishing gear characteristics, with operational scales and categories for each.

Box 3.2 Cont

Figure A Distribution of catch according to type of gear used in inland and marine small-scale fisheries, based on results from characterization matrix

a.



b.

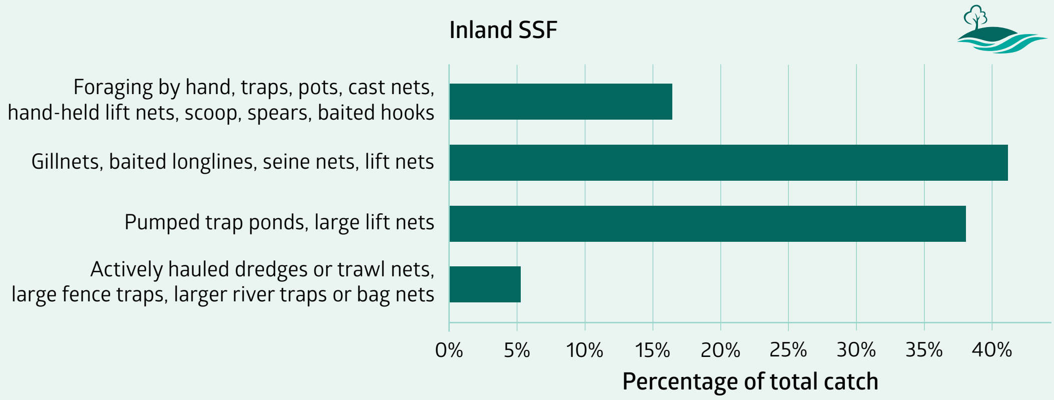
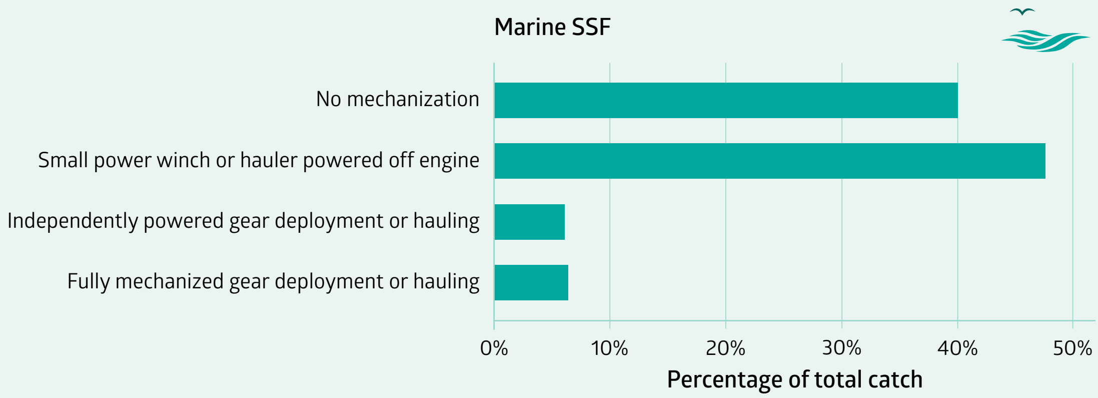
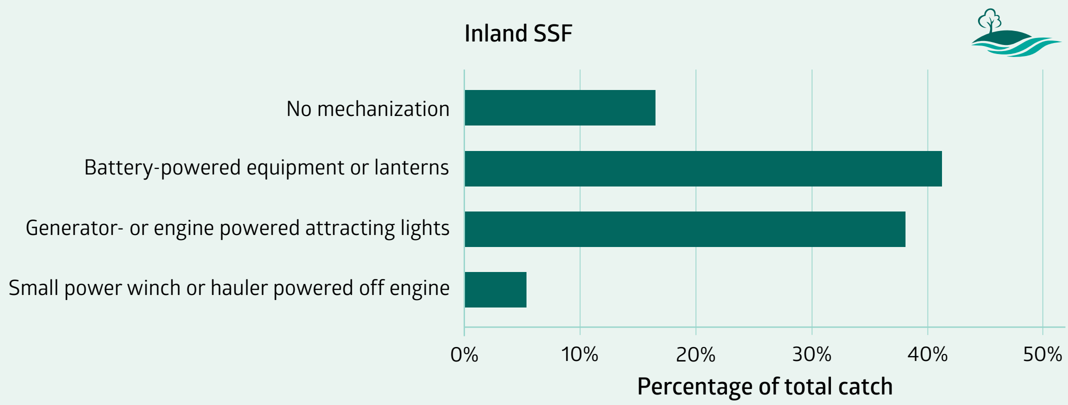


Figure B Distribution of catch according to level of mechanization in inland and marine small-scale fisheries, based on results from characterization matrix

a.



b.



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4

Production and environmental interactions of small-scale fisheries

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4.1 Key findings and messages

Small-scale fisheries production: global figures and regional patterns

- Globally, small-scale fisheries are a significant component of capture fisheries, providing an estimated 36.9 million tonnes of catch per year, with marine small-scale fisheries catch (25.1 million tonnes) more than double that of inland small-scale fisheries (11.8 million tonnes). This corresponds to around 40 percent of total global capture fisheries production. When looking at aggregated (small-scale and large-scale fisheries together) catches, both country and territory case study (CCS) data and FAO FishStat capture production data (FAO, 2020a) show similar figures for inland and marine fisheries (less than 5 percent difference). However, as the FAO FishStat data are not disaggregated by scale of operation, it is not possible to determine any potential differences between the two data sources for the small-scale and large-scale fisheries subsectors.

- Asia was the region with the largest contribution of small-scale fisheries catch during 2013–2017, accounting for 64 percent (23.4 million tonnes) of the global total, while Oceania was the region with the least absolute contribution, at 0.4 million tonnes.

- The range of total small-scale fisheries catch per capita varied across regions, from 52.6 kg/person/year in Oceania, down to 3.4 kg/person/year in Europe. When looking only at the inland subsector, the catch per capita for least developed countries was significantly higher (4.5 kg/person/year) than that of other developing and developed countries or areas (1.0 and 0.4 kg/person/year, respectively).

Coverage and granularity of small-scale fisheries production

- Total catch values, and particularly those for the inland subsector, are likely underestimated mostly due to limited availability of information on unreported or unmonitored catch for the more remote, smaller-scale fisheries (e.g. foot fishers and gleaners in small freshwater bodies and freshwater, brackish and coastal wetlands). The lack of systematic collection of reliable and comprehensive catch data and ancillary information in many small-scale fisheries hinders fisheries assessment and management, as well as a proper understanding of the contribution of small-scale fisheries to sustainable development.

- Although the Illuminating Hidden Harvests (IHH) study was able to achieve considerable taxonomic granularity in catch species composition, a substantial proportion of small-scale fisheries catch were not recorded at the individual species level (40 percent and 62 percent of the catch data obtained from CCS for marine and inland fisheries, respectively, were not associated to individual species), thus constraining the assessment and management of these fisheries. The most common functional groups found in marine small-scale fisheries catches were herring, sardine and anchovy and miscellaneous pelagic species (20 percent and 19 percent, respectively); for inland small-scale fisheries, the most common groups were miscellaneous freshwater fish and cyprinids (63 percent and 15 percent, respectively).

Nature and scale of small-scale fisheries operations

- Harvest efficiencies (calculated as the annual total catch of a given country divided by total number of fishers and/or total kW of the motorized small-scale fisheries fleet) in both marine and inland small-scale fisheries were much higher for the motorized portion of the fleet, as expected. The harvest efficiencies (tonnes/fisher/year) of all fishery types (non-vessel, non-motorized and motorized) showed marked regional differences, being consistently higher for Europe and the Americas, with an overall maximum of 11.6 tonnes/fisher/year in the case of motorized vessels in Europe.

- Small-scale fisheries vary in their technological and operational scale and complexity, both within and between marine and inland subsectors. In fact, while fisheries operating at the lowest scale account for less than 1 percent of the total marine small-scale fisheries catch with available operational information, these fisheries represent 12.9 percent of the inland small-scale fisheries catch. Moreover, the variation in technological and operational scale of small-scale fisheries challenges the definition of a cutoff between small-scale and large-scale subsectors.

Environmental considerations of small-scale fisheries

- While there are examples where actors in small-scale fisheries attempt to minimize or mitigate fishing impacts on the environment, by virtue of the numbers of people engaged, certain interactions of these fisheries with the environment can result in effects that are detrimental to vulnerable species and critical habitats. Data collection efforts should focus on improving the understanding of the environmental impacts of small-scale fisheries on aquatic environments in order to design and implement mitigation measures, while sustaining fishery yields and livelihoods.

- Small-scale fisheries are among the most vulnerable food production systems to the impacts of climate change, as seen in case studies and anecdotal evidence from the literature. However, data and evidence on such impacts on small-scale fisheries are not systematically collected through standardized frameworks. This information is critical to develop and implement well-informed adaptive strategies to promote climate-resilient small-scale fisheries.

Figure 4.1 provides an overview of how small-scale fisheries can contribute to the sustainable use of natural resources.

Small-scale fisheries catch in the IHH study: ten quick facts

Small-scale fisheries catches are averaged over the period 2013–2017.

Small-scale fisheries catch data come from national exclusive economic zones, but do not include catch of foreign fleets.

Small-scale fisheries catch includes subsistence but excludes retained recreational catch.

Catch figures within the IHH report refer to "nominal catch", which is defined as the live weight equivalent of the landings, excluding discards (see also Glossary).

Small-scale fisheries catch data come mostly (80 percent) from already available data sources (official reports, grey and scientific literature).

Small-scale fisheries catch data have been collated by more than 800 in-country experts, independently from the data officially reported to FAO.

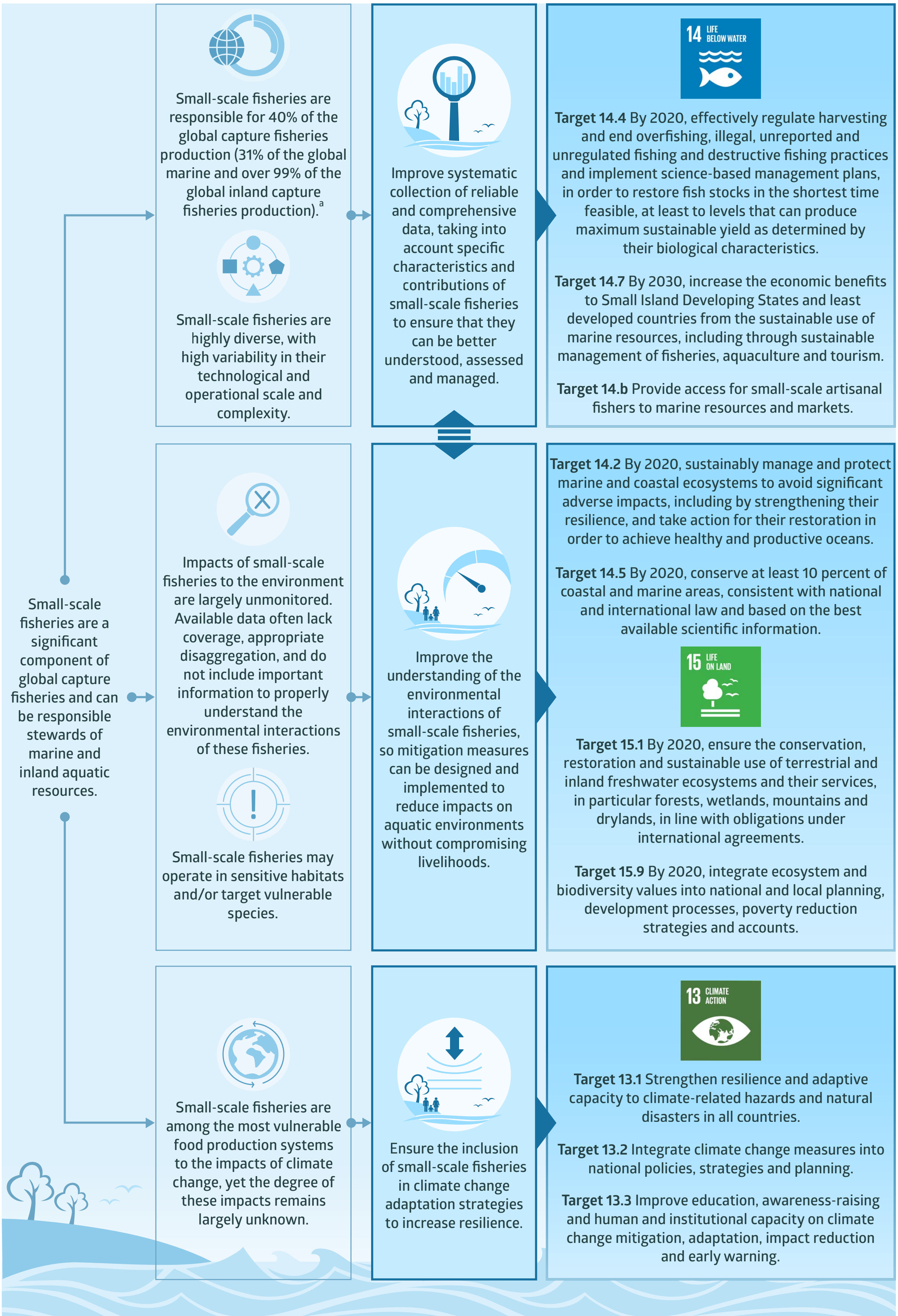
Small-scale fisheries catches are likely under-represented for some countries and/or fisheries and particularly for the inland subsector, due to limited resources to survey the more remote, smaller-scale fisheries with low gross value of production.

Small-scale fisheries catch data, in some cases, also come from primary data collection (surveys, expert elicitation) when other sources have not been available.

Small-scale fisheries catch estimates have been triangulated and validated through official questionnaires and local experts.

Small-scale fisheries catches have been linked to environmental, economic, gender, nutrition and governance aspects in a unique transdisciplinary approach highlighting the overall contribution of small-scale fisheries to sustainable development.

Figure 4.1 Key pathways for the contribution of small-scale fisheries to the sustainable use of natural resources



Note: **a** Reference period 2013–2017.

4.2 Introduction

A substantial portion of current and future capture fisheries production is provided by small-scale fisheries, but the full extent of this contribution is poorly understood because the catch from this subsector is often excluded from, or missed, in national data collection systems and statistical programmes. This commonly occurs due to the low relative priority given to these activities, either because they are perceived to be of low importance for the national economy, or because the budget to operate these systems is directed at large-scale or highly valuable fisheries.

Other important determinants of the effectiveness of data collection and analysis are a country's human and financial resources for these efforts and its technical capacity to collect, curate and analyse the information obtained. In many instances, the dispersed, remote and sometimes informal nature of small-scale fishing means that data and statistical collection systems are unable to cover the subsector in a comprehensive manner. Fisheries may be too dispersed to track, and the data provided may often not be representative of the subsector as a whole. Moreover, the low gross value of production of many small-scale fisheries can be seen as not justifying the investment in data collection protocols at the right spatial and temporal scales or the provision of adequate training to data enumerators in sampling design and data management, resulting in data that are incomplete, not disaggregated between small-scale and large-scale fisheries subsectors, or unreliable. Furthermore, the fishers themselves may have little incentive to report catch data, especially if this requires some form of registration fees or levies on landings; this reluctance is compounded by mistrust as to how data are to be used, for example if the catch is obtained using illegal methods such as small mesh sizes.

A primary goal of the IHH study was thus to develop a comprehensive and reliable global estimate of small-scale fisheries catch based on a rigorous sample consisting of country and territory case studies (CCS) using data available at national level. Sections 4.3, 4.4 and 4.5 of this chapter describe the approach to obtain these estimates and the resulting figures, including the catch estimates from CCS as well as figures extrapolated to the global total, small-scale fisheries catch per region and economic classification, and the taxonomic composition of the global catch.

The range and importance of benefits obtained from small-scale fisheries are evident from this chapter and also the chapters on the economic, gender and nutrition dimensions (Chapters 5, 6 and 7), but they can also have impacts on the ecosystems and environments in which they occur. These impacts need to be monitored and managed to promote the contribution of small-scale fisheries to an economically, socially and environmentally sustainable future for the planet and its people.

The Sustainable Development Goals (SDGs), the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines), the Code of Conduct for Responsible Fisheries, and many other global instruments demonstrate high awareness of the need for conservation and sustainable use of aquatic ecosystems. Yet this awareness has not led to sufficient action at the global level. Moreover, unsustainable pressures on marine and inland waters from human activities, including fisheries, continue to threaten ecosystems and the benefits they generate (Jackson, Woodford and Weyl, 2016; Harrod *et al.*, 2018b; Cochrane, 2021). This situation is particularly acute in developing countries where most of the small-scale fisheries operate, and is primarily due to limited resources and weak institutional and technical capacities to effectively manage fisheries (Ye and Gutierrez, 2017).

The First Global Integrated Marine Assessment reported that all parts of the ocean have been affected to some extent by human impacts such as increasing use of ocean spaces, species introductions, capture fisheries and climate change (Bernal *et al.*, 2016). Inland water systems are under similar pressures, as well as from sectors using freshwater such as agriculture, municipal use, industry and others (Harrod *et al.*, 2018b; Kao *et al.*, 2020).

Small-scale fisheries vary in their technological and operational scale and complexity, and Section 4.6 explores how this relates to the catch of these fisheries. Some of the variation may be explained by differing economic and technological conditions found between developed and developing countries; otherwise, it may be due to species targeted as well as geographic, habitat, ecological or economic factors. The strongest variations in catch according to technology and operational scale were found between marine and inland fisheries, therefore the analysis of these two subsectors is treated separately.

Small-scale fisheries are often assumed to have predominantly inconsequential environmental interactions compared to large-scale fisheries. Yet even if the impacts of individual small-scale fisheries are limited, these may still be significant in aggregate, when considering the number of fishers at local or national scales, the size of the fishing fleet operating in a given area, or the vulnerability of a species or habitat with which the fisheries interact. Indeed, research efforts focused on the small-scale subsector have illustrated that the combined impacts of small-scale fisheries on the environment can be substantial, widespread and in some cases greater than those of large-scale fisheries (e.g. Shester and Micheli, 2011; Jones *et al.,* 2018). Section 4.7 of this chapter provides a synopsis of the main interactions that small-scale fisheries can have with their environment as well as the drivers of these, based on an extensive review of scientific, peer-reviewed literature. It then examines the severity of the impacts of these interactions, the data and monitoring needs related to understanding them, and practical solutions to mitigate them.

The pervasive (and often synergistic) cumulative impacts of human activities frequently result in environmental, social and economic changes to ecosystems worldwide. These changes in turn create adverse pressures on social-ecological systems, leading to complex dynamics that reduce the ability to provide accurate forecasts of climate change impacts (Bindoff *et al.,* 2019; Polasky *et al.,* 2020). Awareness of the impacts of climate change has increased rapidly in recent decades, and they are now mostly recognized as one of the major drivers of social-ecological system change. Warming of the atmosphere and oceans, sea level rise, increased frequency and severity of extreme events and other consequences of climate change have been causing substantial changes in the distribution, abundance and life cycles of fishery resources across the globe (Paukert *et al.,* 2017; Barange *et al.,* eds., 2018; Phillips and Pérez-Ramírez, eds., 2018; Free *et al.,* 2019), most often resulting in detrimental socioeconomic impacts (Sumaila *et al.,* 2011; Free *et al.,* 2019). Section 4.8 draws on a scientific literature review to highlight the current challenges for global small-scale fisheries in light of these impacts, and some current strategies that could be directed to address them.

4.3 Small-scale fisheries production

4.3.1 Background

Statistics on the small-scale fisheries subsector are typically gathered through national fisheries data collection systems. These systems are frequently based on vessel or fisher registrations, logbooks, sampling or enumeration of port landings and/or periodic sample surveys. These may also be linked to, or complemented by, broader agriculture sector or national statistical systems (e.g. household-based surveys).

There are isolated examples where community-based data collection programmes have significantly improved the knowledge base of data-poor fisheries, thus legitimizing this information to inform co-management processes (Ticheler, Kolding and Chanda, 1998; Schroeter *et al.,* 2009; Gutierrez, 2017). In general, these programmes are successful when they target valuable and/or low-mobility resources such as lobster or abalone; in addition, they require well-functioning local institutions (Defeo *et al.,* 2014; Méndez-Medina *et al.,* 2020). More typically, as a result of the challenges outlined in the previous section, substantial areas of small-scale fisheries are excluded or overlooked by national fisheries data collection systems and statistical programmes. In these cases, not only are catch and fishing effort rarely accounted for, but other important information that can be used to inform management and policies is also missed (e.g. size data, biological parameters, fleet and gear characteristics). Selecting which fisheries to monitor may also be a policy choice, informed by the need to focus limited resources for data collection on priority economic areas within fisheries, or by the fact that the costs of collecting small-scale fisheries data might not be justified in terms of the value of the catch. While understandable, the result is a tendency to systematically overlook the scope and scale of small-scale fisheries and their contributions to fish and food supply (Bennett *et al.,* 2021; Simmance *et al.,* 2021; also see Box 4.1).

The inland fisheries subsector is perhaps the most extreme example of this, as it is almost entirely small-scale. In fact, 99 percent of total inland capture production comes from small-scale fisheries, as seen in this study as well as in Funge-Smith (2018) and Funge-Smith and Bennett (2018). Furthermore, inland fisheries are most often remote, sparse and seasonal, thus involving more time (and cost) to cover a representative sample of the catches for a particular region. The challenges of collecting reliable information and statistics on the inland fisheries subsector have been extensively reviewed (Mills *et al.,* 2011; Welcomme, 2011; Bartley *et al.,* 2015; Funge-Smith, 2018). In general, the majority of national inland fisheries monitoring systems largely focus on fisheries and locations where catch volumes are significant (e.g. reservoirs, large natural waterbodies, or large trap fisheries). The dispersed catches from smaller fisheries and extensive floodplain fisheries are either ignored or estimated using crude approximation methods. As a result, inland catches are particularly under-reported – typically with no accurate estimates of fishing effort – and the contributions to livelihoods and local economies are often invisible (Lynch *et al.,* 2016).

4.3.2 Previous efforts to estimate small-scale fisheries catch

There have been periodic efforts to estimate small-scale fisheries catch to draw attention to its regional or global importance. These have attempted to partition aspects of capture fisheries into the contributions of small-scale and large-scale fisheries (discussed in Chapter 3), including several regional-level studies, but with fewer attempts to estimate global small-scale fisheries catch (Table 4.1).

Chuenpagdee *et al.* (2006) developed a database of 140 national marine small-scale fisheries using a mixture of published official information and

Box 4.1

Challenges of data collection in non-vessel-based small-scale fisheries

Although fishing is often associated with the use of a boat, there are numerous examples around the world of small-scale fisheries where fishers access the resource by hand and on foot. These "foot fisheries" typically are found in shallow waters in swamps, streams and lakes, or in estuaries, beaches, tidal flats and coral reefs. Activities include gleaning (picking up aquatic animals and plants) or fishing using such gear as cast nets, box or fence traps, hook and line, and spears. These activities may be occasional, undertaken as part of other daily routines, or seasonal (i.e. when there is an abundance of aquatic resources), such as during spring tides, flood recessions and seasonal migrations. They may also involve some or all members of the household: the elderly, women, children, youth and men (see Chapter 6 on gender). The diversity of locations, fishing methods and species, coupled with the occasional or seasonal nature of the activities, are challenges for systematic collection of catch data. At best it is usually possible to gain only an approximate idea of how much activity is taking place and the amount of catch that is produced. The informal nature of these fisheries also means that investment in comprehensive data collection systems is typically seen as generating little benefit to the state, as there is little prospect of revenue and rarely any formal management of the fisheries. Yet, they often provide important benefits to marginalized populations in terms of food security and nutrition, livelihoods, well-being, and other development-related issues.

In places where foot fisheries are most prevalent, periodic sample surveys may be undertaken, and these may also be linked to focus group reports or other community-based data collection programmes. Nevertheless, these fisheries, in both marine and inland waters, are still overlooked by systematic fisheries data collection and reporting systems, and thus their roles and contributions are missing from national accounts of fisheries. Although the volume of catch they produce might be considered relatively low at national levels, these fisheries provide valuable nutrition and dietary diversity at household level and may aggregate to significant amounts in some areas, for example in Small Island Developing States or around inland waterbodies.[a] Equally important, foot fisheries often represent the only or predominant source of animal protein and/or livelihoods for some coastal and inland communities. Cost-effective and preferably co-produced (or participatory) sampling protocols involving local fisheries communities are particularly needed to improve understanding of this elusive small-scale fishing activity.

Figure A Woman foot fisher using a cast net in a shallow river in Northern Thailand, and her catch. This type of catch is rarely if ever formally reported

Box 4.1 Cont

Figure B Reef gleaning in Timor-Leste. Small invertebrates are gathered at low tide on the coral reef flats close to the house

Note: **a** Bell, J.D., Kronen, M., Vunisea, A., Nash, W.J., Keeble, G., Demmke, A., Pontifex, S. & Andréfouët, S. 2009. Planning the use of fish for food security in the Pacific. *Marine Policy*, 33(1): 64–76; Thomas, A., Mangubhai, S., Fox, M., Meo, S., Miller, K., Naisilisili, W., Veitayaki, J. & Waqairatu, S. 2021. Why they must be counted: significant contributions of Fijian women fishers to food security and livelihoods. *Ocean & Coastal Management*, 205: 105571; O'Meara, L., Cohen, P.J., Simmance, F., Marinda, P., Nagoli, J., Teoh, S.J., Funge-Smith, S., Mills, D.J., Thilsted, S.H. & Byrd, K.A. 2021. Inland fisheries critical for the diet quality of young children in sub-Saharan Africa. *Global Food Security*, 28: 100483.

other sources. The authors used extrapolation and estimation methods to estimate the catch of global small-scale fisheries. They concluded that marine small-scale fisheries catch accounted for 25–33 percent (21 million tonnes) of total global marine fisheries catch in 2000.

In a decade-long process, the Sea Around Us (SAU) initiative conducted a project to estimate catch for marine small-scale fisheries (defined as commercial plus subsistence), using the FAO FishStat global capture fisheries database as a basis and augmenting or allocating figures to estimate small-scale fisheries catch. These adjustments to the FAO FishStat data were based on local expert input as well as applied assumptions, e.g. by projecting forward anchor values of small-scale fisheries catches for years where data were available (Zeller *et al.,* 2016). A recent update of the SAU database resulted in an estimate for the marine small-scale fisheries subsector of roughly 28 percent (27.4 million tonnes, including commercial and subsistence) of the total global capture production as reported by FAO for 2018.

The Hidden Harvest study (World Bank, 2012) was another attempt to estimate small-scale fisheries catch. This study used data from 17 developing countries (representing over half of the world's fishworkers) and other supporting literature and information to derive a global picture of inland and marine small-scale fisheries, which was then contrasted with data from large-scale fisheries. Unlike the above-mentioned approaches, it also incorporated employment, social and economic indicators and included subsistence fishing and pre- and post-harvest activities for both marine and inland fisheries. The study yielded an estimate for marine and inland small-scale fisheries catch of roughly 46 percent (48 million tonnes) of the total global capture fisheries catch, using the latest available data in the period 2004–2007.

According to FAO FishStat data, global inland fisheries catch was 12.1 million tonnes in 2019, representing 12.2 percent of total global capture fisheries production. Inland fisheries are predominantly small-scale in nature, but there are a few larger-scale inland fisheries that may also make a contribution to livelihoods and food security and nutrition (Funge-Smith and Bennett, 2018). Several studies (mostly based on modelling approaches) that compared official catch statistics with case studies have concluded that inland fish catches could be 0.3 to 5.0 times higher than official reports (World Bank, 2012; Bartley *et al.,* 2015; Fluet-Chouinard, Funge-Smith and McIntyre, 2018; Ainsworth, Cowx and Funge-Smith, 2021).

4.4 Approach to estimating catch data in the IHH study

A key goal of the IHH study was to develop global estimates for small-scale fisheries catch based on a representative sample of 58 CCS, 38 for inland and 52 for marine fisheries, accounting for 63 percent and 69 percent of the total global catch respectively, as estimated by FAO in 2020 (Annex A). For the marine subsector, the catch estimates derived from the CCS were then used as inputs for an extrapolation model to generate global estimates of small-scale fisheries catch. For the inland subsector, the data gaps for catches of non-CCS countries and territories were filled using FAO FishStat inland capture data (FAO, 2020a; see Annex A).

In order to capitalize on national data and information for catch estimates, one of the main objectives of the IHH study was to use local experts for the CCS. These CCS experts collated and integrated available information on catch from different sources (including official national data, research surveys, peer reviewed and grey literature, and expert knowledge) to produce disaggregated estimates of small-scale and large-scale fisheries catch, improving as much as possible the coverage and accuracy of the often under-reported data from small-scale fisheries. For those few countries where small-scale fisheries catch data were either lacking, not accessible, or not disaggregated between small and large scales, CCS experts used suitable sampling protocols to collect catch data and provide national estimates (see Annex A).

While in some cases national statistics were amended or augmented based on these sampling protocols, grey/scientific literature or expert input, it is recognized that the results were still often incomplete and that a more accurate account of small-scale fisheries catch at the national level will require substantially more resources than were available for this study. Typically, this would involve routine monitoring programmes targeted at deriving accurate estimates of small-scale fisheries catch. However, this is probably unrealistic, as the costs to collect such data for remote, isolated coastal fisheries with low catch volume, or dispersed inland fisheries in waterbodies and rivers, are too high to be sustained. Periodic sampling assessments of representative small-scale fisheries coupled with robust extrapolation approaches would be more feasible and could provide adequate information for monitoring the status of small-scale fisheries catch and other necessary information aimed at informing management and policymaking.

Overall, the CCS estimates of total small-scale fisheries catch tended to rely mostly on official statistics available within a given country: the percentage of total small-scale fisheries catch directly obtained from official data was 68 percent and 88 percent for marine and inland subsectors, respectively. The rest of the catch data were obtained from multiple sources, including primary data collection in some cases, various estimation methodologies, and/or scientific and grey literature. CCS experts were asked to provide and justify an estimate of the proportion of the total small-scale fisheries catch covered by their data collection or collation approach. Their estimates of the percentage of catch covered in their datasets was variable, with an average of 89 percent, a minimum of 21 percent and a maximum of 100 percent. These experts also confirmed that most of the small-scale fisheries catches that were not covered within their studies were associated with non-vessel-based fisheries or with those operating in remote and isolated areas. Final national CCS estimates of small-scale fisheries catch were corrected according to the coverage estimates provided by the CCS experts to raise them to 100 percent coverage. As a result of this, 2.1 million tonnes overall were added to the marine small-scale fisheries catch estimates from the CCS (corresponding to 10 percent of the total final estimate) and 0.3 million tonnes to the inland small-scale fisheries catch estimates (3 percent of the final total).

4.4.1 Triangulation of catch estimates with other sources

As part of the data validation process (Annex A), catch estimates from the CCS were triangulated with two other sources: (i) ad hoc questionnaire responses, which provided official national-level total catch data disaggregated by small-scale and large-scale fisheries; and (ii) the FAO FishStat global capture production database (FAO, 2020a), which provides national-level total catch data reported by FAO Members on an annual basis (Table 4.2; Annex A).

Ad hoc questionnaire responses

More than 100 ad hoc questionnaire responses were received, of which 37 were from case study countries and territories (16 for inland and 21 for marine fisheries). For the marine subsector, there were negligible overall differences between aggregated small-scale fisheries catch estimated from the CCS and those reported in the ad hoc questionnaire (ca. 370 000 tonnes, Table 4.2). However, the differences between the two sources were substantial for some individual countries.

In comparing the two sources, it is important to note that CCS catches were provided at a higher level of resolution and detail (i.e. at species level, associated with gear, fleets, landed economic value and many other attributes) than the ad hoc questionnaire, and with a high level of transparency in data sources and/or estimation procedures. There are several

Table 4.1 Summary of other initiatives aimed at estimating global small-scale fisheries (SSF) catch

Study	Year	Working definition of SSF and approach used
Bottom-Up, Global Estimates of Small-Scale Marine Fisheries Catches	2000	Study assumed small-scale fisheries activities in each country take place within "inshore fishing areas", defined as shelf area ranging from shoreline to 50 km in distance or 200 m in depth, whichever comes first.
Sea Around Us Database	2013–2017	Study covered commercial small-scale fisheries (named artisanal) plus subsistence fisheries. FAO FishStat global capture production database was used as a basis, with figures augmented or allocated to estimate small-scale fisheries catch.
Hidden Harvest	2004–2007	Study used national definitions of small-scale fisheries and compiled information from 17 case studies to derive a global picture of inland and marine capture fisheries.
Global hidden harvest of freshwater fish revealed by household surveys	Range: 2008 (median year)	Study only covered inland fisheries, with all assumed to be small-scale fisheries. A modelling approach built on household expenditure and consumption surveys from 42 countries was used. An extrapolation model was developed to derive a global estimate.
A review of major river basins and large lakes relevant to inland fisheries	78% of catch data from studies during 2000–2019; range: 1960–2018 for rivers, 1980–2018 for lakes	Study only covered inland fisheries, with all assumed to be small-scale fisheries. Using a river basin approach, the reported catches for different fishery components were compiled to give a basin estimate. FAO FishStat inland fisheries catch data for countries outside of the basins were added to give a final value.
Illuminating Hidden Harvest	2013–2017	Country and territory case study (CCS) experts used the national (legal and/or operational) definitions of small-scale fisheries. A standardized matrix approach was used to understand specific characteristics of small-scale fisheries that contribute to their scale of operation. Data were compiled from 58 CCS, representing 68% of global capture production. Although most data came from official sources (68% and 88% for marine and inland, respectively), other data and approaches were considered. Catches from those 58 countries were then extrapolated to global levels.

Notes: **a** Chuenpagdee, R., Liguori, L., Palomares, M.L.D. & Pauly, D. 2006. *Bottom-up, global estimates of small-scale marine fisheries catches.* Fisheries Centre Research Reports, Vol. 14 No. 8. Vancouver, Canada, University of British Columbia. **b** Zeller, D., Palomares, M.L.D., Tavakolie, A., Ang, M., Belhabib, D., Cheung, W.W.L., Lam, V.W.Y. *et al.* 2016. Still catching attention: *Sea Around Us* reconstructed global catch data, their spatial expression and public accessibility. *Marine Policy,* 70: 145–152. **c** World Bank. 2012. *Hidden harvest: the global contribution of capture fisheries*. Washington, DC.

Input data/information and extrapolation	Catch (million tonnes) [proportion of global capture]			Reference
	Marine SSF	Inland SSF	Total SSF	
~84 country case studies with catch data available; extrapolation to 140 countries using a modelling approach	21 [25–33%]	n.a	n.a	Chuenpagdee *et al.*, 2006[a]
204 countries and territories; based on FAO FishStat catch data and adjusted or reallocated for catch elements not reported in official data	27.4 [28%]	n.a.	n.a.	Zeller *et al.*, 2016[b]
17 developing and 11 developed countries extrapolated to global level, using fixed assumptions	34 [38%]	14 [99%]	48 [46%]	World Bank, 2012[c]
Consumption data from 42 countries extrapolated to 38 additional countries (total 80), representing 93.4% of global catch reported to FAO in 2008	n.a.	16.6 [17.3%]	n.a.	Fluet-Chouinard, Funge-Smith and McIntyre, 2018d., 2018[d]
Global estimate compiled from research data of fisheries within a basin for major hydrological basins; FAO FishStat data used for countries that lie outside major basins	n.a.	15.2 [15.8%]	n.a.	Ainsworth, Cowx and Funge-Smith, 2021[e]
CCS in 58 countries and territories and extrapolated to 180 countries and territories; for inland fisheries, extrapola-tion was not feasible and FAO FishStat data were used for gap filling	25.1 [31.2%]	11.8 [99.7%]	36.9 [40%]	IHH study

Notes cont: **d** Fluet-Chouinard, E., Funge-Smith, S. & McIntyre, P.B. 2018. Global hidden harvest of freshwater fish revealed by household surveys. *Proceedings of the National Academy of Sciences of the United States of America,* 115(29): 7623–7628. **e** Ainsworth, R., Cowx, I.G. & Funge-Smith, S.J. 2021. *A review of major river basins and large lakes relevant to inland fisheries.* FAO Fisheries and Aquaculture Circular No. 1170. Rome, FAO. https://doi.org/10.4060/cb2827en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explanations for the differences in catch volume between the two sources: (i) CCS experts were able to uncover small-scale fisheries catches beyond those reported officially; (ii) CCS experts were not able to have full access to official catch records; and (iii) definitions of small-scale fisheries between CCS experts and official sources might have differed. A follow-up country-by-country analysis of catch volumes and the reasons for data gaps outlined above is needed in order to inform national-level processes and policies aimed at improving information on small-scale fisheries catch.

FAO FishStat global capture production database

The comparison of CCS catch data with FAO FishStat capture production data (FAO, 2020a) for small-scale and large-scale fisheries catches together showed that, in aggregate, total catch estimates were broadly comparable between the two sources, with total estimates from CCS being 8 percent higher than FAO for inland and 2 percent higher for marine fisheries, corresponding to an absolute difference of 0.5 million tonnes and 1.3 million tonnes, respectively. However, direct comparison between the two data sources is problematic, especially for marine small-scale fisheries, as the FAO FishStat data are not disaggregated between small-scale and large-scale fisheries.

In general, any country-specific differences between data on CCS and FAO FishStat total catch (Table 4.2) can be attributed to one or a combination of the following: (i) deficiencies in coverage in any of the sources for either small-scale fisheries or large-scale fisheries; (ii) more up-to-date information included in CCS data (some countries have not reported data to FAO in several years); (iii) different classifications of marine and inland fisheries (especially those in estuarine and other brackish waters); (iv) different data manipulation and estimation processes; (v) different definitions of what constitutes a small-scale fishery; and, to a lesser degree, (vi) inclusion of recreational fisheries in FAO data but not in CCS (as per IHH protocol).

This triangulation exercise was useful to understand how CCS catch data compared to officially reported catch data, as well as to understand some of the reasons for the discrepancies outlined above (including outliers, incomplete or inaccurate data, etc.). However, it is acknowledged that the accuracy of the CCS total catch figures depended largely on the availability and accessibility of high-quality data, the coverage of disaggregated catch data (i.e. inclusion of subsistence and non-vessel-based activities, foot fishers, etc.), and the extent to which there was a clear small-scale fisheries definition within the countries. Other factors that affected the CCS data coverage were the limited time and resources available to data collation by CCS teams, and the inability in most cases to carry out primary data collection to fill gaps in coverage.

Overall, the CCS were able to capitalize on the more detailed data available at national level to provide disaggregated catch estimates for small-scale fisheries

Table 4.2 Summary of catch volumes by data source for marine and inland fisheries (average annual values, 2013–2017)

Data source	Small-scale fisheries catch		Large-scale fisheries catch		Total catch	Countries and territories
	Million tonnes	%	Million tonnes	%	Million tonnes	N
Marine						
CCS	20.15	36.0	35.84	64.0	55.99	52
Comments: These estimates come from 52 country and territory case studies (CCS) carried out in a representative sample (i.e. roughly 69% of global marine capture production, according to FAO FishStat data).						
IHH global figures	25.10	31.2	55.23	68.8	80.33	152
Comments: Small-scale fisheries estimates for IHH global figures come from a prediction model that used the CCS data and predictors to extrapolate small-scale fisheries catch values for non-CCS countries and territories. The 152 countries and territories included represent > 99% of global catch according to FAO FishStat data.						
Ad hoc questionnaire	9.64	37.0	16.43	63.0	26.07	65
Comments: These estimates come from responses to an ad hoc questionnaire sent to all FAO Members and are based on official national statistics. These 65 countries and territories included some with low levels of small-scale fisheries catch, thus adding up to 9.64 million tonnes only.						
FAO FishStat, 2020[a]	na	na	na	na	79.66	241
Comments: These estimates come from official FAO catch data and are based on the official statistics and reporting processes of the countries and territories. They do not distinguish between small-scale fisheries and large-scale fisheries.						
Inland						
CCS	7.55	99.6	0.03	0.4	7.58	38
Comments: These estimates come from 38 CCS carried out in a representative sample (i.e. 63% of global marine capture production, according to FAO FishStat data).						
IHH global figures	11.78	99.7	0.03	0.3	11.81	241
Comments: IHH global estimates were obtained using CCS data and FAO FishStat data for non-CCS countries and territories (assuming 100% of catch was from small-scale fisheries). Large-scale fisheries data here come from CCS.						
Ad hoc questionnaire	3.66	97.9	0.08	2.1	3.74	47
Comments: These estimates come from responses to an ad hoc questionnaire sent to all FAO Members and are based on official national statistics.						
FAO FishStat, 2020[a]	na	na	na	na	11.27	241
Comments: These estimates come from official FAO catch data and are based on the official statistics of countries and territories. They do not distinguish between small-scale fisheries and large-scale fisheries.						

Note: **a** FAO. 2020. Fishery and Aquaculture Statistics. Global capture production 1950–2018 (FishStatJ). In: *FAO Fisheries Division*. Rome. Updated 2020. www.fao.org/fishery/statistics/software/fishstatj/enhttp://www.fao.org/fishery/statistics/software/fishstatj/en by area and species, as well as indicate the number of vessels or fishers, gear type used, time commitments, and environments where fishing takes place, among other relevant information. In addition, this catch data and the details on the nature of the fishing operations were linked to other data on landed economic value, gender, nutrition and governance. Very little or none of this type of information is routinely reported to FAO or entered into a global database.

The CCS highlight both the substantial amount of detail on small-scale fisheries already available in national data (even if coverage may be patchy), and the many challenges related to systematic and comprehensive monitoring and compilation of small-scale fisheries data at national levels.

4.4.2 Estimation of global catch

Marine catch data collected through the CCS were used as inputs to produce marine small-scale fisheries catch estimates for a total of 152 countries (Table 4.2; Annex A). This extrapolation approach could not be applied to inland fisheries due to the complexity of inland systems, which are typically driven by large seasonal and inter-annual variations, as well as the limited availability of suitable predictors (waterbody area and productivity, population engaged in full- or part-time fishing, etc.).

For non-CCS countries and territories, inland fisheries catch figures were taken from the FAO FishStat global capture production database (FAO, 2020a). This approach was justified given that most of the CCS estimates for inland fisheries were primarily based on official data, with the general assumption that close to 100 percent of inland catch would come from small-scale fisheries (as confirmed by the available CCS data).

However, the estimation of global large-scale fisheries catch (particularly marine fisheries) provided in this study is not considered an accurate estimate and should not be interpreted as such, but rather as a reasonable term of comparison to compute the relative contribution of small-scale fisheries to global fisheries production. As the study was focused on the small-scale fisheries subsector, there is a likelihood that the values for large-scale fisheries are underestimated.

4.5 Small-scale fisheries catch estimates

4.5.1 CCS catch estimates

The CCS catch estimates show that small-scale fisheries represent a substantial contribution to capture fisheries in the case study countries and territories (Figure 4.2, Figure 4.3, Figure 4.4, Table 4.2): marine small-scale fisheries catches added up to 20.2 million tonnes (N = 52 countries and territories), contributing 36 percent of total marine fisheries production; for inland fisheries, the small-scale fisheries catch was 7.6 million tonnes (N = 38 countries and territories), representing nearly 100 percent of total inland production. Only four CCS reported data on inland large-scale fisheries (total of ca. 30 000 tonnes); these are not common, and some of the largest have already been discontinued due to policy changes (e.g. the "Fishing Lot" fisheries of Tonlé Sap in Cambodia).

It is important to note that case study countries and territories were selected according to a series of indicators suggesting the importance of their fisheries sector, and of the small-scale fisheries subsector in particular (see Annex A). Therefore, the share of small-scale fisheries catch with respect to total catch for the CCS is expected to be higher than for the global estimates (see Section 4.5.2).

4.5.2 IHH estimates of global small-scale fisheries catch and comparisons with other studies

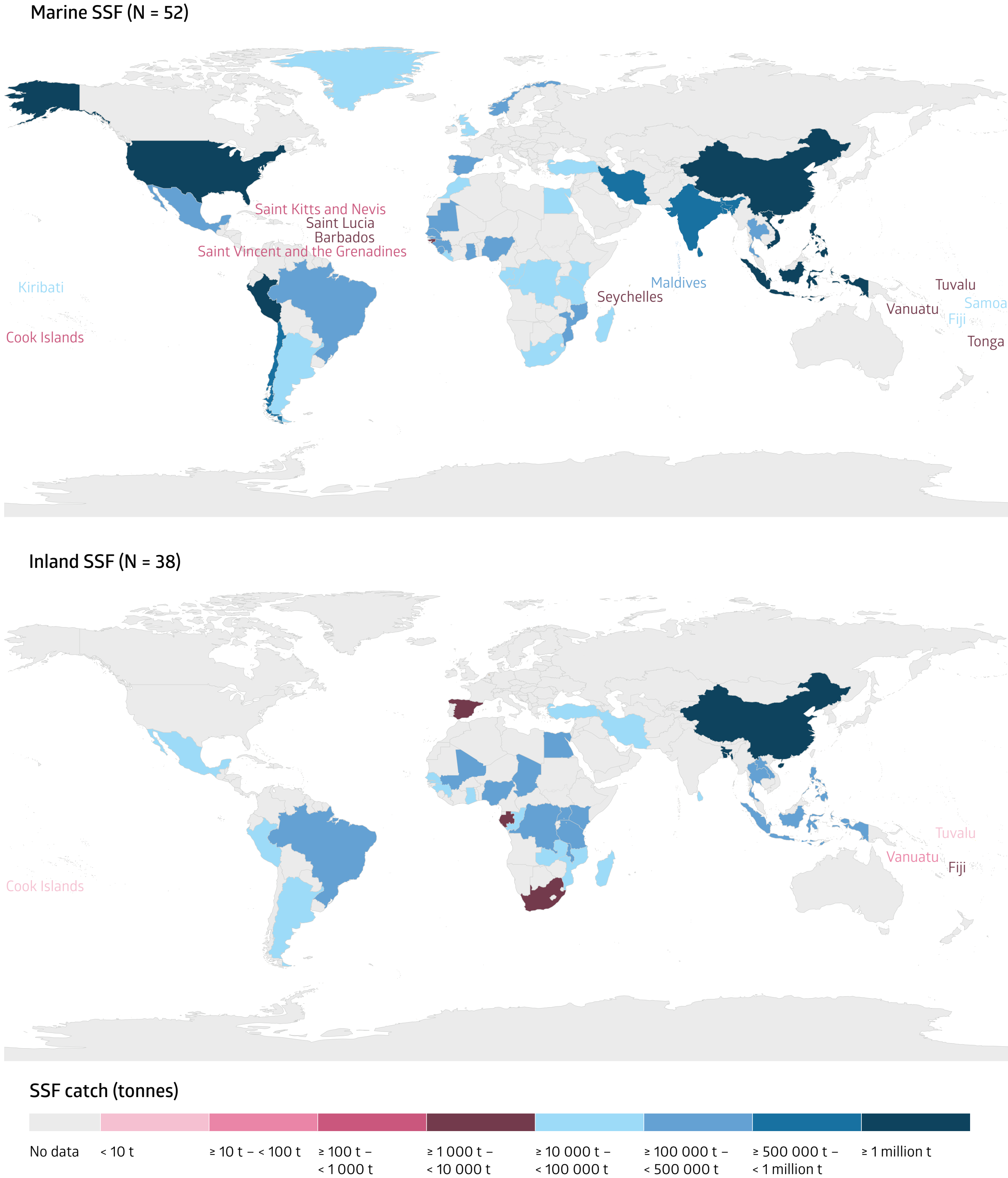
The IHH global estimates reveal that the overall small-scale fisheries catch in marine and inland waters accounts for 40 percent of the world's total capture fisheries production: 25.1 million tonnes for marine and 11.8 million tonnes for inland small-scale fisheries. This corresponds to 31.2 percent of total marine and 99.7 percent of the total inland capture production, respectively (Table 4.2).

The total marine catch from small-scale fisheries estimated by the IHH study (25.1 million tonnes) as well as the proportion of total global marine catch attributed to small-scale fisheries (31.2 percent) are in line with other studies (21–34 million tonnes and 25–38 percent, Table 4.1). The amount of inland catch identified in the IHH study is in line with FAO FishStat data (FAO, 2020a), however this strongly suggests that the CCS were unable to effectively quantify the unreported and unmonitored catch of inland small-scale fisheries.

It is challenging to make direct comparisons between global estimates of small-scale fisheries across the different studies, as time frames, definitions of small-scale fisheries and methodological approaches differ. But all studies confirm the data-limited nature of small-scale fisheries catches, underscoring the strong need to develop and implement better mechanisms for monitoring and reporting of these catches.

The IHH database identified only a small amount of inland catch from large-scale fisheries (0.03 million tonnes); likewise, FAO FishStat data were assumed to belong entirely to small-scale fisheries, with no additional large-scale fisheries identified. There are, however, examples of inland fisheries that demonstrate operational characteristics that are arguably not small-scale (see Box 4.2 for an example), and thus it is assumed that the large-scale fisheries value for inland fisheries presented in Table 4.2 is somewhat underestimated.

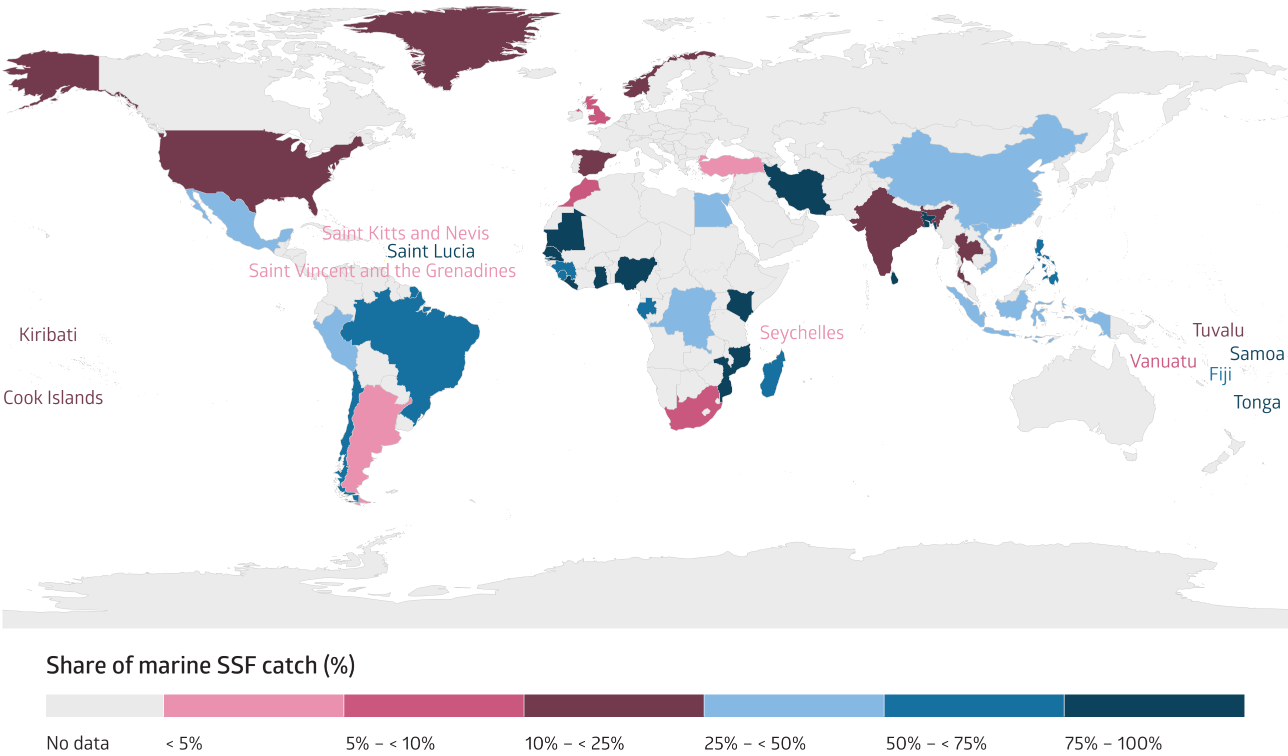
Figure 4.2 Catch ranges for marine and inland small-scale fisheries (SSF) in IHH country and territory case studies (average annual values, 2013–2017)



Source: United Nations Geospatial. 2020. Map geodata [shapefiles]. New York, USA, United Nations, modified by the authors.

Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. Final boundary between the Sudan and South Sudan has not yet been determined.

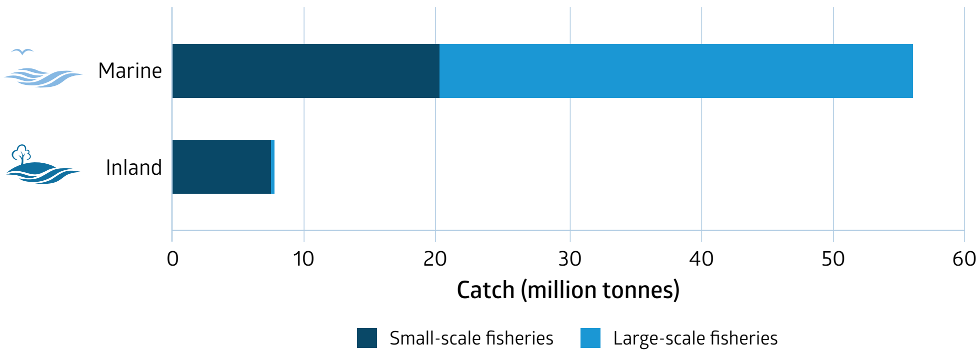
Figure 4.3 Percentage of marine small-scale fisheries (SSF) catch out of total marine catch for IHH country and territory case studies (average annual values, 2013–2017)



Source: United Nations Geospatial. 2020. Map geodata [shapefiles]. New York, USA, United Nations, modified by the authors.

Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. Final boundary between the Sudan and South Sudan has not yet been determined.

Figure 4.4 Total catch by small-scale fisheries and large-scale fisheries subsectors for marine and inland fisheries in IHH country and territory case studies (average annual values, 2013–2017)



Box 4.2

Large-scale operational characteristics in an otherwise small-scale fishery

Flooded areas are some of the most productive inland fishery environments but they are difficult to fish efficiently using active fishing gear (e.g. submerged vegetation may snag active gear such as seine nets or small trawls).

Taking advantage of the fishery bounty of the floodplains requires the use of large, passive gear types that corral and trap the fish. The use of such large trap gear types in a commercial setting is an example of how some apparently small-scale fisheries may display the operational characteristics of large-scale fisheries. The static traps have fences typically of hundreds of meters constructed to direct fish towards the trap area. The fence leads fish into the trap, which may hold 200 kg of fish and is harvested every 2 to 5 days, several times a day if a bag net is used. These are placed in seasonally inundated areas of river or lake floodplains. The gear is a large capital item that requires construction and substantial maintenance. The trap is worked by several people, typically employed by the gear owner or operated as a group for a share of profits with the gear owner. The use of this gear typically also requires the payment of an annual licence fee or is a multi-year concession, which is paid by the gear owner. Large fence trap systems are also used in the Ayeyarwaddy region in Myanmar.

Figure Large fence trap in Tonlé Sap ("Great Lake"), Cambodia

The total inland catch attributed to small-scale fisheries in the IHH database was 11.8 million tonnes, corresponding closely to the figure in the FAO FishStat global capture production database, but lower than estimates from other studies. Some previous research efforts have provided higher global estimates for inland fisheries catch (15.2–16.6 million tonnes) using consumption survey data (Fluet-Chouinard, Funge-Smith and McIntyre, 2018) or a basin catch-aggregation approach (Ainsworth, Cowx and Funge-Smith, 2021).

There are also some earlier, theoretical global yield estimates of inland fisheries based on models that used water area and assumed productivity or yield (Welcomme, 2011; Bartley *et al.*, 2015; Lymer *et al.*, 2016). While these models may give an indication of catch for individual waterbodies or subregions, they can become unreliable when trying to derive a global catch figure. For example, models based on recorded yields for different waterbodies and habitats have projected disproportionate "potential yields" for inland fisheries (e.g. 72 million tonnes in Lymer *et al.*, 2016). The authors of these studies acknowledge that their estimates are unrealistically high, primarily due to their inherent assumption that all waterbodies are fished and are equally accessible and exploited. All of these proxy methods can provide catch estimates that can then be compared with the reported catch, but without rigorous ground truthing, some methods can introduce considerable errors.

Table 4.3 Global estimates of small-scale fisheries (SSF) and large-scale fisheries (LSF) catch by geographic region (average annual values, 2013–2017)

Region	SSF catch (million tonnes)	LSF catch (million tonnes)	Total catch (million tonnes)	% SSF	% LSF
Inland					
Africa	3.03	0.03	3.06	99%	1%
Americas	0.56	0.00	0.56	100%	0%
Asia	7.76	0.00	7.76	100%	0%
Europe	0.41	0.00	0.41	100%	0%
Oceania	0.02	0.00	0.02	100%	0%
Marine					
Africa	3.14	3.13	6.27	50%	50%
Americas	5.02	11.89	16.91	30%	70%
Asia	15.69	26.53	42.22	37%	63%
Europe	0.86	12.74	13.60	6%	94%
Oceania	0.39	0.94	1.33	29%	71%
All					
Africa	6.17	3.16	9.33	66%	34%
Americas	5.58	11.89	17.47	32%	68%
Asia	23.44	26.53	49.97	47%	53%
Europe	1.28	12.74	14.02	9%	91%
Oceania	0.41	0.94	1.35	30%	70%

Due to the fragmented nature of inland fisheries catch estimates outside of the FAO FishStat database, all of these initiatives used data collected under wide-ranging time frames and different estimation or modelling methods. While this complicates direct comparison with the IHH study results, it is still possible to infer a range of plausible estimates of the degree of underestimation of global inland small-scale fisheries catch in the study.

The two most conservative estimates, from Fluet-Chouinard, Funge-Smith and McIntyre (2018) and Ainsworth, Cowx and Funge-Smith (2021), indicate that actual global inland fisheries catch could be in the order of 15.2–16.6 million tonnes. This suggests that the "hidden" inland fisheries catch not recorded in the IHH study could be between 3.4 and 4.8 million tonnes. This would translate into an additional catch of 67–95 kg/fisher/year (estimated 50.6 million inland fishers, including full-time and subsistence). The two regions where the bulk of this missing catch is most likely to occur are Africa and Asia.

Catch by region

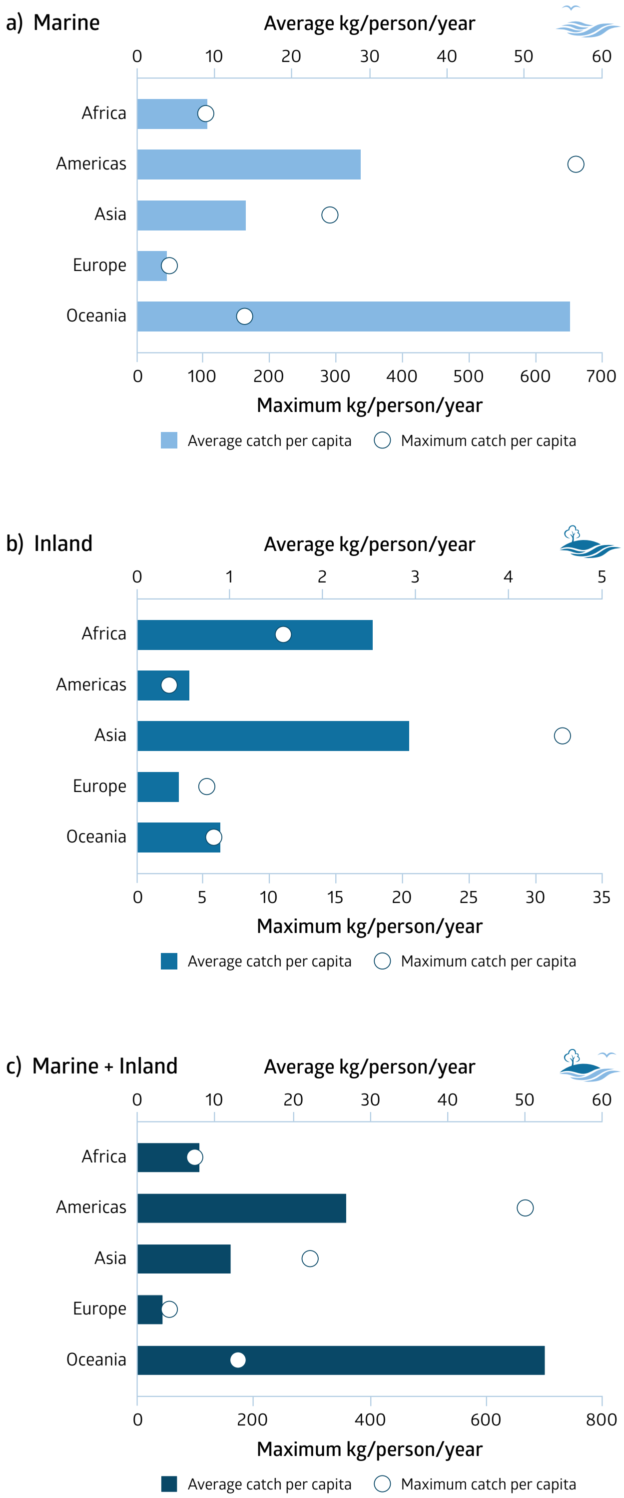
Global small-scale fisheries catch volumes demonstrate important regional differences. For instance, in the IHH study, Asia had the largest small-scale production for both marine and inland fisheries, with 23.4 million tonnes (i.e. 64 percent of the estimated global small-scale fisheries catch) (Table 4.3). This is consistent with the larger numbers of small-scale fishers found in the region (see Chapter 5). The second largest production was in Africa (6.2 million tonnes, 17 percent of global small-scale fisheries catch), with comparable catch volumes between marine and inland small-scale fisheries, due to the high number of landlocked countries in the region. In the Americas, small-scale fisheries catch represented 15 percent of global small-scale fisheries catch (5.6 million tonnes), with a substantially lower proportion of inland catch compared to marine (1:9 ratio). Total small-scale fisheries catch in Europe was relatively low (1.3 million tonnes), accounting for 5 percent of the total global small-scale fisheries catch. The total small-scale fisheries catch of Oceania was also low (0.4 million tonnes, corresponding to 1.1 percent of global small-scale fisheries catch), mostly coming from marine fisheries. This low global contribution reflects the small country and/or shelf sizes and small population sizes in the region, particularly in Small Island Developing States, limiting the number of people that can engage in small-scale fisheries. A very different picture emerges when looking at per capita small-scale fisheries catch (see subsection on small-scale fisheries catch per capita in Section 4.5.2).

When comparing proportions of small-scale and large-scale fisheries, Africa had the largest relative share of small-scale fisheries (66 percent), with the highest values found in Western and Eastern African marine fisheries (84 and 72 percent of the total, respectively), followed by Asia (47 percent). This finding confirms the high importance of small-scale fisheries in these regions, both in absolute and relative terms (Table 4.3, Figure 4.3). Overall, the proportion of small-scale fisheries catch in the Americas was 32 percent (reaching 54 percent for marine fisheries in the Caribbean), while in Oceania it was 30 percent. Besides having low catch volume, Europe also had the smallest share of small-scale fisheries, with only 9 percent.

Table 4.4 Global estimates of small-scale fisheries (SSF) and large-scale fisheries (LSF) catch by national economic classification (average annual values, 2013–2017)

Economic classification	SSF catch (million tonnes)	LSF catch (million tonnes)	Total catch (million tonnes)	% SSF	% LSF
Inland					
Least developed countries	4.74	0.03	4.77	99%	1%
Other developing countries or areas	6.55	0.00	6.55	100%	0%
Developed countries or areas	0.50	0.00	0.50	100%	0%
Marine					
Least developed countries	3.29	1.64	4.93	67%	33%
Other developing countries or areas	18.69	32.86	51.55	36%	64%
Developed countries or areas	3.12	20.74	23.86	13%	87%
All					
Least developed countries	8.03	1.66	9.69	83%	17%
Other developing countries or areas	25.24	32.86	58.10	43%	57%
Developed countries or areas	3.61	20.74	24.35	15%	85%

Figure 4.5 Global estimates of small-scale fisheries catch per capita, by region (average annual values, 2013–2017)



Notes: Average annual catch per capita (bars) and maximum catch per capita (dots in secondary axis) in small-scale fisheries (kg/person/year) by region, for (a) marine subsector, (b) inland subsector, and (c) both subsectors combined.

Catch by national economic classification

The contributions to global small-scale fisheries catch by national economic classification are outlined in Table 4.4. Least developed countries accounted for 22 percent of global small-scale fisheries catch (8.0 million tonnes), with a very high contribution from inland fisheries (59 percent of the total catch within this group). These countries also displayed the highest share of small-scale fisheries with respect to their total catch (83 percent) compared to other groups. These figures highlight the high importance of small-scale fisheries and inland fisheries in least developed countries. Other developing countries or areas produced a further 68 percent of the total small-scale fisheries catch (25.2 million tonnes), comprising 74 percent of global marine small-scale fisheries catch at 18.7 million tonnes, and 56 percent of global inland small-scale fisheries catch at 6.6 million tonnes, with 43 percent of total fisheries catch in these countries coming from small-scale fisheries. Developed countries or areas accounted for 10 percent (3.6 million tonnes) of the total global small-scale fisheries catch, primarily from marine sources (86 percent).

Small-scale fisheries catch per capita

The catch per capita (total catch divided by total population) provides a better understanding of the importance of small-scale fisheries catch for countries within a particular region. In particular, the lower total catch volumes of small countries, especially Small Island Developing States and small landlocked countries, become much more significant when viewed as catch per capita. This value does not account for imports and exports, or how the catch is distributed or utilized within a country.

The mean weight (kg) of small-scale fisheries catch per capita for the inland and marine subsectors was obtained by averaging the national values of small-scale fisheries catch per capita. The results for inland, marine and combined subsectors are broken down by region (Figure 4.5) and then by national economic classification (Figure 4.6).

Overall, marine small-scale fisheries catch per capita exceeded inland catch per capita – which was to be expected, as overall catch of inland small-scale fisheries is lower than marine small-scale fisheries. It is possible to get better estimations of the local importance of catch for local dependent populations in marine and inland small-scale fisheries, but the data requirements are considerable. This aspect has been explored in some detailed work presented in Chapters 5 and 7.

Regionally, the average total small-scale fisheries catch per capita ranged from 7.9–12.1 kg/person/year in Africa and Asia to 26.9 kg/person/year in the Americas, on up to 52.6 kg/person/year in Oceania (Figure 4.5, panel c). Europe had the lowest value at 3.4 kg/person/year. In Oceania, the small-scale fisheries catch may contribute relatively little to the global small-scale fisheries catch, but it is clearly important relative to the population size of the region. This is due primarily to its marine small-scale fisheries, for which the catch per capita stands out at over 55.8 kg/person/year. By contrast, there is only a modest contribution from inland fisheries in several individual countries in this region (mean = 0.9 kg/person/year).

The average catch per capita from marine small-scale fisheries in the Americas was over 28.8 kg/person/year, although the dispersion is very high (ranging from 0.4 to 665 kg/person/year), illustrating the high variability between countries in the region (particularly between Northern America and Central America and the Caribbean). Inland catch per capita for the region was low at 0.6 kg/person/year (ranging from 0.1 to 2.1 kg/person/year).

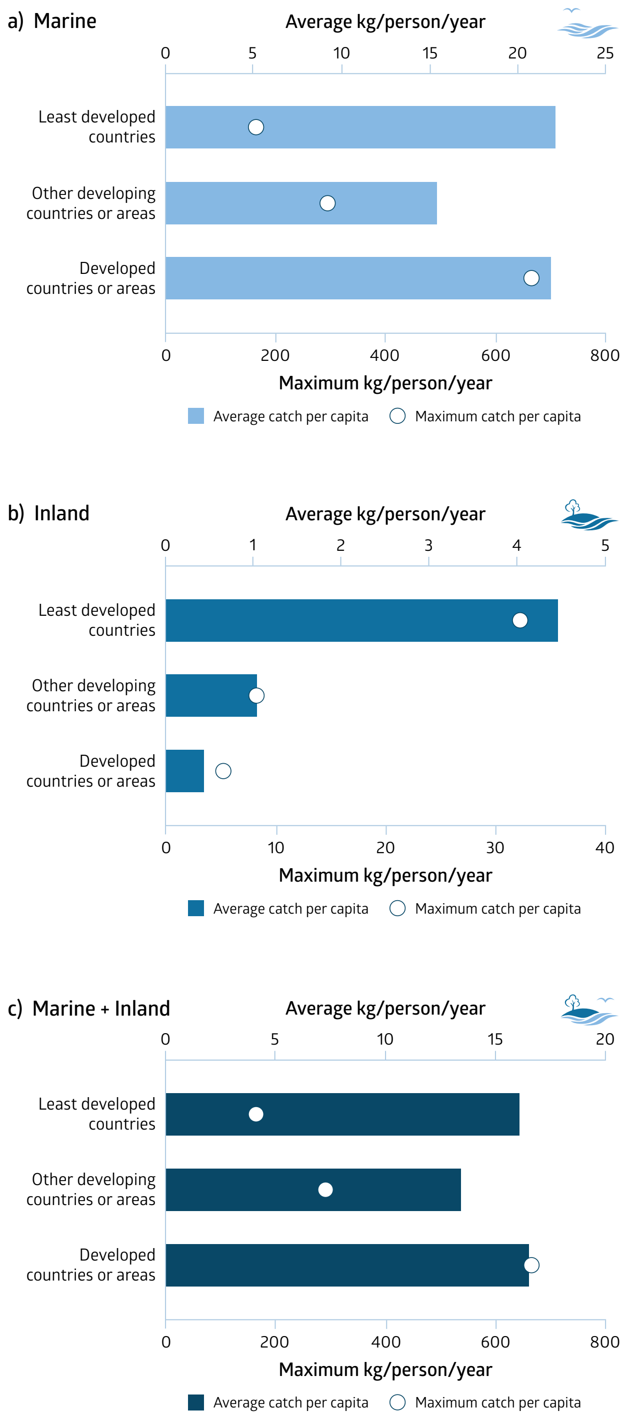
In Asia, average marine small-scale fisheries catch per capita was 14.3 kg/person/year, substantially more than inland fisheries (~2.9 kg/person/year). In Africa, the catch per capita from marine small-scale fisheries was 9.3 kg/person/year and for inland 2.6 kg/person/year.

Disaggregating catch per capita by national economic classification (Figure 4.6) reveals the higher relevance of inland small-scale fisheries in least developed countries (4.5 kg/person/year) relative to other developing countries or areas (~1.0 kg/person/year) and developed countries or areas (0.4 kg/person/year). There was far less difference in the marine catch per capita, with least developed countries and developed countries or areas having approximately similar averages of 22.1 and 21.9 kg/person/year respectively (although the spread in developed countries or areas was far higher, ranging from < 0.01 to 665 kg/person/year, versus ranges of 0.18 to 166 kg/person/year for least developed countries). The marine catch per capita in other developing countries or areas was lower, at 15.5 kg/person/year.

Functional group and taxonomic composition of small-scale fisheries catch

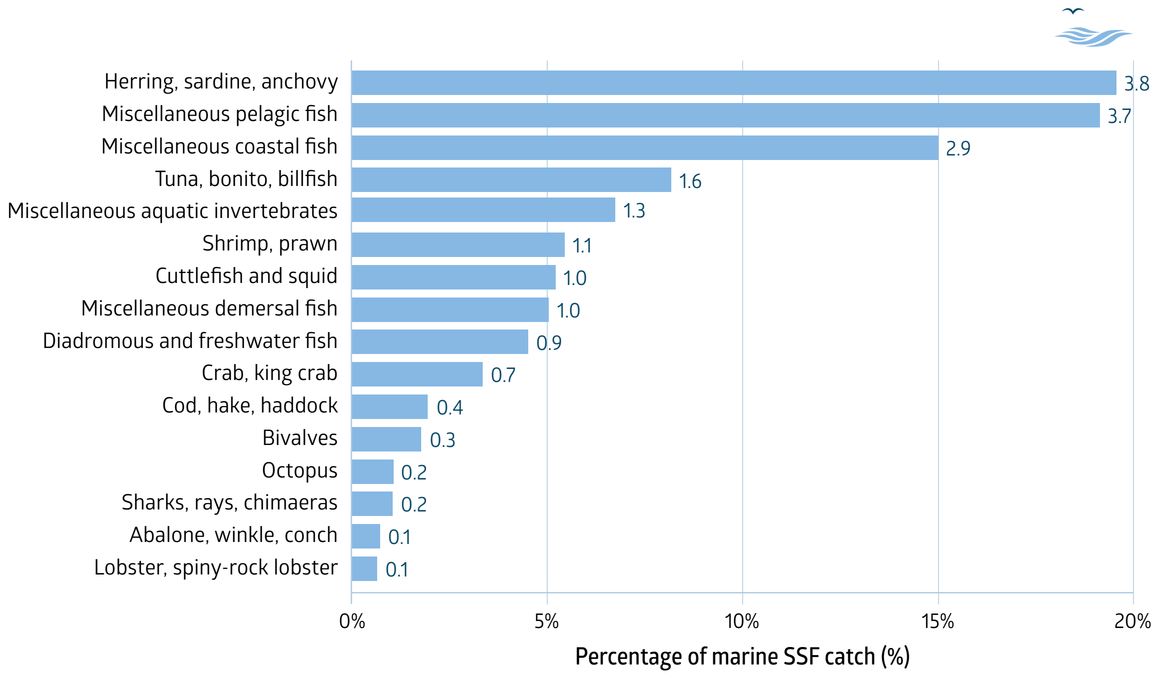
Among the estimated global small-scale fisheries catch, 77 percent (19.4 million tonnes) and 91 percent (10.7 million tonnes) were identified at least at the functional group level (see Glossary) for marine and inland small-scale fisheries, respectively (Figure 4.7 and Figure 4.8). The remaining catch could not be assigned to any specific functional group and was removed from this analysis. Among marine small-scale fisheries, the most common functional group was herring, sardine and anchovy (3.8 million tonnes, 20 percent), closely followed by miscellaneous pelagic fish (3.7 million tonnes, 19 percent) (Figure 4.7; for more details on taxonomic composition within functional groups, see Table 4.5). Most small pelagic species tend to be quite resilient to fishing, but may be more highly influenced by climate factors. Importantly, these species are also less dependent upon coastal habitat quantity and quality for their recruitment and productivity. Miscellaneous coastal fish was the third most common group (2.9 million tonnes, 15 percent) followed by tuna, bonito and billfish,

Figure 4.6 Global estimates of small-scale fisheries catch per capita, by national economic classification (average annual values, 2013–2017)



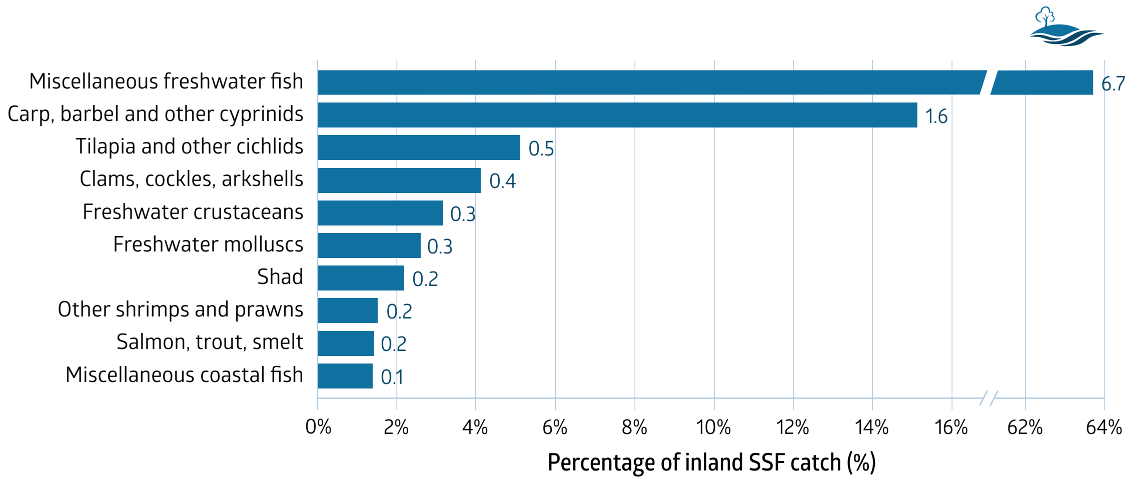
Notes: Average annual catch per capita (bars) and maximum catch per capita (dots in secondary axis) in small-scale fisheries (kg/person/year) by national economic classification, for (a) marine subsector, (b) inland subsector, and (c) both subsectors combined.

Figure 4.7 Global estimates of percentage of marine small-scale fisheries (SSF) catch by functional group. Numbers on bars represent catch volumes in million tonnes (average annual values, 2013–2017)



Notes: Graph represents 77 percent of estimated global marine small-scale fisheries catch. The remaining 23 percent was not associated to any specific functional group. Functional groups contributing < 1 percent are not shown.

Figure 4.8 . Global estimates of percentage of inland small-scale fisheries (SSF) catch by functional group. Numbers on bars represent catch volumes in million tonnes (average annual values, 2013–2017)



Notes: Graph represents 91 percent of estimated global inland small-scale fisheries catch. The remaining 9 percent was not associated to any specific functional group. Functional groups contributing < 1 percent are not shown.

Table 4.5 Main families (contribution > 5 percent) within the top eight and top three functional groups for marine and inland small-scale fisheries (SSF), respectively, in IHH country and territory case studies (average annual values, 2013–2017)

Functional group	Family	Total SSF catch (tonnes)	% Catch within functional group
Marine SSF			
Herring, sardine, anchovy	Clupeidae	2 425 843	72%
	Engrauliadae	923 949	27%
Miscellaneous pelagic fish	Carangidae	1 280 883	40%
	nei	888 806	28%
	Scombridae[a]	553 949	17%
	Stromateidae	202 719	6%
Miscellaneous coastal fish	Sciaenidae	610 194	26%
	Nemipteridae	288 190	12%
	Serranidae	211 958	9%
	Synodontidae	154 832	7%
	Mugilidae	147 116	6%
	Sparidae	144 171	6%
Tuna, bonito, billfish	Scombridae	1 288 677	96%
	Istiophoridae	25 494	2%
	Xiphiidae	10 642	1%
Miscellaneous aquatic invertebrates	nei	678 978	56%
	Squillidae	140 395	12%
	Rhizostomatidae	86 750	7%
	Ulmaridae	82 085	7%
Shrimp, prawn	Penaeidae	455 599	50%
	Sergestidae	240 808	26%
	nei	163 134	18%
Cuttlefish and squid	Ommastrephidae	364 007	45%
	Sepiidae, Loliginidae, Sepiolidae	353 189	44%
	nei	93 342	12%
Miscellaneous demersal fish	Trichiuridae	568 260	64%
	Muraenesocidae	205 097	23%
Inland SSF			
Miscellaneous freshwater fish	nei	1 736 617	46%
	Latidae	331 797	9%
Carp, barbel and other cyprinids	Cyprinidae	819 128	100%
Tilapia and other cichlids	Cichlidae	445 291	100%

Note: **a** Only genera included in this category are *Rastrelliger* and *Scomber*. Other genera of the Scombridae family are within the tuna, bonito and billfish functional group.

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which accounted for 1.6 million tonnes (8 percent). The next three groups were all invertebrate groups that were also caught in quantities over one million tonnes, namely miscellaneous aquatic invertebrates (1.3 million tonnes, 7 percent), shrimp and prawn (1.1 million tonnes, 5 percent) and cuttlefish and squid (1.0 million tonnes, 5 percent). Miscellaneous demersal fish accounted for a further 1.0 million tonnes in total (5 percent). Demersal species tend to be more habitat-dependent and may also be less resilient to overfishing or habitat degradation. Diadromous and freshwater fish appeared within the data for marine small-scale fisheries (0.9 million tonnes, 5 percent) as well as many fisheries operating in estuarine areas containing both marine and inland species, as a result of how CCS experts classified their fisheries (e.g. marine, inland or brackish). The remaining functional groups accounted for 2.1 million tonnes (11 percent of global marine small-scale fisheries catch identified at functional group level).

For the inland subsector (Figure 4.8), the most common functional group was, by far, miscellaneous freshwater fish at 6.7 million tonnes (63 percent) followed by carp, barbel and other cyprinids (1.6 million tonnes, 15 percent) and tilapia and other cichlids (0.5 million tonnes, 5 percent).

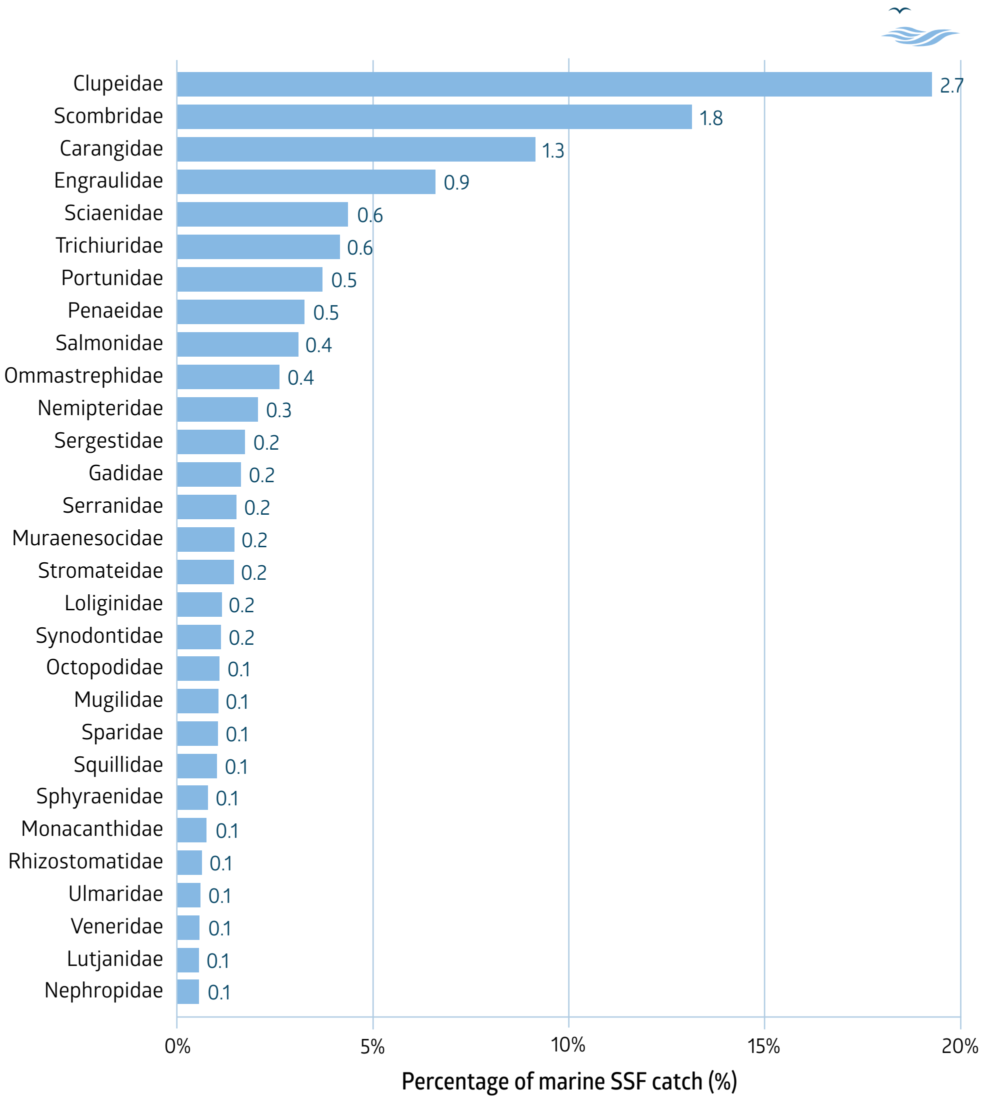
While gap filling and extrapolation were conducted at the functional group level to obtain global small-scale fisheries catch estimates, CCS data offered a finer taxonomic resolution of a subsample of the catch. In fact, 69 percent of this data was identified at family level at least for marine small-scale fisheries (a total of 14.0 million tonnes) and 41 percent for inland small-scale fisheries (3.1 million tonnes), while 60 percent and 38 percent, respectively, were identified down to species level. More detailed taxonomic composition of the catch within the main functional groups, as shown in Table 4.5, is critically important for improved fisheries management as well as to understand the economic and nutritional value of the catch.

It is important to note that, for inland fisheries, most of the finer taxonomic resolution data came from African CCS, and therefore the picture provided by CCS data is biased towards this region. In fact, 56 percent of inland catch from African CCS was identified at family level, against only 30 percent and 27 percent for Asia and the Americas respectively. For Europe, the inland small-scale fisheries catch identified at family level was 100 percent and for Oceania it was 98 percent, although both regions had very low catch volumes overall.

For marine fisheries, the information on taxonomic composition of small-scale fisheries catch was more balanced across regions, with the proportion of small-scale fisheries catch identified at family level ranging between 60 percent and 76 percent, except for Oceania, where it was only 9 percent.

Overall, within the subsample of catch data from CCS that was identified at family level, the most represented families for marine fisheries were Clupeidae (e.g. herring and sardine), Scombridae (e.g. mackerel, tuna and

Figure 4.9 Percentage of marine small-scale fisheries (SSF) catch by taxonomic family for IHH country and territory case studies. Numbers on bars represent catch volumes in million tonnes (average annual values, 2013–2017)



Notes: Graph represents 69 percent of total marine small-scale fisheries catch from IHH country and territory case studies (14 million tonnes). The remaining catch was not identified at this or lower taxonomic level. Families contributing < 1 percent are not shown.

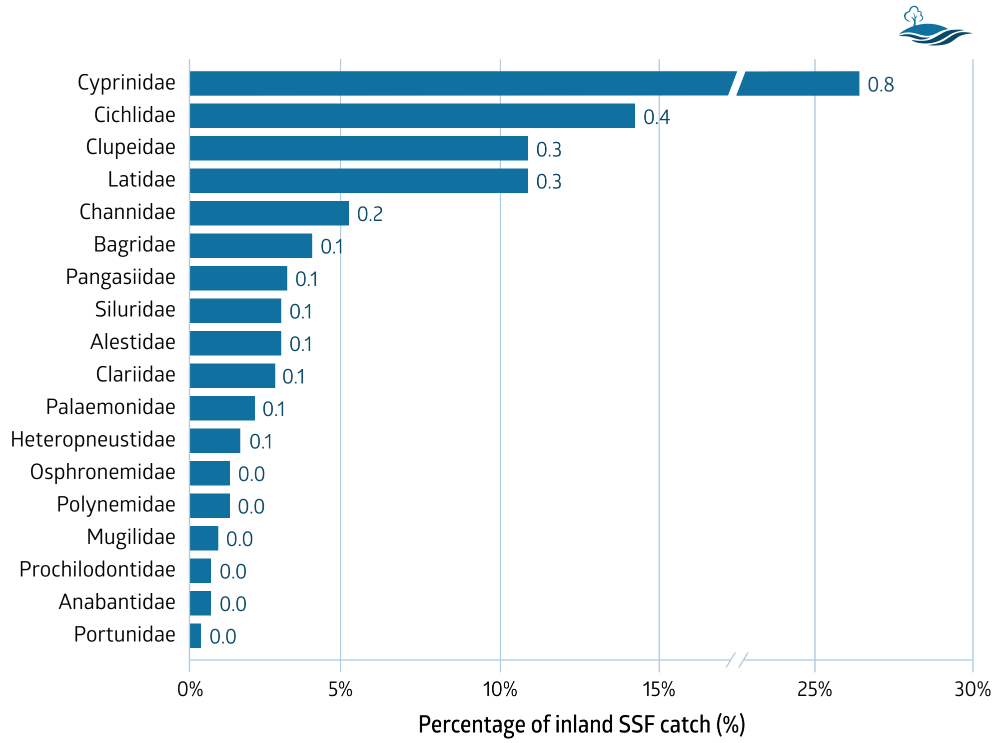
bonito), Carangidae (e.g. scad and jack) and Engraulidae (e.g. anchovy), adding up to almost 50 percent of the catch identified at this taxonomic level and confirming the importance of pelagic fish in the marine small-scale fisheries catch (Figure 4.9).

For inland small-scale fisheries, of the 41 percent of catch identified, the most represented families were Cyprinidae, Cichlidae, Clupeidae and Latidae. These families accounted for over 60 percent of the identified catch (Figure 4.10) but as previously mentioned, most family information available from the CCS came from African CCS; the other CCS did not provide detailed taxonomic composition of inland catch. The generally poor quality of reporting at species level in inland fisheries data (namely, the large portion – around 60 percent – of inland small-scale fisheries catch that was not identified at a sufficient level of taxonomic resolution) greatly limits the understanding of which species, or functional groups thereof, underpin a substantial amount of the inland small-scale fisheries production. This remains an important hidden aspect of global inland fisheries, and small-scale fisheries in general, with subsequent consequences for how these fisheries are monitored and managed.

4.5.3 Harvest efficiency estimates

For the purpose of this study, the harvest efficiency for a given country was calculated in two ways: (i) annual total catch divided by total number of fishers, and (ii) annual total catch divided by total kW of the motorized small-scale fisheries fleet (where applicable). These metrics are not intended to represent national or regional catch rates or catch per unit effort, but are an indication of how efficient small-scale fishers or motorized vessels are in harvesting their catch. Although it is expected that these efficiencies will greatly vary with gear types and species composition of the catch, regional averages provide an indication of the harvest efficiency of small-scale fisheries at that level.

Figure 4.10 Percentage of inland small-scale fisheries (SSF) catch by taxonomic family for IHH country and territory case studies. Numbers on bars represent catch volumes in million tonnes (average annual values, 2013–2017)



Notes: Graph represents 41 percent of total marine small-scale fisheries catch from IHH country and territory case studies (3.1 million tonnes). The remaining catch was not identified at this or lower taxonomic level. Families contributing < 1 percent are not shown.

Harvest efficiencies in tonnes per fisher per year were estimated by fleet type (i.e. no vessel, non-motorized vessel, motorized vessel) and showed marked difference both across fleet types and regions (Table 4.6). In marine small-scale fisheries operating without vessels (e.g. involving foraging by hand, gleaning, harpooning), the harvest efficiency was lowest in Asia (0.1 tonnes/fisher/year), higher in Oceania (1.7 tonnes/fisher/year) and highest in the Americas (7.0 tonnes/fisher/year). This significantly higher estimate in the Americas was mostly due to the dominance of highly productive and efficient cephalopod fisheries (i.e. octopus). For marine non-motorized fleets, harvest efficiency was also higher in the Americas (3.4 tonnes/fisher/year) but lower in Oceania (1.7 tonnes/fisher/year). Finally, for marine motorized fleets, harvest efficiency was highest in Europe (11.6 tonnes/fisher/year) and lowest in Oceania (0.9 tonnes/fisher/year).

For the inland subsector, the harvest efficiency of small-scale fisheries operating without vessels (e.g. involving foraging by hand, gleaning, cast nets, hook and line) was lowest in Africa (0.07 tonnes/fisher/year) while in Asia the value was double at 0.14 tonnes/fisher/year. Europe had a high figure (1.8 tonnes/fisher/year), although this estimate came from a single crayfish fishery. The harvest efficiency levels for inland non-motorized fleets were remarkably similar in Africa (1.8 tonnes/fisher/year) and the Americas (1.6 tonnes/fisher/year), but substantially higher for Asia (4.3 tonnes/fisher/year). This high value for Asia possibly reflects the catch from highly productive small waterbodies that abound in the region, some of which may also be enhanced or stocked. The harvest efficiency of inland motorized fleets was highest in Africa (11.4 tonnes/fisher/year) followed by Asia (6.6 tonnes/fisher/year), and lowest in the Americas (3.7 tonnes/fisher/year). The high value for Africa is a reflection of either a bias in the data towards the productive African Great Lakes fisheries or an underestimation of the number of fishers operating in the motorized sector. For instance, the reported catch levels for combined motorized and non-motorized fleets in African Great Lakes fisheries are typically in the order of only 3 tonnes/fisher/year (Kolding and van Zwieten, 2012). In Asia, the high value is possibly driven by case studies from large waterbodies (such as the Caspian Sea) and reservoirs.

When looking at marine harvest efficiencies by national economic classification (Table 4.7), the lowest values corresponded to least developed countries for non-vessel-based fisheries (0.1 tonnes/fisher/year), developed countries or areas for non-motorized fleets (1.5 tonnes/fisher/year) and other developing countries or areas for motorized fleets (4.3 tonnes/fisher/year). Unsurprisingly, the overall highest efficiency was for motorized fleets in developed countries or areas (11.4 tonnes/fisher/year).

For the inland subsector, the highest efficiency (16.1 tonnes/fisher/year) was for motorized fleets operating in large lakes in least developed countries. This is in marked contrast to marine small-scale fisheries, where motorized fleets in developed countries or areas were the most efficient (11.4 tonnes/fisher/year). This reflects the efficiency gains of inland motorized fleets in the African Great Lakes, which in many ways resemble marine small-scale fisheries in their geographic scale and in their targeting of both small pelagic species and larger, higher-value demersal species.

Inland motorized fleets in other developing countries or areas are substantially less efficient (3.9 tonnes/fisher/year), similar to their marine counterparts (4.3 tonnes/fisher/year). Likewise, inland non-motorized fleets in other developing countries or areas had an efficiency level (3.1 tonnes/fisher/year) similar to their marine counterparts (3.0 tonnes/fisher/year). Fishing without vessels was most efficient (1.8 tonnes/fisher/year) in developed countries or areas (based on a single example of a seasonal, crayfish fishery) and least efficient in other developing countries or areas (0.1 tonnes/fisher/year).

Looking now at the second harvest efficiency calculation involving total kW of the motorized fleets, harvest efficiency levels in tonnes/kW/year also showed marked regional differences (Table 4.8). For the marine subsector, estimates were highest for Africa (1.0 tonnes/kW/year) and lowest for Oceania (0.1 tonnes/kW/year). The higher value in Africa is primarily due to the dominance of small pelagics in the catch of the motorized fleet. In the inland subsector, harvest efficiencies were highest for Asia (0.8 tonnes/kW/year) and lowest for the Americas (0.2 tonnes/kW/year). Analysis of harvest efficiency by national economic classification (Table 4.9) indicated higher values for marine small-scale fisheries in least developed countries (1.3 tonnes/kW/year), primarily due to the dominance of highly productive and efficient small pelagic fisheries. The harvest efficiencies of inland small-scale fisheries were similar between other developing and least developed countries (0.52 and 0.51 tonnes/kW/year, respectively).

Table 4.6 Small-scale fisheries harvest efficiency in tonnes/fisher/year for marine and inland subsectors by region and fleet type, in IHH country and territory case studies (average annual values, 2013–2017)

Region	No vessel	Non-motorized vessel	Motorized vessel	Countries (N)
Marine (tonnes/fisher/year)				
Africa	0.29	2.23	3.75	17
Americas	6.95[a]	3.40	6.73	10
Asia	0.06	1.68	6.11	10
Europe	0.93	na	11.62	3
Oceania	1.73	1.67	0.89	6
Inland (tonnes/fisher/year)				
Africa	0.07	1.81	11.35	14
Americas	na	1.61	3.66	4
Asia	0.14	4.28	6.64	8
Europe	1.79[b]	na	na	1
Oceania	na	na	na	na

Notes: Table based on 82 percent of total marine small-scale fisheries catch and 72 percent of total inland small-scale fisheries catch from IHH country and territory case studies (i.e. 16.6 and 5.5 million tonnes respectively). The remaining catch could not be associated to any specific motorization level. **a** High value resulting from highly productive and efficient octopus fisheries. **b** Value from one country/fishery in Europe (the seasonal fishery for the red swamp crayfish *Procambarus clarkii* in Spain).

Table 4.7 Small-scale fisheries harvest efficiency in tonnes/fisher/year for marine and inland subsectors by national economic classification and fleet type, in IHH country and territory case studies (average annual values, 2013–2017)

National economic classification	No vessel	Non-motorized vessel	Motorized vessel	Countries (N)
Marine (tonnes/fisher/year)				
Least developed countries	0.05	1.53	4.87	13
Other developing countries or areas	2.75	2.98	4.29	29
Developed countries or areas	0.93	1.48	11.42	4
Inland (tonnes/fisher/year)				
Least developed countries	0.14	1.74	16.08	11
Other developing countries or areas	0.07	3.13	3.85	15
Developed countries or areas	1.79[a]	na	na	1

Notes: Table based on 82 percent of total marine small-scale fisheries catch and 72 percent of total inland small-scale fisheries catch from IHH country and territory case studies (i.e. 16.6 and 5.5 million tonnes respectively). The remaining catch could not be associated to any specific motorization level. **a** Value from one country/fishery in Europe (red swamp crayfish *Procambarus clarkii* fishery in Spain).

Table 4.8 Small-scale fisheries harvest efficiency in tonnes/kW/year for marine and inland subsectors by region, in IHH country and territory case studies (average annual values, 2013–2017)

Region	Marine (tonnes/kw/year)	Marine countries (N)	Inland (tonnes/kw/year)	Inland countries (N)
Africa	0.95	16	0.49	8
Americas	0.31	10	0.19	4
Asia	0.68	10	0.78	6
Europe	0.32	3	na	na
Oceania	0.12	6	na	na

Notes: Table based on 82 percent of total marine small-scale fisheries catch and 72 percent of total inland small-scale fisheries catch from IHH country and territory case studies (i.e. 16.6 and 5.5 million tonnes respectively). The remaining catch could not be associated to any specific motorization level.

Table 4.9 Small-scale fisheries harvest efficiency in tonnes/kW/year for marine and inland subsectors by national economic classification, in IHH country and territory case studies (average annual values, 2013–2017)

National economic classification	Marine (tonnes/kw/year)	Marine countries (N)	Inland (tonnes/kw/year)	Inland countries (N)
Least developed countries	1.29[a]	12	0.51	7
Other developing countries or areas	0.35	29	0.52	11
Developed countries or areas	0.28	4	na	na

Notes: Table based on 82 percent of total marine small-scale fisheries catch and 72 percent of total inland small-scale fisheries catch from IHH country and territory case studies (i.e. 16.6 and 5.5 million tonnes respectively). The remaining catch could not be associated to any specific motorization level. **a** Catch highly dominated by small pelagic fish.

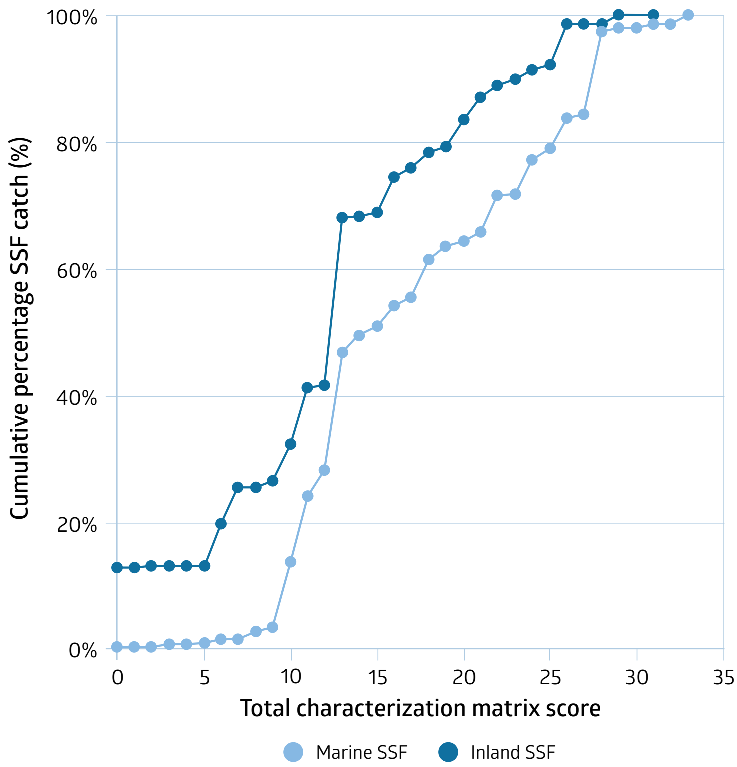
4.6 Technological and operational scales of small-scale fisheries catch

Globally, small-scale fisheries vary in their technological and operational scale and complexity. Some of these differences can be explained by variations in economic and technological conditions between developed and developing countries or areas; in other cases this may be due to geographic, habitat, ecological, or market differences between the target species. Some of the strongest variations are seen between marine and inland fisheries, thus the following analysis treats the two subsectors separately.

In order to understand the small-scale fisheries catch distribution across technological and operational scales, the total cumulative catch from the 58 CCS was plotted (Figure 4.11) against the characterization matrix scores (see Chapter 3), highlighting the following patterns:

- While there is very little catch recorded (3.4 percent) from marine small-scale fisheries with scores of 0 to 9 (i.e. fisheries activities typically involving foot fishers or small canoes with passive gear), inland fisheries in the same scale range account for 26.4 percent of the catch. This highlights how a significant proportion of inland fisheries catch comes from activities at a low scale of operation (i.e. foot fishers operating passive gear in rivers, floodplains or small waterbodies). As noted in previous sections, these are likely the type of fisheries to be mostly under-represented in official statistics and thus underestimated in this study.
- For both marine and inland small-scale fisheries, the majority of the catch (75.6 percent and 65.8 percent, respectively) is produced by fishery units scoring between 10 and 25, which corresponds to a wide range of small-scale fisheries from mid-size canoes to mid-size motorized vessels with some onboard refrigeration facilities and crews of 3–8 fishers.
- Looking at the upper scale range, 16.3 percent of the total marine small-scale fisheries catch is landed by fisheries scoring between 26 and 33, while only 1.5 percent of the inland small-scale fisheries catch is landed by fisheries in the same range. This is rather intuitive, as marine small-scale fisheries may target offshore resources (e.g. tuna) and/or small pelagic species that are highly abundant (e.g. anchoveta), but which require larger-sized vessels and engines as well as storage and refrigeration to exploit them effectively.
- While operational definitions of small-scale fisheries at national level are common and needed in order to define and implement suitable management frameworks, as well as to define adequate social and economic policies, this global analysis highlights the patterns along the operational and technological scales and their associated challenges in defining a cutoff between small-scale and large-scale fisheries.

Figure 4.11 Distribution of cumulative catch across operational and technological scales (i.e. characterization matrix scores) for marine and inland small-scale fisheries (SSF) in IHH country and territory case studies (average annual values, 2013–2017)



Notes: Total catch with characterization scores assigned was 17.7 million tonnes and 1.6 million tonnes for marine and inland small-scale fisheries, respectively. Maximum possible scores in the characterization matrix was 36 for marine fisheries and 39 for inland fisheries.

4.6.1 Marine small-scale fisheries operations

Of the total marine small-scale fisheries catch from the CCS, 77 percent (15.6 million tonnes) was characterized in terms of technological and operational scales using the matrix approach (Table 4.10).

The majority of marine small-scale fisheries catch (69.8 percent) is caught by vessels shorter than 12 m and weighing under 10 gross tonnage (GT); this is unsurprising, as small-scale fisheries are often classified on the basis of vessel size. However, there is still a significant amount of small-scale fisheries catch (28.1 percent) coming from vessels up to 24 m in length and weighing up to 50 GT, with 0.7 percent of marine small-scale fisheries catch coming from vessels longer than 24 m and weighing more than 50 GT. These might be considered medium-scale operations, and they include mostly fisheries targeting tuna and small pelagics. Only 1.4 percent of the total catch is associated with non-vessel-based fishing (i.e. foot fishers), which is due mostly to the relatively low harvest efficiency levels and/or under-representation of these fisheries in official statistics. As discussed in Box 4.1 (Section 4.3.1), data and statistics on foot fishers are typically under-reported; therefore it is likely the percentage is actually higher, particularly for certain developing world regions. This perceived low contribution should not undermine the critical importance of these non-vessel-based fisheries for local livelihoods and food security and nutrition.

Motorization in small-scale fisheries is more typical in marine fisheries than inland fisheries (see Table 4.10 and Table 4.11). The majority of marine small-scale fisheries catch (75.4 percent) is caught by vessels that are motorized with outboard or inboard engines of less than 100 horsepower (hp). Furthermore, 20.5 percent of the marine small-scale fisheries catch comes from vessels with inboard engines of less than 400 hp, and only 1.8 percent of the catch comes from vessels with inboard engines of greater than 400 hp (typically tuna vessels).

Mechanization is relatively common in marine small-scale fisheries, with 59.1 percent of the total catch obtained using some form of mechanization to achieve higher catch per unit effort. Almost half (47.6 percent) of the catch comes from lightly mechanized operations (i.e. with a small power winch or hauler powered off the engine).

The majority of the catch (66.0 percent) is gathered using passive gear, including larger gear sets that are deployed passively (e.g. longlines, trap sets, gillnets/driftnets) and another 20.7 percent using labour-intensive gear (mostly small gear handled manually, such as hand-held tools/spears, hand-hauled seines

Table 4.10 Percentage of total marine small-scale fisheries (SSF) catch by five characteristics of vessel technology and two operational characteristics, for IHH country and territory case studies (average annual values, 2013–2017)

Characteristic	Dimensions for score	% Marine SSF catch
Technological		
Size of fishing vessel	No vessel	1.4%
	< 12 m, < 10 GT	69.8%
	12 to ≤ 24 m, < 50 GT	28.1%
	> 24 m, > 50 GT	0.7%
Mechanization	No mechanization	39.9%
	Small power winch/hauler powered off engine	47.6%
	Independently powered gear deployment/ hauling	6.1%
	Fully mechanized gear deployment/hauling	6.4%
Motorization	No engine	2.3%
	Outboard/inboard engine ≤ 100 hp	75.4%
	Inboard engine > 100 hp to ≤ 400 hp	20.5%
	Inboard engine > 400 hp	1.8%
Fishing gear type	Labour-intensive gear	20.7%
	Passive gear	66.0%
	Gear with aggregating devices	2.6%
	Highly active gear	10.7%
Refrigeration/storage	No (cold) storage	22.4%
	Ice box (i.e. on deck)	26.5%
	Ice hold (i.e. below deck)	48.7%
	Refrigerated hold	2.4%
Operational		
Fishing trip duration	< 6 hours	10.0%
	Day trip (< 24 hours)	70.0%
	> 1 day to < 4 days	15.7%
	> 4 days	4.3%
Fishing location and range	≤ 100 m from shoreline / baseline/ high-water mark	2.4%
	> 100 m, ≤ 10 km from shoreline / base-line / high-water mark	66.6%
	> 10 km, ≤ 20 km from shoreline / base-line / high-water mark	14.5%
	> 20 km from shoreline/baseline	16.5%

Notes: Table based on 77 percent of total marine small-scale fisheries catch from IHH country and territory case studies, or 15.6 million tonnes. The difference between this figure and the total marine small-scale fisheries catch from the IHH country and territory case studies is due to differences in the number of fishery units that were included in this analysis.

and pole-lines). Furthermore, 10.7 percent of marine small-scale fisheries catch is gathered using highly active gear (gear types that require vessel power to encircle, chase, deploy and retrieve fish) while only 2.6 percent of the catch is gathered using gear with aggregating devices (which includes larger gear sets that use aggregating and attracting methods, such as light attraction and fish aggregating devices).

In small-scale fisheries, relatively low volumes of catch are stored using onboard refrigeration, which is a reflection of the low levels of mechanization and relatively short fishing trips involved. Compared to inland fisheries, the vessels used in marine fisheries tend to be larger and the fishing trips tend to be longer, thus increasing the need for more developed storage and chilling or refrigeration capacity. In marine small-scale fisheries, 22.4 percent of the catch is landed without any form of chilled storage, while 26.5 percent is preserved in on-deck cold boxes. The majority of marine small-scale fisheries catch (48.7 percent) is however preserved in ice holds below deck. The lack of chilled storage available to some marine small-scale fisheries may limit their reach to distant markets as well as discourage them from engaging in offshore fishing and/or longer fishing trips. In fact, 63.9 percent of the total marine small-scale fisheries catch is sold fresh from the boat, with a further 21.4 percent of the catch locally processed or preserved. Freezing of catch is rare, at only 14.7 percent of the catch.

The bulk of marine small-scale fisheries catch (80.0 percent) is gathered during fishing trips of one full day or less, while 20.0 percent is gathered during trips of more than 24 hours. In addition, the majority of marine small-scale fisheries catch (69.2 percent) is caught within 10 km from the shoreline. This is consistent with the finding that approximately 75.4 percent of catch is from vessels that have engines (typically outboard) of less than 100 hp, which limits the distance that can be travelled. Of the marine small-scale fisheries catch that is caught further offshore, 14.5 percent is caught within 20 km from shore and 16.5 percent beyond 20 km from shore.

4.6.2 Inland small-scale fisheries operations

Of the total inland small-scale fisheries catch from the CCS, 80 percent (6.1 million tonnes) was characterized in terms of technological and operational scales using the matrix approach (Table 4.11).

A substantial proportion (13.9 percent) of the inland small-scale fisheries catch is produced by fisheries operating without vessels, typically in floodplains and shallow waters, thus underscoring the importance of foot fishing and manually handled gear in the inland subsector. Although most recorded inland small-scale fisheries catch (57.1 percent) is gathered using vessels between 4 and 8 m in length, there is still one-quarter (25.5 percent) of the catch that is gathered using small vessels (shorter than 4 m). Only 3.4 percent of the catch is caught by vessels longer than 8 m, most often targeting small pelagic fish.

Over three-quarters of the inland small-scale fisheries catch (75.5 percent) is gathered using either non-motorized vessels or no vessels at all. Vessels with small outboard engines (< 25 hp) make up 23.7 percent of the source of catch, while only 0.8 percent of the catch comes from vessels with engines larger than 40 hp.

The majority of total inland small-scale fisheries catch (84.2 percent) is gathered without mechanization. A modest proportion (14.3 percent) of the catch is gathered by vessels using some mechanization, primarily battery-powered lights for night fishing. Haulers and other power equipment can be found on larger vessels operating in large inland waterbodies, but this only accounts for 1.5 percent of the inland small-scale fisheries catch.

Small-scale, labour-intensive fishing gear or methods, such as hand foraging, weirs, pots, seine nets, cast nets or hook and line, only accounted for 16.4 percent of the total inland small-scale fisheries catch estimated in this study. The largest proportion of inland small-scale fisheries catch, 41.2 percent, is caught using gillnets, longlines, seine nets and lift nets. A further 38.0 percent of inland small-scale fisheries catch is obtained using lift nets and trap ponds. Finally, only 5.3 percent of the catch is obtained using large-scale fixed gear, such as large fence traps and fixed bag nets or active trawls or dragged gear, thus highlighting how much of inland fisheries falls within the spectrum of very small scales of operation.

The majority of inland catch (75.0 percent) is landed without any form of onboard cold storage. This reflects limitations in access to ice, or the fact that fish is sold immediately in short value chains. The shorter duration of fishing trips also makes icing potentially irrelevant. A further 22.1 percent of inland small-scale fisheries catch is stored in simple ice boxes. Only 2.9 percent of the inland catch is stored in ice holds or subject to refrigeration. The lack of chilled storage available to inland small-scale fisheries may limit the reach of their market access, and would also help to explain why inland fisheries that generate large volumes of fish (all year or during seasonal gluts) tend to engage in other preservation techniques (drying, smoking, salting, fermenting). For instance, the African Great Lakes fisheries produce huge volume of fish which are dried before entering extended value chains across the continent (Kirema-Mukasa, 2012).

Approximately 49.7 percent of the inland small-scale fisheries catch is obtained from occasional fishing and foraging activities. Inland fishing activities conducted seasonally or on short-duration trips account for 15.6 percent of the total inland small-

Table 4.11. Percentage of total inland small-scale fisheries (SSF) catch by five characteristics of vessel technology and two operational characteristics, for IHH country and territory case studies (average annual values, 2013–2017)

Characteristic	Dimensions for score	% Inland SSF catch
Technological		
Size of fishing vessel	No vessel	13.9%
	< 4 m	25.5%
	4 m to 8 m	57.1%
	> 8 m	3.4%
Mechanization	No mechanization	84.2%
	Battery-powered equipment/lanterns	14.3%
	Generator- or engine-powered attracting lights	0.7%
	Small power winch / hauler powered off engine	0.8%
Motorization	N.A. (i.e. no vessel)	23.8%
	No engine	51.8%
	Outboard engine < 25 hp	23.7%
	Inboard engine > 40 hp	0.8%
Fishing gear type	Foraging by hand, traps, pots; cast nets, hand-held lift nets, scoops, spears, baited hooks	16.4%
	Gillnets, baited longlines; seine nets, lift nets	41.2%
	Pumped trap ponds; large lift nets	38.0%
	Actively hauled dredges / trawl nets; large fence traps, large river traps / bag nets	5.3%
Refrigeration/ storage	No (cold) storage	75.0%
	Insulated box / icebox	22.1%
	Ice hold	0.8%
	Refrigerated hold	2.1%
Operational		
Fishing trip duration	Occasional foraging	49.7%
	Seasonal fishing, short trips	15.6%
	Regular fishing trips, all-day	30.6%
	Multi-day fishing trips	4.0%
Fishing area / waterbody type	Seasonal waterbodies, wetlands and small streams, rice fields	13.3%
	Less than ~5 km from shore in permanent rivers, medium waterbodies, wetlands	60.5%
	Large rivers, large waterbodies, reservoirs ≤ 500 km^2	3.9%
	Inland seas, large lakes and waterbodies > 500 km^2	22.4%

Notes: Table based on 80 percent of total inland small-scale fisheries catch from IHH country and territory case studies, or 6.1 million tonnes. The difference between this figure and the total marine small-scale fisheries catch from the IHH country and territory case studies is due to differences in the number of fishery units that were included in this analysis.

scale fisheries catch, while 30.6 percent of the catch comes from regular fishing or all-day trips. This illustrates the particularly diverse nature of inland small-scale fisheries livelihoods, where a proportion of fishers undertake seasonal or occasional fishing activities as part of a diversified livelihood, and others (but fewer of them) pursue inland fisheries as a full-time livelihood. Only 4.0 percent of the inland small-scale fisheries catch comes from multi-day fishing trips, due to the limited number of inland waterbodies where such extended fishing activities can take place (e.g. larger waterbodies such as the Caspian sea or the African Great Lakes).

In the inland small-scale fisheries subsector, most catch (60.5 percent) is gathered within 5 km from shore, indicating that the activity is largely based around small waterbodies and rivers. A further 22.4 percent comes from large waterbodies and inland seas and 13.3 percent from seasonal waterbodies and wetlands. It is interesting to note that, even though rivers and medium perennial waterbodies provide the majority of the inland catch, inland fisheries activities are often seasonal, part-time or occasional (see above paragraph). One caveat with this observation is that the most dispersed and elusive fishing takes place in seasonal waterbodies, small streams and wetlands, and this remains poorly quantified.

4.7 The environmental interactions of small-scale fisheries

4.7.1 Introduction

The environmental interactions of small-scale fisheries are often assumed to be mostly inconsequential compared to large-scale fisheries (Jaquet and Pauly, 2008). However, even if small-scale fisheries have limited environmental impacts when evaluated individually, the impacts may still be significant in the aggregate, depending on the number of fishers at local or national scales, the size of the fishing fleet operating in a given area, the vulnerability of a species or habitat that the fisheries interact with, or the gear types used. Increased research efforts focused on small-scale fisheries have illustrated that the combined environmental impacts of these fisheries can be significant, widespread and in some cases greater than those of large-scale fisheries (e.g. Shester and Micheli, 2011; Jones *et al.,* 2018; Exton *et al.,* 2019). The severity of these impacts is case-specific, largely determined by the health of the ecosystems in which a given fishery operates and the aggregated fishing intensity and nature of its operations. It is therefore important to remember that "small does not mean insignificant" (McCluskey and Lewison, 2008).

Evaluating the environmental impacts of small-scale fisheries is often complex because these fisheries commonly interact with (and are in turn impacted by) other fisheries, industries and climate processes, and are typically situated within complex coastal or freshwater ecosystems. The environmental interactions of small-scale fisheries can be both direct and indirect, and the impacts may be felt beyond the target species and habitats around which the fishing activities take place. For example, the destruction of coral reefs from blast fishing causes direct reductions of live coral biomass in the immediate vicinity of a blast, but can also cause significant reductions in coral recruitment in neighbouring areas where such activities may never have taken place (Fox and Caldwell, 2006).

Through a review of a broad range of scientific, peer-reviewed literature, this section provides a synopsis of the main interactions that small-scale fisheries have with their environment, and attempts to respond to the following key questions:

- What are the principal environmental interactions of small-scale fisheries?
- What determines the severity of the impact of these interactions?
- What are some of the practical solutions to mitigate the impacts of the environmental interactions of small-scale fisheries?
- What are the data and monitoring needs related to the environmental interactions of small-scale fisheries?

The primary focus of this section is on the interactions of small-scale fisheries with habitats and non-target species; it does not cover impacts of fishing pressure on fish populations and associated ecosystems.

4.7.2 Small-scale fisheries interactions with non-target species

Bycatch, or the incidental capture of non-target species, can include species and sizes not specifically targeted in a fishery; species that are protected, endangered or threatened; juvenile fish; and organisms for which there is no intended use.

A standard definition of bycatch is difficult to determine because of the very diverse nature of the world's fisheries, historical differences in how bycatch has been defined nationally, ambiguities associated with bycatch-related terminology, and choices of individual fishers on how different portions of their catch are valued and used (FAO, 2011b). Simply put, "bycatch is in the eye of the beholder", as this classification of a species depends very much on the fisher catching the fish and how that catch is subsequently utilized. In small-scale fisheries, where most of the catch is valued for direct consumption or post-harvest processing, many species considered bycatch in larger-scale fisheries will still be eaten or sold.

For bycatch that is returned to the water or discarded, mortality rates are often high (Campana, Joyce and Manning, 2009; Davis, 2002; Yergey *et al.,* 2012), yet usually go unrecorded as they are not landed. Many small-scale fisheries are generally assumed to have low discard rates (Karp *et al.,* 2019), likely driven by stereotypical scenarios of the developing world in which all landed fish that are not sold are eaten locally by fishers and their families. However, small-scale fisheries vessels typically have limited storage capacity and often limited access to ice on board, or lack onshore storage facilities to retain quality of fish for consumption. This means that some small-scale fisheries do indeed return a portion of their bycatch to the water.

Evaluating the overall amounts of bycatch and discards in small-scale fisheries is difficult due to a general lack of monitoring of landings and even less emphasis on monitoring of discarded bycatch. Bycatch information is also often confusing, due to wide variations in the definition of target versus non-target catch (Davies *et al.,* 2009), further impeding efforts to estimate bycatch and discards accurately. In those small-scale fisheries that have enough data to inform evaluations of bycatch and discards, the picture is varied.

In small-scale fisheries in Greece, the low commercial value of species caught results in 78 percent of the catch being discarded. These discards commonly come from trammel net or longline fishing activities (Tzanatos *et al.,* 2007). This appears to be true across much of Southern Europe, where discards in small-scale net fisheries are largely a result of the low commercial value of the species, followed by catch spoilage (rendering it unfit for market) or small size (Gonçalves *et al.,* 2007). The practice of high-grading, where low-value catch is discarded to preserve quota for higher-value fish, has also been reported in some small-scale fisheries in Europe (Villasante *et al.,* 2019).

In small-scale fisheries in the Galapagos archipelago, discarding has been historically prevalent and largely driven by market demands. More recently, however, discard rates have decreased as local fishers increase the diversity of their catch portfolios to maintain overall catch biomass levels (Zimmerhackel *et al.,* 2015). In the inland fisheries of the Amazon basin, this diversification of the catch portfolio has been proposed as an appropriate management strategy to reduce fishing pressure on commonly targeted stocks (Hallwass and Silvano, 2016).

Most of these examples are somewhat typical in developed countries or situations of abundant resources. For small-scale fisheries in developing countries, where resources may be under greater pressure or harvest efficiency may be low, it is far more typical for all landed bycatch to be either sold, consumed directly or processed, and in some instances used as animal feed or fertilizer. Nevertheless, for some small-scale fisheries with large catch volumes but small vessel size, only the most valuable part of an individual fish is retained, despite there being use for the rest of the carcass. For example, when a large shark is caught by a small vessel (e.g. a dugout canoe in the Pacific), the high-value jaws and fins may be retained and the rest of the carcass discarded (McCoy, 2006). This is not classic "finning" as may occur in larger-scale longline fisheries, but rather the result of the limited storage capacity of these small-scale fisheries vessels (K. Friedman, personal communication, 2021).

The interactions of megafaunal species (e.g. turtles, marine mammals and seabirds) with small-scale fisheries operations constitute a large part of the literature on small-scale fisheries bycatch. Such interactions can have reciprocal consequences for megafauna and fishers alike: mortality for the bycatch, and destruction of fishing gear for the fishers. This has been reported in marine fisheries in the Mediterranean (Gonzalvo, Giovos and Moutopoulos, 2015; Lauriano *et al.,* 2009), the Baltic Sea (Kauppinen, Siira and Suuronen, 2005; Königson *et al.,* 2013), Sweden (Königson *et al.,* 2013) and South Africa (Wickens *et al.,* 1992), as well as in the inland fisheries of the Amazon basin (Barbieri *et al.,* 2012; Loch, Marmontel and Simões-Lopes, 2009). In many cases there is a significant amount of bycatch of, and mortality for, these megafaunal species. But if megafauna population numbers are low, then these species will not be able to sustain the level of mortality. Although mortality rates are often dependent on the species and on the gear types used, this can constitute a primary problem for the conservation of threatened megafauna.

Megafauna bycatch in large-scale fisheries is well known to cause declines in migratory species including seabirds, marine mammals and sea turtles in some cases (Lewison *et al.,* 2014), but similar interactions in small-scale fisheries, particularly gillnet fisheries (Reeves, McClellan and Werner, 2013), should not be overlooked (Bronwell Jr, Reeves and Read, 2019; Soykan *et al.,* 2008). In fact, small-scale fisheries can be just as harmful, if not more, as large-scale fisheries when it comes to the bycatch of megafauna. Alfaro-Shigueto *et al.* (2010) note that "despite the definition as small-scale, the magnitude of [small-scale fisheries] gillnet fleets and their cumulative fishing effort are vast and are of concern with regard to their long-term sustainability and their impacts and interactions with large marine vertebrates". A good example is the comparison between the use of small-scale fisheries gillnets in Peru (> 100 000 km per year) with the ones used by high seas fleets of Taiwan Province of China, which are about 14 times shorter (Alfaro-Shigueto *et al.,* 2010). In many cases it is not possible to compare relative impacts of small-scale fisheries and large-scale fisheries on bycatch because of the limited amount of comprehensive data on these (potentially widespread) impacts, as these fisheries use vessels too small to support observers for bycatch reporting.

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Bycatch in inland small-scale fisheries is reported much less frequently than in marine fisheries. This supports findings by Raby *et al.* (2011) who note that only 3 percent of all bycatch literature focuses on inland fisheries. This is perhaps not surprising, as bycatch and conservation research efforts tend to be higher for marine fisheries, possibly because of the commercial value of these fisheries. Inland small-scale fisheries catch is estimated here to be less than half that of marine small-scale fisheries (approximately 11.8 million tonnes annually, versus 25.1 million tonnes). Moreover, most of the world's inland foot fisheries are situated in developing countries, are relatively dispersed and are not closely monitored (Funge-Smith, 2018). The obvious lack of research effort in inland fisheries is alarming, considering that freshwater ecosystems are experiencing documented species loss from a combination of fishing and environmental pressures, whereas only one strictly marine fish species is considered to have gone extinct in the last 400 years (Dulvy and Kindsvater, 2017; McCauley *et al.*, 2015; FAO, 2021a).

4.7.3 Habitat interactions of small-scale fisheries

The habitat interactions of small-scale fisheries are diverse and, as with many environmental interactions associated with the subsector, are usually context-specific. Comparing lobster traps, fish traps, set gillnets and drift gillnets in Mexico, Shester and Micheli (2011) concluded that set gillnets have the most significant overall interaction with non-target species and kelp and coral habitats in small-scale fisheries, with higher mean discard levels than most large-scale fisheries in the country. At the same time, trap fisheries in the Caribbean and Thailand were found to damage underlying substrata on coral reefs and in benthic habitats (including damage to seagrasses, hard corals and soft corals) as well as generating significant amounts of bycatch (Sheridan *et al.*, 2005; Suebpala *et al.*, 2021). In Kenya, beach seines were found to have the most significant impacts on coral reef biodiversity, followed by gillnets, despite hand-held spear fishers having the highest number of interactions (through hand and foot contact) with live corals per unit of catch (Cinner, 2009).

The above examples are all from marine fisheries; habitat impacts from inland fisheries activities are less commonly reported. There are some similarities to marine fisheries, with dragged gear such as beach seines affecting riparian and benthic (i.e. sea bottom) vegetation and having consequent impacts on nursery habitats. There are also some specific aspects that are not found in coastal or marine waters, such as the diversion or drainage of habitats for fish-aggregating purposes. Typically however, the major impacts on inland fisheries habitats are driven by activities outside of the fisheries sector.

Much of the peer-reviewed literature on the habitat interactions of small-scale fisheries concerns coral reef systems, with blast fishing noted as the most immediately destructive practice, and one having

long-lasting consequences. Aside from the primary damage to hard coral, the rubble from blast fishing creates unstable "killing fields" that hinder the recruitment of new Scleractinian corals, particularly in areas with strong water currents (Fox *et al.,* 2003; Fox and Caldwell, 2006). The slow rate of natural regeneration of many hard coral communities means that full recovery of extensively blasted reefs may take up to several hundred years (Riegl and Luke, 1999). Elsewhere, *muro-ami*, a fishing technique employed in South-eastern Asia that uses an encircling net together with pounding devices to scare fish out of corals, has also been shown to cause lasting damage to hard corals (Bell *et al.,* 2006; Campbell and Pardede, 2006), as has the use of crowbars to break and remove corals for the live coral trade (Bruckner, 2001; Lampe *et al.,* 2017). The impacts of small-scale fisheries on coral systems are compounded by the fact that such stressed reefs are likely to be more vulnerable to additional stressors such as warming waters, disease and invasive species (Knowlton, 2001).

Another commonly noted impact of small-scale fisheries on coral systems involves the use of cyanide mixtures to stun and collect fish for the aquarium and live seafood trade. The ecosystem-scale effects of cyanide fishing should not be taken lightly when considering the full spatial extent of the practice, which has historically included much of the coral reef environment of South-eastern Asia, particularly Viet Nam, Indonesia, Malaysia and the Philippines (Barber and Pratt, 1999; Cornish and McKellar, 1998). The traditional use of natural poisons such as rotenone (derived from some plant species) to catch fish in lagoons, rivers and streams, was at one time common in Pacific Island countries, and there are similar practices still used by Indigenous Peoples in Latin America and the Caribbean (Mejía and Turbay, 2007). The global extent of such poisoning practices today is largely unreported in peer-reviewed articles, and remains anecdotal.

The impacts of towed or pushed gears on benthic habitats in small-scale fisheries are generally assumed to be less severe than those from towed bottom-fishing gear in large-scale fisheries. This is mainly because most small-scale fisheries are unable to tow heavy, destructive gear over a sufficient distance to cause benthic habitat damage at the same spatial scale as large-scale fisheries. For example, the use of mini-trawls in a small-scale prawn fishery in Brazil has been shown not to produce significant losses of benthic diversity or cause significant damage to the estuarine benthos over which they are operated (Costa and Netto, 2014).

The use of pushnets, whereby a net supported on booms is pushed along the seabed in shallow water, is relatively common in South-eastern Asia and may typically be undertaken from a boat, but also by hand in the case of small "scissor" pushnets. With this method, the target species are small finfish, shrimp and other crustaceans. Although pushnets are assumed to be small and light, the overall impact from their high combined number poses a threat to sensitive seagrass habitats and mudflats adjacent to mangrove forests, and hence the practice has been increasingly discouraged and has declined in recent years (Soykan *et al.,* 2008; Tokrisna, Boonchuwong and Janekarnkij, 1997). Pushnets can also cause significant recruitment problems for certain fisheries, due to their disturbance of habitats crucial to the early development of many species as well as their small, non-selective mesh sizes. In the Bay of Bengal, hand pushnets have been responsible for 94.6 percent (by number) of the catch of shrimp fry, but at the same time have caused significant reductions in offshore recruitment of shrimp, actually reducing shrimp productivity on large-scale trawling grounds (Islam, 2003). Again, this is a reminder that although operational comparisons between individual large-scale and small-scale fisheries may suggest the relatively less destructive nature of the latter, the sum of their cumulative interactions can be significant.

4.7.4 Environmental interactions of pre- and post-harvest small-scale fisheries activities

The environmental interactions of pre- and post-harvest small-scale fisheries activities are largely overlooked in the peer-reviewed literature. Of these, the most closely related to harvesting is that of pre-harvest bait collection, which often has significant consequences for habitats and species via three main interaction routes:

1. Trampling of habitats composed of living organisms (i.e. biogenic habitats such as corals and oyster reefs) during bait collection and gleaning: This has been reported in biogenic habitats such as mussel beds (Smith and Murray, 2005), coral reefs (Hauzer, Dearden and Murray, 2013a), seagrass beds (Barradas *et al.,* 2018) and rocky shore systems with algal turfs (Huff, 2011). The effects of trampling have also been correlated with significant changes in local fauna abundance and behaviour, such as declining local seabird populations due to temporary loss of habitat (Watson *et al.,* 2017) and changes in burial behaviour of small benthic invertebrates induced by vibrations from foot traffic (Johnson *et al.,* 2007).

2. Extraction of bait resources at unsustainable levels: For example, in the Lakshadweep Islands of India, heavy exploitation of inshore coastal species for live bait has led to dramatic, long-lasting declines in near-shore forage fish populations. This could be avoided by moving bait collection slightly further offshore to target different species with similar bait suitability (Gopakumar, Pillai and Koya, 1991). Bait collection in small-scale fisheries mostly involves low-trophic-level species. However, there are higher-trophic-level cases, such as the illegal harvesting of the Amazon river dolphin by local small-scale fisheries for use as bait in catfish (*Calophysus macropterus*) fisheries, which have caused significant declines in local dolphin populations (Mintzer *et al.,* 2013).

3. Species caught as bycatch during bait collection and collection of seed for aquaculture stocking: This relates closely to the bycatch and discards of species based on non-selective gear use, and is covered above in Section 4.7.2 (see also Islam and Ahmed, 2001). Small-scale fisheries may be involved in the collection of seed (postlarval crustaceans, juvenile fish) for stocking of aquaculture, which can result in bycatch of non-target species (FAO, 2011c). This has been a historic concern for the postlarval shrimp collection industry in Bangladesh, where the shrimp are harvested using pushnets and sorted on the shore, while the small fish bycatch is discarded (Ahamed *et al.,* 2012). There are similar concerns with the small-scale fisheries collection of grouper seed for ongrowing in aquaculture cages (Mous *et al.,* 2006; Tupper and Sheriff, 2008).

The pre-harvest activities of many small-scale fisheries involve the use of wood resources. Examples include boat-building, gear fabrication and the erection of semi-permanent marine structures, such as Indonesia's *bagans* that are built in shallow habitats to catch small pelagic species (Pauly and Chua, 1988). This widespread use of wood can have significant negative consequences for terrestrial environments due to localized deforestation effects (Amarasinghe, Amarasinghe and Nissanka, 2002). The building of brush or fish parks, known collectively as *acadjas* or *athu kotu*, is common in many coastal lagoons in Western Africa (Benin, Nigeria and Togo), Madagascar, and in mangrove estuaries of Sri Lanka (Senanayake, 1981; Welcomme, 1972; Welcomme and Kapetsky, 1981). These fishing methods considerably increase fishery yields (Abdul, Omoniyi and Udolisa, 2004), but the requirement of between 30 and 40 tonnes of wood per year to keep some brush parks functioning has led to significant local deforestation, increased rates of siltation and changes in local hydrodynamics. Related research in Benin has also recorded significant reductions in dissolved oxygen concentrations and increased nitrites, which are attributed to local hydrodynamic changes resulting from the many brush park developments in the country (Dedjiho *et al.,* 2014).

Looking at post-harvest activity, the high reliance on fuelwood resources for smoking and cooking of small-scale fisheries catch also poses similar problems. Kallon *et al.* (2017) note that in Sierra Leone, fish-smoking processes threaten local mangrove forests. The same is true in Madagascar, where the commercial production of charcoal from mangrove wood has now been made illegal other than for subsistence use, which is still highly monitored (Dave, Tompkins and Schreckenberg, 2017). Complicating matters, the overexploitation by fisheries of species found in the country's mangroves has been linked to reduced productivity in local mangrove systems. This promotes feedback loops in which overexploitation leads to lower mangrove productivity that in turn causes lower fishery yields, forcing fishers to increase their fishing efforts or turn to the exploitation of mangrove wood for revenue generation (Chacraverti, 2014).

In recent years, however, the most commonly reported post-harvest small-scale fisheries environmental interaction has been that of "ghost fishing", in which derelict, lost gear continues to fish independently (i.e. without the intervention of fishers) because it is not recovered during closed seasons. Many ghost-fishing studies revolve around net gear types. Gillnets again feature heavily in this research; they are known to ghost fish for 100–800 days (sometimes even longer), with net lifespans largely dependent on the strength of the net filaments and the amount of fouling by macroalgae (Ayaz *et al.*, 2006; Tschernij and Larsson, 2003). Traps and pots also have significant ghost-fishing capacity. In the Gulf of Mexico, a "ghost" crab pot is estimated to kill up to 600 crabs per year (Guillory, 1993) while in Moreton Bay, Australia, contemporary crab pots are estimated to kill up to 223 crabs per year. In the latter case, the total estimated mortality is between 112 000 and 671 000 crabs per year in an area of less than 2 000 km² (Campbell and Sumpton, 2009).

Table 4.12 Selected examples of practical interventions to mitigate negative environmental interactions of small-scale fisheries

Environmental interaction	Intervention	Example	Example Reference[a]
Bycatch	Escape mechanisms built into fishing gear	Ghost-fishing octopus and fish traps in northeastern Atlantic Ocean	Erzini *et al.*, 2008[b]
Bycatch	Lighting / acoustic reflector systems strung along nets	Light-emitting diode (LED) lights used to reduce turtle bycatch in Northern Peru; simulations of different gillnet modifications to increase acoustic visibility in order to avoid toothed whale bycatch	Ortiz *et al.*, 2016[c]; Kratzer *et al.*, 2020*d*
Bycatch of seabirds	Temporal gear ban	Bycatch of Cory's shearwater (*Calonectris diomedea*) in the Mediterranean	Laneri *et al.*, 2010[e]
Habitat destruction	Greater resource responsibility granted to women who frequently show greater levels of stewardship	Small-scale fisheries in Sundarban mangrove forest, Bangladesh	Hoque Mozumber *et al.*, 2018[f]
Habitat destruction above water	Riparian and coastal habitat protection	Fisheries around the Amazon River floodplain	Castello *et al.*, 2017[g]
Habitat destruction below water	Gear and fishing method restrictions, area closures and mesh size regulations	Coral reefs in Kenya	Mangi and Roberts, 2006[h]
Ghost fishing	Use of degradable materials in gear	Escape mechanisms for sablefish traps in United States of America	Scarsbrook *et al.*, 1988[i]

Notes: This is not intended to be an exhaustive list, but examples found in the scientific literature. **a** Some of the interventions are noted by multiple authors, but only a single example of each is included for reference. **b** Erzini, K., Bentes, L., Coelho, R. & Lino, P. 2008. Catches in ghost-fishing octopus and fish traps in the northeastern Atlantic Ocean (Algarve, Portugal). *Fishery Bulletin,* 106(3): 321–327. **c** Ortiz, N., Mangel, J.C., Wang, J., Alfaro-Shigueto, J., Pingo, S., Jimenez, A., Suarez, T., Swimmer, Y., Carvalho, F. & Godley, B.J. 2016. Reducing green turtle bycatch in small-scale fisheries using illuminated gillnets: the cost of saving a sea turtle. *Marine Ecology Progress Series,* 545: 251–259. **d** Kratzer, I.M.F., Schäfer, I., Stoltenberg, A., Chladek, J.C., Kindt-Larsen, L., Larsen, F. & Stepputtis, D. 2020. Determination of optimal acoustic passive reflectors to reduce bycatch of odontocetes in gillnets. *Frontiers in Marine Science,* 7: 539. **e** Laneri, K., Louzao, M., Martínez-Abraín, A., Arcos, J.M., Belda, E.J., Guallart, J., Sánchez, A., Giménez, M., Maestre, R. & Oro, D. 2010. Trawling regime influences longline seabird bycatch in the Mediterranean: new insights from a small-scale fishery. *Marine Ecology Progress Series,* 420: 241–252. **f** Hoque Mozumder, M.M., Shamsuzzaman, M.M., Rashed-Un-Nabi, M. & Karim, E. 2018. Social-ecological dynamics of the small scale fisheries in Sundarban Mangrove Forest, Bangladesh. *Aquaculture and Fisheries,* 3(1): 38–49. **g** Castello, L., Hess, L.L., Thapa, R., McGrath, D.G., Arantes, C.C., Reno, V.F. & Isaac, V.J. 2017. Fishery yields vary with land cover on the Amazon River floodplain. *Fish and Fisheries,* 19(3): 431–440. **h** Mangi, S.C. & Roberts, C.M. 2006. Quantifying the environmental impacts of artisanal fishing gear on Kenya's coral reef ecosystems. *Marine Pollution Bulletin,* 52(12): 1646–1660. **i** Scarsbrook, J.R., McFarlane, G.A. & Shaw, W. 1988. Effectiveness of experimental escape mechanisms in sablefish traps. *North American Journal of Fisheries Management,* 8(2):158–161.

4.7.5 Severity of the environmental interactions of small-scale fisheries

The severity of the environmental interactions of small-scale fisheries may be defined broadly as a product of the sensitivity of the habitat type in which the fishing activities take place, the extent of damage from the particular fishing gear types and methods used, and the vulnerability to overexploitation of bycatch and other impacted species. For example, coral reef systems are generally more susceptible to habitat damage from mixed-species blast fishing than from handlining (Bailey and Sumaila, 2015; Muallil *et al.,* 2014). For fisheries targeting demersal fish species, the use of gillnets in areas of high cetacean abundance presents a far greater risk of cetacean bycatch than the use of bottom trawls (Reeves, McClellan and Werner, 2013). Similarly, for reef fisheries using spearguns, targeting only high-trophic-level species likely presents a greater risk of overfishing and secondary trophic interactions than targeting lower-trophic-level species (see Godoy *et al.,* 2010). These examples highlight how differences in habitat type, gear type and target species can pose very different environmental risks. The reality of the environmental interactions of small-scale fisheries, however, is far more complex than such nominal descriptions.

The environmental interactions of small-scale fisheries often act in synergy with those of large-scale fisheries, exacerbating their impacts (Guyader *et al.,* 2013; Purcell and Pomeroy, 2015). Moreover, in many fisheries, particularly but not exclusively inland fisheries, conditions are further aggravated by multiple terrestrial and aquatic resource users unrelated to fisheries, whose own environmental interactions contribute to many of the problems faced by small-scale fisheries. These fisheries may recover quickly when fishing effort is reduced, but they are generally less able to recover from the environmental degradation. Furthermore, Cohen *et al.* (2019) argue that small-scale fisheries are often squeezed out of geographic, political and economic spaces by larger-scale economic and environmental conservation interests.

These broader drivers of the environmental interactions of small-scale fisheries are complex and highly multidimensional, involving numerous ecological, economic, social and governance factors. This underscores the need for holistic approaches to understanding these interactions, as well as developing solutions to reduce those interactions that have long-term negative consequences for the environment and the fishers that rely on it.

4.7.6 Practical solutions to mitigate harmful environmental interactions of small-scale fisheries

The diverse nature of small-scale fisheries demands equally diverse and case-specific interventions to reduce or remediate their environmental interactions (Table 4.12). Physical interventions can include changes to fishing gear to reduce bycatch or habitat interactions, while activity-based interventions may involve, for example, seasonal or area closures and bycatch limits, among others.

4.7.7 Data collection for monitoring of small-scale fisheries environmental interactions

Data collection and monitoring are often lacking in the small-scale fisheries subsector, largely due to a paucity of financial investment from governments (see Section 4.3.1; Begossi, 2010; Gutierrez, 2017) combined with the diverse, remote and complex nature of these fisheries. As a result of these factors, available data are often sparse. Despite the significant data and monitoring requirements for small-scale fisheries management, these efforts are still crucial in moving towards better practices that reduce these fisheries' negative environmental interactions while supporting livelihoods (Agapito *et al.,* 2019).

The need for baselines on which to build management interventions, including baseline stock assessments, is often noted as a specific priority area (Fazrul *et al.,* 2015; Gopakumar, Pillai and Koya, 1991; Mintzer *et al.,* 2013). The literature describes a diverse array of data needs related to minimizing the negative environmental interactions of small-scale fisheries activities, and thus enhancing the sustainable production and associated ecosystem services of these fisheries (Table 4.13). Adequate, targeted data collection is required to accurately describe the environmental interactions of the fishing activities, the populations being exploited, and the role and behaviour of fishers in these interactions.

It is equally important to note that data must also be collected and analysed to measure and understand the effectiveness of any management intervention put into place. This may not necessarily rely on the same data that are used to measure the environmental interactions under consideration. For example, measuring catch volume and coral damage from blast fishing will clearly paint a picture of exploitation levels and habitat damage, as well as the subsequent recovery of resources if interventions have been successful. However, for a situation in which multiple management interventions have been put in place (protected areas combined with education programmes, for instance), proper evaluation of the different interventions and their effects will require data on such diverse aspects as entry into protected areas, uptake of educational programmes, and improvements in fisher knowledge. Similarly, it is essential to understand the reliance of fishers on targeted resources to properly inform evidence-based fisheries management.

A common hindrance to data collection in many small-scale fisheries is the lack of funding to support management and capacity building. This is particularly

Table 4.13 Examples of data and/or monitoring needs for better understanding and mitigating negative environmental interactions of small-scale fisheries

Environmental interaction	Specific data / monitoring need	Reference
Bycatch and discards	Monitoring of both fisher behaviour and fish populations	Jones *et al.*, 2018[a]
Bycatch	Better identification of composition of catch data (at species level) so bias towards easily identifiable species can be identified and re-moved	Temple *et al.*, 2018[b]
Megafauna bycatch	Effective programmes of bycatch monitoring (e.g. onboard observers, remote electronic monitoring [REM])	Bugoni *et al.*, 2008[c]
Cyanide fishing (i.e. coral death)	Funding and support for monitoring from the national parks service or other relevant authority or interest group; improved systems of data collection at local levels	Pet-Soede, Cesar and Pet, 1999[d]
Overfishing, selectivity and bycatch	Mobilization of local associations and groups to help monitoring efforts	Mangi and Roberts, 2006 [e]
Megafauna bycatch	Research and management implementation that follows a multidisciplinary approach	Alfaro-Shigueto *et al.*, 2010[f]
Size selectivity, bycatch and discards	Assessments of catch composition and size distributions over time at representative landing sites to understand spatial, inter- and intra-species catch rates, and regional/national patterns of catch and species distributions	Doherty *et al.*, 2014[g]
Size selectivity, bycatch and discards	Monitoring required to understand impacts for each fishing gear type used in fishery and/or fishery region	Tzanatos *et al.*, 2007[h]
Bycatch and interactions with vulnerable species and species protected under international conventions (e.g. Convention on International Trade in Endangered Species of Wild Fauna and Flora)	Improved data collection on endangered, threatened, protected (ETP) species	FAO, 2021[i]; Worawit *et al.*, 2020[j]

Notes: **a** Jones, B., Unsworth, R., Udagedara, S. & Cullen-Unsworth, L. 2018. Conservation concerns of small-scale fisheries: by-catch impacts of a shrimp and finfish fishery in a Sri Lankan lagoon. *Frontiers in Marine Science,* 5(FEB): 52. **b** Temple, A.J., Kiszka, J.J., Stead, S.M., Wambiji, N., Brito, A., Poonian, C.N., Amir, O.A. *et al.* 2018. Marine megafauna interactions with small-scale fisheries in the southwestern Indian Ocean: a review of status and challenges for research and management. *Reviews in Fish Biology and Fisheries,* 28(1): 89–115. **c** Bugoni, L., Neves, T.S., Leite Jr, N.O., Carvalho, D., Sales, G., Furness, R.W., Stein, C.E., Peppes, F.V., Giffoni, B.B. & Monteiro, D.S. 2008. Potential bycatch of seabirds and turtles in hook-and-line fisheries of the Itaipava Fleet, Brazil. *Fisheries Research,* 90(1–3): 217–224. **d** Pet-Soede, L., Cesar, H.S.J. & Pet, J.S. 1999. An economic analysis of blast fishing on Indonesian coral reefs. *Environmental Conservation,* 26(2): 83–93. **e** Mangi, S.C. & Roberts, C.M. 2006. Quantifying the environmental impacts of artisanal fishing gear on Kenya's coral reef ecosystems. *Marine Pollution Bulletin,* 52(12): 1646–1660. **f** Alfaro-Shigueto, J., Mangel, J.C., Pajuelo, M., Dutton, P.H., Seminoff, J.A. & Godley, B.J. 2010. Where small can have a large impact: structure and characterization of small-scale fisheries in Peru. *Fisheries Research,* 106(1): 8–17. **g** Doherty, P.D., Alfaro-Shigueto, J., Hodgson, D.J., Mangel, J.C., Witt, M.J. & Godley, B.J. 2014. Big catch, little sharks: insight into Peruvian small-scale longline fisheries. *Ecology and Evolution,* 4(12): 2375–2383. **h** Tzanatos, E., Somarakis, S., Tserpes, G. & Koutsikopoulos, C. 2007. Discarding practices in a Mediterranean small-scale fishing fleet (Patraikos Gulf, Greece). *Fisheries Management and Ecology,* 14(4): 277–285. **i** FAO. 2021. *Better data collection in shark fisheries: learning from practice.* FAO Fisheries and Aquaculture Circular No. 1227. Rome. **j** Worawit, W., Ahmad, A., Sulit, V.T., Isara, C., Sukchai, A. & Suwanee, S. 2020. *Terminal Report. Regional sharks, rays and skates data collection.* Bangkok, Southeast Asian Fisheries Development Center.

true in developing countries, which often have limited or weak management capacities, but at the same time are home to precisely those small-scale fisheries and environmental regions where the greatest actions may be required (e.g. areas or habitats that are significant in terms of biodiversity, coral cover, productivity or ecosystem services).

In some cases, lack of funding has been overcome via community-based data collection programmes which have proven to be cost-efficient mechanisms for collecting and interpreting data. For example, in California in the United States of America, a small-scale sea urchin diving fishery implemented a participatory data collection programme that lasted over ten years, significantly improving the knowledge base for this data-poor fishery (Schroeter *et al.,* 2009). Data collection and information systems involving collaboration between fishers and managers must be validated, legitimized and institutionalized for them to be effectively used in fisheries management (Gutierrez, 2017). But, as noted by Begossi (2010), fishers' empirical knowledge of natural resources makes it useful to include them in management processes, particularly to help highlight gaps in scientific knowledge. This is important, as it can help to reduce unnecessary investments in scientific data collection processes and to provide direction for future research and management efforts (Grant and Berkes, 2007; Zukowski, Curtis and Watts, 2011).

4.7.8 Managing the environmental interactions of small-scale fisheries

As discussed in Chapter 8, management approaches that help move small-scale fisheries towards more environmentally sound, sustainable practices broadly require decentralization (fisheries management controlled by fishing communities) rather than centralization (fisheries management controlled by a single authority). Most of the changes required to mitigate the negative environmental interactions of small-scale fisheries affect fishers and the associated coastal communities directly, thus underscoring how successful, long-term, positive change must originate from the fishers and communities themselves.

Decentralization in small-scale fisheries broadly concerns bottom-up management approaches driven by fishers, instead of top-down directives originating from centralized governments or management bodies. For this reason, local rather than national governance and management is largely considered more beneficial in small-scale fisheries management scenarios (Pita *et al.,* 2019). The involvement of fishers directly in management design and implementation (i.e. shifting away from the idea of "management as control") helps redefine resources not as commodities, but as elements of an ecosystem upon which fishers rely (Berkes, 2003; Fischer *et al.,* eds., 2015). This approach emphasizes stewardship, exemplified by cases in which fishers' involvement in management processes has significantly aided the recovery of historically overexploited resources where previous government interventions were not beneficial (Castello *et al.,* 2009).

The management and governance of small-scale fisheries cannot be disconnected from local practices, realities and needs. When this is the case, then higher levels of centralized governance can become a major impediment to achieving sustainability in small-scale fisheries (although this centralization may be essential in certain specific cases, such as the management of migratory species). At the same time, a shift towards decentralization in small-scale fisheries does not necessarily mean fishers will be given exclusive rights to manage their resources, nor does it necessarily entail reductions in management intensity, rules or sanctions for offenses. Long *et al.* (2017) note that polarized views of management as either top-down or bottom-up are generally unhelpful, and governance approaches need to seek integration at all levels. Wever *et al.* (2012) reiterate this point about integration by suggesting that to achieve more socially just and environmentally sound coastal management, local communities need better information, enhanced capacity and official support in their efforts to protect the local ecosystems upon which they rely.

4.7.9 Conclusion

Small-scale fisheries are geographically widespread, occurring in marine and freshwater systems and encompassing the entire value chain, from harvesting of fish stocks to pre- and post-harvest activities. Their environmental interactions are therefore diverse, and the severity of these is largely dependent on a myriad of factors acting in synergy with one another. The main factors are target species, habitats and ecosystems in which the fishing activity occurs, intensity and type of fishing gear or practices used, and opportunity costs of fishing for the area that is fished.

Whether addressing, for example, the bycatch of marine megafauna or the destruction of coral habitats with blast fishing, solutions to help mitigate the negative environmental interactions of small-scale fisheries must be found on a case-by-case basis to account for the multiple complexities of even the simplest of these interactions. Each will require its own tailored management approach that must also factor in the social, economic and governance context of each fishery. One message, however, is quite clear: small-scale fisheries data collection requires increased financial investment and enhanced human capacity to fully understand and quantify each environmental interaction. Efforts therefore must be made to highlight the importance of small-scale fisheries to local livelihoods, cultures and traditions, even if their large-scale fisheries counterparts are economically more profitable in the eyes of government managers and research funders.

To date, quantitative assessments of the environmental interactions of small-scale fisheries appear to be sparse in the scientific literature, and by extrapolation are unlikely to be available to decision-makers. Nonetheless, these assessments are certainly needed to fully understand how much small-scale fisheries activities contribute to environmental degradation compared to other activities. Data collection efforts covering a wide array of indicators therefore need to be implemented with continuity and consistency to effectively monitor these fisheries and their environmental interactions. Holistic assessments of small-scale fisheries activities must include data and information on fishing gear, selectivity, fishing effort, captures, habitat and ecosystem characteristics, and the behaviour of fishers – including the reasons fishers engage in activities that have negative environmental outcomes. Likewise, catch records should include target, bycatch and discarded species. In almost all cases, the involvement of local communities and fishers in monitoring programmes is a helpful approach for obtaining cost-effective and reliable data, especially given that small-scale fisheries are often characterized by sparse and numerous landing sites. Better monitoring of pre- and post-harvest activities (and their own interactions with the environment) is also required to fully understand the environmental interactions of the subsector.

Finally, while the need for more data on the environmental interactions of small-scale fisheries is clear, emphasis also needs to be placed on measuring the success or failure of different measures to reduce those interactions that are harmful to the environment. Success stories in which small-scale fisheries have reversed or halted environmental degradation, to the benefit of fishers and their communities, need more promotion (as in this report, for instance) to highlight those interventions and practices that show promise. Without such reporting, defining best practices for diverse small-scale fisheries to build on will be difficult. Furthermore, this information must also be linked to non-environmental data in such areas as food security and nutrition, well-being and poverty to provide a truly holistic picture of these environmental interactions and their drivers, and how best to address them.

4.8 Impacts of climate change on small-scale fisheries

4.8.1 Introduction

Human activity on coastlines and in water basins is increasing in intensity, frequently resulting in the loss or degradation of coastal and freshwater ecosystems worldwide, in some cases at even higher rates than other ecosystems (Bindoff *et al.,* 2019; Halpern *et al.,* 2019a; He and Silliman, 2019; Paukert *et al.,* 2017). Many coastal (i.e. marine) and freshwater social-ecological systems (SES) are facing three major threats: (1) increasing urbanization and industrialization, (2) increasing use of aquatic space and resources, and (3) climate change and its related stressors (Defeo and Elliott, 2021). Moreover, the effects of the first two threats are making coastal and inland fisheries more susceptible to the impacts of the third. Climate change stressors are altering oceanographic and hydrological processes as well as the biogeochemical and physical properties of water, sediment and the biota in many regions, in turn altering the structure and functioning of ecosystems and related SES (He and Silliman, 2019; Defeo *et al.,* 2021a). These detrimental effects are weakening the ability of coastal areas and inland waters to provide ecosystem services and societal goods and benefits, such as fisheries and tourism (Barbier, 2015; Elliott *et al.,* 2015; Bindoff *et al.,* 2019; Duarte *et al.,* 2020).

Freshwater ecosystems are more strongly influenced by natural processes and human activities occurring upstream or adjacent to lakes, reservoirs, rivers or wetlands. This is of particular concern, as many human activities are detrimental to fisheries, including river damming for hydropower and habitat restructuring for agricultural purposes, as well as industrial and municipal uses that discharge contaminants. In many freshwater ecosystems, climate change also has a pronounced effect (Harrod *et al.,* 2018a, b). It has been estimated that 65 percent of inland waters are moderately or highly threatened by anthropogenic stressors (Vörösmarty *et al.,* 2010), limiting their ability to support human populations and fisheries-related livelihoods. Evidence of the impacts of climate change on these ecosystems and the fisheries they support have also been widely documented in the literature, although long-term data are still lacking for many of the critical regions and countries (e.g. the tropics) where productive inland fisheries are found. Furthermore, global and regional studies addressing the impacts of climate change on fisheries have been biased towards the marine subsector.

Small-scale fisheries operate in and rely on these ecosystems, constituting complex SES that make critical contributions to food and nutrition security and to the livelihoods of millions of people. They generate income and economic stability through the harvesting, processing and marketing of fish products (see Chapter 5; FAO 2015; Cohen *et al.,* 2019). Small-scale fisheries account for 40 percent of global fish catch (Table 4.1) and employ more than 90 percent of the world's fishers (Chapter 5). The urgency of promoting responsible and sustainable fishing practices and securing the socioeconomic development of small-scale fisheries is the primary justification for this IHH report, one that has been raised in FAO (2015) and related work (e.g. Jentoft *et al.,* 2017; Westlund and Zelasney, eds., 2019). In addition, it is explicitly addressed within SDG 14 (Chuenpagdee and Jentoft, eds., 2019; FAO, 2020b).

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Given the impacts listed above, climate change is therefore affecting the global productivity of both marine and inland fisheries (Paukert *et al.,* 2017; Phillips and Pérez-Ramírez, eds., 2018; Free *et al.,* 2019). Warming and other climate change stressors frequently alter the distribution, demography and life-cycle traits of exploited species, with direct fishery implications through changes in the quantity, quality and predictability of catch (Brander, 2007; Barange *et al.,* eds., 2018; Free *et al.,* 2019), resulting in greater uncertainty and often detrimental socioeconomic impacts (Sumaila *et al.,* 2011; Free *et al.,* 2019).

Small-scale fisheries are known as one of the food production sectors most vulnerable to climate change (Barange *et al.,* eds., 2018), but the assessment of climate-induced changes and impacts in these fisheries is often hampered by the limited data or lack of data disaggregation for the SES that they inhabit. Additionally, the data and resolution of climate change models are often too coarse for the projections to be used to inform management and/or policies at the local level (e.g. fishery level). Consequently, small-scale fisheries remain largely overlooked in the climate change literature (Kalikoski *et al.,* 2018; Bindoff *et al.,* 2019; Monnier *et al.,* 2020).

This section provides relevant information to highlight the current challenges related to the effects of climate change on small-scale fisheries. It provides a brief synopsis of the review of the relevant scientific literature, from which the current strategies to address the effects of climate change in these SES are drawn.

Two case studies in South America are presented that reflect the multidimensional and multifactorial nature of the effects of climate change on small-scale fisheries, and illustrate key challenges confronting them globally. In addition, an example of the effects of climate change on the inland fisheries of the Lower Mekong Basin is outlined. The section then synthesizes the implications of the impacts of climate change on small-scale fisheries and provides some recommendations on how to better address and understand such impacts to inform adaptation and mitigation strategies.

4.8.2 Perceived effects of climate change on small-scale fisheries

Partial review of the scientific literature

In order to evaluate whether and how climate change effects in small-scale fisheries have been documented in the scientific literature, a preliminary review was performed for the period 1990–2020 using the SCOPUS database. The first scan resulted in more than 400 hits. Each was analysed individually to further scrutinize whether the scientific study truly addressed the issue of the impacts of climate change on small-scale fisheries. The final scan reduced the dataset to 107 papers. Some of them were global in scope (24), others included a regional approach that involved several countries (13), and the remaining ones included specific analyses in 40 countries (Figure 4.12). The findings from this review are as follows.

- There has been an exponential increase in the number of scientific articles relating to climate change and small-scale fisheries, particularly since 2016 (Figure 4.12, panel a).
- Of the papers analysed, 85 percent dealt with coastal (marine) small-scale fisheries, whereas only 7 percent covered inland small-scale fisheries. Another 4 percent considered both subsectors, and the remaining 4 percent dealt with general issues relating to climate change and small-scale fisheries, without discriminating by subsector (Figure 4.12, panel b).
- In terms of the methodological approaches used, almost 50 percent of the papers reviewed employed either perception analysis and stakeholder interviews or observational/qualitative analysis, whereas long-term assessments using mixed methods and multiple information sources were particularly scarce (14 percent, Figure 4.12, panel c).
- Almost half of the total number of papers identified employed vulnerability and adaptation analyses. Other topics included assessment of climate change impacts, and management and policy implications of these impacts (Figure 4.12, panel d).
- It is evident from the studies analysed that climate change stressors (e.g. abnormally warm water temperatures) are altering the distribution, demographics, and life-cycle traits of exploited species, affecting the quantity and quality of the catch and resulting in detrimental socioeconomic impacts.
- With few exceptions (e.g. see Box 4.4), the lack of reliable long-term observational measurements has precluded detection of change in small-scale fisheries affected by climate change. Moreover, there is poor empirical evidence that social, economic and ecological trends in small-scale fisheries can be unambiguously attributed to climate change.

Warming hotspots

Unsurprisingly, the effects of climate change on oceans have not been homogeneous. Several areas of the ocean are warming faster than others: these "warming hotspots" (Hobday and Pecl, 2014) and their associated biological impacts (Pecl *et al.*, 2014) suggest that the livelihoods of coastal communities living in hotspot areas, as well as their exploited resources, may be at higher risk compared to other regions.

Warming hotspots provide unique opportunities to explore the effects of ocean warming on small-scale fisheries in contrasting geographic and climatic regions with different socioeconomic contexts, thereby also demonstrating the global and highly complex scope of the issue (Pecl *et al.*, 2014; Hobday *et al.*, 2016; Cochrane *et al.*, 2019). They represent excellent case studies for observing temporal changes in fishery indicators, assessing ecological and social vulnerability, and developing adaptation options and management strategies (Hobday *et al.*, 2016).

In addition to the warming hotspots identified by Hobday *et al.* (2016), there are others (see Figure 4.13) that could potentially be important sites for addressing social-ecological changes in small-scale fisheries. Two case studies based on a long-term analysis of small-scale fisheries within warming hotspots are illustrated in Box 4.3.

Freshwater ecosystems have relatively low buffering capacity and are therefore sensitive to climate-related shocks and variability. For instance, the analysis by Harrod *et al.* (2018a) of a set of river basins on all continents showed an expected increase in water temperature of up to 1.8 °C, with geographical heterogeneities. Given that this may also happen in hydrological cycles, the combined impact of these stressors could result in inland hotspots, although the extent of these impacts will be greater in some areas than in others (see Box 4.4 for an example in the Lower Mekong Basin).

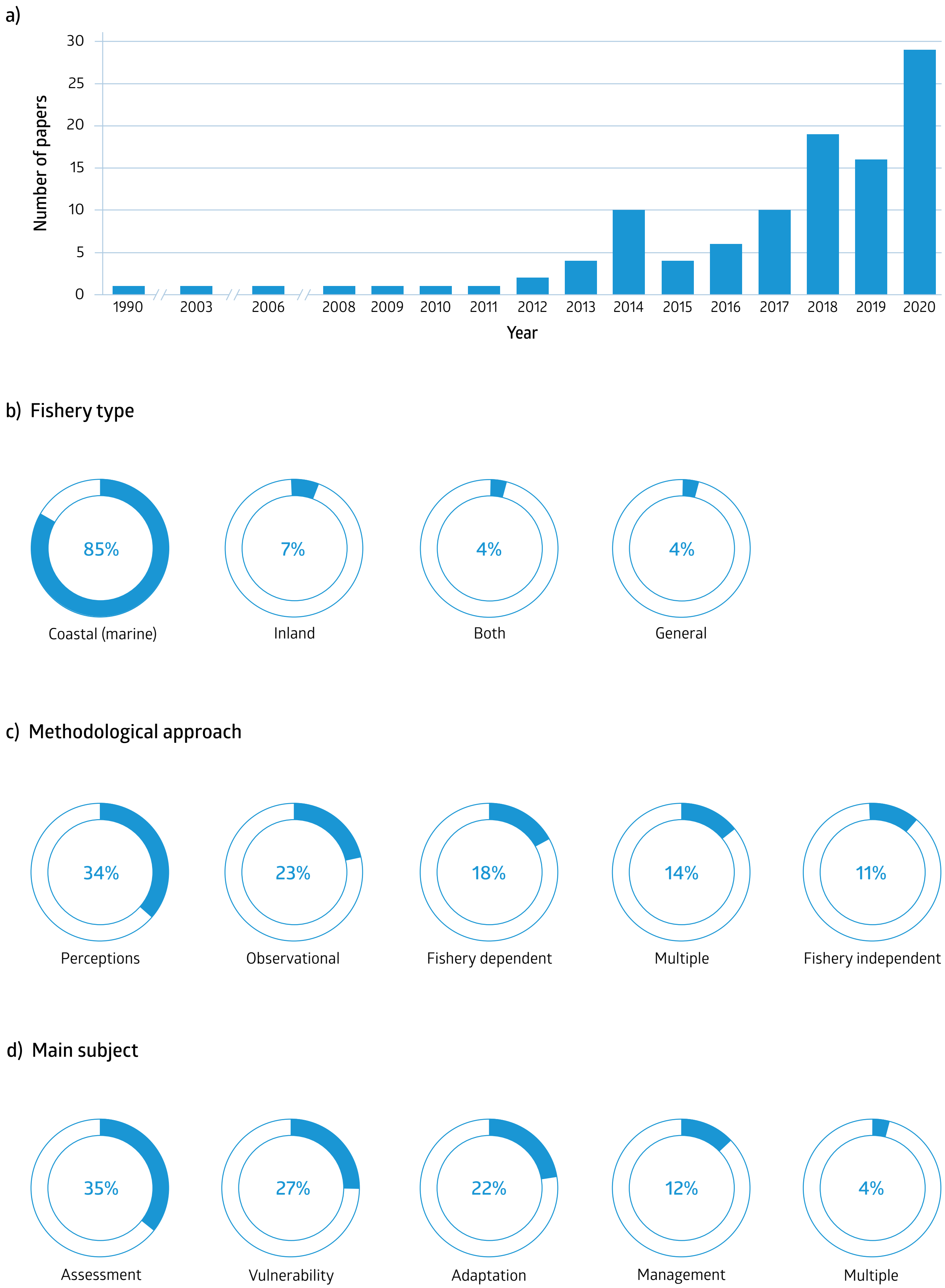
4.8.3 Perspectives and recommendations

Methodological approaches and research needed to inform policies

Recommended methodological approaches and research needed to inform mitigation and adaptation policies identified in this section include the following:

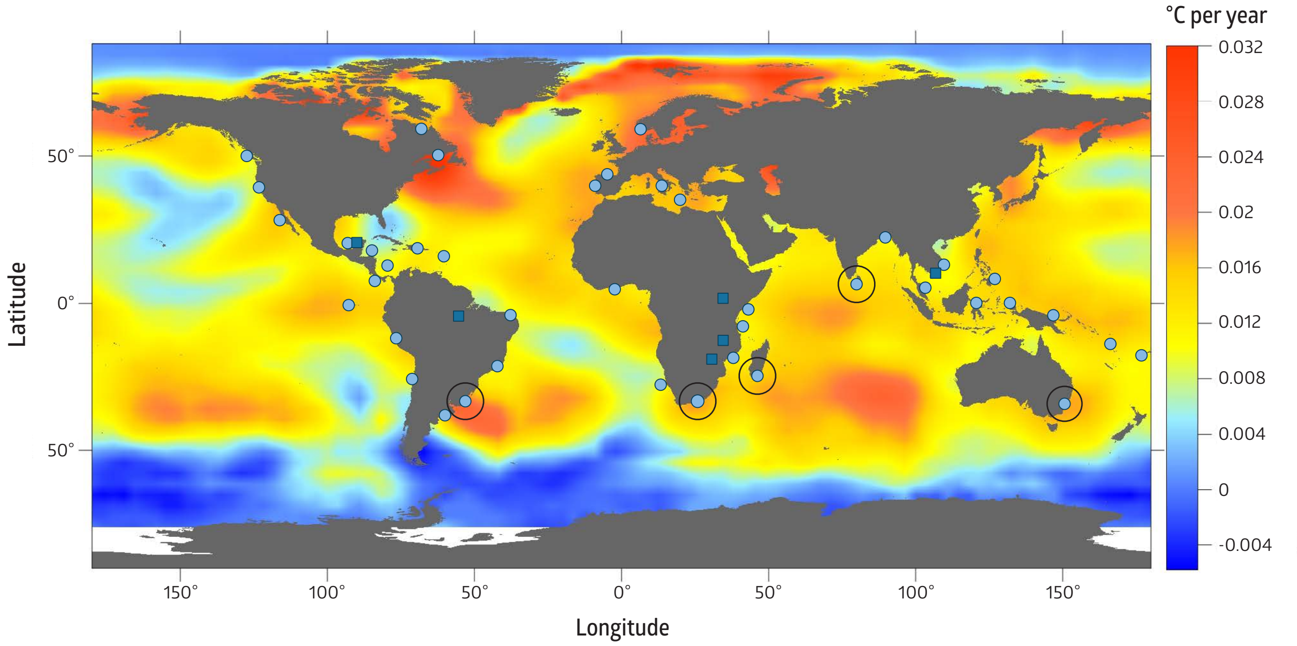
- Apply different methodological approaches (e.g. mixed-methods approach) simultaneously while including diverse information sources (e.g. traditional and scientific knowledge) to capture emerging views and different sources of evidence of the effects of climate change on small-scale fisheries. In addition, integrating different knowledge formats derived from natural and social sciences through interdisciplinary research could increase the ability to explore, promote, strengthen and support strategies on adaptation and mitigation of climate change impacts on small-scale fishers.
- Develop meta-analytical approaches to assess the vulnerability of small-scale fisheries to climate change at a global scale (or even focusing specifically on critical warming hotspots) and to provide global insights on exposure, sensitivity and adaptive capacity of the ecological and social components of these SES. The detection of common response patterns disaggregated by taxa and geographical region could also help elucidate the relevance of climate change as a primary causal agent of current trends.
- Develop long-term, efficient and accurate data collection methods aiming at quantifying key indicators of the three dimensions of sustainable development (social, economic and environmental) at the local level.
- Quantify the relative influence of multiple drivers/ stressors acting simultaneously on small-scale fisheries at different spatial and temporal scales, to understand the compound effects of multiple types of exposure (i.e. multidimensionality) and the interdependencies between drivers.

Figure 4.12 Review of literature on climate change impacts in small-scale fisheries



Notes: **a** Number of scientific papers published per year (period 2000–2020) on climate change impacts in small-scale fisheries, registered in the partial scan of the SCOPUS database. Distribution of papers (percentage) by **b** fishery type, **c** methodological approach and **d** main subject.

Figure 4.13 Annual rate of ocean warming, using sea surface temperature anomalies (°C per year) for the period 1960–2019



Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. Final boundary between the Sudan and South Sudan has not yet been determined.

Notes: Legend colour guides in the right margin are spaced by 0.004 °C per year. Circled (in blue) are five marine climate hotspots that include small-scale fisheries. Localities, countries or regions where climate change impacts on small-scale fisheries were found in the scientific literature scan (SCOPUS database) are also indicated: marine fisheries denoted by blue filled dots, inland fisheries denoted by red empty dots.

Source: Hobday, A.J., Cochrane, K., Downey-Breedt, N., Howard, J., Aswani, S., Byfield, V., Duggan, G. et al. 2016. Planning adaptation to climate change in fast-warming marine regions with seafood-dependent coastal communities. *Reviews in Fish Biology and Fisheries*, 26: 249–264.

- Assess the opportunities for capitalizing on shifts in stock distribution or enhanced productivity that result from climate-driven changes in species distributions and the consequent diversification of the portfolio available to small-scale fishers. This could help in reducing revenue variability and mitigating other risks and uncertainties associated with climate change.
- Make overall assessments of climate change vulnerability through integrated approaches, considering social, economic and environmental dimensions and governance and institutional arrangements.

Adapting to climate change: policy options, design and implementation

The papers reviewed for this section, together with the literature review, provide unequivocal evidence that climate change has already caused noticeable shifts in the distribution and abundance of several coastal species targeted by small-scale fisheries. For the inland small-scale fisheries, relevant topics identified include: the tolerance of inland fisheries for changes in temperature, stream flows, salinity and other environmental factors linked to climate change; and the capacity of fish species and fisheries to adapt to these changes (Paukert *et al.*, 2017).

Harrod *et al.* (2018a, b) have shown that there is a wide range of physiological and ecological impacts on both fish and the freshwater ecosystems supporting inland fisheries related to water temperature, water availability, water flow and other ecological perturbations. Therefore, important shifts in species compositions are expected. The likely future impact of these climate-induced changes, in combination with a variety of other anthropogenic pressures (e.g. overextraction of water, overexploitation of fish, introduction of non-native species, pollution, and habitat degradation and fragmentation) and increases in human populations, could lead to a major deterioration of these ecosystems (Harrod *et al.*, 2018a, b). Given the scale of direct and indirect impacts of climate change, the adaptive capacity of all temperate, tropical and subarctic freshwater ecosystems and existing inland fisheries is relatively low. Marine species having stronger biogeographic affinities to the tropics are increasing in prominence over those with cold-water affinities, leading to the tropicalization of marine systems (Cheung, Watson and Pauly, 2013). This highlights the need to develop adaptation plans to minimize, or capitalize on, the effects of tropicalization on the economy and food security of coastal communities.

Box 4.3

Two case studies on warming hotspots in South America

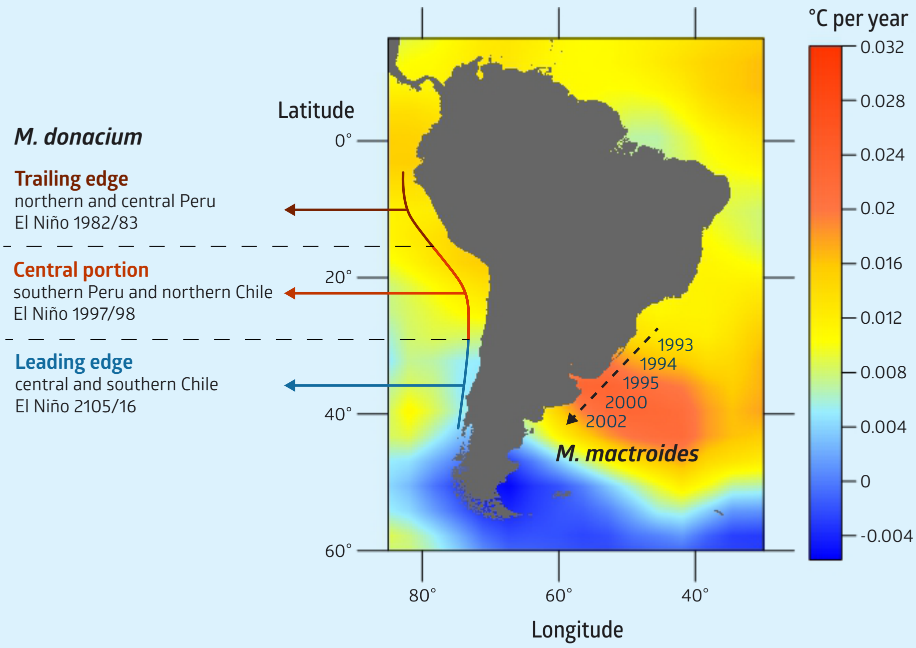
Case study 1

One of the largest and most intense warming hotspots is the southwestern Atlantic Ocean.[a] Here, the geographic expansion of warm waters along the Brazil Current (see figure) is affecting a wide region of southern Brazil, Uruguay, and the northern shelf of Argentina. The following changes have been observed:[b] (i) warming at a significant rate of 0.2 °C per decade, and (ii) a consistent, long-term poleward shift in the position of the warm water front (20 °C isotherm). This has been accompanied by increases in both sea level rise and the speed and frequency of onshore winds and storm surges.[c]

The yellow clam *Mesodesma mactroides* is an intertidal bivalve with cold-water affinities that has been commercially exploited within the area of influence of this warming hotspot.[d] Mass mortalities of this clam began to occur at the start of the climate shift during the 1990s; these continued sequentially in a poleward direction, following the movement of tropical waters.[e] A long-term decrease in abundance and individual size, together with deteriorated body condition, were associated with this ocean warming.[f]

Compounding the problem, an increase in the frequency and duration of harmful algal blooms, combined with more intense and frequent offshore winds – both climate-driven stressors that are closely linked to warming along the Uruguayan coast – have adversely affected yellow clam fishing activities, with associated revenue losses for fishers.[g] Clam populations have yet to recover to the abundant levels found before the mass mortality onset, denoting a high sensitivity to warming as well as poor adaptive capacity.[h] The yellow clam fishery in Uruguay was closed for 14 years, and those in Argentina and Brazil are still closed, affecting economic incomes and local community livelihoods.[i] Fishers' negative perceptions (gathered via questionnaire) of these climate change impacts highlight the urgent need to promote climate resilience and adaptability in this fishery.[j]

Figure Dates of mass mortalities of two cold temperate beach clams, *M. donacium* (Pacific) and *M. mactroides* (Atlantic)



Notes: El Niño events affected Pacific clams, whereas mortalities in the Atlantic followed the climate shift during the 1990s and occurred sequentially in a poleward direction. Ocean and scale colour denotes the annual rate of warming (°C) for the period 1960–2019.

Source: Extracted from Defeo, O., McLachlan, A., Armitage, D., Elliott, M. & Pittman, J. 2021. Sandy beach social-ecological systems at risk: regime shifts, collapses and governance challenges. *Frontiers in Ecology and the Environment*, 19(10): 564–573.

Box 4.3 Cont

Case study 2

Along the Pacific coast of South America, El Niño pulse disturbances have led to regime shifts and collapses in the associated surf clam (*Mesodesma donacium*) small-scale fisheries in Peru (see figure), but in southern Chile these have led to population increases.[k] The 1982/83 El Niño affected the trailing edge of the clam distribution (i.e. northern and central Peru), reducing the abundance so much that landings did not return to pre-mortality levels.[l] The next El Niño (1997/98) affected fisheries in the central portion of the range (southern Peru and northern Chile), resulting in local clam extinctions and restructured benthic communities.[m] The Peruvian surf clam fishery has remained closed since 1999, as surf clam populations have not recovered. The lack of response of this stock to long-term fishery closures suggests that the system exceeded critical thresholds (i.e. tipping points), first shifting abruptly from one state to another and then triggering a social-ecological collapse. Finally, the 2015/16 El Niño particularly affected populations at the leading edge of the range in southern Chile, resulting in a fishery closure in open-access fishing grounds until 2022. In essence, pulse perturbations (i.e. El Niño events) and weak governance (open-access systems) acted together to produce long-term clam stock crashes and fishery closures, with consequent economic hardship for the associated fishing communities.[n]

a Franco, B.C., Defeo, O., Piola, A.R., Barreiro, M., Yang, Hu., Ortega, L., Gianelli, I. *et al.* 2020. Climate change impacts on the atmospheric circulation, ocean, and fisheries in the southwest South Atlantic Ocean: a review. *Climatic Change*, 162: 2359–2377. **b** Ortega, L., Celentano, E., Delgado, E. & Defeo, O. 2016. Climate change influences on abundance, individual size and body abnormalities in a sandy beach clam. *Marine Ecology Progress Series*, 545: 203–213. **c** Franco, B.C., Defeo, O., Piola, A.R., Barreiro, M., Yang, Hu., Ortega, L., Gianelli, I. *et al.* 2020. Climate change impacts on the atmospheric circulation, ocean, and fisheries in the southwest South Atlantic Ocean: a review. *Climatic Change*, 162: 2359–2377; Gianelli, I., Ortega, L., Pittman, J., Vasconcellos, M. & Defeo, O. 2021. 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Box 4.4

Development and climate change impacts on Lower Mekong Basin fisheries

The Mekong basin has an area of around 800 000 km^2 and is shared between six countries: Cambodia (19 percent), China (22 percent), Lao People's Democratic Republic (25 percent), Myanmar (3 percent), Thailand (23 percent) and Viet Nam (8 percent).[a] Despite being the 25th largest river basin, the Lower Mekong Basin (LMB) (i.e. downstream from China and Myanmar) is home to the largest inland fisheries in the world, with an estimated annual catch of 2.3 million tonnes as of 2012. The fish and other aquatic mammals captured in these fisheries provide an average of 50 percent of animal protein to a population of 56 million people.[b] This catch was valued at USD 11 billion dollars in 2015, or between 2 and 18 percent of GDP in the four countries of concern.[c]

The annual monsoon increases river discharge in the basin twentyfold,[d] driving a major flood pulse that inundates the vast, highly productive floodplains, which serve as temporary feeding and growth areas for most fish species. As the waters recede, fish migrate out of flooded areas, returning to tributaries and dry-season waterbody refuges. These massive migrations are intensively exploited by the riparian populations throughout the basin, and the fish caught in this period are used as a protein source throughout the year, thanks to traditional preservation techniques.

There has been rapid population growth in the LMB over recent decades, with agricultural development increasing to meet the growing demand for food. To satisfy the associated irrigation needs, water abstraction has increased, causing delays and reductions in the flood pulse to which the life cycles of fish in the LMB have been adapted. At the same time, upland and floodplain forests and wetlands have been converted to arable land, with negative consequences for watersheds, aquatic ecosystems and fish.

The impacts of these developments on water resources and fish species are reinforced by climate change, which is predicted to cause higher evaporation rates and reduced rainfall during the dry season.e Climate change is also predicted to induce heavier rainfall during the wet season, leading to more intense and extreme flood events and subsequent economic losses.[f] As a result dykes and other forms of flood protection have been built to protect farmland and infrastructure, but as these disconnect the rivers from their floodplains, preventing fish from entering their growing and breeding habitats, the fisheries are negatively impacted despite the greater amounts of water.

Alongside climate change effects, the increasing demand for energy (especially renewable electricity) in the LMB countries is driving the construction of hydropower dams. By the early 2000s, most of the major tributaries of the Mekong had already been dammed (there are 12 dams in the Chinese Lancang section of the river), but the lower Mekong had been spared mainstream barriers. Now, however, there are two mainstream dams in operation in the LMB, with a further nine more planned.[g] These dams not only block fish migrations, but also change the size and timing of the flood pulse and remove sediment from the water. For instance, since the completion of the Xayabouri mainstream dam in the Lao People's Democratic Republic, the colour of the Mekong downstream of the dam has changed from the normal *café au lait* to a transparent or bluish hue.[h] In 2020, fish catches in Cambodia collapsed because of historically low water levels,[i] with the large flood pulse that drives the Tonlé Sap fishery at only a fraction of its usual size. It is not yet clear whether this failure in the flood pulse was primarily driven by climate change (low rainfall) or a result of damming (retention and diversion of water); it was quite likely a combination of the two.[j] Whichever the cause, the impacts on the fishery are clear, and while inland fisheries often recover well from occasional dry years, this kind of massive perturbation will have completely unknown consequences for LMB fisheries.

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Box 4.4 Cont

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Adaptation to climate change refers to adjustments in biophysical (i.e. environmental), economic, social and institutional (i.e. governance) systems in response to actual or expected climatic effects or impacts in small-scale fisheries, and the corresponding changes in processes, practices and structures to either moderate the potential damage from climate change or benefit from the opportunities associated with it. There are several ways to group climate change adaptation strategies; one way, following the rationale of small-scale fisheries as complex SES, is to group them considering the four sustainability pillars (Stephenson *et al.,* 2018; Barange *et al.,* eds., 2018; Bindoff *et al.,* 2019; Bahri *et al.,* eds., 2021; Gianelli *et al.,* 2021):

- **Biophysical:** incorporate environmental variables, and risk and uncertainty, into fisheries assessments; address the effects of multiple types of exposure of SES to compound stressors, assessing their relative contributions and uncertainty; enhance monitoring systems, including monitoring of environmental variables, through community-based data collection programmes;
- **Economic:** identify and develop new fisheries opportunities to capitalize on distributional shifts or enhanced productivity; increase diversification of employment opportunities within and outside the fisheries sector; develop risk insurance schemes that indemnify fishers against loss and damage after climate shocks; ensure that waterbody management considers and supports inland fisheries livelihoods;
- **Social:** improve access to highly nutritious, well-balanced food to support food security and nutrition, ensuring social and economic development even as fish abundance is reduced; identify social barriers to adaptation, particularly in cases where there is a heavy reliance on small-scale fisheries for employment or a lack of physical capital;
- **Institutional/management:** strengthen overall governance through flexible and adaptive community-based institutions and co-governance; develop and implement flexible policies and management actions to promote climate-resilient small-scale fisheries; build policy and management strategies to redirect fishing effort to other species to avoid additional pressure on those already threatened by climate change; provide funding for long-term, interdisciplinary research programmes to improve collection of small-scale fisheries data essential for understanding climate change impacts and providing catch forecasts under different management scenarios.

As part of a suggested FAO fisheries and aquaculture adaptation toolbox, Poulain, Himes-Cornell and Shelton (2018) split adaptation into three categories that are non-mutually exclusive: institutional adaptation, livelihood adaptation, and risk management and reduction. Considering small-scale fisheries are usually data-poor systems, with often limited human and financial resources available for research and monitoring, it is important to prioritize the identified options based on the characteristics of the SES, the local or regional climate change effects, and the institutional and technical capacities. Although many of these recommendations are not uniquely relevant in the context of adaptation to climate change, they should be tailored to reflect the effects and impacts of climate change on small-scale fisheries.

Among the many adaptation options identified in the literature, there is a short-term need to develop no-regret (or low-regret) options such as adaptive strategies to strengthen collective action and empower small-scale fishing communities. Flexible policies and adaptive management actions should be developed to tackle the challenge of promoting climate-resilient small-scale fisheries capable of providing fundamental ecosystem services, securing food security and nutrition, and ensuring sustained livelihoods and human well-being for generations to come.

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5.

Small-scale fisheries contributions to economic value and livelihoods

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5.1 Key findings and messages

Economic value of small-scale fisheries production

- Extrapolating from 58 country and territory case studies (CCS), the average annual landed economic value of the global small-scale fisheries catch during 2013–2017 was estimated to be almost USD 77.2 billion in nominal terms, including more than USD 58.1 billion from marine small-scale fisheries and over USD 19.0 billion from inland small-scale fisheries. This estimate is approximately 49 percent higher than the figure obtained in the initial Hidden Harvest study in 2012, though different sources and methods were used.
- The estimated total revenues from the harvesting segment of small-scale fisheries are comparable to the total revenues generated by some of the largest industries in the ocean economy.
- In comparison with large-scale fisheries, for the 68 CCS (representing 70 percent of the global catch reported in FAO FishStat [FAO, 2020a]), small-scale fisheries generated 44 percent of the total landed economic value of the catch. This share reflects the significant portion of catch value generated by small-scale fisheries in many countries worldwide.

Small-scale fisheries livelihoods: employment, subsistence, and additional livelihoods dependent upon fisheries

- Estimates extrapolated from 78 national household-based surveys show that 60.2 million people were employed part or full time along the small-scale fisheries value chain in 2016 (compared to 7.3 million people estimated for large-scale fisheries). This confirms that small-scale fisheries account for almost 90 percent of global fisheries employment.
- Of these, an estimated 27.5 million were employed part or full time in the harvesting segment of the value chain (14.6 million in inland and 12.9 million in marine small-scale fisheries).
- Women account for 35 percent of the total employment along the small-scale fisheries value chain (20.9 million).
- Women represent roughly one-half (49.8 percent) of the people employed part or full time in the post-harvest segment of the small-scale fisheries value chain.

- The total employment along small-scale fisheries value chains in 2016 was equivalent to 1.9 percent of the globally employed population, or 1 out of every 50 jobs worldwide, and equivalent to 6.7 percent of agricultural employment (i.e. crop, livestock, forestry and fisheries). Marine small-scale fisheries are likely the subsector with the largest employment in the ocean economy.
- Additionally, an estimated 52.8 million people were engaged in small-scale fisheries harvesting or processing for subsistence at least once a year: 36.0 million (68.1 percent) in inland fisheries and 16.8 million (31.9 percent) in marine fisheries. Of these, 23.8 million were women (45.2 percent).
- Together, these estimates show that 113.0 million people were either employed in small-scale fisheries along the value chain or engaged in harvesting or processing for subsistence in 2016.
- These 113.0 million people have an estimated 378.7 million additional household members. Therefore, considering all of those employed in small-scale fisheries along the value chain, plus those engaged in subsistence activities[3] and their dependents, the number of those whose livelihoods are at least partially dependent upon small-scale fisheries is 491.7 million people.
- These 491.7 million people represent 6.6 percent of the world population as of 2016 and 13.2 percent of the population in the 45 least developed countries. Under the current methodology, which is based on national surveys, there are likely still more people unaccounted for who are dependent on small-scale fisheries.

Role of small-scale fisheries in exports of fish and fish products

- International trade was a significant feature of small-scale fisheries in the CCS (inclusive of informal trade), across all regions. According to estimates for 22 countries studied, representing 48 percent of global marine capture fisheries production, on average almost 26 percent of the marine small-scale fisheries catch by volume was exported during the period 2013–2017.
- According to estimates for nine countries studied, representing 25 percent of global inland capture fisheries production, on average just over 16 percent of the inland small-scale fisheries catch was exported in the period 2013–2017.

Figure 5.1 provides an overview of the economic and livelihood benefits of small-scale fisheries, and how these benefits can contribute to sustainable development.

5.2 Introduction

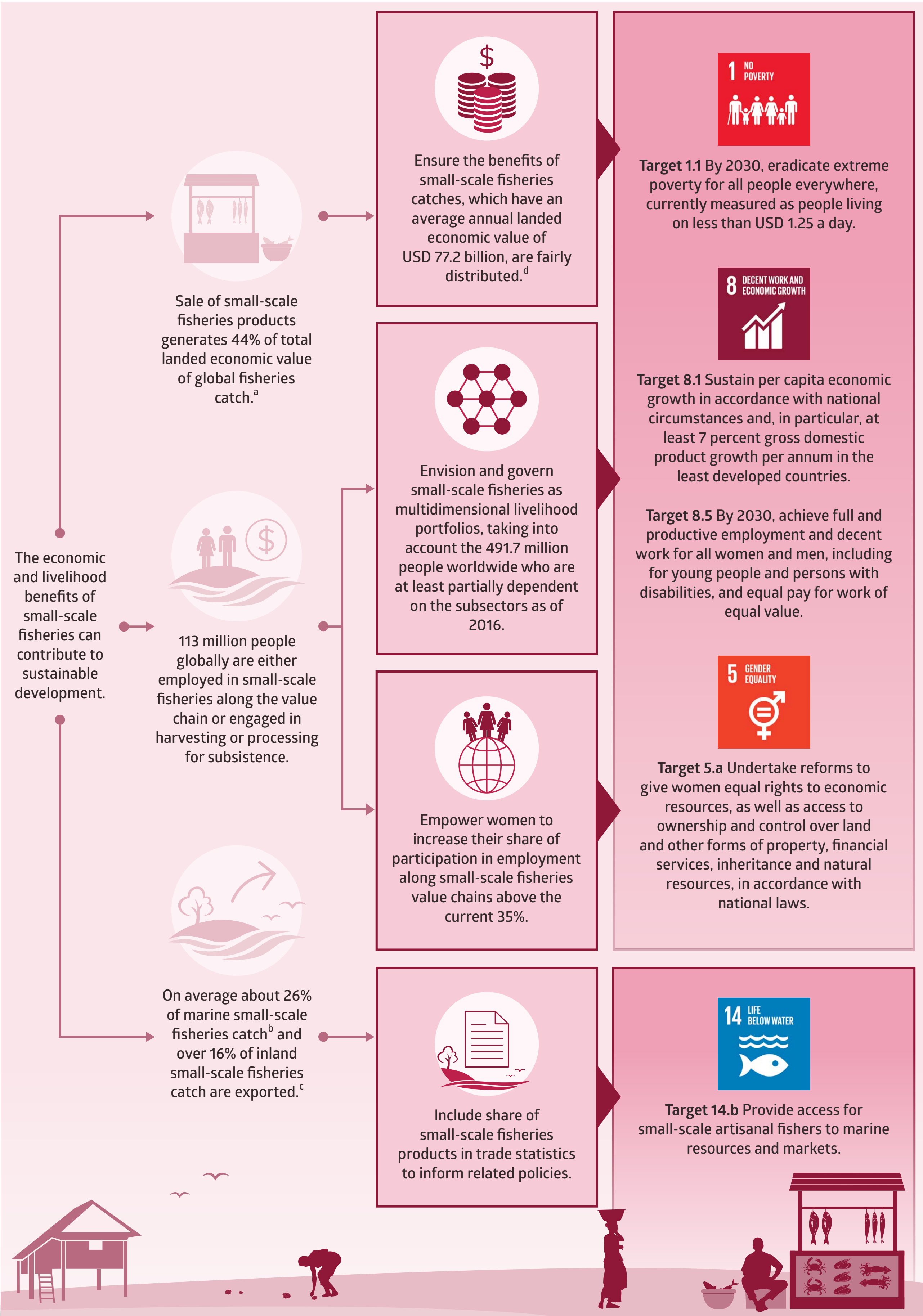
The social and economic roles played by small-scale fisheries have been well recognized by scholars since at least the middle of the twentieth century, and the serious plight of many small-scale fishers and fishing communities has been acknowledged for just as long. For example, in the early 1970s FAO wrote of small-scale fisheries that "the people engaged in these activities and their families continue, with few exceptions, to live at the margin of subsistence and human dignity" (FAO, 1974, cited in Béné, 2003). At much the same time, Smith (1979) referred to poverty as being a global characteristic of traditional fishing communities and, using the example of four South-eastern Asian countries, pointed out that the average incomes of fishers in all of those countries were lower than the average national incomes per capita. Nevertheless, the author reported that the traditional fisheries in those countries made important contributions to their national economies.

Since then, as shown by the many references included in this chapter, much has been written on the conflicting characteristics of small-scale fisheries, where their importance for nutrition and livelihoods stands in stark contrast with the high levels of poverty and low standards of living so prevalent in the subsector. A common perception is that these fisheries are typically among the poorest of the poor, and the subsector is often an employer of last resort (Béné, 2003; Schuhbauer and Sumaila, 2016). While the reality is more complex, that basic position has not changed and, as noted in the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines), "Despite their importance, many small-scale fishing communities continue to be marginalized, and their contribution to food security and nutrition, poverty eradication, equitable development and sustainable resource utilization – which benefits both them and others – is not fully realized" (FAO, 2015).

The reasons for the desperate conditions of so many small-scale fishers and communities has also been widely studied. Early interpretations fell into two interconnected categories: the first, that fishers were poor because open access to limited natural resources had resulted in these resources being overexploited; and the second, that fishers were poor because they did not have access to any better alternatives (Béné, 2003). Current understanding recognizes that these two hypotheses are too simplistic, and that poverty and its causes are multidimensional. It is not just that incomes are low: there are many related challenges, including the remoteness of the areas where small-scale fisheries

[3] Assuming this engagement is sufficiently frequent to allow for some dependence upon fisheries for livelihoods.

Figure 5.1 Key pathways through which economic and livelihood benefits of small-scale fisheries can contribute to sustainable development



Notes: **a** Based on 58 IHH country and territory case studies. **b** Based on 22 IHH country and territory case studies, representing 48 percent of global marine capture fisheries production. **c** Based on nine IHH country and territory case studies, representing 25 percent of global inland capture fisheries production. **d** In nominal terms for marine and inland small-scale fisheries; reference period 2013–2017.

frequently operate, the low levels of formal education and frequently poor health found among fishers and fishworkers, and the inadequate provision of education, health and other social services, among other factors (FAO, 2015; Westlund, Holvoet and Kébé, eds., 2008).

Small-scale fisheries catch is used in different ways throughout national and local economies: some portions are retained for own consumption while other portions are sold locally or nationally through fisheries value chains, or internationally in global aquatic food markets. International trade in fish and fish products has grown rapidly over the last 50 years in keeping with the growth of trade in general (FAO, 2020b), and small-scale fisheries have been a part of this growth. The sale of fishery products in global markets has potential costs and benefits: the potentially higher earnings must be weighed against the risk of reduced availability and higher prices for local consumers as well as greater incentives for overexploitation. Understanding the extent of the participation of small-scale fisheries in international trade, as is addressed in this chapter, is therefore another important consideration for the implementation of the SSF Guidelines and the achievement of the Sustainable Development Goals.

Due in part to the informality and in some cases seasonality of small-scale fisheries, their contributions to local and national economies are still often overlooked or hidden in national fisheries statistics (Smith and Basurto, 2019), or narrowly measured around single objectives (Schuhbauer and Sumaila, 2016; Weeratunge *et al.,* 2014). Acknowledging that a broad, multidimensional perspective on development requires taking into account other aspects of poverty, such as access to public services, this chapter focuses on synthesizing estimates of a number of socioeconomic indicators frequently used by governments to help improve their understanding of small-scale fisheries and strengthen their support to the subsector. First, in Section 5.3, the chapter assesses the economic value of small-scale fisheries worldwide, using total revenues from harvesting ("landed economic value"[4]) as an initial indicator. Beyond revenue, there is broad consensus that the number of people involved in small-scale fisheries is a significant indicator of the subsector's contribution to economies (Béné, 2006), so Section 5.4 provides gender-disaggregated estimates of the number of individuals employed along small-scale fisheries value chains or engaged in subsistence activities and additional livelihoods dependent on these fisheries. Finally, given that the fish landed by small-scale fisheries circulates in various markets as part of local and national economies, Section 5.5 summarizes estimates of the catch that is exported. These estimates provide a first measure of the role of these fisheries in an increasingly globalized system of international trade (FAO, 2018b). The dynamics of the global aquatic food market have become increasingly relevant for small-scale fisheries, as developing countries' share of international aquatic food trade flows has steadily increased from 1976 to 2019 (FAO, 2021b), while production processes for some 77.7 percent of the aquatic foods consumed worldwide are exposed to competition from trade (Tveteras *et al.,* 2012).

5.2.1 Links to the Sustainable Development Goals and the SSF Guidelines

While small-scale fisheries contribute towards achieving a broad range of targets linked to the Sustainable Development Goals (SDGs), the estimates presented in this chapter of landed economic value and livelihoods illustrate the importance of this subsector to SDG 1 (No poverty), SDG 5 (Gender equality) and SDG 8 (Decent work and economic growth). They illustrate in particular the contribution of small-scale fisheries to income growth for the poorest households (SDG Target 1.1), resilience of the poor (Target 1.5), equal rights of women to economic resources (Target 5.a), sustained per capita economic growth (Target 8.1), and full and productive employment and decent work for all women and men (Target 8.5), among others. This chapter emphasizes the safety net provided by small-scale fisheries (Béné, Hersoug and Allison, 2010), wherein they enhance the resilience of the poor and otherwise vulnerable in the face of climate-related extreme events and other economic, social and environmental shocks and disasters.

Additionally, this chapter's estimates of the role of small-scale fisheries in international trade are directly relevant for SDG goals and targets that address inequality (SDG 10), ocean use (SDG 14) and partnerships (SDG 17), including access for small-scale fishers to marine resources and markets (Target 14.b – none of the targets make explicit reference to inland small-scale fisheries). They are also relevant to the principle of special and differential treatment for developing countries, in particular least developed countries, in accordance with World Trade Organization (WTO) agreements (Target 10.a) and the need for a universal, rules-based, open, non-discriminatory and equitable multilateral trading system under the WTO, in part through the conclusion of negotiations under its Doha Development Agenda (Target 17.10).

Finally, the SSF Guidelines note that small-scale fisheries "often underpin the local economies in coastal, lakeshore and riparian communities and constitute an engine, generating multiplier effects in other sectors." The indicators estimated here can also help measure progress towards implementation of the SSF Guidelines provisions related to social development, employment and decent work, and to gender equity and equality, among others.

[4] Landed economic value is defined here as the product of the landed volume and the price per unit of volume (e.g. per tonne) received at the point of landing or first sale (Melnychuk *et al.,* 2017).

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5.2.2 Previous estimates of the economic value of small-scale fisheries, in terms of value of production (landed economic value)

A sector's contribution to a national economy is typically measured in terms of its value added, or its contribution to the gross domestic product (GDP). Accordingly, the initial 2012 Hidden Harvest study, in addition to estimating the landed economic value of the catch, compiled a range of national estimates of the contribution of capture fisheries to GDP,[5] estimating a global gross value added of USD 274 billion in 2007 (World Bank, 2012). However, in many countries, collecting data on the specific value added from small-scale fisheries remains challenging given the often informal nature of their activities, and therefore the size of their contribution to the economy may be underestimated. For that reason, it was decided in this Illuminating Hidden Harvests (IHH) study to use a more readily available proxy: the total value of production from the harvesting segment of small-scale fisheries value chains (i.e. the landed economic value). This proxy measures upstream and downstream multiplier effects that, taken together, can make significant contributions to the economy, notably to rural economies (Béné, Macfadyen and Allison, 2007). Estimating the landed economic value derived from global fisheries is an important step toward enhancing awareness of the significant social and economic benefits arising from these activities (Swartz, Sumaila and Watson, 2013), and in this case from those of the small-scale fisheries subsector more broadly.

Measures of the economic contributions of fisheries are often limited by a lack of ex-vessel price data (prices at first sale) (Melnychuk *et al.*, 2017), especially in small-scale fisheries, and as such the landed economic value of small-scale fisheries catch has rarely been estimated at the global level (Mills *et al.*, 2011). Typically, information on price and value has been available for aquatic food products after processing, but not for the landed economic value. Sumaila *et al.* (2007) first proposed a global database of ex-vessel prices to estimate the total landed economic value of marine fisheries catch over time, based on the Sea Around Us database (using national datasets) of catch and aggregated prices by functional group of species. This database was subsequently updated and expanded in 2013 to estimate the total landed economic value of marine fisheries to be USD 100 billion in 2005 (Swartz, Sumaila and Watson, 2013), and again in 2017 to produce an estimate of USD 150 billion in 2010 (noting that these estimates may better reflect large-scale prices, depending on where the data were sourced) (Tai *et al.*, 2017). Melnychuk *et al.* (2017) also created a global database

[5] This relied upon using a multiplier to estimate post-harvest contributions.

of estimated ex-vessel prices for individual species by converting export prices of fish products into ex-vessel prices, and pairing these with species from the global FAO FishStat capture fisheries database. Finally, the previous Hidden Harvest study estimated the value of the catch from capture fisheries to be in the order of USD 96 million, of which USD 46 billion was generated by small-scale fisheries (World Bank, 2012). FAO regularly estimates this global landed economic value as well, obtaining a figure of USD 146 billion in 2019, including both small- and large-scale fisheries (FAO, 2021b).

At the regional level, while not directly comparable, the Too Big To Ignore network has compiled case studies with estimates of the landed economic value of small-scale fisheries catch, ranging from USD 272 million in the Pacific Islands to USD 21 billion in Asia and Oceania for the year 2016 (Gillett, 2009; TBTI, 2016, 2018a, 2018b). Finally, the Organisation for Economic Co-operation and Development (OECD) maintains a database on the landed economic value of marine capture fisheries for 35 countries, for which it recorded a total figure of USD 79 billion for 2018 (OECD, 2021).

5.2.3 Previous estimates of employment in small-scale fisheries

FAO has traditionally collected data on the number of fishers by country and territory, with a breakdown by gender and location (inland, coastal or deep-sea). However, these data are typically reported by governments in aggregated forms that do not permit accurate estimates of small-scale fisheries employment along the value chain or of participation in subsistence activities. Starting in 2002, FAO estimated that small-scale fisheries employ more than 90 percent of the world's capture fishers, based on an employment dataset from 1990 (FAO, 2002, 2012, 2014), though this estimate has not been updated or revised in recent years.

Generating accurate measures of total fishers and fishworkers worldwide is challenging enough, but generating credible estimates of the proportion of them participating in small-scale fisheries has been even more difficult (Basurto *et al.,* 2017a, b). A 1975 University of Rhode Island study referred to in Smith (1979) suggested there could be up to 15 million small-scale fishers globally, while Thomson (1980) suggested a total global employment of 8 million (Table 5.1). Neither of those estimates included subsistence activities or the wider range of livelihoods supported within small-scale fisheries value chains – important components that are explored in this chapter. Since the advent of the "Thomson Table", various studies have attempted to estimate levels of participation in small-scale fisheries at global and regional levels. Of these, the largest estimate to date is 108 million people (almost evenly split between inland and marine fisheries), generated by the 2012 Hidden Harvest study (World Bank, 2012) (Table 5.1).

Table 5.1 Non-exhaustive list of previous estimates of small-scale fisheries (SSF) employment

Study (year)	SSF employment	Estimates include post-harvest employment? (Y/N)	Estimates include both inland and marine fisheries?	Notes
Global				
Thomson, 1980[a]	> 8 million	No	Marine only	"Thomson Table": specifies "number of fishers" employed; assumed not to include post-harvest employment
Lindquist, 1988[b]	> 12 million	No	Marine only	Update of previous Thomson Table estimates
Pomeroy and Williams, 1994[c]	14–20 million; rises to 50 million if post-harvest included	Yes	Marine and inland; also includes aquaculture	Number of people in developing countries "involved in fisheries and aquaculture"; rises to 50 million if post-harvest operations included
McGoodwin, 2001[d]	40 million	Yes	Marine and inland	Divided evenly between harvesting and post-harvest segments of the value chain, supporting the livelihoods of more than 200 million people worldwide (using a 1 to 5 multiplier for dependents and supporting services)
Berkes *et al.*, 2001[e]	50 million	No	Marine and inland	Harvesting segment of the value chain, supporting the livelihoods of 250 million people worldwide (using a 1 to 5 multiplier for household size)
Pauly (2006)[f]; Chuenpagdee *et al.*, 2006[g]	> 12 million	No	Marine only	Number of fishers employed
World Bank, 2012[h]	108 million	Yes	Marine and inland	Available data compiled from 19 country case studies and extrapolated to missing countries
Teh and Sumaila, 2013[i]	22 million (± 0.45)	No	Marine only	Harvesting segment of the value chain for marine small-scale fisheries, which, combined with estimated 28 million marine large-scale fishers, supported part- and full-time employment ("indirect employment") of an estimated 210 million people worldwide
Kolding, Béné and Bavinck, 2014[j]	> 30 million	No	Marine and inland	Update of previous Thomson Table estimates
Funge-Smith and Bennett, 2019[k]	25 million	Yes	Inland only	Inland small-scale fisheries, for both harvesting and post-harvest segments of the value chain
Harper *et al.*, 2020[l]	2.1 million (± 0.09)	No	Women in marine fisheries only	Women employed in harvesting segment of the marine small-scale fisheries value chain

Table 5.1 Cont

Study (year)	SSF employment	Estimates include post-harvest employment? (Y/N)	Estimates include both inland and marine fisheries?	Notes
Regional				
Guyader *et al.*, 2013[m]	0.1 million	N/A	Marine only	Europe
de Graaf and Garibaldi, 2014[n]	9 million	Yes	Marine and inland	Africa, marine and inland small-scale fisheries, including both harvesting and post-harvest segments of the value chain
Belhabib, Sumaila and Pauly, 2015[o]	≈ 1 million	No	Marine only	Western Africa (22 countries), harvesting segment of the value chain; additional 700 000 subsistence fishers estimated, plus 4.8 million dependents
FAO, 2020[p]	0.1 million	Yes	Marine and inland	Mediterranean and Black Sea, marine and inland small-scale fisheries, including harvesting and post-harvest segments of the value chain
Pascual-Fernández, Pita and Bavinck, eds., 2020[q]	0.1 million	No	Marine and inland	Europe, harvesting segment of the value chain for marine and inland small-scale fisheries
Isaacs, Onyango and Akintola, eds., 2020[r]	2.3 million	N/A	Marine and inland	Africa

Notes: **a** Thomson, D. 1980. Conflict within the fishing industry. NAGA. *ICLARM Newsletter*, 3: 3–4. **b** Lindquist, A. 1988. Thanks for using NAGA. *ICLARM Quarterly*, 11: 16–17. **c** Pomeroy, R. & Williams, M. 1994. *Fisheries co-management and small-scale fisheries: a policy brief*. Manila, International Center for Aquatic Living Resources Management. **d** McGoodwin, J. 2001. *Understanding the cultures of fishing communities: a key to fisheries management and food security*. FAO Fisheries Technical Paper No. 401. Rome, FAO. **e** Berkes, F., Mahon, R., McConney, P., Pollnac, R. & Pomeroy, R. 2001. *Managing small-scale fisheries. Alternative directions and methods*. Ottawa, International Development Research Centre. **f** Pauly, D. 2006. Major trends in small-scale marine fisheries, with emphasis on developing countries, and some implications for the social sciences. *MAST*, 4(2): 7–22. **g** Chuenpagdee, R., Liguori, L., Palomares, M.L.D. & Pauly, D. 2006. *Bottom-up, global estimates of small-scale marine fisheries catches*. Fisheries Centre Research Reports, Vol. 14 No. 8. Fisheries Centre, University of British Columbia. **h** World Bank. 2012. *Hidden harvest: the global contribution of capture fisheries*. Washington, DC. **i** Teh, L.C.L. & Sumaila, U.R. 2013. Contribution of marine fisheries to worldwide employment. *Fish and Fisheries*, 14: 77–88. **j** Kolding, J., Béné, C. & Bavinck, M. 2014. Small-scale fisheries: importance, vulnerability, and deficient knowledge. In: S. Garcia, J. Rice & A. Charles, eds. *Governance for marine fisheries and biodiversity conservation. Interaction and coevolution*, pp. 317–331. Wiley-Blackwell. https://doi.org/10.1002/9781118392607.ch22 **k** Funge-Smith, S. & Bennett, A. 2019. A fresh look at inland fisheries and their role in food security and livelihoods. *Fish and Fisheries*, 20(6): 1176–1195. **l** Harper, S., Adshade, M., Lam, V.W.Y., Pauly, D. & Sumaila, U.R. 2020. Valuing invisible catches: estimating the global contribution by women to small-scale marine capture fisheries production. *PLoS ONE*, 15(3): e0228912. https://doi.org/10.1371/journal.pone.0228912 **m** Guyader, O., Berthou, P., Koutsikopoulos, C., Alban, F., Demanèche, S., Gaspar, M.B., Eschbaum, R. *et al.* 2013. Small-scale fisheries in Europe: a comparative analysis based on a selection of case studies. *Fisheries Research*, 140: 1–13. **n** de Graaf, G. & Garibaldi, L. 2014. *The Value of African Fisheries*. FAO Fisheries and Aquaculture Circular No. 1093. Rome, FAO. **o** Belhabib, D., Sumaila, U.R. & Pauly, D. 2015. Feeding the poor: contribution of West African fisheries to employment and food security. *Ocean & Coastal Management*, 111(July): 72–81. **p** FAO. 2020. *The State of Mediterranean and Black Sea Fisheries 2020*. General Fisheries Commission for the Mediterranean. Rome. https://doi.org/10.4060/cb2429en **q** Pascual-Fernández, J.J., Pita, C. & Bavinck, M., eds. 2020. *Small-scale fisheries in Europe: status, resilience and governance*. MARE Publication Series 23. Cham, Switzerland, Springer International Publishing. https://doi.org/10.1007/978-3-030-37371-9 **r** Isaacs, M., Onyango, P. & Akintola, S.L., eds. 2020. *Small-scale fisheries in Africa: a regional portrait*. TBTI Global Publication Series. St. John's, Canada, TBTI. 132 pp.

In addition to estimates of employment along small-scale fisheries value chains, some regional studies have also assessed the number of livelihoods dependent on small-scale fisheries. For example, Salas *et al.* (2007) found that in Latin America and the Caribbean, 2 million people were dependent upon small-scale fisheries for employment, food and livelihoods. And Harper *et al.* (2013) estimated that women account for 56 percent of small-scale fisheries catch in the Pacific region.

The reliability of the new figures on small-scale fisheries employment and livelihoods of this chapter was further assessed against a number of official data sources (e.g. FAO employment figures). A detailed discussion on the comparisons of IHH figures with other data sources can be found in Annex B.

5.2.4 Previous estimates of exports in small-scale fisheries

Following a similar trend in the global economy, international trade in aquatic foods has grown significantly in recent decades. The value of aquatic food exports increased at an average annual rate of 7 percent in nominal terms from 1976 to 2019, with 221 countries and territories participating in this trade (FAO, 2020a). In 2019, roughly 37 percent of aquatic foods produced (in live weight equivalent) entered global markets (FAO, 2020a). Small-scale fisheries are increasingly interacting with these global aquatic food markets through international trade, though in complex, context-specific ways (e.g. based on import/export dynamics, foreign investment, and trade barriers and market access) that have led to differing opinions on the contributions of these interactions to the sustainable development of small-scale fisheries (Crona *et al.,* 2016). There is significant literature on the role of international trade in small-scale fisheries and the implications for poverty reduction and food security (O'Neill *et al.,* 2018; Crona *et al.,* 2015, 2016; Béné, Hersoug and Allison, 2010; Kurien, 2005; Béné, Bennett and Neiland, 2004). Building upon these studies, the assessment in this chapter focuses on the extent of fisheries exports in 26 country and territory case studies (CCS) and, for a smaller number of countries and territories, the contribution of small-scale fisheries to total national aquatic food exports.

Methods used and contribution to existing knowledge

Methods and data sources for estimates of landed economic value.

Although accurate estimates of the economic contribution of small-scale fisheries have traditionally been limited by the availability of data, specific case studies and household-based survey data have allowed for improved understanding of the importance of these fisheries to national and local economies. This IHH report presents a new database of ex-vessel fisheries prices disaggregated by scale of operation (i.e. small or large), using data compiled from 58 CCS (see Figure A.5 in Annex A) over a five-year period. By extrapolating from these, a new global estimate of the landed economic value of small-scale fisheries production – i.e. the total value of production from the harvesting segment – was derived, based on the average annual ex-vessel price of each species caught (as reported in the CCS) and the volume of catch estimated in this report (see Chapter 4). Using this dataset of small-scale fisheries ex-vessel prices, regional and global totals were predicted as averages for this period (see Annex A, Section A.4.1) using a random forest regression analysis. Thus the new IHH database adds a set of prices specific to small-scale fisheries, whereas the Sumaila *et al.* (2007) database was more a reflection of large-scale prices, albeit compiled from a much longer time period than this report. Similarly, the Melnychuk *et al.* (2017) database included prices by species from a review of existing data, but not disaggregated by scale of operation.

Methods and data sources for estimates of livelihoods.

Building on the estimates of global employment along small-scale fisheries value chains generated by the Hidden Harvest (World Bank, 2012) study and the Teh and Sumaila (2013) study, the IHH study systematically collected more standardized household-level data through different surveys, notably labour force surveys and household income and expenditure surveys. These were carried out in countries around the world as part of a number of different initiatives, allowing for comparison and aggregation. The surveys covered respondents' activity over a relatively short reference period (typically a week) and were usually collected quarterly, allowing for analysis of seasonal employment in fisheries. They included questions related to employment along fisheries value chains and number of people working alongside respondents (as a proxy for enterprise size[6]). Using regression analyses, regional and global estimates of employment along small-scale fisheries value chains, and of subsistence activities, were predicted from a sample of these national surveys (see Annex A, Section A.4.2). If a variable was not available in a survey, then it was imputed based on information from other surveys.

These household-based surveys allow for estimates from a larger dataset than previously available (see Figure A.7 in Annex A), with more detail than before on the nature and makeup of these fisheries activities. The estimates are disaggregated not only by gender, but also by inland and marine fisheries within the harvesting segment of small-scale fisheries value chains. Furthermore, based on respondents' reported activity over the full year (or in some surveys over

[6] This also included the number of employees at respondents' places of work.

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the last month or week), many of the surveys allow for estimates of the number of people who engage in small-scale fisheries harvesting or processing solely for subsistence. In this way, the survey data provide perhaps the clearest picture to date of the role that small-scale fisheries play in supporting livelihoods worldwide. Beyond the new information they add to the 2012 Hidden Harvest study, the surveys may also provide an additional data source for future FAO estimates of small-scale fisheries.

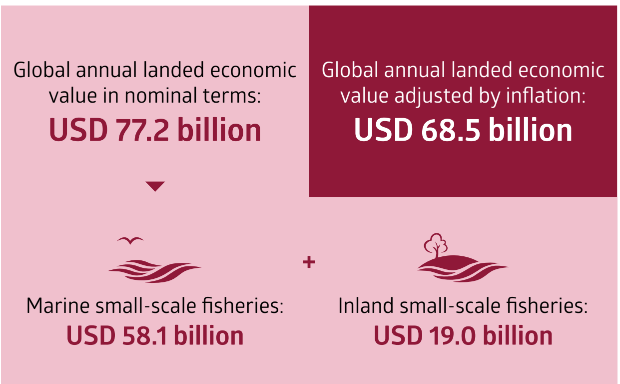
Methods and data sources for estimating the level of exports.

For exports, with a few exceptions, official country statistics do not currently provide any indication of the production system from which their traded products originate, and hence whether they originate from small-scale fisheries as well as from large-scale fisheries or aquaculture. There have been studies focusing on specific cases, such as sea cucumber exports from Pacific small-scale fisheries (Purcell *et al.*, 2017), shrimp product exports from Senegal (Ziegler *et al.*, 2011) and mud crab exports from a fishery in Madagascar (Zelasney *et al.*, eds., 2020), but there are few estimates at the regional or even national level (though broader studies of aggregated aquatic food exports from low-income countries have been conducted) (UNCTAD, 2017)2016. As such, this report provides the most extensive review to date of the interaction of small-scale fisheries with global aquatic food markets, and the first effort to estimate the contribution of small-scale fisheries to formal national export volumes of aquatic foods in selected CCS (see Annex A, Section A.4.3).

5.3 Size and scale of the economic contributions of small-scale fisheries: landed economic value

Figure 5.2 presents the global annual landed economic value estimated for this report (average of the period 2013–2017) from marine and inland small-scale fisheries catch, expressed both in nominal terms and adjusted by inflation patterns (using 2012 as the base year).

Figure 5.2 Summary results of the analysis of global landed economic value of small-scale fisheries, extrapolated from 58 IHH country and territory case studies (average annual values, 2013–2017)



Extrapolating from the 58 CCS the average landed economic value of small-scale fisheries catch over the period 2013–2017 is estimated to be USD 77.2 billion in nominal terms, including more than USD 58.1 billion from marine small-scale fisheries, and over USD 19.0 billion from inland small-scale fisheries (Table 5.2, Figure 5.2, Figure 5.3).

5.3.1 Geographic distribution of small-scale fisheries production value

In terms of geographic distribution (Figure 5.3), the majority (69.1 percent) of the landed economic value from small-scale fisheries estimated in this study for the period 2013–2017 was generated in Asia, followed by the Americas (13.8 percent) and Africa (12.9 percent)). In Africa, inland small-scale fisheries generated more landed economic value (USD 5.6 billion) than marine small-scale fisheries (USD 4.2 billion) – the only region for which this was the case (and reflecting the estimates of inland fisheries for a small number of countries). Looking at national economic classification, the contribution from inland small-scale fisheries in least developed countries (LDCs) is quite significant, generating an estimated 10 percent of the global landed economic value, as opposed to inland small-scale fisheries in developed countries or areas, which generated less than 1 percent of the global total, and almost 14 percent of the contribution from inland small-scale fisheries generated by other developing countries or areas. Across LDCs, the majority of the estimated landed economic value from small-scale fisheries catch was generated by inland small-scale fisheries (58.2 percent), whereas in developed countries or areas a much higher majority of the total catch – almost 92 percent – was generated by marine small-scale fisheries.

5.3.2 Labour productivity in small-scale fisheries

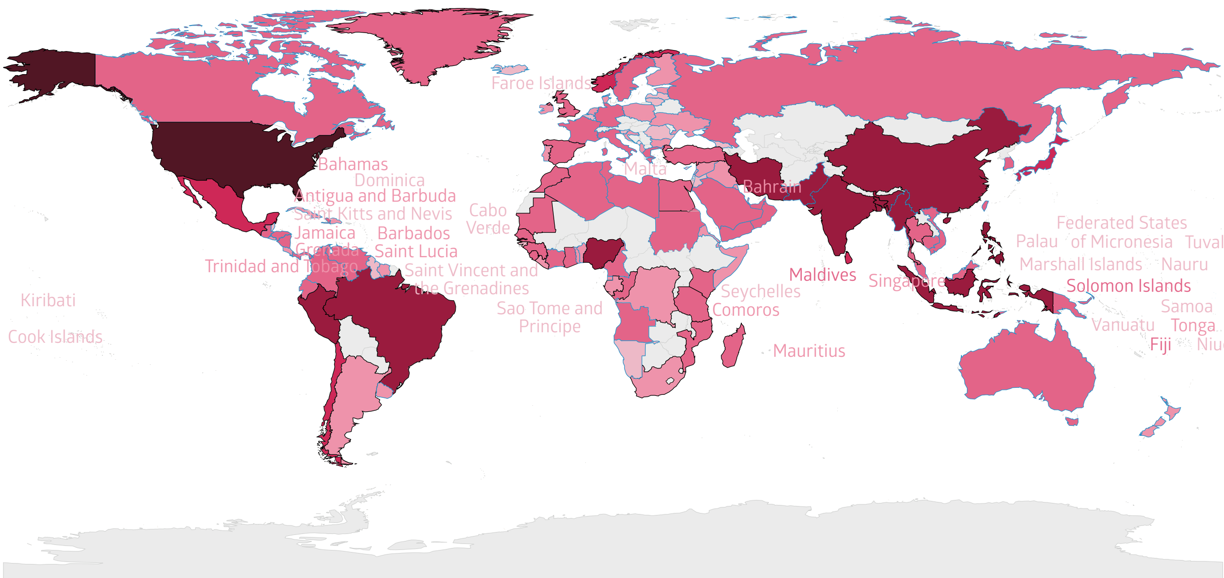
Consistent with the focus of international policy on the labour productivity of small-scale food producers (SDG Target 2.3), estimates based upon the CCS of

Table 5.2 Global estimates of landed economic value of small-scale fisheries (SSF) catch, extrapolated from 58 IHH country and territory case studies (average annual values, 2013–2017)

Region (No. of countries)	Total landed value (USD million)	Total catch (million tonnes)	Average price (USD/tonne)	Standard deviation from mean price (USD/tonne)	% landed value (% of global SSF landed value)	Marine/inland distribution (% of total SSF landed value for region)
Marine small-scale fisheries						
Africa (n = 38)	4 251.9	3.1	1 996.6	1 360.7	5.5	42.9
Asia (n = 35)	41 380.4	15.7	2 258.4	666.4	53.6	77.6
Europe (n = 29)	2 038.1	0.9	3 174.1	1 352.6	2.6	77.5
Oceania (n = 16)	606.9	0.4	2 026.2	1 192.1	0.8	97.4
Americas (n = 34)	9 829.0	5	2 671.1	1 833.5	12.7	92.4
Total (n = 152)	58 106.3	25.1	2 435.5	1 399.8	75.3	75.3
Inland small-scale fisheries						
Africa (n = 45)	5 663.6	3	1 201.7	669.9	7.3	57.1
Asia (n = 37)	11 966.9	7.8	1 677.9	997.5	15.5	22.4
Europe (n = 37)	592	0.4	2 075.7	1 255.0	0.8	22.5
Oceania (n = 10)	16.2	0	677.8	519.3	0	2.6
Americas (n = 26)	810.5	0.6	1 443.1	755.2	1.1	7.6
Total (n = 155)	19 049.2	11.8	1 530.7	997	24.7	24.7
Marine and inland small-scale fisheries						
Africa (n = 56)	9 915.5	6.2	1 565.6	1 111.3	12.9	
Asia (n = 49)	53 347.4	23.4	1 960.1	895.8	69.1	
Europe (n = 39)	2 630.1	1.3	2 558.3	1 400.8	3.4	
Oceania (n = 17)	623	0.4	1 507.6	1 182.0	0.8	
Americas (n =38)	10 639.5	5.6	2 139.0	1 580.7	13.8	
Total (n = 199)	77 155.5	36.9	1 978.7	1 293.3	100	

Figure 5.3 Global estimates of landed economic value of marine and inland small-scale fisheries catch by country, extrapolated from 58 IHH country and territory case studies (average annual values, 2013–2017)

Marine small-scale fisheries



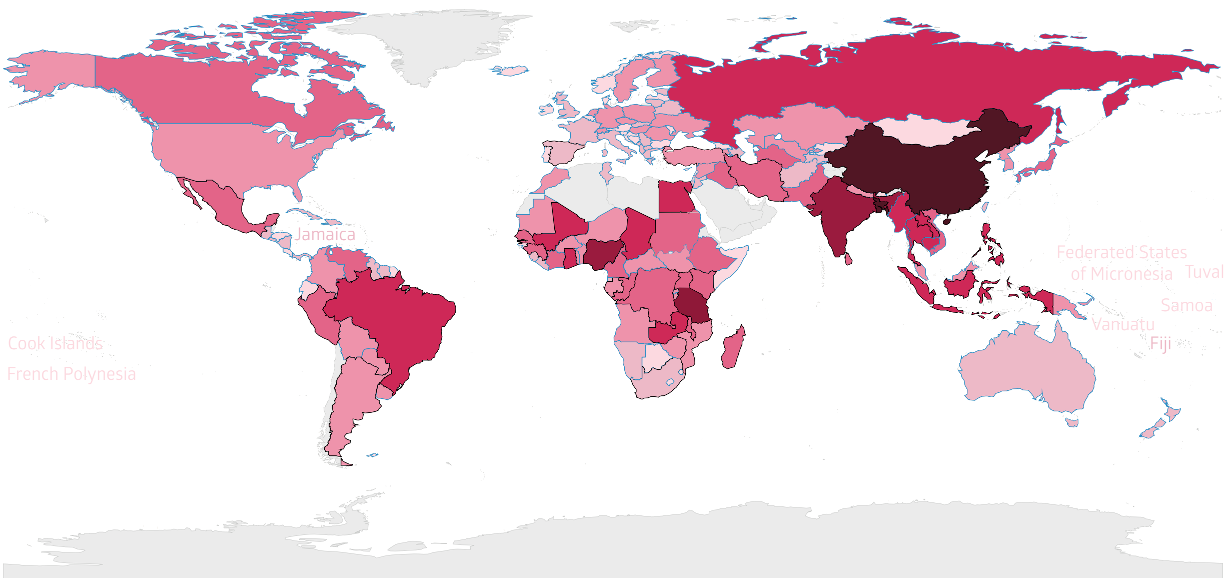
Landed economic value

Not applicable/ no data	≤ USD 0.1 million	> USD 0.1 million and ≤ USD 8.5 million	> USD 8.5 million and ≤ USD 33.1 million	> USD 33.1 million and ≤ USD 534 million	> USD 534 million and ≤ USD 1 billion	> USD 1 billion and ≤ USD 4.3 billion	> USD 4.3 billion

Source

Country and territory case studies	Estimated from regression analysis

Inland small-scale fisheries



Landed economic value

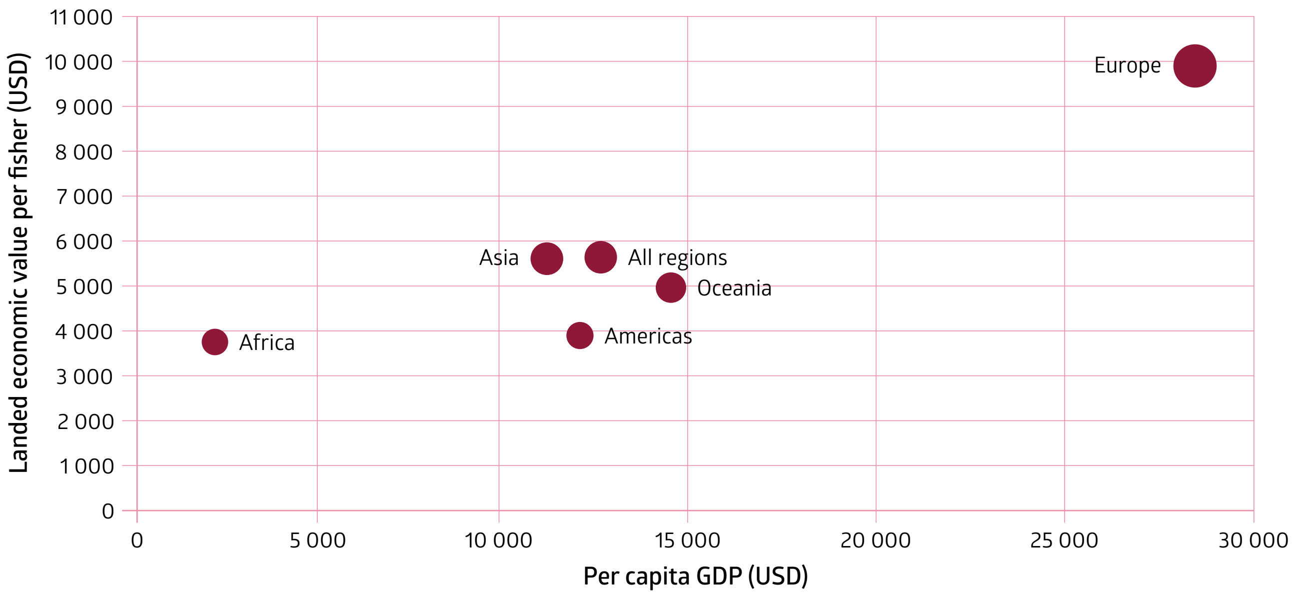
Not applicable/ no data	≤ USD 0.43 million	> USD 0.43 million and ≤ USD 3.5 million	> USD 3.5 million and ≤ USD 41.4 million	> USD 41.4 million and ≤ USD 266.3 million	> USD 266.3 million and ≤ USD 1 billion	> USD 1 billion and ≤ USD 3 billion	> USD 3 billion

Source: United Nations Geospatial. 2020. Map geodata [shapefiles]. New York, USA, United Nations, modified by the authors.

Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. Final boundary between the Sudan and South Sudan has not yet been determined.

Notes: Black lines in figure indicate countries with data extracted from country and territory case studies. Red lines indicate countries with data estimated from random forest regression analysis.

Figure 5.4 Global estimates of landed economic value of catch (extrapolated from 58 IHH country and territory case studies [average annual values, 2013–2017]) per small-scale fisher, plotted against average per capita GDP (number of small-scale fishers extrapolated from household-based surveys for 78 countries in 2016), by region



Notes: Values of per capita GDP were taken from the World Bank world development indicators. Household-based surveys include labour force surveys and household income and expenditure surveys.

the average landed economic value of catch per small-scale fisher (excluding those in subsistence small-scale fisheries) can provide a crude indicator of the volume of output per worker, and subsequently the broader macroeconomic conditions in which these fisheries operate (Table 5.3). On average, the estimated output value per fisher for 2013–2017 was roughly twice as high in marine as in inland small-scale fisheries, consistent across regions and national economic classifications, reflecting differences in both catch rates per fisher and in average ex-vessel prices (see Table 5.3). The average output value per fisher was over twice as high in developed countries or areas than in LDCs and other developing countries or areas, for both marine and inland small-scale fisheries (on average 2.6 and 2.3 times higher, respectively) (Figure 5.4 and Table 5.3)[7]

5.3.3 Profile of small-scale fisheries production value

The global small-scale fisheries catch volume and corresponding landed economic value (average of the period 2013–2017), by detailed functional group, are presented in Figures 5.4 and 5.5 (panel a) alongside the percentage distribution of landed economic value by detailed functional group (panel b). The functional group of species caught by marine small-scale fisheries (Figure 5.5) with the highest share of the global landed economic value was miscellaneous marine species (20 percent of global landed economic value), followed by shrimp and prawn (15.4 percent, largely from China) and miscellaneous aquatic invertebrates (12 percent), with no clear geographic pattern.

For inland small-scale fisheries (Figure 5.6), a clearer geographic pattern in the distribution of landed economic value of catch was evident. Miscellaneous freshwater fish represented the highest share of total landed economic value in South-eastern Asian countries, whereas in Northern and Central Europe (including the Russian Federation) the highest share was represented by salmon, trout and smelt, as well as miscellaneous freshwater fish. In Eastern Europe the highest share was represented by carp, barbel and other cyprinids, and in Africa miscellaneous freshwater fish held a relatively large share in many countries, though in six countries tilapia and other cichlids were in the majority.

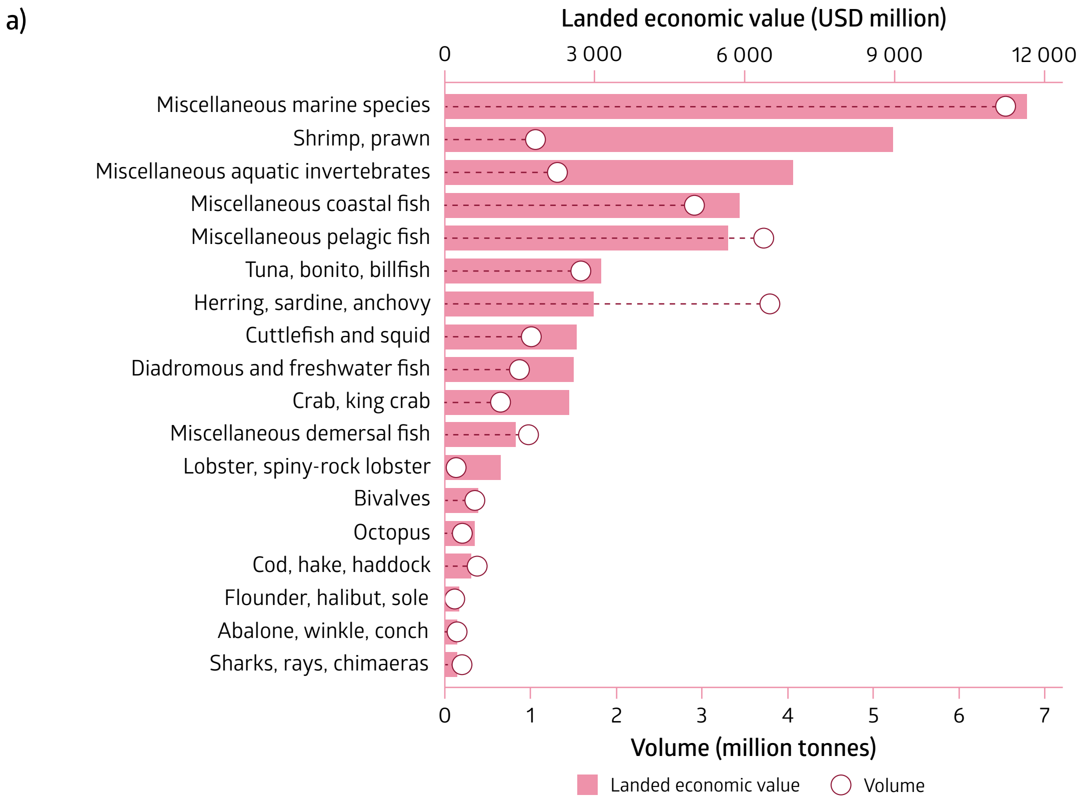
[7] Comparing this indicator of labour productivity in small-scale fisheries to national income based on a simple log-log regression model suggests a positive correlation between an increase in national per capita income and the landed economic value of small-scale fisheries catch per fisher (with an estimated elasticity of 0.7 regardless of national income level – i.e. a 1 percent increase in national income per capita is associated with an expected increase in the landed economic value of small-scale fisheries catch per fisher of 0.7 percent). In LDCs and other developing countries or areas, however, the analysis suggests that the average landed economic value of small-scale fisheries catch per fisher only increases after a national income threshold within the range of USD 1 016 to USD 1 122 is crossed, while the output value per small-scale fisher increases at a faster rate when higher national income levels are achieved, with the rate then starting to decrease at the highest income levels.

Table 5.3 Global estimates of landed economic value of catch (extrapolated from 58 IHH country and territory case studies [average annual values, 2013–2017]) per small-scale fisher (SSF) (number of small-scale fishers extrapolated from household-based surveys for 78 countries in 2016)

Average value of catch per fisher (USD)				Marine–inland ratio	Mean per capita total GDP (USD)
Marine SSF		Inland SSF			
Level of economic development					
Developed countries or areas (n = 33)	13 705.4	Developed countries or areas (n = 38)	6 641.2	2.06	31 017.2
LDC (n = 27)	5 190.4	LDC (n = 34)	2 878.6	1.8	1 121.9
Other developing countries or areas (n = 74)	5 269.9	Other developing countries or areas (n = 61)	2 849.7	1.85	8 230.4
Total (n = 134)	7 331.3	Total (n = 133)	3 940.4	1.86	12 699.2
Region					
Africa (n = 36)	5 012.6	Africa (n = 44)	2 492.4	2.01	2 459.9
Asia (n = 34)	7 164.7	Asia (n = 31)	4 043.5	1.77	11 261.2
Europe (n = 26)	12 616.5	Europe (n = 32)	7 164.1	1.76	28 456.5
Oceania (n = 9)	8 302.3	Oceania (n = 4)	1 622.1	5.12	14 560.6
Americas (n = 29)	5 365.3	Americas (n = 22)	2 423.3	2.21	12 142.9
Total (n = 134)	7 331.3	Total (n = 133)	3 940.4	1.86	12 699.2

Notes: LDC = least developed country. Household-based surveys include labour force surveys and household income and expenditure surveys.

Figure 5.5 Global estimates of volume and landed economic value of marine small-scale fisheries catch by detailed functional group of species (panel a), and distribution of landed economic value (percentage of total) by functional group (panel b), extrapolated from 52 IHH country and territory case studies (average annual values, 2013–2017)



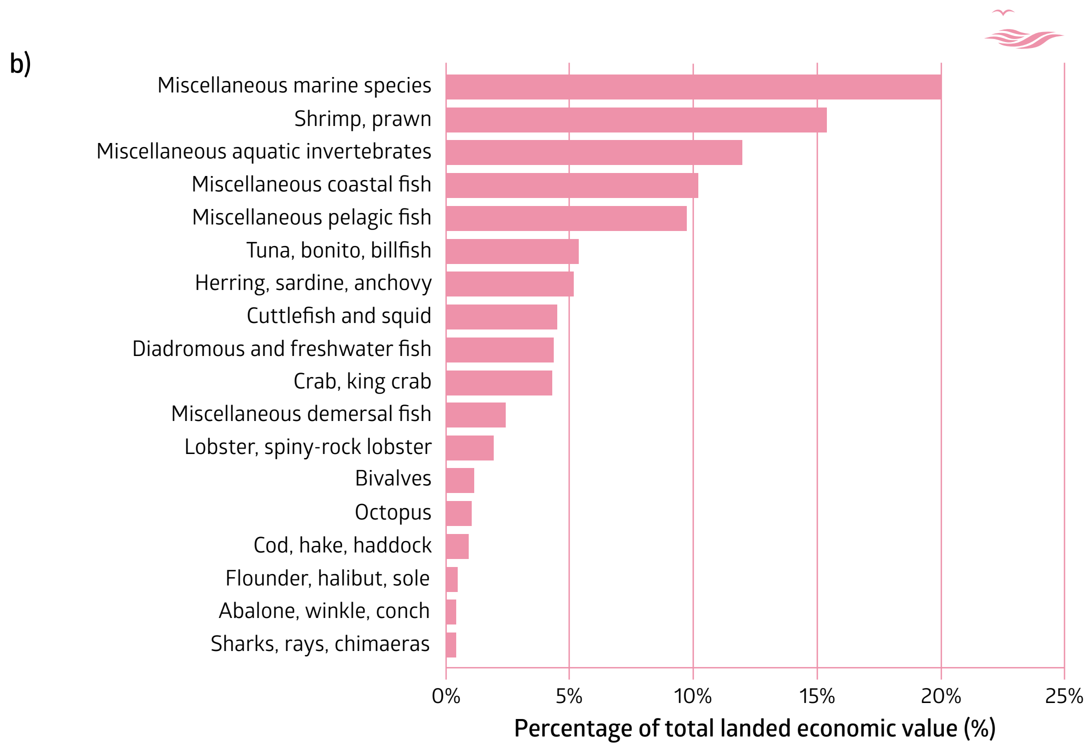
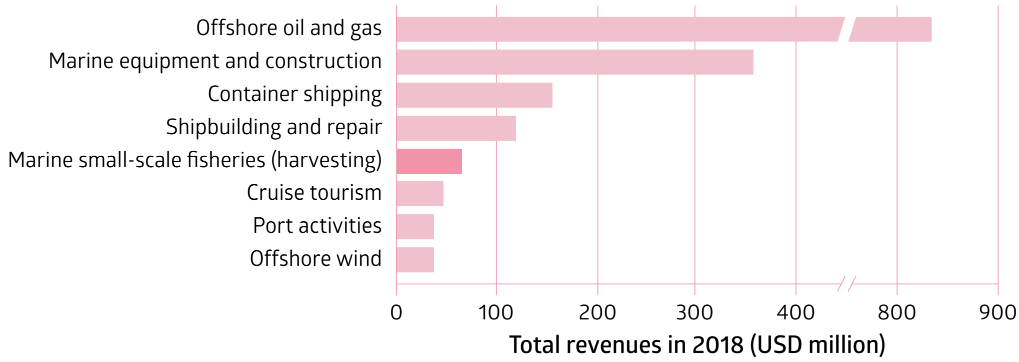


Figure 5.6 Global estimates of volume and landed economic value of inland small-scale fisheries catch by detailed functional group of species (panel a), and distribution of landed economic value (percentage of total) by functional group (panel b), extrapolated from 38 IHH country and territory case studies (average annual values, 2013–2017)

Note: nei = not elsewhere included.

Figure 5.7 Comparison of total global revenues from harvesting segment of marine small-scale fisheries value chains (in 2018 USD) with 2018 revenues from the largest industries in the ocean economy



Note: Industries based on 2016 OECD report *The Ocean Economy in 2030*, but excluding aquatic food production (to avoid double-counting) and coastal tourism.

Sources: Virdin, J., Vegh, T., Jouffray, J.B., Blasiak, R., Mason, S., Österblom, H., Vermeer, D., Wachtmeister, H. & Werner, N. 2021. The ocean 100: transnational corporations in the ocean economy. *Science Advances*, 7(3). For ocean economy industries: OECD. 2016. *The Ocean Economy in 2030*. Paris.

5.3.4 Reference points – putting it into context

The estimated USD 77.2 billion in global landed economic value of small-scale fisheries catch (annual average 2013–2017) is equivalent to USD 68.5 billion in 2012 (i.e. adjusted to 2012 dollars). This figure significantly exceeds the USD 46 billion for 2012 estimated in the initial Hidden Harvest study (World Bank, 2012), and is based on larger sets of case studies and price data for global extrapolation. A comparison of the nine country case studies for which the landed economic value of small-scale fisheries was estimated in the 2012 Hidden Harvest study (representing 41 percent and 37 percent, respectively, of the total marine and inland small-scale fisheries catch estimated in that study) with the results for the same countries estimated here, suggests that in these cases, the landed economic value from small-scale fisheries increased roughly 50 percent from USD 22.5 billion in 2012 to USD 33.8 million in 2016. This increase was driven by a 160 percent increase in the estimated average price of marine small-scale fisheries catch (with total volume estimated to have decreased over the time period between the two studies, mostly in one of the CCS). The estimated landed economic value of inland fisheries catch from the nine countries, on the other hand, remained relatively unchanged from 2012 to 2016, though both production and prices increased in some specific cases. Similarly, the average of USD 58.1 billion in landed economic value of the marine small-scale fisheries catch over the period 2013–2017 is comparable, though it exceeds the estimate of USD 48.7 billion (in nominal terms) from marine small-scale fisheries over this period from the Sea Around Us project (Sea Around Us, 2016).

Looking at the fisheries sector as a whole, for the 58 CCS (representing approximately 68 percent of the global catch reported in FishStat [FAO, 2020a]), small-scale fisheries generated 44 percent of the total global landed economic value of the catch, while large-scale fisheries represented 56 percent. This highlights the significant portion of total catch value generated by small-scale fisheries in many countries worldwide.

Beyond capture fisheries and aquaculture, marine small-scale fisheries share the world's oceans with many other economic interests, including tourism, energy and transportation, that are increasingly interdependent (OECD, 2016). In comparison to the largest ocean-based industries, revenues from the harvesting segment of small-scale fisheries value chains are dwarfed by offshore oil and gas (small-scale fisheries equivalent to roughly 7 percent) and maritime equipment and construction (equivalent to 16 percent). Their revenues are equivalent to just under one-third of container shipping and roughly one-half of shipbuilding, but are higher than those for cruise tourism, port activities and offshore wind (Figure 5.7) (Virdin *et al.*, 2021)

5.3.5 Data limitations

The estimates of global landed economic value were based on extrapolations from 58 CCS that compiled average annual prices, which do not reflect significant intra-annual fluctuations that typically affect small-scale fisheries. More broadly, the indicator of landed economic value focused narrowly on the economic contribution of the harvesting segment of the small-scale fisheries value chain and did not capture the significant roles of pre- and post-harvest activities, which are typically dominated by women. Additionally, this likely underestimated the landed economic value from gleaning activities largely carried out by women as well (Harper *et al.*, 2020). Finally, this indicator only captured gross economic value but not value added, which is more widely used (Box 5.1).

Box 5.1

The challenges of measuring the impact of small-scale fisheries on national economic growth: case studies throughout the tropics

Despite criticisms (see Stiglitz, Fitoussi and Durand, 2018; Philipsen, 2015[a]), gross domestic product (GDP)[b] remains the economic growth indicator used most widely by policymakers, and thus the contributions of specific industries or sectors to GDP are often referenced to highlight their relative importance in national economies. These contributions are measured in terms of their gross value added (GVA),[c] which in aggregate constitutes GDP for a given time period (with adjustments for taxes and subsidies). Similarly, the GVA of an economic sector's entire value chain can be measured to indicate its contribution to GDP.

In theory, the contribution of one or more small-scale fisheries value chains to the growth of a national economy can be measured in terms of the value added.[d] In practice, however, there are a number of challenges in measuring the value added of small-scale fisheries. For instance, there is a lack of comprehensive data given these fisheries' frequent informality, and even when available, the data are not often disaggregated by scale of production. Another challenge is that data and estimates are generally only available for the harvesting segment of the value chain (e.g. recorded for "primary production activities" and based on first-sale prices), and thus don't factor in post-harvest value addition (e.g. that included in manufacturing accounts). A third challenge is that some economic activities provide inputs to the small-scale fisheries value chain that would not have occurred otherwise, but are accounted for in other sectors and not linked to the fisheries – i.e. the challenge is in defining the economic agents within the value chain whose production is counted, and those outside of it who are excluded as inputs or intermediate consumption. Further, in some countries fisheries sector data are included with agriculture activities in national accounts, further "hiding" the value added from small-scale fisheries.

Given these challenges, efforts to date have struggled to estimate the value added from small-scale fisheries, with some providing only a partial measure. This lack of estimates can potentially reinforce the underappreciation by policymakers of the wider roles of these fisheries in society, and hence the deprioritizing of these fisheries in policy agendas. More data

Table Summary of estimated impact of small-scale fisheries (SSF) on GDP in four IHH country case studies

Country	Year	Total revenues from SSF production (USD)	SSF value added (USD)		
			Direct	Indirect	Total
Malawi	2018	201 822 386	189 554 886	8 114 794	197 669 680
Mozambique	2017	791 915 553	777 303 996	2 424 166	779 728 162
Peru	2015	1 846 084 079	1 423 768 872	298 713 320	1 722 482 192
Sierra Leone	2017	196 379 244	137 160 108	33 539 999	170 700 107

Notes: **a** Stiglitz, J., Fitoussi, J. & Durand, M. 2018. *Beyond GDP: measuring what counts for economic and social performance*. Paris, OECD. https://doi.org/10.1787/9789264307292-en; Philipsen, D. 2015. *The Big Little Number: how GDP came to rule the world and what to do about it*. Princeton, USA, Princeton University Press. **b** GDP is the total market value of all goods and services produced annually within a country's borders. **c** GVA is an economic measure of the value of goods and services produced in a region, industry or sector of an economy (United Nations. 2003. *National accounts: a practical introduction*. Studies in Methods, Handbook of National Accounting. Series F, No. 85). It measures the increase in income after deduction of the costs of intermediate inputs in production. The GVA of an economic sector = total sector revenue – intermediate consumption (e.g. initial costs). **d** The value added of one or more small-scale fisheries value chains (wages, financial charges, taxes, gross operating profit) = total value generated by the chain (volume of final product multiplied by price) minus value of intermediate consumption (total monetary value of goods and services consumed as inputs in production, such as fuel, food, ice, repair and maintenance, and insurance).

are required to ensure inclusion of the value added at post-harvest, as well as accounting for the value added induced by small-scale fisheries but often assigned to other sectors in national accounting frameworks – something the initial 2012 Hidden Harvest study referred to as "the extended GDP contribution" (and which is relevant for SDG Indicator 14.7.1).

To illustrate the above challenges, as well as the shortcomings of using GDP as an indicator to assess the relative importance of small-scale fisheries to national economies, an analysis is presented here of value added estimates from four IHH country and territory case studies (CCS): Malawi, Mozambique, Peru and Sierra Leone. Based on data collected for the value chains in each country (see Section A.4.1.5 in Annex A), estimates of value added from small-scale fisheries were generated for the four countries, including induced value added from economic activity providing inputs to the value chain (see table below).

The results from this analysis suggest that the value added from small-scale fisheries contributed to 1.2–5.4 percent of GDP in the CCS, but was often the majority of the total fisheries sector contribution to GDP (based on comparisons to previous estimates of total fisheries sector GDP in the four countries, where these were disaggregated by scale of operation). Compared to previous estimates from the literature on fisheries sector GDP and the percentage of GDP contribution from fisheries (noting that these are not always for the same years), these results indicate that small-scale fisheries value added as a percentage of fisheries GDP ranges from 30 to 180 percent (see Section A.4.1.5.2 in Annex A). The results illustrate that the lack of disaggregated data on small-scale fisheries may result in underestimations of these fisheries' contributions to GDP – e.g. from 30 to 100 percent. Furthermore, the fact that small-scale fisheries value-added estimates from the present analysis exceed previous estimates for the overall fisheries sector GDP from other studies in Mozambique (and possibly Malawi) suggests that some of the value added from small-scale fisheries production is unaccounted for.

In terms of the wider impact of small-scale fisheries on value added in the four CCS, estimates of the indirect (or hidden) value added ranged from negligible in Malawi (4 percent of direct value added) and Mozambique (0 percent), to significant in Peru (21 percent) and Sierra Leone (25 percent). The latter two countries illustrate that in some cases, even with data to estimate the contribution of small-scale fisheries to GDP, significant wider contributions to the economy are likely to be unaccounted for and hence overlooked.

% of direct value added to labour	Total value added as % of previous estimates of fisheries GDP	Total value added as % of agriculture GDP	Total value added as % of national GDP
44	30–180[e]	8.1	2.2
45	135–180[f]	21.7	5.4
54	50[g]	15.6	1.2
40	45–50[h]	7.6	4.6

Notes Cont: **e** Government of Malawi. 2019. 2019 Annual Economic Report. Ministry of Finance, Economic Planning and Development. Lilongwe; Torell, E.C., Jamu, D.M., Kanyerere, G.Z., Chiwaula, L., Nagoli, J., Kambewa, P., Brooks, A. & Freeman, P. 2020. Assessing the economic impacts of post-harvest fisheries losses in Malawi. *World Development Perspectives*, 19: 100224. **f** Benkenstein, A. 2013. *Small-scale fisheries in a modernizing economy: opportunities and challenges in Mozambique*. SAIIA Research Report 13, Governance of Africa's Resources Program. Johannesburg, South African Institute of International Affairs (SAIIA); FAO. 2007. *Fishery Country Profile: The Republic of Mozambique*. Rome. **g** Christensen, V., De la Puente, S., Sueiro, J.C., Steenbeek, J. & Majluf, P. 2014. Valuing seafood: the Peruvian fisheries sector. *Marine Policy*, 44: 302–311. **h** FAO. 2010. *Fishery Country Profile: Sierra Leone*. Rome; Neiland, A.E., Cunningham, S., Arbuckle, M., Baio, A., Bostock, T., Coulibaly, D., Gitonga, N.K., Long, R. & Sei, S. 2016. Assessing the potential contribution of fisheries to economic development – the case of post-Ebola Sierra Leone. *Natural Resources*, 7(6): 356–376.

5.4 Livelihoods supported by small-scale fisheries: employment, subsistence activities, and additional livelihoods dependent upon these fisheries

Figure 5.8 presents an overview of the IHH study estimates of the number of people who are dependent, either directly or indirectly, on employment and subsistence activities in small-scale fisheries.

5.4.1 Total small-scale fisheries employment and subsistence fishing

The concept of employment is distinguished from the concept of subsistence in labour statistics (see Glossary for definitions used, and Box 5.2). The two concepts are measured differently, yet both are required in order to better understand the diversified and often opportunistic strategies individuals and households employ in small-scale fisheries in order to support livelihoods (Allison and Horemans, 2006). Such measurement often poses a challenge given that an estimated 61 percent of the world's workforce is informal (ILO, 2018),[8] particularly in small-scale fisheries. Participation in these fisheries may be the primary work activity conducted by households in parallel with other work activities not related to fisheries, or a complementary effort that provides additional income to support livelihoods, particularly to fill "livelihood gaps" during agriculture off-seasons (Béné and Friend, 2011; Mills *et al.,* 2011). Like other primary economic activities (e.g. agriculture), employment along the small-scale fisheries value chain can often be characterized as irregular and seasonal, leading to a substantial variety of livelihoods involving multiple occupations, often characterized by vulnerability (Béné, 2009; Davis, Di Giuseppe and Zezza, 2017; Oya, 2015). As such, for many households, the definition of employment in this subsector extends far beyond the typical conception of a "full-year" activity, particularly in inland fisheries where participation is primarily part time (Funge-Smith and Bennett, 2019). Moreover, the average income (at least from the harvesting segment of the value chain) in this subsector is likely below the nationally determined minimum living wage in many countries (Giron-Nava *et al.,* 2021)[9]

Given the nature of household participation in small-scale fisheries, the estimates presented here include both part- and full-time employment across the different segments of the small-scale fisheries value chain and engagement in subsistence activities (harvesting or processing).

To generate global estimates of participation in small-scale fisheries activities, this study used standardized household-level data systematically collected through national labour force surveys and household income and expenditure surveys conducted over the last decade. These surveys allowed for estimates of the total number of people involved in small-scale fisheries activities from a larger dataset than previously available, disaggregated by gender and including data on employment along small-scale fisheries value chains and on subsistence activities (harvesting or processing), providing perhaps the clearest picture to date of the role that these fisheries play in supporting livelihoods worldwide (see Section A.4.2 in Annex A).

The data from these surveys in 78 countries and extrapolated to the global level show that, in 2016, an estimated 120.4 million people were either employed throughout the value chain in all capture fisheries (both small- and large-scale combined), or engaged in subsistence activities (harvesting or processing) at least once during the year[10] (though more frequently in surveys that recorded shorter reference periods), with small-scale fisheries accounting for 93.9 percent of this total, equivalent to 113.0 million people (Table 5.4).

Of the 120.4 million people participating in capture fisheries, an estimated total of 67.5 million people, equivalent to 2.1 percent of the globally employed population,[11] were employed full or part time in 2016 along the fisheries value chain. Of these, an estimated 60.2 million were employed in the small-scale fisheries subsector either part or full time across all value chain segments and 7.3 million were employed in large-scale fisheries, suggesting that 89.2 percent of global fisheries employment was in small-scale fisheries that year. In the same year, an estimated 52.8 million additional people were engaged in small-scale fisheries for subsistence (harvesting or processing) at some point during the year, based on surveys covering respondents' activity over the full year[12] (Table 5.4).

[8] Informality is characterized by the International Labour Organization (ILO) in terms of either (i) employment in the informal sector: an enterprise-based concept defined in terms of the characteristics of the place of work (e.g. enterprises that are not registered); or (ii) informal employment: a job-based concept defined in terms of the employment relationship and protections associated with the job itself (e.g. entitlements to pension schemes) (ILO, 2018).

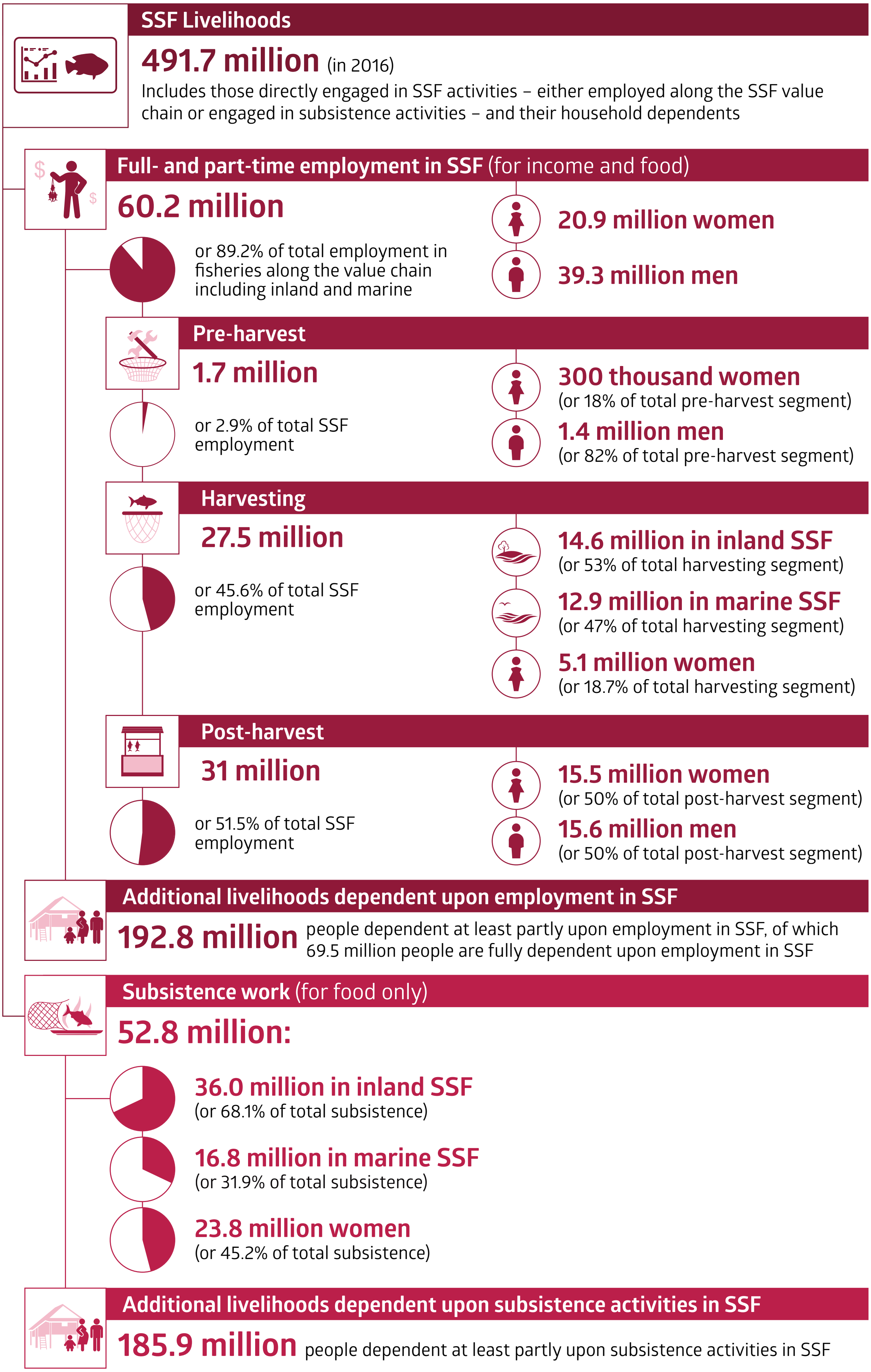
[9] The minimum living wage is consistent with measures to determine the poverty line, though wage is only one component of income considered.

[10] With the uncertainties around this estimate between a lower and upper bound of 100.2 million people and 139.9 million people, respectively.

[11] Estimated by the ILO at 3.2 billion (ILO, 2021).

[12] The lower and upper bound for engagement in subsistence activities in small-scale fisheries was 43.2 and 61.9 million, respectively.

Figure 5.8 Overview of global estimates of small-scale fisheries (SSF) employment, engagement in subsistence activities and additional livelihoods dependent on small-scale fisheries in 2016, extrapolated from household-based surveys for 78 countries



Note: Household-based surveys include labour force surveys and household income and expenditure surveys.

Box 5.2

Definitions for employment and subsistence

Employment: All persons of working age who, during a short reference period, were engaged in any activity to produce goods or provide services for pay or profit: (i) employed persons "at work", i.e. who worked in a job for at least one hour during the reference period; and (ii) employed persons "not at work" due to temporary absence from a job, or to working-time arrangements (such as shifts in work, flexitime and compensatory leave for overtime). This includes both part- and full-time employment in order to capture seasonal variation.

Subsistence: Also defined as "working mainly for own consumption", this refers to individuals of any sex and age that carry out an activity at least once over the survey reference period in order to produce and process fish which is predominantly consumed by their own household, with no transaction occurring in the marketplace.

Source: Adapted from the ICLS resolution (2013) available at https://www.ilo.org/wcmsp5/groups/public/—-dgreports/—-stat/documents/normativeinstrument/wcms_230304.pdf

5.4.2 Inland and marine small-scale fisheries harvesting employment and engagement in subsistence fishing

Of the estimated 27.5 million people employed in the harvesting segment of small-scale fisheries value chains in 2016 either part or full time, over one-half (14.6 million) were employed in inland small-scale fisheries, as compared to 46.8 percent (12.9 million) in marine small-scale fisheries (Table 5.4). In comparison, based on extrapolation that same year, an estimated 2.4 million people were employed in the harvesting segment of large-scale fisheries value chains either part or full time. This means that of the total number of people employed in the harvesting segment of marine fisheries value chains (also 14.6 million), 88.1 percent are in small-scale fisheries, and similarly for the harvesting segment of inland fisheries value chains (15.3 million), 95.3 percent are in small-scale fisheries. These results are consistent with past estimates that 90 percent of all fishers categorized in government reporting to FAO as coastal and inland, unidentified and unspecified fishers, are found in small-scale fisheries (FAO, 2002).

Of the estimated 52.8 million people engaged in subsistence activities (harvesting or processing) in small-scale fisheries at some point in 2016, 68.2 percent (36.0 million) did so in inland fisheries, with the remainder (31.8 percent, or 16.8 million people) in marine fisheries.

5.4.3 Employment and subsistence activities in pre- and post-harvest segments of the value chain

Small-scale fisheries have often been defined narrowly in terms of harvesting activity. As a result, the significant pre- and post-harvest activities that support livelihoods and contribute significantly to economies are easily ignored or marginalized (Mills *et al.*, 2011; Smith and Basurto, 2019). However, as shown in Table 5.4, pre- and post-harvest activities constitute an estimated 2.9 percent and 51.5 percent respectively of total estimated employment in small-scale fisheries. For small- and large-scale fisheries combined, the harvesting segment constituted an estimated 44.3 percent of total fisheries employment in 2016 (though with significant seasonal variability – see Box 5.3), as compared to 3.2 percent and 52.4 percent in the pre- and post-harvest segments, respectively.

5.4.4 Geographic distribution of small-scale fisheries employment and subsistence activities

The dominant role of small-scale fisheries in global fisheries employment estimated in this study is consistent across regions, with the exception of Europe (Figure 5.9).

Among regions, Asia dominates participation in small-scale fisheries activities with 92.6 million (81.9 percent) of the estimated 113.0 million people worldwide who are either employed along the small-scale fisheries value chain or engaged in subsistence activities (harvesting or processing). The region is followed by Africa (12.0 percent), the Americas (3.8 percent) and Oceania (1.4 percent). Together, Asia and Africa account for 93.9 percent of those either employed in the small-scale fisheries value chain or engaged in harvesting or processing for subsistence (Figure 5.10 and Figure 5.11).

Globally, almost three-quarters (72.5 percent) of the estimated number of people employed part or full time in small-scale fisheries are found in ten countries (Table 5.5), with China having by far the highest number – almost twice that of India, which has the second highest. Looking at number of persons engaged in small-scale fisheries for subsistence (harvesting or processing), China again has the highest, followed by Bangladesh, India and Pakistan. In the aggregate (i.e. employment and subsistence combined), China (31.4 percent), India (11.6 percent) and Bangladesh (11.4 percent) represent just over half of the total number of people (113.0 million) participating in small-scale fisheries worldwide. While these absolute numbers may be lower in other countries, the relative contribution of small-scale fisheries employment is still significant. In many small Pacific Island countries, for instance, the contribution of small-scale fisheries to national employment is relatively high, for example supporting two out of every ten workers.

Table 5.4 Regional and global estimates of small- and large-scale fisheries employment (part- and full-time) and subsistence activities in 2016, extrapolated from household-based surveys for 78 countries, by segment of the value chain

Region	Pre-harvest	Harvesting		Subsistence fishing		Post-harvest Inland and marine		Total
	inland/ marine	Inland	Marine	Inland	Marine	Processing	Trading	
Small-scale fisheries								
Africa	306 090	2 653 300	1 358 476	3 451 521	1 207 386	1 366 190	3 276 366	13 619 328
Asia	1 012 241	11 248 332	9 797 426	31 650 165	14 801 713	5 236 511	18 838 478	92 584 866
Europe	156 087	58 259	170 880	0	0	177 591	415 566	978 383
Oceania	21 034	111 256	177 088	688 286	336 430	77 760	141 650	1 553 504
Americas	230 578	527 170	1 359 168	207 443	494 203	634 160	849 072	4 301 794
Total	1 726 030	14 598 317	12 863 038	35 997 415	16 839 732	7 492 211	23 521 133	113 037 876
Large-scale fisheries								
Africa	20 981	21 763	186 067			296 371	303 388	828 569
Asia	242 878	675 343	1 161 775			846 902	1 796 162	4 723 060
Europe	153 731	7 269	190 245			275 391	285 738	912 374
Oceania	1 090	0	13 798			15 005	22 236	52 128
Americas	47 112	11 265	185 718			280 084	271 844	796 023
Total	465 791	715 640	1 737 603			1 713 752	2 679 368	7 312 154
Total capture fisheries								
Africa	327 070	2 675 063	1 544 543	3 451 521	1 207 386	1 662 560	3 579 754	14 447 897
Asia	1 255 120	11 923 675	10 959 201	31 650 165	14 801 713	6 083 412	20 634 640	97 307 926
Europe	309 818	65 528	361 125	0	0	452 982	701 304	1 890 757
Oceania	22 123	111 256	190 886	688 286	336 430	92 765	163 886	1 605 633
Americas	277 690	538 435	1 544 886	207 443	494 203	914 244	1 120 916	5 097 817
Total	2 191 821	15 313 957	14 600 641	35 997 415	16 839 732	9 205 964	26 200 500	120 350 030

Note: Household-based surveys include labour force surveys and household income and expenditure surveys.

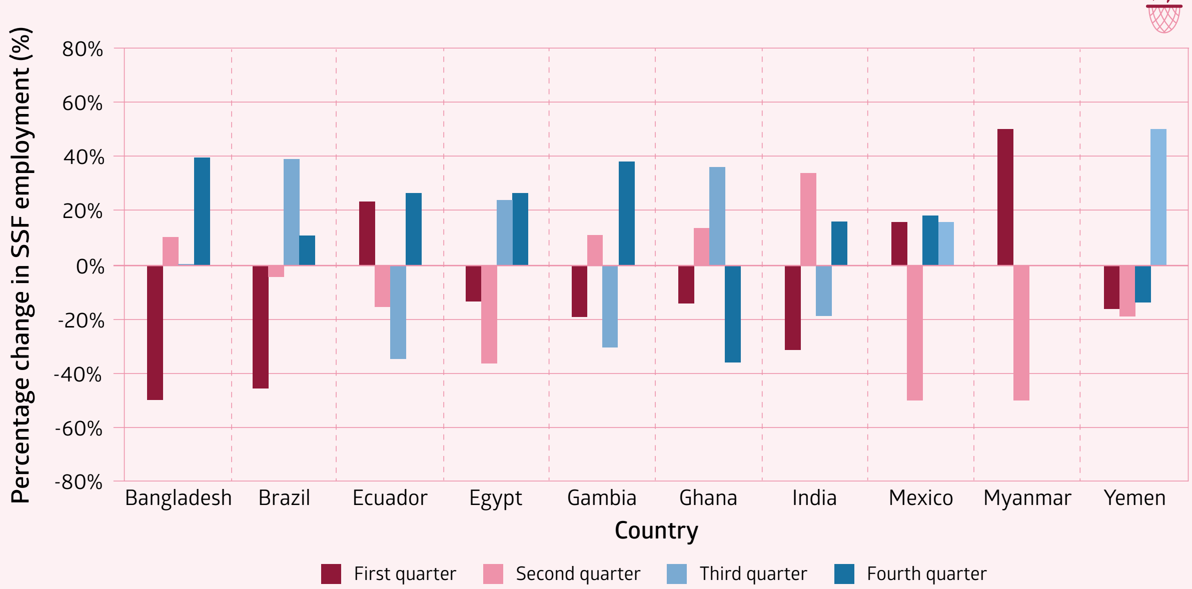
Box 5.3

Seasonality in small-scale fisheries employment

Participation in small-scale fisheries often varies significantly with seasons, and the vast majority of participants are engaged for only a fraction of the year. For this reason, estimates of small-scale fisheries employment in the harvesting segment of the value chain presented as an annual average may mask the influx of participants that occurs during peak seasons. The estimates presented here for employment in the harvesting segment of small-scale fisheries were calculated from national household-based surveys, which are typically conducted quarterly and averaged over a year (or provided as snapshots at different times for different countries, similar to a random sample). Here, however, the data are shown quarterly to illustrate the seasonal variation (though it was not possible to determine from responses the reasons for this variation). The ten countries selected, based on data availability, were Bangladesh, Brazil, Ecuador, Egypt, the Gambia, Ghana, India, Mexico, Myanmar and Yemen.

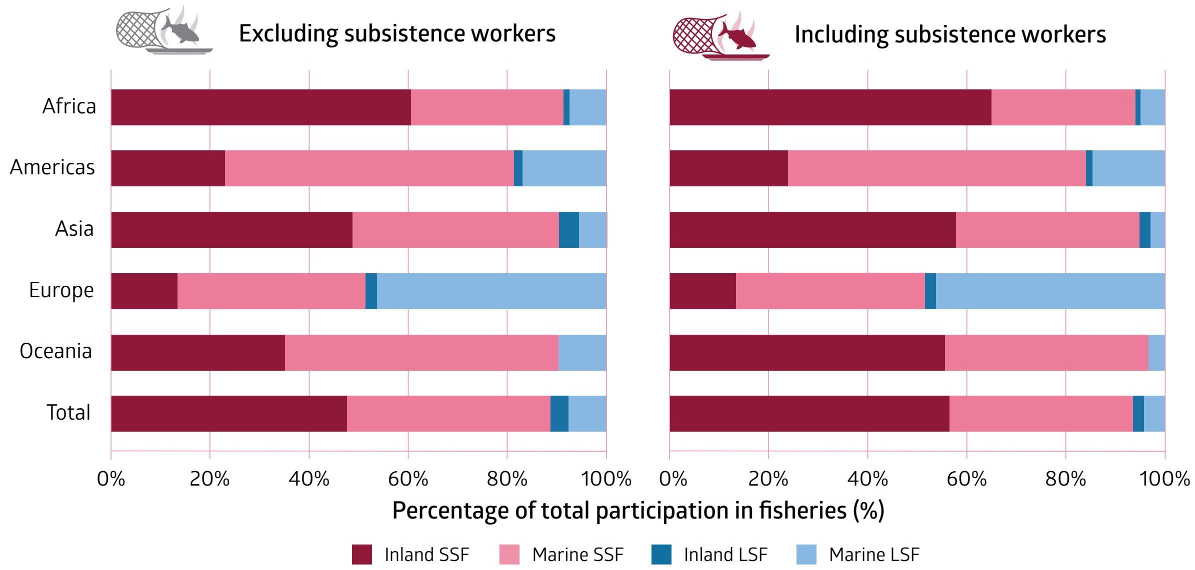
These ten countries illustrate the irregularity of employment commonly found in many small-scale fisheries, where a diversity of livelihood strategies is typically required. For example, in both India and Bangladesh, employment in the harvesting segment of small-scale fisheries during the second and fourth quarter of the year is 50 and 40 percent higher, respectively, compared to the annual average. Employment in small-scale fisheries (harvesting) in India during the peak season is more than three times higher than the corresponding employment during the low season. Similarly, in Bangladesh, employment in the harvesting segment during the high season is more than 2.5 times higher than the corresponding level of employment during the low season. The figure below illustrates this seasonal variation in these examples.

Figure Seasonal variation (quarterly change) in employment in the harvesting segment of small-scale fisheries (SSF) in ten countries, with respect to the annual average, estimated from household-based surveys



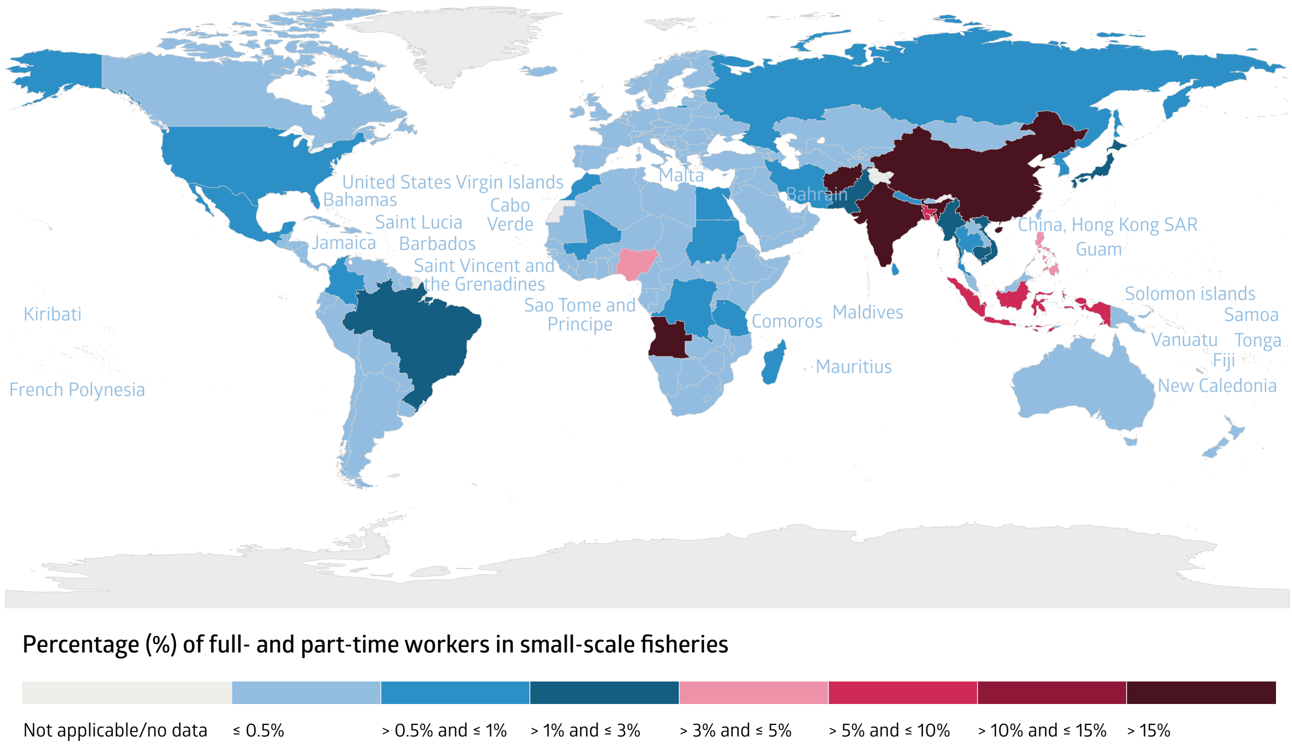
Notes: These examples cover different years based on data availability: Bangladesh, 2013; Brazil 2018; Ecuador, 2015; Egypt, 2017; Gambia, 2013; Ghana, 2017; India, 2018; Mexico, 2018; Myanmar 2019; Yemen, 2014. Household-based surveys include labour force surveys and household income and expenditure surveys.

Figure 5.9 Global estimates of participation in small-scale fisheries (SSF) and large-scale fisheries (LSF) in 2016 by region, including all segments of the value chain (percentage of total participation in fisheries), extrapolated from household-based surveys for 78 countries



Note: Household-based surveys include labour force surveys and household income and expenditure surveys.

Figure 5.10 Geographic distribution by country of part- and full-time employment in the small-scale fisheries value chain in 2016, extrapolated from household-based surveys for 78 countries

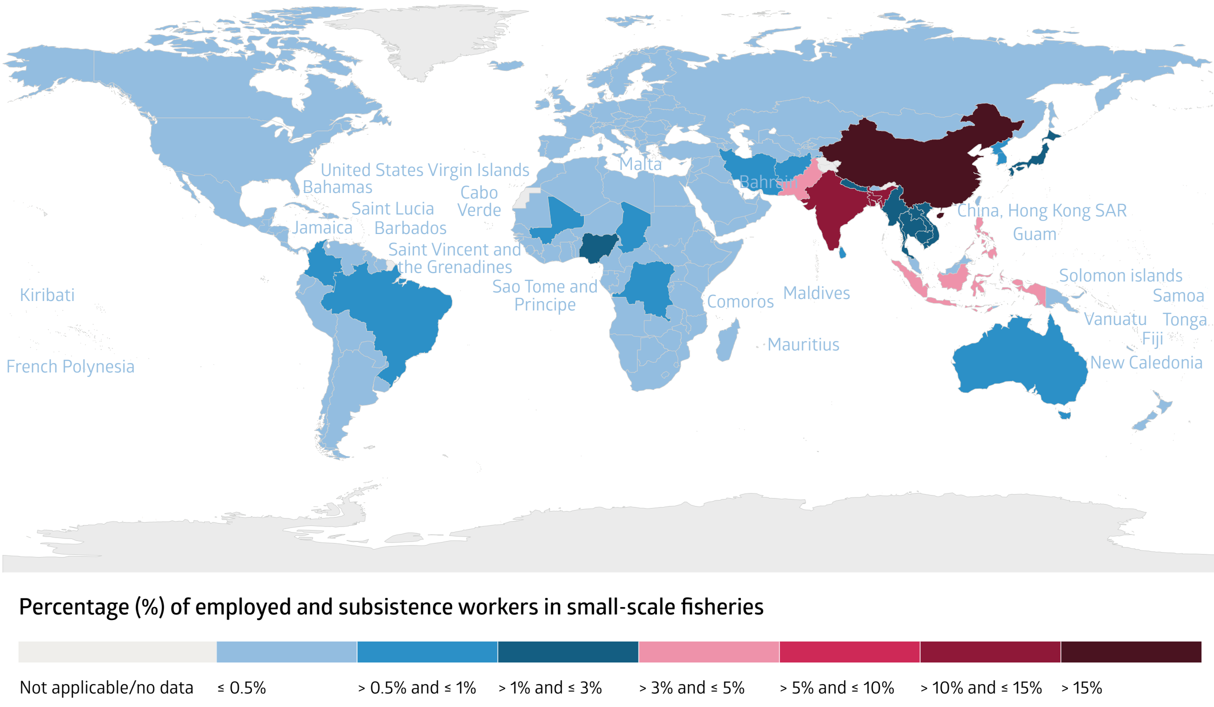


Source: United Nations Geospatial. 2020. Map geodata [shapefiles]. New York, USA, United Nations, modified by the authors.

Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. Final boundary between the Sudan and South Sudan has not yet been determined.

Notes: Percentages refer to total numbers employed along the small-scale fisheries value chain in each country, expressed as a percentage of the global total. Household-based surveys include labour force surveys and household income and expenditure surveys.

Figure 5.11 Geographic distribution by country of total employment in small-scale fisheries and participation in subsistence activities in 2016, extrapolated from household-based surveys for 78 countries



Source: United Nations Geospatial. 2020. Map geodata [shapefiles]. New York, USA, United Nations, modified by the authors.

Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. Final boundary between the Sudan and South Sudan has not yet been determined.

Notes: Percentages refer to total numbers employed along the small-scale fisheries value chain and engaged in subsistence activities in each country, expressed as a percentage of the global total. Total employment includes both part- and full-time employment combined. Household-based surveys include labour force surveys and household income and expenditure surveys.

Table 5.5 Ten countries with the largest national estimates of part- and full-time small-scale fisheries employment and engagement in subsistence activities in 2016 , based on household-based surveys

Country	Employment (part- and full-time)	Subsistence activities	Total small-scale fisheries participation
China	18 068 356	17 453 780	35 522 136
India	9 580 693	3 541 877	13 122 570
Indonesia	3 317 355	1 406 037	4 723 392
Bangladesh	3 189 814	9 704 662	12 894 476
Nigeria	2 552 434	765 636	3 318 070
Philippines	2 283 761	1 322 176	3 605 937
Pakistan	1 429 764	2 992 800	4 422 564
Myanmar	1 287 058	1 988 939	3 275 997
Japan	1 022 986	187 109	1 210 095
Viet Nam	930 463	416 875	1 347 338
Total	43 662 684	39 779 891	83 442 575

Note: Household-based surveys include labour force surveys and household income and expenditure surveys.

Data is mainly collected on landed catches from the artisanal canoes of fishers (male dominated fishing) by the Ministry of Fisheries and Aquaculture Development. While women fish by gleaning in estuaries, their activities are not included in national statistics"

(Bilecki, 2019)

5.4.5 Participation of women in small-scale fisheries

Disaggregating by gender this chapter's estimates for fisheries employment and subsistence fishing, it emerges that 47.1 million women were either partially or fully employed in capture fisheries value chains or engaged in subsistence activities in 2016, representing 39.1 percent of the total people active in the sector. The proportion is estimated to be slightly higher in small-scale fisheries (39.6 percent). Of the 47.1 million women, 94.9 percent (44.7 million) are either employed in small-scale fisheries value chains or engaged in subsistence activities (harvesting or processing) in small-scale fisheries.

Women's participation in small-scale fisheries is highly concentrated in the post-harvest segment of the value chain and in subsistence activities (harvesting or processing), which combined account for 87.9 percent of the total number of women participating in the subsector. Globally, roughly one-half (49.8 percent) of the people employed part or full time in the post-harvest segment of small-scale fisheries and 45.2 percent of people engaged in subsistence activities within the subsector are women (Figure 5.12). In addition, despite the lack of data on women's participation in these fisheries (Harper *et al.*, 2020) it is estimated that 18.7 percent of the people employed in the harvesting segment are women. The level of women's participation in small-scale fisheries employment varies significantly by country, and in some cases is much lower than the average (e.g. in Northern African countries), similar to women's participation rates in the labour force more broadly in these countries. However, women in Africa make up a much larger percentage of the population engaged in small-scale fisheries for subsistence than in any other region. In this context, even though it may be reported as subsistence fishing, this activity by women may include post-harvest tasks such as smoking and drying fish for their own consumption.

5.4.6 Subsistence fishing and the often "hidden" role of small-scale fisheries as a safety net

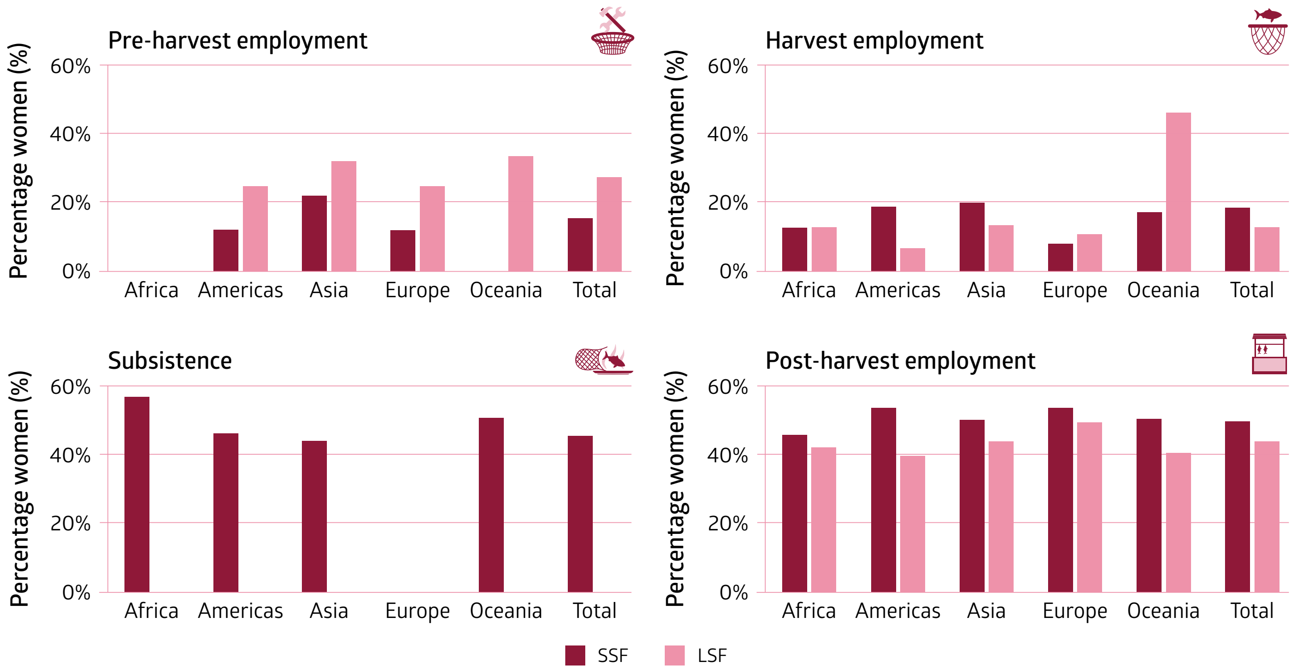
In many if not most cases, small-scale fisheries make modest contributions to household economies through temporary fishing activities, as part of multi-activity livelihood strategies that could be defined as occupational plurality in some cases, and where open or common access to the resources allows them to function as a safety net (Béné, 2006). One example of this "safety net function" of small-scale fisheries is the prevalence of subsistence workers in these fisheries, predominantly (though not exclusively) throughout low-income to lower-middle-income countries, as well as in many communities of Indigenous Peoples in high-income countries.

As mentioned previously, in addition to the estimated 27.5 million people who were employed part or full time in the harvesting segment of the small-scale fisheries value chain (and who may retain some portion of catch for their own consumption), an estimated 52.8 million people worldwide were engaged in subsistence activities (harvesting or processing) at some point in 2016, equivalent to almost one-half (46.7 percent) of all people participating in small-scale fisheries (either employed or engaged in subsistence fishing) (Table 5.4).[13] In Asia and Oceania, the majority of the people participating in small-scale fisheries are engaged in subsistence activities, followed by Africa where one-third of participants do so – though many who are considered employed in these fisheries (i.e. because a majority of the product from their activities is sold) still keep some of the catch for their own consumption (Figure 5.13). These global estimates were generated based on data provided in 31 national surveys, representing 79 percent of the total estimated number of persons engaged in subsistence fishing.

A focus on specific country examples further illustrates the prevalence of people engaging in harvesting or processing activities in small-scale fisheries for subsistence. Although a non-random sample, the ten geographically diverse countries shown in Figure 5.14 all have employment sectors in which small-scale fisheries play a significant role. In these countries, on average, the number of people engaging in small-scale fisheries for subsistence at some point during the year is nearly ten times the estimated number of people employed part or full time in the harvesting segment of the small-scale fisheries value chain. For example, in the Lao People's Democratic Republic, of the total number of people who participate in the harvesting segment of small-scale fisheries, less than 3 per cent work in exchange for pay or profit, while the remaining 97 percent engage in subsistence harvesting activities.

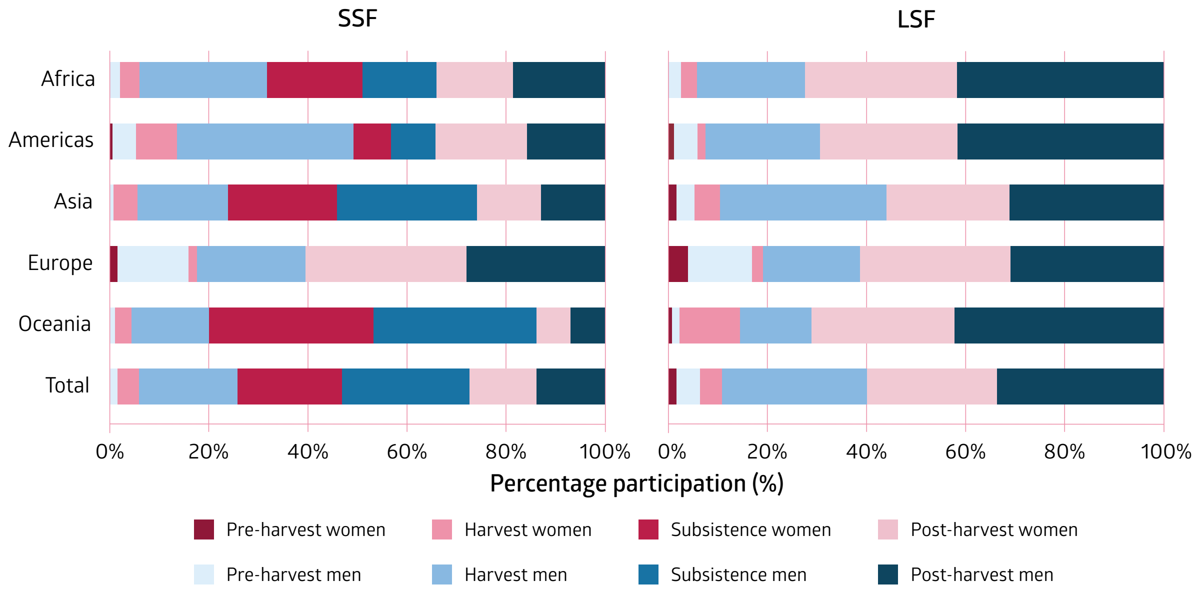
[13] Note that due to a lack of data available from surveys, the number of people engaged in subsistence activities in Europe has not been estimated.

Figure 5.12 Global estimates of women as a percentage of persons employed part- or full-time in small-scale fisheries (SSF) and large-scale fisheries (LSF) or engaged in subsistence fishing in 2016 by region, extrapolated from household-based surveys for 78 countries



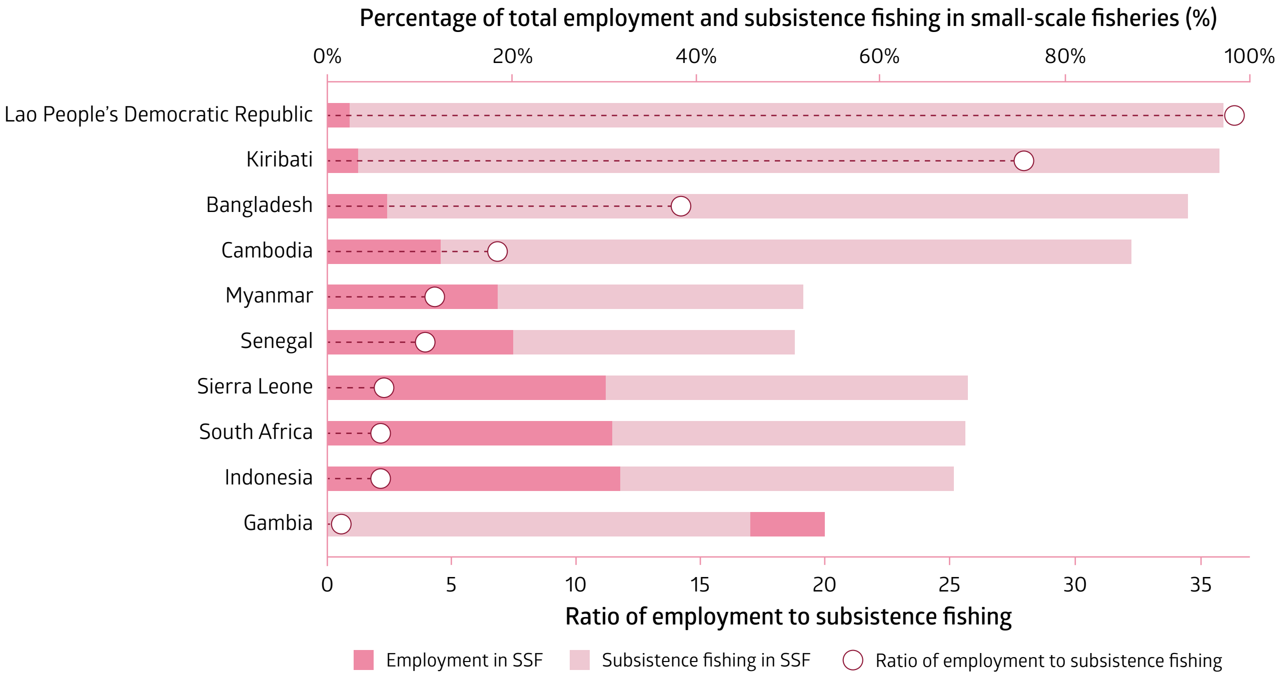
Note: Household-based surveys include labour force surveys and household income and expenditure surveys.

Figure 5.13 Global estimates of participation in small-scale fisheries (SSF) and large-scale fisheries (LSF) employment and subsistence activities in 2016, by gender and region, extrapolated from household-based surveys for 78 countries



Note: Household-based surveys include labour force surveys and household income and expenditure surveys.

Figure 5.14 Proportion of people employed in harvesting and engaged in subsistence activities in small-scale fisheries (SSF), estimated from household-based surveys for ten countries



Notes: These examples cover different years based on data availability: Lao People's Democratic Republic, 2017; Kiribati, 2015; Bangladesh, 2013; Cambodia, 2013; Myanmar, 2019; Senegal, 2012; Sierra Leone, 2011; South Africa, 2017; Indonesia, 2015; Gambia, 2016. Household-based surveys include labour force surveys and household income and expenditure surveys.

In absolute terms, Bangladesh is home to the largest number of people engaged in subsistence activities (harvesting or processing), at almost 10 million.

These examples illustrate how many participants in small-scale fisheries would be uncounted or "hidden" without considering engagement in subsistence activities (harvesting or processing) in small-scale fisheries together with employment in the harvesting segment of the small-scale fisheries value chain. The case of the Lao People's Democratic Republic vividly illustrates this point: an estimated 16.9 percent of the total population in the country engages in harvesting or processing activities for subsistence, and this proportion is even higher for many subnational administrative units (Figure 5.15). However, the share of total national employment across all sectors that is employed in the harvesting segment of the small-scale fisheries value chain is only 0.9 percent.

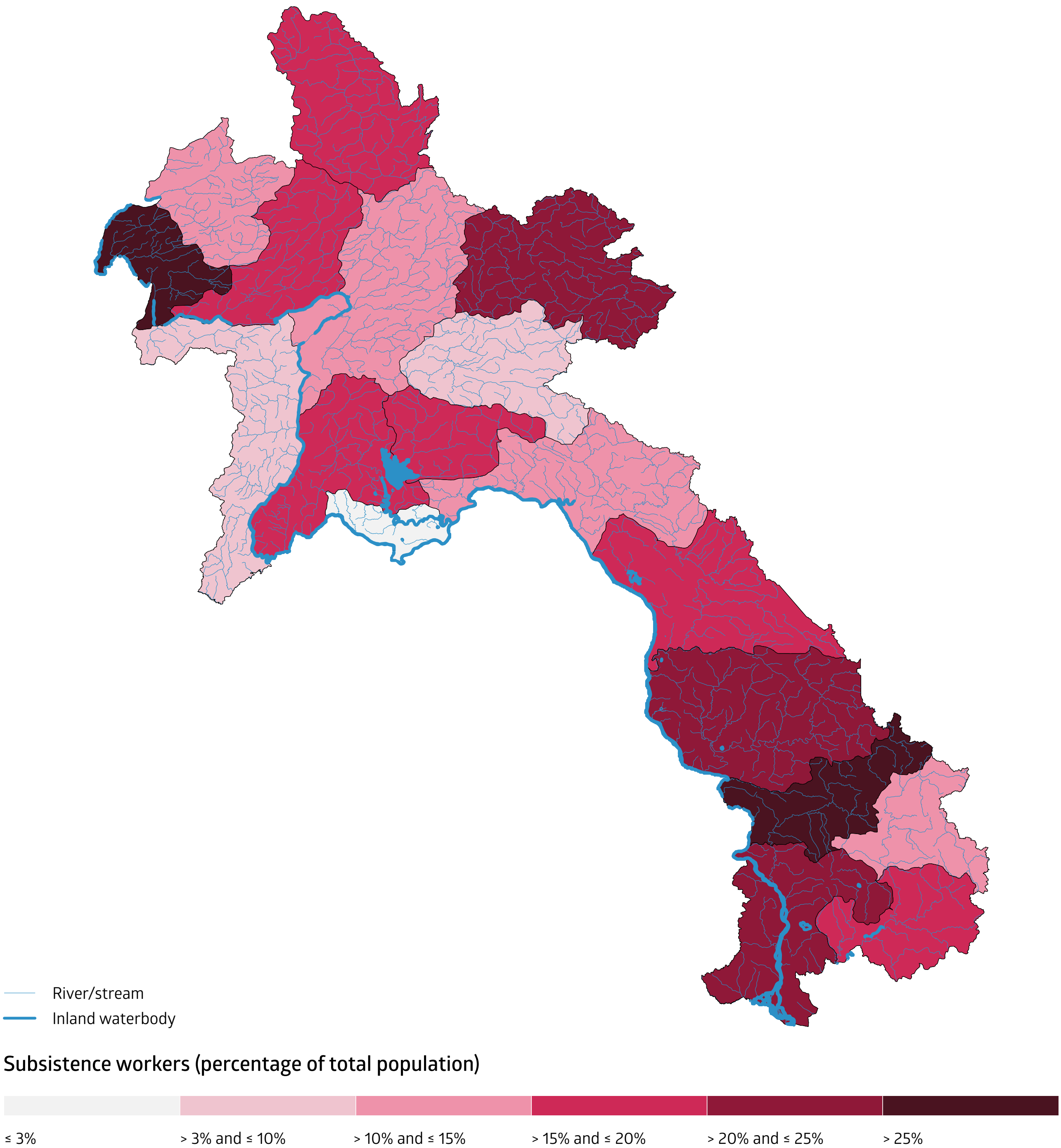
Disaggregating the data on subsistence activities by gender shows that women account for 45.2 percent of the global population engaged in small-scale fisheries harvesting or processing for subsistence; in Africa and Oceania, they represent the majority of people engaged in these activities. These estimates reinforce findings from previous studies highlighting the fundamental role of women in subsistence activities, for example that as much as 80 percent of the catch for own consumption in Melanesia is caught or processed by women (Harper *et al.*, 2013).

The ten countries with the largest total number of people engaged in subsistence activities accounted for 80.2 percent of the estimated global total, led by China (33.1 percent) and followed by Bangladesh (18.4 percent), India (6.7 percent), Pakistan (5.7 percent), Myanmar (3.8 percent), Thailand (2.8 percent), Indonesia (2.7 percent), the Philippines (2.5 percent), Nepal (2.5 percent) and the Lao People's Democratic Republic (2.0 percent). Two of these ten, Bangladesh and India, were also classified as low-income food-deficit countries in 2018 (FAO, 2021c). In 18 countries in Africa and Asia, the estimates show that more people were engaged in harvesting or processing activities for subsistence at some point in 2016 than those who were employed part or full time in small-scale fisheries value chains.

Beyond those countries with the largest total number of people engaged in subsistence fishing, extrapolations suggest that significant portions of the global population were likely to be engaged in subsistence activities at least once during 2016, including in a number of low-income food-deficit countries.

In the majority of countries with survey data available, people are considered to have engaged in small-scale fisheries for subsistence if their survey responses indicate they have done so at least once during the year, and not continuously. However, data available from nine national surveys (representing 25 percent of the estimated global total number of persons participating in subsistence activities) suggest a higher intensity of effort. These surveys were conducted at least quarterly and

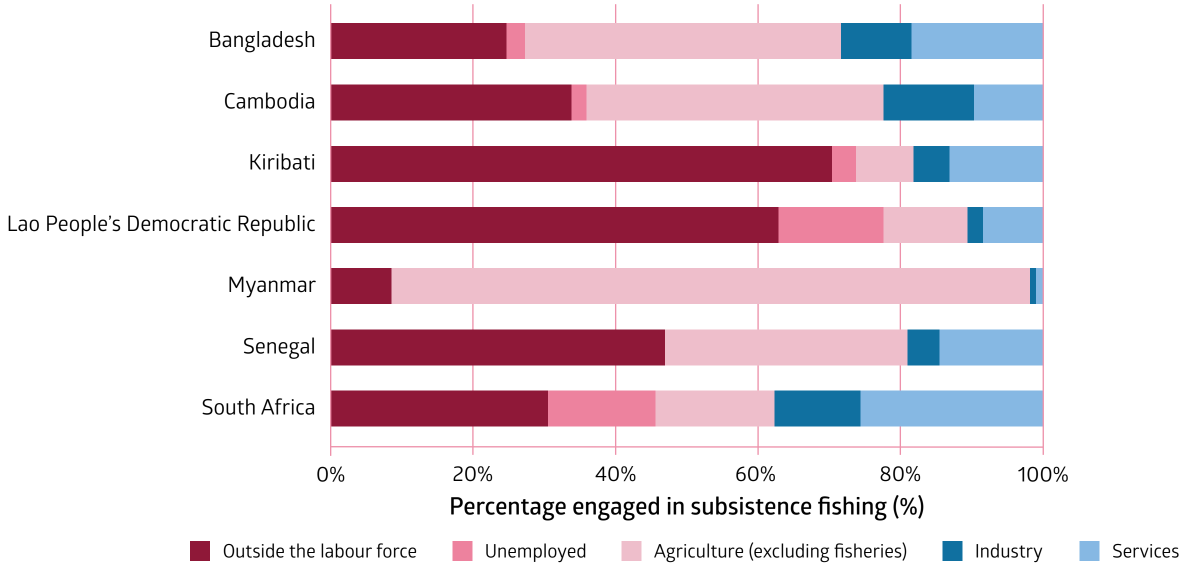
Figure 5.15 Share of population (by province) engaged in subsistence activities in the Lao People's Democratic Republic (percentage of total population in each province), estimated from a 2017 labour force survey



Source: United Nations Geospatial. 2020. Map geodata [shapefiles]. New York, USA, United Nations, modified by the authors.

asked respondents if they had engaged in small-scale fisheries for subsistence at least one hour during the last month, or in some cases during the last week. Additional surveys in Cambodia and Lao People's Democratic Republic (1.0 million and 1.1 million estimated subsistence fishers respectively) were conducted only once per year, but confirmed that the activity occurred within the previous week (i.e. the recall period). Finally, for seven countries representing 23 percent of the estimated global total engaged in subsistence activities, on average subsistence workers spent a reported 4.2 hours per week fishing or processing fish, suggesting a significant investment of time in these activities. Where data are available, subsistence activities account for a significant amount of time spent per week, typically as part of a broader livelihood strategy that often includes multiple activities. For those countries where more detailed data were available (Figure 5.16), a large proportion of persons engaged in small-scale fisheries for subsistence were also found to be employed in the harvesting segment of agriculture (crops and livestock), such as in Bangladesh (44.4 percent), Cambodia (42.1 percent) and Senegal (33.5 percent). These examples illustrate that agricultural households may frequently depend

Figure 5.16 Share of the population engaged in subsistence fishing in seven countries, by main economic sector and labour force status, estimated from household-based surveys



Notes: These examples cover different years based on data availability: Bangladesh, 2013; Cambodia, 2013; Kiribati, 2015; Lao People's Democratic Republic, 2017; Myanmar, 2019; Senegal, 2012; South Africa, 2017. Household-based surveys include labour force surveys and household income and expenditure surveys.

upon subsistence fisheries as part of their livelihood strategies. Perhaps even more illustrative of the safety net function of subsistence fisheries in many low-income and lower-middle-income countries is the fact that a large share of those persons who engage in this activity fall outside of the labour force[14] (i.e. neither employed nor available and looking for work[15]), for example 70.6 percent in Kiribati, 62.8 percent in the Lao People's Democratic Republic, 47 percent in Senegal, 34.1 percent in Cambodia and 24.9 percent in Bangladesh, among others (Figure 5.16). Moreover, in some countries a significant share of those who participate in subsistence fisheries are unemployed (i.e. not employed but actively looking for a job), for example 14.6 percent in both the Lao People's Democratic Republic and South Africa, and 3.2 percent in Kiribati.

For a more local example, in the Province of Savannakhet between the Mekong river and areas dedicated to agriculture in the Lao People's Democratic Republic, estimates show that more than 252 000 people were engaged in harvesting or processing activities in small-scale fisheries for subsistence in 2017 (24.8 percent of the total population in the province), while only 19 700 (7.7 percent) were employed along the small-scale fisheries value chain. This example and those above highlight the importance of subsistence activities as a safety net for households, particularly for many who fall outside of the labour market.

5.4.7 Total livelihoods dependent on small-scale fisheries

Total livelihoods dependent upon small-scale fisheries are defined here as the total numbers of persons employed along fisheries value chains plus the members of their households. By this definition, an estimated 129.7 million people are either employed along small-scale fisheries value chains or fully dependent upon those who are (Table 5.6), and this number rises to a total of 253.0 million when those at least partially dependent are included. If those persons engaged in small-scale fisheries for subsistence at some point during the year and their household members are added to the definition, the total estimated number of people employed in small-scale fisheries, engaged in subsistence activities in the subsector or at least partially dependent upon either increases to 491.7 million for 2016, or 6.6 percent of the world's population that year.[16] Excluding the 55 high-income countries, the total number considered to be at least partially dependent upon small-scale fisheries[17] in the remaining 132 countries was 472.6 million, or 7.6 percent of those countries' combined populations in 2016. Within the 45 LDCs, the total was 127.0 million people, or 13.2 percent of those countries' combined populations in 2016.

[14] A large set of people, also called the "inactive population", are typically outside the labour force. This population includes children, students, pensioners, housewives and discouraged job seekers (among others), provided that they are not working and are not available or looking for work.

[15] See ILO definition of unemployment: https://www.ilo.org/wcmsp5/groups/public/---dgreports/---stat/documents/publication/wcms_422438.pdf

[16] Based on a world population of 7 466 964 according to the UN Department of Economic and Social Affairs Total Population database.

[17] "At least partially dependent" refers to those people employed in small-scale fisheries, engaged in subsistence activities or at least partially dependent upon either.

Table 5.6 Global estimates of total livelihoods dependent upon small-scale fisheries employment and subsistence fishing in 2016, extrapolated from household-based surveys for 78 countries

	Employment			Subsistence fishing	
Region	**Employed**	**Dependents (full)** Including employed	**Dependents (partial)** Including full dependents and employed	**Subsistence workers**	**Dependents (partial)** Including subsistence workers
Africa	8 960 421	17 825 915	42 269 420	4 658 907	17 298 259
Asia	46 132 988	103 766 243	189 281 514	46 451 878	214 604 069
Europe	978 383	2 042 439	4 243 848		
Americas	3 600 148	5 239 743	15 085 795	701 646	2 599 846
Oceania	528 788	835 431	2 078 715	1 024 716	4 278 363
Total	60 200 729	129 709 771	252 959 292	52 837 147	238 780 538

Notes: Livelihoods at least partially dependent on small-scale fisheries include those defined as fully dependent – the two are not mutually exclusive. Household-based surveys include labour force surveys and household income and expenditure surveys.

Again, while the data for estimates of subsistence workers in harvesting or processing only allow for measures of those who were engaged in the activity at least once in the last year, for roughly a quarter of these workers the data capture a higher frequency of activity (e.g. engagement in the activity at least once in the last month, or in some cases the last week). Similarly, data for seven country populations (representing 23 percent of the estimated global total engaged in small-scale fisheries for subsistence) show that, on average, subsistence fishers and processors spent 4.2 hours fishing per week reported. This sample provides justification for the assumption that those engaged in subsistence activities did so more frequently than once per year, and hence that the members of their households are considered to be at least partially dependent upon small-scale fisheries. While this number only represents people at least partially dependent upon small-scale fisheries for subsistence, it illustrates the prevalence of livelihoods linked in some way to this activity, particularly in LDCs.

5.4.8 Reference points – putting it into context

Of the estimated 3.2 billion people employed worldwide in 2016 (ILO, 2021), 60.2 million or 1.9 percent were employed part or full time along the small-scale fisheries value chain (roughly 1 out of every 50 jobs on the planet). By contrast, an estimated 902.1 million people were employed in the agriculture sector in 2016 (i.e. crop, livestock, forestry and fisheries), or 28.3 percent of the global total (ILO, 2021), so that the estimated employment in small-scale fisheries value chains is equivalent to 6.7 percent of agricultural sector employment (marine animal foods only constitute approximately 2 percent of the human diet, with the remainder consisting of plants and terrestrial animals [Bonhommeau *et al.*, 2013]). Similarly, an estimated 491.7 million people were at least partially dependent on small-scale fisheries in 2016, in comparison to estimates on the order of over 2.6 billion people dependent upon agriculture for their livelihoods (Alston and Pardey, 2014).As with any economic activity, comparisons of small-scale fisheries employment with global employment, or even national employment, mask the outsized role the activity can play in providing jobs at the local or subnational level in many low-income and lower-middle-income countries (Box 5.4).

Within the global fisheries sector, small-scale fisheries dominate in terms of employment, accounting for almost 90 percent of this activity in the sector in 2016. Based on this figure, marine small-scale fisheries are likely the largest employer in the ocean economy and probably larger than all other major ocean-based industries combined – estimated at 31 million direct full-time jobs in 2010 across ten ocean-based industries including large-scale fisheries (OECD, 2016) – though the data do not permit a breakdown of the pre- and post-harvest employment estimates between inland and marine small-scale fisheries.

Box 5.4

Examples of the role of small-scale fisheries employment at the subnational level, where it may be concentrated in a relatively small area of a country

As with any economic activity, the relative importance of the contributions of small-scale fisheries to the economy depends to some extent upon the level at which this is measured (global, national, local, etc.). It bears emphasizing that employment in small-scale fisheries value chains may account for a relatively small fraction of national employment in a given country, but for a much larger share of employment at subnational levels, such as coastal or riparian provinces, or districts. To illustrate this point, microdata from household-based surveys were matched with spatial administrative data from 14 countries across six regions selected based on data availability, in order to compare employment in the harvesting segment of small-scale fisheries to total employment at subnational levels (based on administrative jurisdictions at the regional, district or village level).

For these 14 countries, employment in the harvesting segment of small-scale fisheries is often concentrated in a few local areas, where the percentage employed in harvesting is much higher than the corresponding percentage at the national level. At the national level, over one-third of the employed population in these countries is engaged in activities related to agriculture (crops, livestock or forestry), while over 41 percent is engaged by the service sector, with the remainder mainly distributed between the manufacturing and construction sectors (13.3 and 9 percent, respectively), in the aggregate. Employment in the harvesting segment of small-scale fisheries only accounts for less than 0.6 percent of total employment in the aggregate, but with substantial heterogeneity across countries, ranging from a minimum of 0.3 percent in India to a maximum of 9.1 percent in Kiribati.

However, national measures can mask the geographic concentration of small-scale fisheries and their importance to local economies. In these cases (see table below), harvesting activities in small-scale fisheries provide over 20 percent of employment in 12 administrative areas across six countries (Chile, Egypt, India, Mexico, Sierra Leone and Yemen). For some of the administrative areas studied, for example in India, Chile and Egypt, approximately one-half of the workforce is employed in the harvesting segment of small-scale fisheries. While the total employed population of the 31 administrative areas reviewed across the 14 countries may not be large in absolute terms or relative to the national populations (corresponding to more than 9.5 million employed people, in the aggregate), these cases illustrate how small-scale fisheries can be geographically concentrated within countries, and hence may play an outsized role at the local level for many coastal and riparian regions, even if not apparent in national measures.

Table Employment distribution in small-scale fisheries (harvesting), crops and livestock, and services at subnational level in 14 countries (percentage of total employment in coastal or riparian administrative areas), estimated from household-based surveys

Country	Subnational area	Administrative area	% of total employment in the coastal or riparian subnational area, by sector		
			SSF (harvesting)	Crops and livestock	Services
Bangladesh	Lakshmipur	District	8.9	31.8	35.4
Bangladesh	Cox's Bazar	District	8.3	45.2	35.4
Brazil	Amazonas	State	3.4	14.3	66.3
Brazil	Pará	State	3.1	11.5	65.9
Cambodia	Keb	Province	17.4	10.6	46.8
Cambodia	Koh Kong	Province	13.5	17.5	53.8
Chile	Puqueldon	Commune	60.4	5.4	20.9

Box 5.4 Cont

Table Cont

Country	Subnational area	Administrative area	% of total employment in the coastal or riparian subnational area, by sector		
			SSF (harvesting)	Crops and livestock	Services
Chile	Queilen	Commune	42.0	6.2	32.9
Chile	Chonchi	Commune	36.8	4.4	37.6
Egypt	El Matareya	Subdivision	54.3	0.0	35.1
Egypt	Markaz El Burlos	Subdivision	30.3	34.0	31.2
Egypt	Metoubes	Subdivision	20.1	21.7	33.1
Egypt	Remanah	Subdivision	11.3	6.7	65.1
Gambia	Kombo South	District	6.6	33.3	46.1
Gambia	Banjul City Council	District	3.1	0.4	78.2
India	Diu	District	43.7	0.0	63.7
India	Yanam	District	43.2	7.6	12.9
India	Lakshadweep	District	18.3	5.1	58.2
Indonesia	Maluku Utara	Province	6.2	44.0	39.9
Indonesia	Maluku	Province	5.5	34.8	48.5
Mexico	Tamiahua	Municipal	22.9	0.5	19.8
Mexico	San Mateo Del Mar	Municipal	19.5	0.0	7.3
Peru	Tumbes	Region	8.6	12.8	70.3
Peru	Loreto	Region	7.1	46.6	35.6
Senegal	Saint-Louis	Region	6.9	39.6	32.9
Senegal	Fatick	Region	6.4	54.4	23.0
Sierra Leone	Kwamebai Krim	Chiefdom	25.0	84.4	9.4
Sierra Leone	Sittia	Chiefdom	22.6	54.8	25.8
Tunisia	Gabes	Governorate	6.3	2.7	39.4
Tunisia	Mednine	Governorate	5.8	6.9	50.3
Yemen	Al-Mhrah	Governorate	32.2	0.9	53.0

Notes: These examples cover different years based on data availability: Bangladesh, 2013; Brazil, 2018; Cambodia, 2013; Chile, 2017; Egypt, 2017; Gambia, 2013; India, 2017; Indonesia, 2015; Mexico, 2018; Peru, 2015; Senegal, 2012; Sierra Leone, 2011; Tunisia, 2014; Yemen, 2014. Household-based surveys include labour force surveys and household income and expenditure surveys.

The limitations of measuring participation in small-scale fisheries with standard measures of employment (where people work for remuneration) is illustrated through this example from India: "Women working in home-based processing (fish drying) work: some are full-time, if their husband is also engaged and it's their household's main enterprise – however, they aren't paid. Rather, it's a household income. The typical model would be the husband goes to harbour to procure fish; the women dry it; then the man takes it to market. Other women dry fish only when there is an excess harvest that can't be disposed of. If their husbands are fishermen or deceased, and it's their main income, they control the process and thus receive the income. Their daughters may help as unpaid assistants. Still other women work as paid wage labourers for those (usually men, sometimes women) who have large processing enterprises. Women who are fish traders tend to work full time, as do men who are fish traders.

(H. Hapke, Gender Advisor for India, personal communication, 2019)

5.4.9 Data limitations

The heterogeneity of livelihoods in small-scale fisheries makes it challenging to arrive at one figure that accounts for both part- and full-time employment as well as subsistence fishing, all of which are subject to seasonal variations. Traditional labour market indicators that do not account for subsistence activities in small-scale fisheries will miss the importance of the subsector as a safety net for vulnerable populations, as well as the labour inputs of women. Such gender "blind spots" occur because many of the socioculturally defined roles and responsibilities of women fall into the category of reproductive labour, and thus are not adequately captured in labour force surveys.

With exceptions, government agencies responsible for fisheries typically do not conduct regular sample surveys to measure participation in employment and subsistence activities in small-scale fisheries, including identifying employment in secondary sectors supporting small-scale fisheries value chains. When surveys are in fact carried out, these agencies do not work with others (e.g. ministries of labour) to fully capture the nature of small-scale fisheries and their contributions to employment and livelihoods. In addition, survey results may be unrepresentative because the method used for collecting and presenting these data can often reflect gender biases in sampling design, data collection and analysis, and dissemination.

5.4.10 The challenge of estimating post-harvest employment

Employment in the post-harvest segment of the small-scale fisheries value chain is often difficult to estimate, as it is not highly aggregated, organized or industrialized, and may not be well reflected in national statistical systems (Funge-Smith and Bennett, 2019). In many instances, multipliers have been used, based on an assumed ratio of post-harvest employment to observed harvest employment. For example, the initial Hidden Harvest study (World Bank, 2012) found that "among case study countries, for each person employed as a fisher, two to three are employed in post-harvest activities", including part-time (Mills *et al.*, 2011; Béné, Macfadyen and Allison, 2007). The estimates presented in this chapter revise this ratio down to 1:1.3 (see Annex B), reflecting a larger data set on the one hand, but also, on the other, acknowledging that a significant amount of employment may remain "hidden" in the categories used by household-based survey instruments (e.g. trading and marketing). Additionally, more detailed data available from the Living Standard Measurement Study (World Bank, 2021) conducted in Malawi (2016–2017) and the United Republic of Tanzania (2015) illustrated that persons working in small-scale fisheries often performed multiple jobs along the value chain, ranging from harvesting to processing to trading, such that the number of jobs carried out was significantly higher than the number of persons employed in the subsector. This multiplicity of post-harvest jobs performed by the same persons may also explain some of the differences found in the harvest to post-harvest ratio from previous estimates, given that the household-based surveys used (labour force surveys, household income and expenditure surveys) count persons rather than jobs, thus potentially underreporting some jobs along the value chain.

5.5 The role of small-scale fisheries in international trade of fish products

Figure 5.17 shows the average estimated share of catch exported from marine and inland small-scale fisheries, using a sample of 26 countries and territories.[18]

5.5.1 Proportion of small-scale fisheries production exported

The growing participation of small-scale fisheries in global aquatic food markets has been viewed with both optimism and caution: it presents an opportunity to increase incomes and reduce poverty (Steenbergen *et al.,* 2019), but at the same time poses a risk in terms of increased resource exploitation, inequality and food insecurity. Increasing prices, for instance, could lead to an increase in fishing effort (Crona *et al.,* 2016). Global aquatic food export data do not allow for distinguishing whether the product originates from large-scale fisheries, small-scale fisheries or aquaculture. Therefore, in order to assess the extent of participation of small-scale fisheries in international trade, expert judgement and other available information were consulted by local researchers in the 58 CCS and used to estimate the share of small-scale fisheries catch exported (at the level of functional group of species). These data were available for at least 85 percent of the small-scale fisheries catch in 26 countries and territories (see Section A.4.3 in Annex A).

These 26 countries and territories are responsible for a significant portion of the world's total aquatic food exports – almost 44 percent of the volume[19] and 46 percent of the value of these exports during the 2013–2017 period, according to FAO FishStat trade statistics of fisheries and aquaculture products (FAO, 2020a). In the corresponding 26 CCS, 22 had

[18] Argentina, Bangladesh, Barbados, Brazil, Chile, China, Ghana, Greenland, Indonesia, Kenya, Liberia, Madagascar, Maldives, Morocco, Norway, Peru, Philippines, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Senegal, South Africa, Thailand, Uganda, United Kingdom of Great Britain and Northern Ireland, and Viet Nam.

[19] Export data are expressed in net product weight. The share in quantity is provided for indicative purposes only, as the total might result to be not fully comparable due to the different compositions of the product forms being exported by these countries and at global level (i.e. the total of net product tonnes is the result of the sum of whole fish, fillets, fishmeal, fish oil, etc).

Figure 5.17 Summary of small-scale fisheries exports in 26 countries and territories (average annual volumes for 2013–2017), based on IHH country and territory case studies data

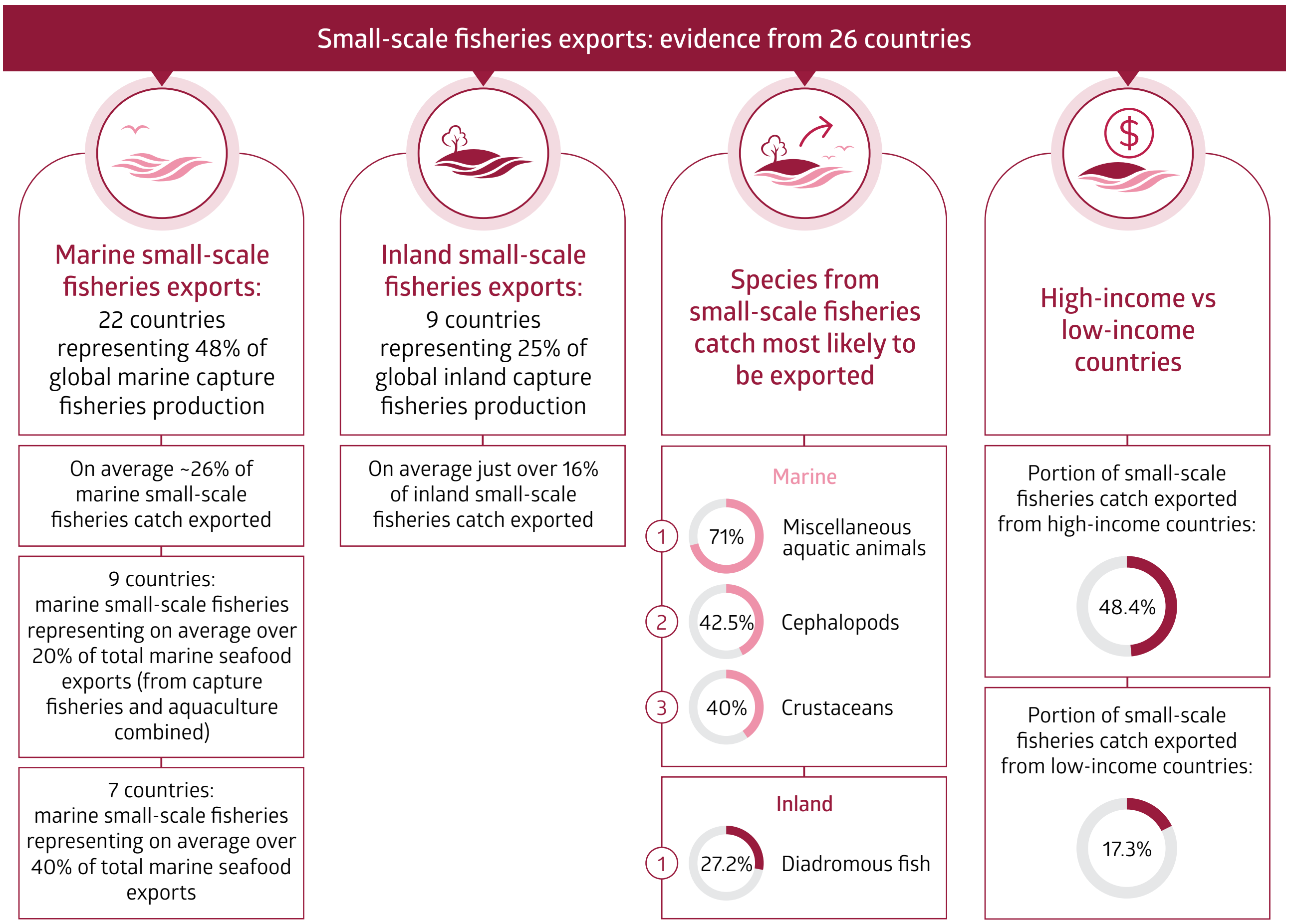
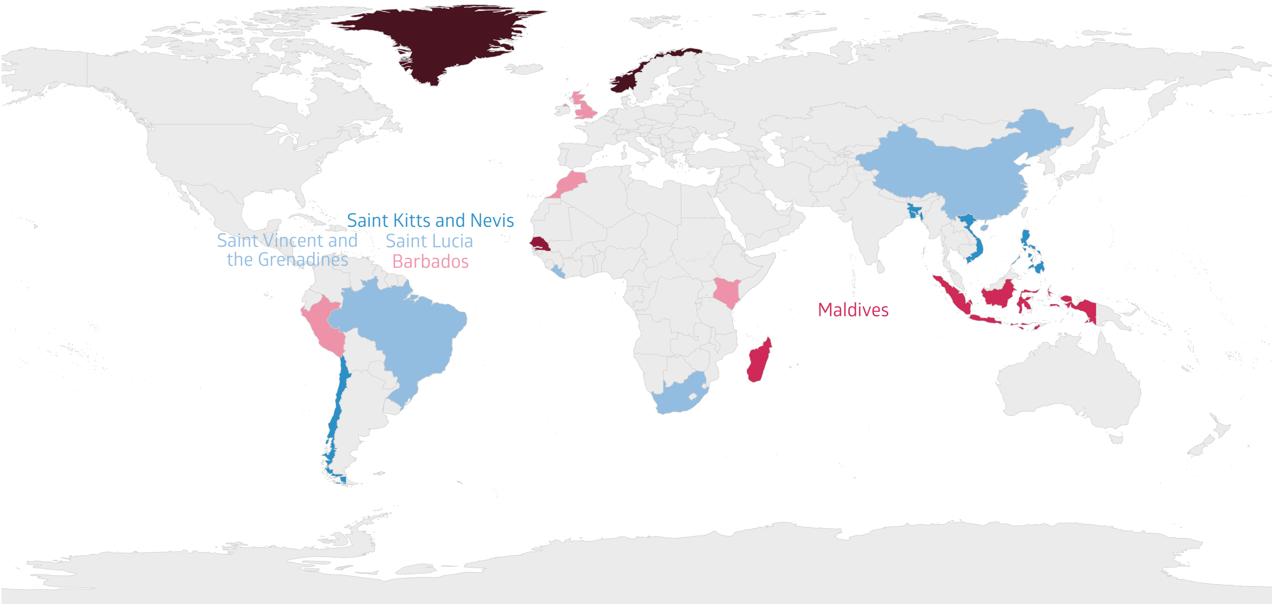
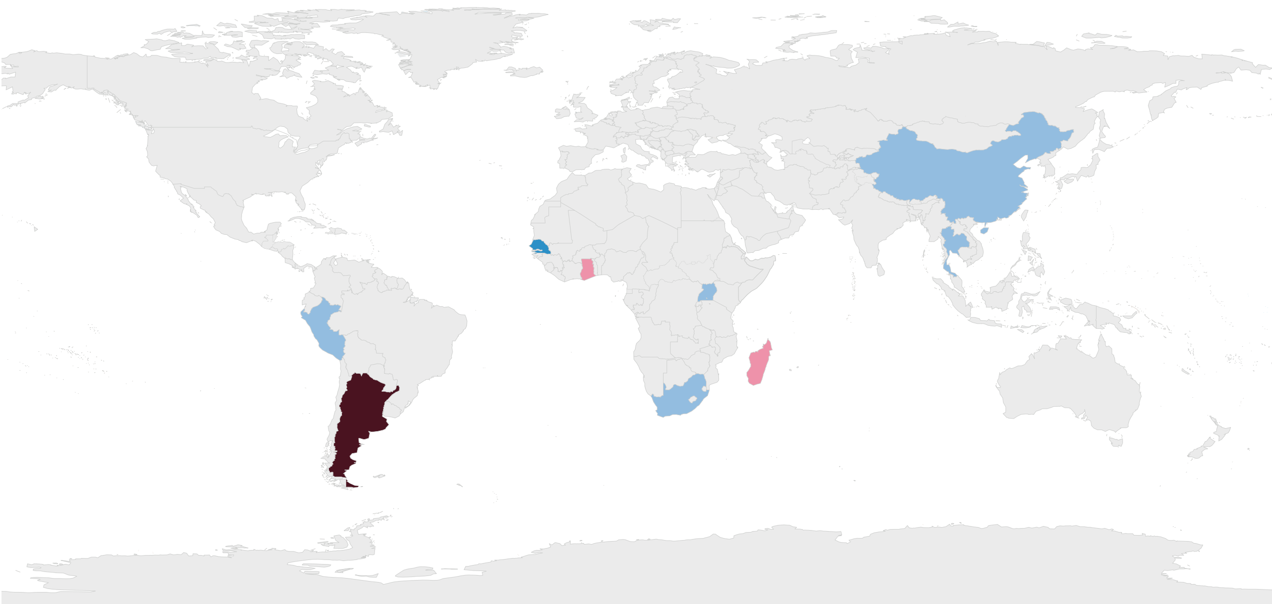


Figure 5.18 Estimated share of marine and inland small-scale fisheries catch exported for 26 IHH country and territory case studies (average percent volume of catch exported, 2013–2017)

Marine small-scale fisheries



Inland small-scale fisheries



Average percent volume (%) of catch exported

Not applicable/no data | ≤ 5% | > 5% and ≤ 15% | > 15% and ≤ 30% | > 30% and ≤ 50% | > 50% and ≤ 75% | > 75%

Source: United Nations Geospatial. 2020. Map geodata [shapefiles]. New York, USA, United Nations, modified by the authors.

Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. Final boundary between the Sudan and South Sudan has not yet been determined.

reliable export data on marine small-scale fisheries,[20] nine on inland small-scale fisheries,[21] and five on both.[22] During the same 2013–2017 period, the 22 countries with data on exports of marine small-scale fisheries represented over 48 percent of global marine capture fisheries (38.8 million tonnes, out of 80.4 million tonnes in live weight equivalent), and the nine countries studied for inland small-scale fisheries exports represented almost 25 percent of global inland capture fisheries production (2.8 million tonnes, out of 11.4 million tonnes) (FAO, 2020a).

Although not based on a fully representative sample, the analysis of these countries and territories suggests that international trade features significantly in many small-scale fisheries: on average almost 26 percent of marine small-scale fisheries catch was exported in the 22 countries analysed and just over 16 percent of inland small-scale fisheries catch in the nine countries analysed (Figure 5.18). At the regional level, the six countries in Africa averaged 28 percent of their marine small-scale fisheries catch exported, and the eight American and six Asian countries averaged 22 and 18 percent respectively, while the two European countries averaged 74 percent.

5.5.2 Types of species caught by small-scale fisheries that are most frequently exported

For the marine small-scale fisheries in the CCS (where more data were available), catch identified as miscellaneous aquatic animals (e.g. aquatic invertebrates such as sea urchins and other echinoderms, including sea cucumbers) was the functional group of species most frequently exported (70.7 percent), followed by cephalopods (42.5 percent) and crustaceans (40.0 percent). The patterns vary by region, with the countries in Europe and Africa exporting on average an estimated 74.9 and 54.8 percent of total marine small-scale fisheries catch of cephalopods, the countries in the Americas exporting 45.7 percent (with mean prices for cephalopods higher than the averages for the majority of other functional groups of species), and the countries in Asia exporting 2.2 percent. Moreover, in the CCS, the percentage of both marine and inland catch exported for certain functional groups of species varies widely across regions.

This is the case, for example, for pelagic marine fish and molluscs (excluding cephalopods), which are more likely to be exported from the countries in Europe compared to the other regions (Table 5.7).

Acknwledging that relatively few CCS included estimates of the amount exported for a number of major functional groups of species caught by small-scale fisheries, these cases still provide an indication as to the types of products exported by some small-scale fisheries. For example, according to these CCS, sea urchins and other echinoderms (e.g. Echinoidea, Echinodermata, *Athyonidium chilensis*, cubozoa, Hydrozoa and Scyphozoa) are frequently exported from marine small-scale fisheries in a number of both high- and low-income countries. From inland small-scale fisheries, river eels (such as *Anguilla bicolor*, *A. marmorata* and *A. mossambic)* and carp, barbel and other cyprinids (e.g. *Cyprinus carpio*) as well as miscellaneous freshwater fish (e.g. *Prochilodus lineatus*, *Odontesthes bonariensis*) are frequently exported. In the case of Lake Victoria, most of the Nile perch (*Lates niloticus*) fishery catch is exported (Kolding, Béné and Bavinck, 2014). Similarly, most of the sun-dried pelagic species that make up much of the inland catch throughout Africa are exported (Kolding *et al.,* 2019).

5.5.3 The apparent relationship between national income level and estimates of small-scale fisheries exports

While developing countries were responsible for 61 percent of the total volume (in live weight equivalent) and 54 percent of the total value of world trade of fish and fish products in the period 2013–2017 (FAO, 2020a), analysis of the 26 CCS for which export estimates were available highlights that small-scale fisheries catch from high-income countries was more likely to be exported than that from low-income countries, though the relationship is positive but not linear. For these 26 countries, the portion of small-scale fisheries catch exported tended to increase much faster after national income crossed a threshold of USD 15 800 per capita (Figure 5.19), corresponding to 9.6 in natural logarithms. Accordingly, the high-income countries studied exported the largest portion of catch from small-scale fisheries, while low-income and lower-middle-income countries showed much smaller portions of small-scale fisheries catch exported; in this sample, however, the smallest portion came from upper-middle-income countries (Table 5.8). It should be noted that, while the portion of small-scale fisheries catch exported from the high-income countries studied was almost three times higher than that from the low-income countries, the latter still showed significant participation in international trade (17.3 percent of small-scale fisheries catch exported on average).

[20] Bangladesh, Barbados, Brazil, Chile, China, Greenland, Indonesia, Kenya, Liberia, Madagascar, Maldives, Morocco, Norway, Peru, Philippines, Senegal, South Africa, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, United Kingdom of Great Britain and Northern Ireland, and Viet Nam.

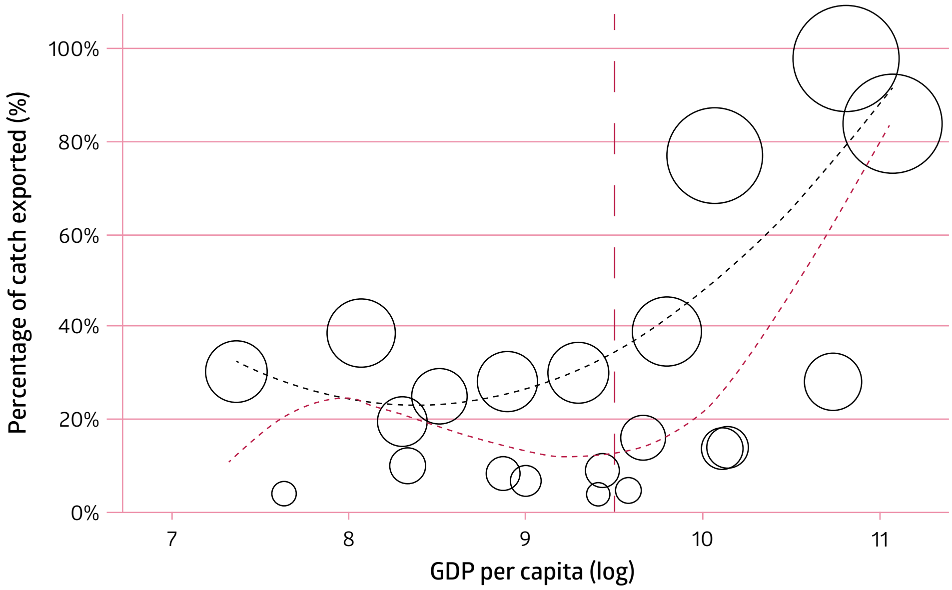
[21] Argentina, China, Ghana, Madagascar, Peru, Senegal, South Africa, Thailand and Uganda.

[22] China, Madagascar, Peru, Senegal and South Africa.

Table 5.7 Percentage of estimated marine and inland small-scale fisheries catch exported by major functional group in 26 IHH country and territory case studies (average annual values, 2013–2017)

Major functional group	Region				
	Africa	Americas	Asia	Europe	Total
Marine small-scale fisheries					
Cephalopods (n = 11)	54.8	45.7	2.2	74.9	42.5
Crustaceans (n = 17)	51.6	38.4	27.7	46.8	40
Demersal marine fish (n = 19)	22.4	19.3	11.6	60.3	22.6
Diadromous fish (n = 5)		53.1	4	64.8	35.8
Freshwater fish (n = 3)	52.5	0			17.5
Marine fish nei (n = 7)	31.3	0.2	7.7	79.7	19.2
Marine species nei (n = 2)	9.2		0		4.6
Miscellaneous aquatic animals (n = 6)	90.6	48.6		97.2	70.7
Molluscs, excluding cephalopods (n = 14)	23.9	7.1	9.8	50.4	18.4
Pelagic marine fish (n = 20)	15.8	21.5	12.4	54	20.8
Shrimp, prawn (n = 10)	53.8	2.6	19.3	32	28.9
Species nei (n = 4)		10	53.2	10	20.8
Inland small-scale fisheries					
Crustaceans (n = 3)	16.9		0		11.3
Diadromous fish (n = 2)	54.4	0			27.2
Freshwater fish (n = 8)	6.5	38.51	0		12.9
Freshwater species nei (n = 2)			0		0
Molluscs, excluding cephalopods (n = 1)			0		0
Pelagic marine fish (n = 2)	8.8				8.8
Shrimp, prawn (n = 4)	13.5	0	0		6.8
Species nei (n = 1)	25				25

Figure 5.19 Percentage of catch exported and GDP per capita (log) in 26 IHH country and territory case studies (average annual values, 2013–2017)



Notes: The dashed red vertical line represents the turning point (equivalent to USD 15 800 when back transformed), i.e. the point after which higher income levels are associated with larger portions of catch from small-scale fisheries. Values of per capita GDP were taken from the World Bank world development indicators.

Table 5.8 Percentage of small-scale fisheries (SSF) catch exported, by national income group, in 26 IHH country and territory case studies (average annual values, 2013–2017)

SSF catch exported (marine and inland)		Marine small-scale fisheries		Inland small-scale fisheries	
World Bank income group	Percentage	FAO region	Percentage	FAO region	Percentage
High-income (n = 6)	48.4	High-income (n = 6)	48.4	High-income (n = 0)	
Low-income (n = 4)	17.3	Low-income (n = 2)	18.1	Low-income (n = 2)	16.4
Lower-middle-income (n = 9)	24.4	Lower-middle-income (n = 7)	27	Lower-middle-income (n = 2)	17.6
Upper-middle-income (n = 12)	12.6	Upper-middle-income (n = 7)	10.7	Upper-middle-income (n = 5)	15.4
Total (n = 31)	22.9	Total (n = 22)	25.8	Total (n = 9)	16.2

Notes: "n" refers to number of observations (i.e. countries) studied in each income group. Some countries were studied twice, as they had reliable data for both marine and inland small-scale fisheries. World Bank income group classification is used.

Table 5.9 Marine small-scale fisheries export volumes for 13 IHH country and territory case studies, as percentage of total marine aquatic food export volumes reported to FAO

Country	Years	Marine small-scale fisheries exports as % of total marine aquatic food export volumes[a] (average, by quintile)
Africa		
Gambia	2013, 2015, 2016	(40–60%)
Mauritania	2014, 2015, 2016, 2017	(80–100%)
Nigeria	2013, 2014, 2015, 2016, 2017	(40–60%)
Senegal	2013, 2014, 2015, 2016, 2017	(60–80%)
Seychelles	2013, 2014, 2015	(0–20%)
Asia		
Philippines	2013, 2014, 2015, 2016, 2017	(20–40%)
Indonesia	2013, 2014, 2015, 2016, 2017	(20–40%)
Maldives	2014, 2015, 2016, 2017	(> 100%)
Europe		
United Kingdom of Great Britain and Northern Ireland	2013, 2014, 2015, 2016, 2017	(0–20%)
Oceania		
Fiji	2013, 2014, 2016, 2017	(0–20%)
Caribbean		
Barbados	2013, 2014, 2015, 2016, 2017	(80–100%)
South America		
Chile	2013, 2014, 2015, 2016, 2017	(40–60%)
Peru	2013, 2014, 2015, 2016, 2017	(20–40%)

Note: **a** Total aquatic food export volumes include capture fisheries and aquaculture, and were taken from: FAO. 2020. Fishery and Aquaculture Statistics. Global capture production 1950–2018 (FishStatJ). In: *FAO Fisheries Division*. Rome. Updated 2020. www.fao.org/fishery/statistics/software/fishstatj/en

5.5.4 Comparison with information available from FAO: towards estimating the share of small-scale fisheries catch in national aquatic food exports

With a few exceptions, international trade statistics, including the ones compiled by FAO from official national sources, do not distinguish between products and species originating from aquaculture or capture, or between large- or small-scale fisheries. As a result, the international trade data do not capture the volume of exports from small-scale fisheries, nor the interactions of these exports with global aquatic food markets. Therefore, disaggregating the data on aquatic food export volumes is not currently possible at the global level, but the CCS can provide context-specific examples. In fact, in addition to estimates of the proportion of small-scale fisheries catch that is exported, some of the CCS also had data available on the total volume exported. This was compared to the total national exports of aquatic food products of those countries using the FAO FishStat trade statistics (FAO, 2020a) of fisheries and aquaculture products, which contains data for about 200 countries and territories and over 1 000 species and products, in value and volume (in net product weight).

Results from the case study data on small-scale fisheries export volumes (in net product weight) compiled for this study were available for comparison with FAO data in at least three years between 2013 and 2017 in 13 CCS for marine small-scale fisheries, four CCS for inland small-scale fisheries, and one other CCS for both combined. In these cases, the small-scale fisheries export volumes were compared to the national total aquatic food export volumes reported by countries to FAO,[23] to give an indication of the contribution of small-scale fisheries to the total. The cases were not randomly selected and so are not representative of other countries, but do provide examples from diverse geographical locations.

In 10 of the 13 CCS with data available on marine small-scale fisheries export volumes as well as data from FAO on total marine aquatic food exports, marine small-scale fisheries contributed on average more than 20 percent of the total marine aquatic food exports (from capture fisheries and aquaculture combined), and in seven of these cases over 40 percent (Table 5.9).

For all four CCS with data available on inland small-scale fisheries export volumes, these exports significantly exceeded the total estimated exports of freshwater species separately identified in FAO FishStat (FAO, 2020a) trade statistics (Table 5.10). In these examples, the difference could reflect either cross-border trade not recorded by governments in official statistics (i.e. “hidden”), and/or misclassified miscellaneous exported products (i.e. species not specified as freshwater or marine in statistics reported to FAO), which cause an underestimation of total freshwater aquatic food export volumes in FAO statistics.

5.5.5 Data limitations

For the CCS, data were requested on the volumes of small-scale fisheries catch exported. These data were typically compiled by examining official trade statistics collected in the countries by customs or national statistical agencies, which are expressed in net product weight volume (typically after processing and value addition). The data provided in the CCS on the amount of small-scale fisheries catch are therefore assumed to similarly be in product weight, but in some instances may have been reported in live weight equivalent of the catch and are thus not fully comparable. In addition, national trade statistics in some instances might underestimate the operations associated with exports. For example, unrecorded cross-border trade, which occurs in some countries in Africa and Asia, is often not adequately reflected in official statistics. This may have been the case in the CCS data as well.

Table 5.10 Inland small-scale fisheries export volumes for four IHH country and territory case studies, as percentage of total inland seafood export volumes reported to FAO

Country	Years	Inland small-scale fisheries exports as % of total inland aquatic food export volumes[a] (mean, by quintile)
Malawi	2014, 2015, 2016, 2017	> 5th (> 100%)
Senegal	2013, 2014, 2015, 2016, 2017	> 5th (> 100%)
Uganda	2013, 2014, 2015, 2016, 2017	> 5th (> 100%)
Argentina	2013, 2014, 2015, 2016, 2017	> 5th (> 100%)

Note: **a** Total aquatic food export volumes include capture fisheries and aquaculture, and were taken from: FAO. 2020. Fishery and Aquaculture Statistics. Global capture production 1950–2018 (FishStatJ). In: *FAO Fisheries Division*. Rome. Updated 2020. www.fao.org/fishery/statistics/software/fishstatj/en

[23] FAO FishStat trade data were divided between marine and inland species, even though this split may not be fully accurate, due to a significant amount of trade reported by countries where the species was not specified (i.e. it was not possible to determine whether it was freshwater or marine), which was then included under marine species.

Required citation for this chapter:

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6.

Towards gender inclusivity and equality in small-scale fisheries

Sarah Harper (University of Victoria and Wildlife Conservation Society) and Danika Kleiber (WorldFish and James Cook University)

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6.1 Key findings and messages

- An estimated 44.7 million women worldwide participate in small-scale fisheries value chains or engage in subsistence activities, which translates into 39.6 percent of the total people active in the subsector. Women represent 15.4 percent of total employment in the pre-harvest segment of the small-scale fisheries value chain (e.g. gear fabrication and repair, bait and ice provisioning, boat-building), 18.7 percent in the harvesting segment (including vessel-based and non-vessel-based activities), 49.8 percent in the post-harvest segment (e.g. processing, transporting, trading, selling) and 45.2 percent of the total actors engaged in small-scale fisheries subsistence activities.

- Women participate in small-scale fisheries most commonly through informal and unpaid activities, limiting their social protections and security. While this participation can be partially highlighted through estimates of engagement in subsistence activities, much of it continues to be systematically excluded from official fisheries data collection and analysis, and thus women's contributions are insufficiently considered in fisheries decision-making.

- Women are over-represented in intertidal, low-gear, invertebrate fisheries due to limitations in access to gear and fishing habitats. These fisheries are less likely to be defined as fishing, and thus may not be monitored, resulting in underestimations of catch, social importance and environmental impact.

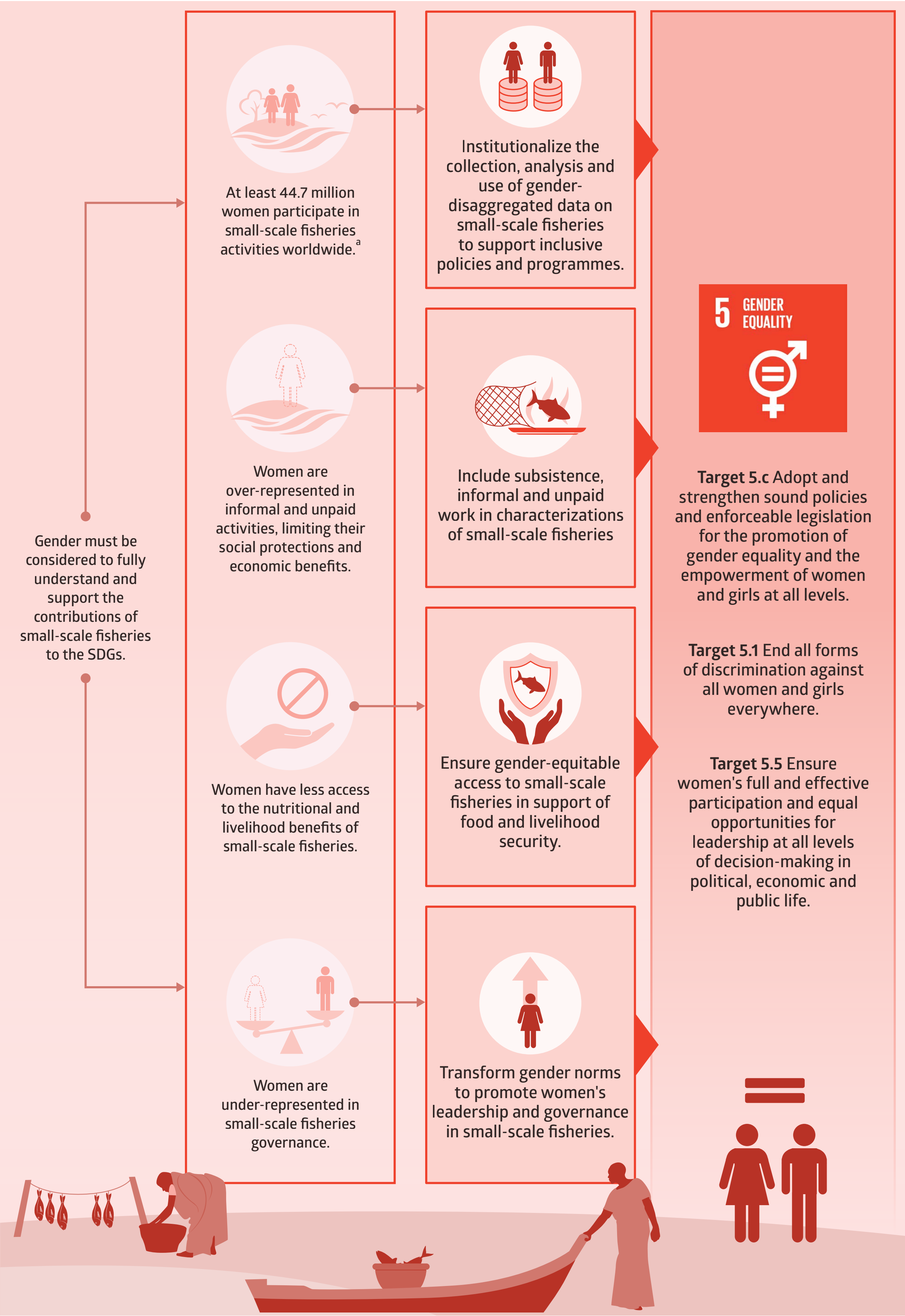
- Women in many contexts have less access to small-scale fisheries, but also stand to significantly benefit from that access, with broad societal implications for food security and nutrition and poverty alleviation.

- Women continue to be under-represented in small-scale fisheries governance systems, and those who do participate are typically only able to engage in limited ways. Barriers include gender-blind small-scale fisheries policy, and lack of capacity to implement existing policy.

- The Illuminating Hidden Harvests (IHH) study illustrates that gender-disaggregated fisheries data are still rare, especially in official national-level fisheries statistics. Gender disaggregation should be the minimum requirement for all monitoring and research that informs fisheries policies and programmes. Gender-blind data or biased data collection methodologies overlook women in fisheries, obscuring the full contributions of small-scale fisheries towards the realization of the Sustainable Development Goals (SDGs) and towards achieving gender-inclusive fisheries policies and practices, as called for by the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines).

Figure 6.1 provides an overview of key pathways through which gender considerations in small-scale fisheries support their contribution to sustainable development.

Figure 6.1 Key pathways through which gender considerations support the contributions of small-scale fisheries to sustainable development



Note: **a** Reference year 2016.

6.2 Introduction

Small-scale fisheries cannot be understood without considering gender, and this requires confronting the continued absence of women in the already limited data available on small-scale fisheries (Kleiber, Harris and Vincent, 2015; Harper *et al.*, 2017). The first attempt to gauge the scale of women's engagement in small-scale fisheries globally was done in the 2012 Hidden Harvest study (World Bank, 2012). The findings in this study underscored the need for commitments to gender equity and equality, which have been further articulated in international policy guidance, specifically the SSF Guidelines and the SDGs (FAO, 2015). However, it has proven elusive to translate these into action, in particular the commitment to closing the gender data gap.

The gender data gap in small-scale fisheries is a sexist phenomenon whereby the vast majority of information gathered by fisheries management and related agencies and institutions refers only to men. This data gap persists because fisheries, as with many other sectors, are caught in a self-reinforcing, gender-blind[24] feedback cycle (Figure 6.2; adapted from FAO, 2017b). In this cycle, sexist data are both a product and a reinforcer of structures[25] that present a limited view of the contributions of the small-scale fisheries subsector to economies, food security and nutrition, and sustainable development (Lentisco and Lee, 2015). The gender data gap is not unique to small-scale fisheries. It has been documented at a global scale in many labour markets, and is identified as a major barrier to the realization of the SDGs (Buvinic and Levine, 2016). Investigating how sexist data are perpetuated, and more importantly where these data are being challenged in small-scale fisheries, can elucidate best practices for data collection processes that are gender-aware and gender-inclusive, and also take into account other intersecting identity characteristics such as age, class, race and religion (Box 6.1; Figure 6.3). These practices can add insights on means to strengthen small-scale fisheries contributions to sustainable development.

This chapter seeks to address the challenge sexist data present and outline the opportunities associated with gender-inclusive small-scale fisheries structures. It does so by assessing gender-related gaps and barriers that persist in the collection and analysis of small-scale fisheries data, with examples that highlight pathways towards gender inclusivity and equality,[26] as critical information for the implementation of the SSF Guidelines and for fully understanding the contributions of small-scale fisheries to the SDGs. Specifically, the chapter focuses on answering the following:

- What are the gendered patterns of participation in the pre-harvest, harvesting and post-harvest segments of small-scale fisheries value chains? What types of activities are recorded, and which are missing from small-scale fisheries economic analyses?
- What species do women and men harvest, using what gear types and in which habitats? Which species are included, and which are missing from the analysis?
- How does gender determine access to the nutritional and livelihood benefits of small-scale fisheries? What are the current data limitations to understanding differences in access to these benefits?
- How is gender addressed in small-scale fisheries governance in terms of representation, distribution of authority and mechanisms of accountability? What are the monitoring gaps to assess gender equity in governance?

In responding to these questions, the chapter illuminates a fuller picture of the contributions from small-scale fisheries as they relate to four thematic areas of the SDGs: economics, environment, nutrition and governance. It concludes by returning to the challenge of sexist data structures to identify key actions to catalyse the transition from "gender-blind" to "gender-inclusive" small-scale fisheries research, policy and practice.

This chapter is informed by qualitative and quantitative data from three main sources: 58 country and territory case studies (CCS), IHH employment datasets for 78 countries, and input from 28 IHH gender advisors.[27] Together these sources were used to identify gaps and barriers to collecting and reporting gender-inclusive small-scale fisheries data, while also illuminating what is known about gender and small-scale fisheries. The data sources are described in Annex A; Table 6.1 outlines which sources were used to answer questions across each thematic area.

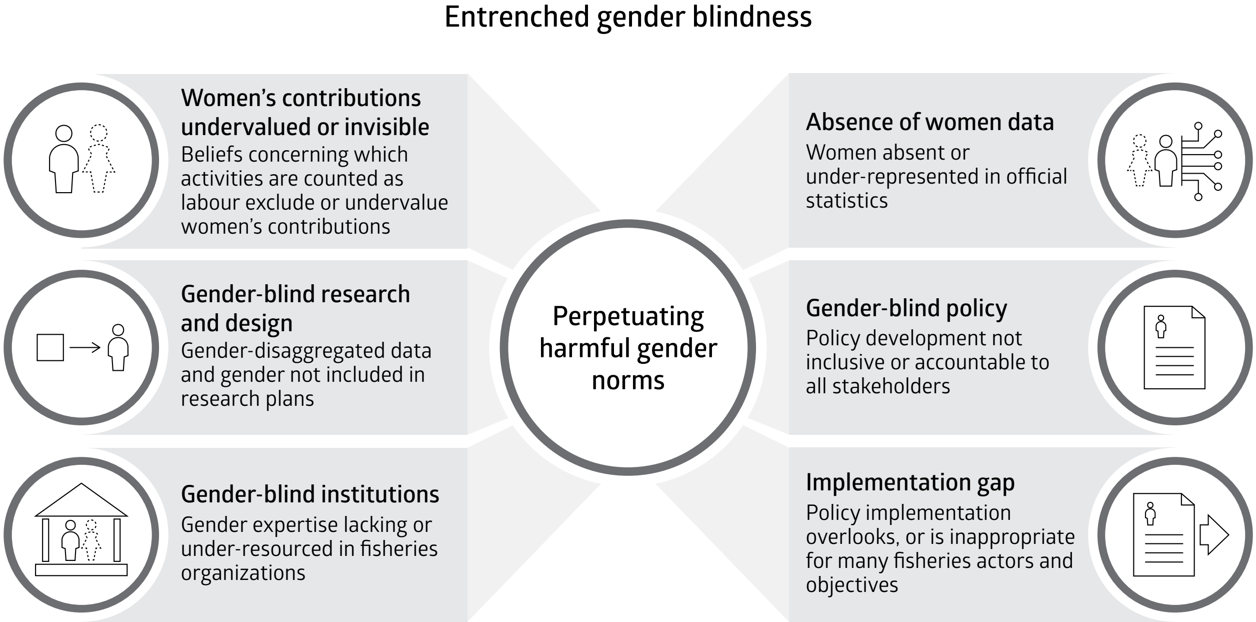
[24] This can include policy documents that do not address gender, but also research and development that ignores the roles, rights and responsibilities associated with women and men as well as power dynamics between women and men, and girls and boys (Kleiber *et al.*, 2019).

[25] These structures include data collection, monitoring and evaluation systems, policies, institutions, and norms that characterize and govern small-scale fisheries.

[26] See glossary of IHH terms.

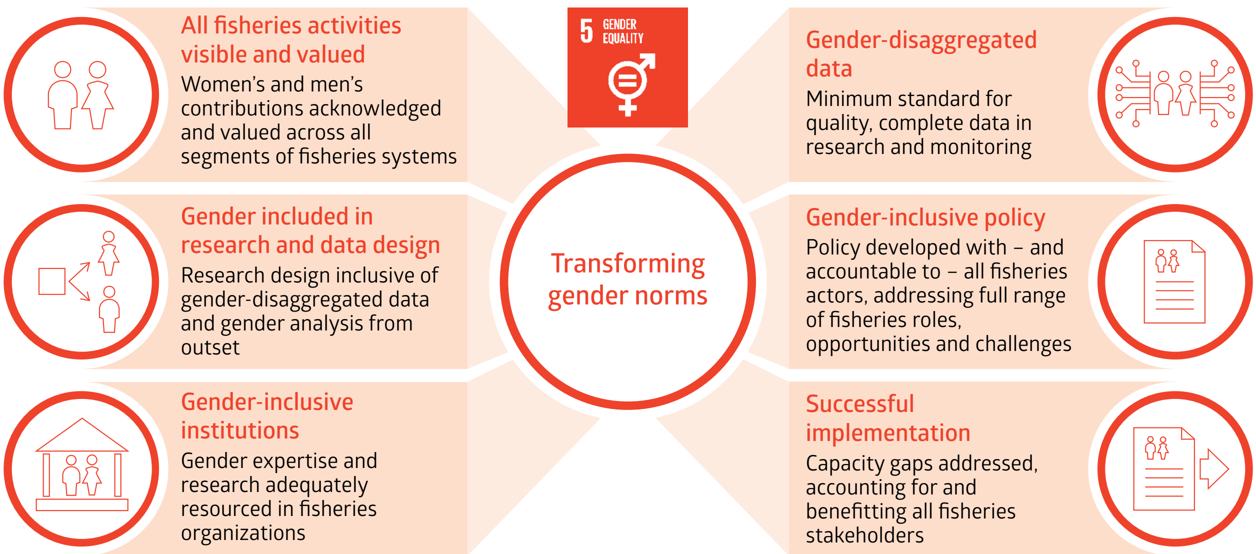
[27] To integrate gender across the IHH study, a team of 28 gender advisors (79 percent women, 21 percent men) with national or regional expertise from around the world was assembled (see Annex A for a list of countries and names).

Figure 6.2 Cycle of gender blindness that is reinforced by a policy, research and social environment that perpetuates gender disparities and inequality



Source: Framework first inspired by: FAO. 2017. *Towards gender-equitable small-scale fisheries governance and development: a handbook.* N. Biswas, ed. Rome. Framework further informed by a workshop on capacity and capability indicators for the integration of gender into small-scale fisheries: Kleiber, D., Cohen, P., Gomese, C. & McDougall, C. 2019. *Gender-integrated research for development in Pacific coastal fisheries.* Program Brief: FISH-2019-02. Penang, Malaysia, CGIAR Research Program on Fish Agri-Food Systems. https://digitalarchive.worldfishcenter.org/bitstream/handle/20.500.12348/2826/FISH-2019-02.pdf.

Figure 6.3 Cycle of gender inclusivity and equality that is reinforced by an enabling environment where policy, research and social structures and systems are intent on reducing gender disparities and increasing gender equity in fisheries



Source: Framework first inspired by: FAO. 2017. *Towards gender-equitable small-scale fisheries governance and development: a handbook.* N. Biswas, ed. Rome. Framework further informed by a workshop on capacity and capability indicators for the integration of gender into small-scale fisheries: Kleiber, D., Cohen, P., Gomese, C. & McDougall, C. 2019. *Gender-integrated research for development in Pacific coastal fisheries.* Program Brief: FISH-2019-02. Penang, Malaysia, CGIAR Research Program on Fish Agri-Food Systems. https://digitalarchive.worldfishcenter.org/bitstream/handle/20.500.12348/2826/FISH-2019-02.pdf.

Box 6.1

Gender and disaggregated data

Sex and gender describe different but related things.[a] While sex is usually used to describe biological traits of female and male animals, gender describes the socially defined roles, responsibilities and behaviours that are assigned to women and men. Sex and gender are both complex and non-binary, and they interact with each other. The understanding of how they are defined and used by science and culture is rapidly evolving. However, in a broad sense, assuming that gender and sex are the same reinforces the error that gender roles are based in biology and therefore unchangeable.

Social rules involving gender influence how women and men interact with their natural environment and with socioeconomic systems. This includes their ability to participate in and benefit from small-scale fisheries as well as influencing how they are managed, which varies greatly with circumstance. In recognition of this, gender is central to understanding the multiple dimensions of small-scale fisheries and their contribution to sustainable development.

The term "gender-disaggregated" is used to describe any data that include information on women and men. It is recognized that some practitioners prefer to refer to this type of data as sex-disaggregated, to distinguish it from other more in-depth and nuanced types of gender analysis that take into account contextualized and culturally grounded relationships. Indeed, it is acknowledged that binary disaggregation by gender is a baseline requirement for data quality, but it is not sufficient for full gender analysis.

Gender does not merely shape the different roles and relationships that men and women tend to have in informal and formal activities associated with small-scale fisheries. It also affects the opportunities and responsibilities they are given, and the challenges and risks they face, in relation to all aspects of sustainable development. Moreover, the ways in which gender is understood affect the power and agency women and men experience in governing and managing fisheries, in pursuing opportunities to improve well-being or economic performance in fisheries value chains, and in accessing productive assets (e.g. parts of fishing grounds, gear types or vessels, or infrastructure such as markets). Research and development initiatives that have a proper understanding of gender and its influence on other economic, environmental, nutrition and governance aspects of small-scale fisheries, are better positioned to secure or improve the contributions of small-scale fisheries to sustainable development.

Note: **a** D'Ignazio, C. & Klein, L.F. 2020. *Data feminism*. Cambridge, USA, MIT Press.

Table 6.1 Data and methods used for gender analysis of different thematic areas

Thematic area	Data sources	Methods
Economics	Country and territory case studies (CCS); labour force surveys; household income and expenditure surveys; censuses; input from gender advisors	Feminist approach to data science: investigating multiple data sources and uncovering bias[a]
Environment	CCS; input from gender advisors	"Foot fisheries" (i.e. fishing without a vessel) used as an imperfect proxy for fishing activities in which women tend to participate[b]
Nutrition	Input from gender advisors	IIntersectionality[c]
Governance	Input from gender advisors; CCS; Duke University database of civil society organizations	Gender-inclusive governance, gender mainstreaming[d]

Notes: **a** D'Ignazio, C. & Klein, L.F. 2020. *Data feminism*. Cambridge, USA, MIT Press. **b** Kleiber, D., Harris, L.M. & Vincent, A.C.J. 2015. Gender and small-scale fisheries: a case for counting women and beyond. *Fish and Fisheries,* 16(4): 547–562.**c** Cooper, B. 2016. Intersectionality. In: L. Disch & M. Hawkesworth, eds. *The Oxford handbook of feminist theory,* pp. 385–406. Oxford, UK, Oxford University Press. **d** FAO. 2015. *Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication.* Rome.

6.3 Participation by women in small-scale fisheries value chains and subsistence activities

> *Women's work is often excluded from fisheries data collected by the Department of Fisheries. This is particularly the case for processing, but also the other kinds of 'shadow work' that sustain fishermen.*
>
> *(J.L. Johnson, Gender Advisor for Uganda, personal communication, 2020)*

From bookkeeping and provisioning for fishing trips, to informal processing and transport and sale of fish and invertebrates, many small-scale fisheries activities are neither enumerated nor remunerated, and these activities tend to be disproportionately done by women (Gopal *et al.*, 2020). Without these activities and inputs (i.e. informal employment and unpaid work, including care work), essentially all fishing operations and communities would not function, and fish would not make it to market or consumers. Yet, many of these activities continue to be invisible to policymakers and managers. This is because fisheries continue to be mainly considered from the harvesting (and environmental) perspective and to some extent the market for the product, but rarely include the full picture of actors and activities, including the entire fisheries value chain, subsistence fishing and processing, and all relevant inputs.

Of the 58 CCS included here, 25 had some (but often limited) gender-disaggregated data. Data extracted from labour force surveys and household income and expenditure surveys (rather than fisheries surveys) provided a more comprehensive set of gender-disaggregated data to understand gendered patterns of participation in small-scale fisheries. These data suggest that women represent 15.4 percent of total employment in the pre-harvest segment of the small-scale fisheries value chain (e.g. gear fabrication and repair, bait and ice provisioning, boat-building), 18.7 percent in the harvesting segment (including vessel-based and non-vessel based activities), 49.8 percent in the post-harvest segment[5] (e.g. processing, transporting, trading, selling) and 45.2 percent of total actors engaged in subsistence fishing and processing. Overall, data collected for this study suggest that 44.7 million women worldwide participate in small-scale fisheries employment along the value chain or engage in subsistence activities (harvesting and processing), meaning that women represent an estimated 39.6 percent of total participation in the subsector (Table 6.2). While this number appears to be less than the previous global estimate of 46 percent from the Hidden Harvest study (World Bank, 2012), this latest estimate is more broadly based, as it involves a much larger dataset of countries and different estimation approaches. However, the figures presented here likely still underestimate the contributions from women in small-scale fisheries because of overall limitations in the availability of small-scale fisheries data.

Gendered patterns of participation in fisheries are dynamic, with gender roles and responsibilities shifting over time in relation to social, economic and environmental pressures and trends (Gustavsson, 2020; Thomas *et al.*, 2021). However, in many contexts, fisheries-related activities are segregated along gender lines with other identity factors intersecting to determine who does what and where (Pedroza-Gutiérrez, 2019). Input from gender advisors in the IHH study indicated a commonly observed pattern where men are involved in full-time and year-round fishing activities, whereas women's involvement tends to be in occasional, seasonal and unpaid/informal activities, often labelled an extension of their domestic responsibilities.

Some of the barriers to collecting gender-disaggregated fisheries data identified in this study involve a lack of institutional capacity, such as low funding, no gender training for staff, and not enough women researchers. The structural focus is on fishing and the market, but women are not assumed to be key players in the sector; hence the collection, analysis and dissemination of gender-disaggregated employment data is given lower priority.

6.3.1 Pre-harvest segment

Data reflecting the scope and scale of participation in pre-harvest activities, such as making/repairing nets and gear and bait acquisition, are limited in official datasets, especially those activities performed by women. For example, in Galicia, Spain, net-weavers (who are predominantly women) are not recognized or represented in fisher guilds or accorded labour rights (E. Ojea, 2020, Gender Advisor, Spain). By contrast, in Chile some national-level data exist for pre-harvest segment employment, disaggregated by gender, while in one region of Brazil official data include the number of women engaged in gear repair and bait acquisition (Brazil and Chile CCS). Where pre-harvest employment data exist, whether disaggregated or not, the numbers likely under-represent women's contributions due to the invisibility and devaluation of certain activities and employment. For instance, in Nigeria, net-making is considered an extension of women's reproductive or household activities and is therefore not included

Table 6.2 Global estimates of small-scale fisheries (SSF) participation by gender for pre-harvest, harvesting, post-harvest and subsistence activities in inland and marine subsectors in 2016, extrapolated from 78 labour force and household-based surveys

Activity		Total	Women	Men	% women
Pre-harvest	Marine + Inland	1 726 030	266 064	1 459 966	15.4
Harvesting - commercial	Inland	14 598 317	2 932 685	11 665 632	20.1
	Marine	12 863 038	2 208 733	10 654 305	17.2
Subsistence (harvesting and processing)	Inland	35 997 415	15 941 880	20 055 535	44.3
	Marine	16 839 732	7 919 975	8 919 757	47.0
Post-harvest	Processing	7 492 211	3 646 122	3 846 089	48.7
	Trade	23 521 133	11 805 858	1 715 275	50.2
Total	SSF	113 037 876	44 721 316	68 316 560	39.6

Note: Informal and unpaid activities including care work are not fully captured by the data sources and thus these estimates do not convey the totality of women's contributions to small-scale fisheries.

in censuses of fisheries employment (K. Fakoya, 2020, Gender Advisor, Nigeria). Due to the informal and unpaid nature of many pre-harvest activities, these are often not valued or considered as work, and are therefore not recognized or recorded as fisheries employment. In the United Kingdom of Great Britain and Northern Ireland, "women often do the 'paperwork', value added-tax (VAT) returns, crew settling and other administration for fishing businesses including online aspects" (M. Gustavsson, 2020, Gender Advisor, United Kingdom of Great Britain and Northern Ireland), yet these are rarely considered in estimates of fishing costs, which focus on costs of crewing vessels but not the work involved in getting those crew on board, fed and paid.

6.3.2 Harvesting segment

The fisheries where women participate most tend to be dispersed, with the activity carried out on foot and using minimal gear (Harper *et al.*, 2020). For many countries in this study, these fisheries were poorly captured in terms of data collection and monitoring. Gender norms often restrict women from participating in harvesting activities, especially boat-based fishing, where fisheries data collection efforts tend to be focused. Thus the fishing activities where women participate most are systematically excluded, resulting in gender-biased employment data in many contexts. However, some countries in the study revealed small-scale fisheries employment data that were more gender-inclusive. For example in Peru and the Philippines, inland fishing activities dominated by women such as gleaning and seaweed harvesting are included in the official data, disaggregated by gender. For Peru, small-scale fisheries data provided by the Instituto del Mar del Perú (IMARPE) have been disaggregated by gender since 2012, when IMARPE and the Instituto Nacional de Estadística e Informática (INEI) joined forces with the Peruvian Ministry of Production (PRODUCE) to conduct the country's first census of small-scale fishers (Guevara-Carrasco and Bertrand, eds., 2017). The availability of these data has made gender analysis of Peruvian seafood value chains possible (Christensen *et al.*, 2014) and provides an example of mainstreaming gender-disaggregated data collection through coordination across agencies that collect and analyse demographic and fisheries data.

6.3.3 Post-harvest segment

The segments of the fish value chain where women are most present and visible are processing, marketing and trading, although men also participate to varying degrees. In Kerala, India, "women are primarily involved in post-harvest activities as labourers in prawn peeling, home-based and wage labourers in fish drying, and as fish traders. A small number work as auctioneers and export agents (i.e. procure products for exporters)" (H. Hapke, 2020, Gender Advisor, India). In the United Republic of Tanzania, Zanzibar, over the last two decades the number of women fish traders in local markets has increased substantially, such that they are now commonly seen there in equal numbers to men (Fröcklin *et al.*, 2013; M. Torre-Castro, 2020, Gender Advisor, United Republic of Tanzania). Nevertheless, structurally, many fisheries agencies continue to focus on production, and thus the data lack accurate representation of post-harvest activities, especially those associated with the small-scale subsector. An exception to this is India's National Marine Fisheries Census, where, although not counted under the category of "fisher", women are enumerated in the table of "fishing allied activities", i.e. fish marketing, making or repairing nets, curing/processing, peeling, labourer and others (Central Marine Fisheries Research Institute, 2010).

6.3.4 Subsistence harvesting and processing

Many small-scale fishing activities are not counted as "employment" in fisheries data because they are not market-oriented, nor are they done in exchange for pay or profit. Here, these contributions have been partially captured through data extracted from labour force surveys and/or household income and expenditure surveys, which indicate that globally 23.3 million women participate in marine and inland harvesting and processing activities for subsistence, representing 45.2 percent of all those engaged in subsistence activities in the subsector.[28] Participation by women in subsistence activities is highest in Africa and Oceania where women represent 56.8 percent and 50.4 percent, respectively, of all those participating in small-scale fisheries, without remuneration, to feed their families. Because subsistence activities are informal and unpaid, women's participation is under-represented in fisheries datasets that focus on commercial species and paid work. For example, in Ghana and the Gambia, women glean for oysters and shellfish in estuaries, but data representing these activities are not reflected in national fisheries statistics (Bilecki, Torell and Owusu, 2015; Njie and Drammeh, 2011; UNCTAD, 2014; A. Fent, 2020, Gender Advisor, the Gambia). Likewise in processing, activities that take place in plants and factories may be recorded in national employment datasets, but those that take place in informal or private spheres are not. Examples of this are found in Rio Grande, Brazil, where women work in sheds or backyards at home, processing occasionally whenever they have fish (L. Hellebrandt, 2020, Gender Advisor, Brazil); and in the United Republic of Tanzania, where women occupy informal market spaces (M. de la Torre-Castro, 2020, Gender Advisor, United Republic of Tanzania). These spaces are not captured in the data, especially where surveys have not been adapted to local contexts, but they still constitute an important part of small-scale fisheries value chains.

6.4 Women's fishing activities: methods, habitats and species

Women and men engage in small-scale fisheries activities all over the world (Kleiber, Harris and Vincent, 2015). But, as the following quotes illustrate, the types of fishing they engage in varies greatly, shaped by context-specific societal expectations of women and men (Frangoudes and Gerrard, 2018; de la Torre-Castro *et al.*, 2017; Lentisco and Lee, 2015; Short *et al.*, 2020; Thomas *et al.*, 2021), as well as differential access to fisheries resources including capital, gear, and fishing grounds (Wosu, 2019).

> *The intertidal zone is for women, the coral reef is for men. Shells are for women, fish are for men.*
>
> *(Siar, 2003)*

Mirroring the gender data gaps in small-scale fisheries employment data, how fishing and fishers are defined and valued often renders women invisible (Kleiber, Harris and Vincent, 2014; Smith and Basurto, 2019). Boat-based, gear-driven fishing activities that are income-earning and full time are often elevated in data collection and policy priorities, precisely overlooking the contribution of women and other marginalized groups (Kleiber, Harris and Vincent, 2015; Thorpe *et al.*, 2014; Williams, 2015). Taken together, this leads to women's fishing contributions being largely unaccounted for in official fisheries data (Harper *et al.*, 2017). Moreover, from an environmental perspective, this also results in underestimations of catch volume and species targeted, as well as the habitat impacts of women's fishing activities (Harper *et al.*, 2020; Kleiber, Harris and Vincent, 2014).

[28] See Chapter 5 for more detail on these estimates.

> *Gleaning shellfish is women's major fishing activity because it can be done close to home, takes relatively little time, requires no costly fishing equipment and may be done in the company of children.*
>
> *(Tekanene, 2006)*

6.4.1 Fishing methods and gear used

The CCS data on fishing methods, effort, catch volume and species caught were not gender-disaggregated because it was assumed the data were not likely to be available. However, the data on women's fisheries in the foot fisheries[29] category was used as a proxy, as previous work has found women are more numerous in these fisheries (Kleiber, Harris and Vincent, 2015; see Table 6.1). Foot fisheries include gleaning or gathering activities in coastal and inland shoreline habitats carried out with tools such as poles and hooks, but often just hands and feet, as well as those carried out from the shore using nets or lines, and sometimes traps.

As explained above, the biases in data collection processes mean that foot fishing was likely under-reported in the CCS data, highlighting the scarcity of data on these fisheries, particularly in existing small-scale fisheries management systems. Of the 58 CCS included in this chapter, 17 provided data on foot fisheries. Drawing on information from the gender advisors, and from the broader gender and fisheries literature, an additional 20 CCS were found with some evidence of foot fishing that was not specifically captured in the datasets. For example, in Madagascar, all fisheries listed in the CCS data were classified as vessel fisheries, which overlooks the gleaning fisheries that have been documented in smaller studies, which are harder to access and extrapolate from (L. Robson, 2019, Gender Advisor, Madagascar). For a further 15 CCS, the data did not provide details that allowed for distinctions between vessel and foot fisheries, even though both are likely to occur. For example, in Kiribati the type of fishing was not characterized, but there is literature that documents gleaning fisheries there and in 11 other large ocean states in the Pacific (Kronen and Vunisea, 2009).

Women-dominated fishing methods and gear, such as foraging by hand, hand nets or beach seines, do not often involve a boat or other expensive gear, while fisheries dominated by men, such as longline and trolling, require boats and often a considerable investment in gear (Figure 6.4). Women and men's gear use overlaps considerably, but as explained by one gender advisor, "most of the fishing methods done by women are also done by men; however, there are fishing methods that are exclusively used by men" (A. Ferrer, 2019, Gender Advisor, the Philippines). Some of the method categories used can hide gender distinctions. For example, divers and gleaners often use similar tools such as hands, spears, claps and/or tongs, and they may even fish in the same intertidal habitat: some during high tide, others at low tide. In other cases, the same gear can be used differently by women and men, with different ecological impacts. For example, mosquito nets are used by both women and men in Mozambique, but modifications to the nets, and the methods used to deploy them, make men's fishing practices more likely to result in ecological damage (Short *et al.*, 2020).[30]

6.4.2 Fishing habitats

Women tend to fish in nearshore habitats such as estuaries, mangroves and intertidal areas, while men dominate offshore fishing habitats (Figure 6.5). As with fishing methods, there is considerable overlap and variation in habitat use between men and women. "Culturally, where women [are] allowed to participate in fishing, they are confined to fish in nearshore or shallow waters of rivers, lagoons, lakes, etc." (K. Fakoya, 2019, Gender Advisor, Nigeria), while "men utilize the whole seascape" (S. Fröcklin, 2019, Gender Advisor, United Republic of Tanzania). However, in some countries such as Fiji, cultural shifts have enabled women to fish in a wider range of habitats, target a wider diversity of species, use boats to fish, and transport fish to market to supplement household income (Thomas *et al.*, 2021, 2020).

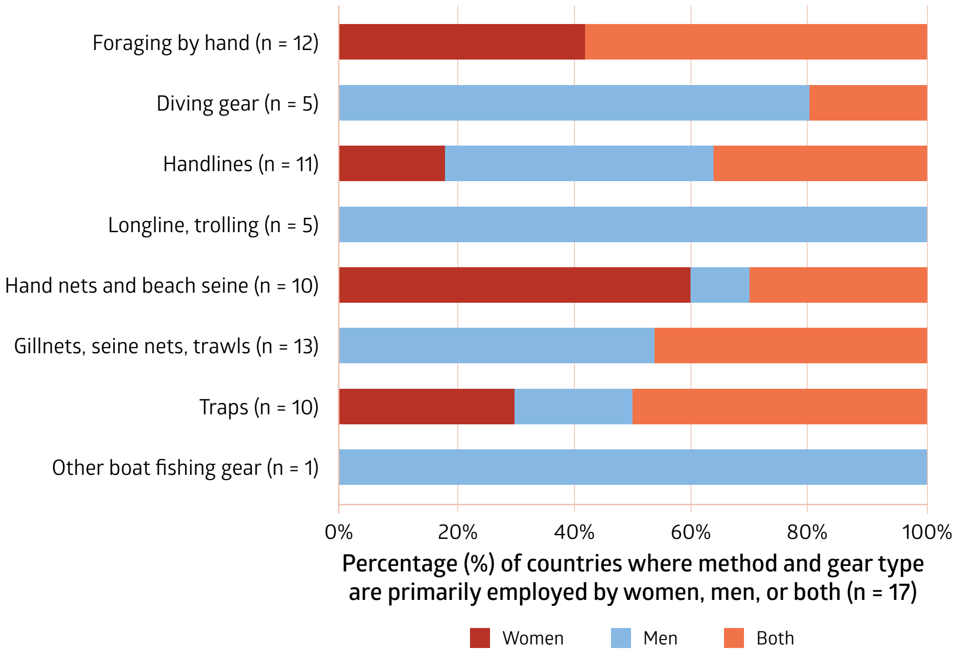
6.4.3 Species harvested

From the information gathered through the CCS, men appear to dominate finfish and arthropod (i.e. crab, lobster and shrimp) fisheries, while women dominate bivalve and gastropod fisheries (Figure 6.6). These gender differences are closely linked to where and how women and men fish, and how these overlap with the availability of aquatic species. The resulting differences in access to various species can in turn shape how women and men benefit from their fishing activities. For example, in the United Republic of Tanzania, Zanzibar, sea cucumbers are highly targeted by both men and women; however, all the species of sea cucumber with high market value are fished and sold by men (Eriksson *et al.*, 2010; Eriksson, de la Torre-Castro and Olsson, 2012). In other contexts, such as the Central Philippines, the species targeted by women (such as shellfish) have the lowest economic value at one-fifth the value of fish, and almost one-tenth the value of crab and shrimp (Kleiber, 2014).

[29] Defined in this case as fisheries where the activity is done on foot, without the use of boats. It therefore includes but is not limited to activities such as those in coastal and inland fisheries in India, where women use their feet to gather clams or feel for fish.

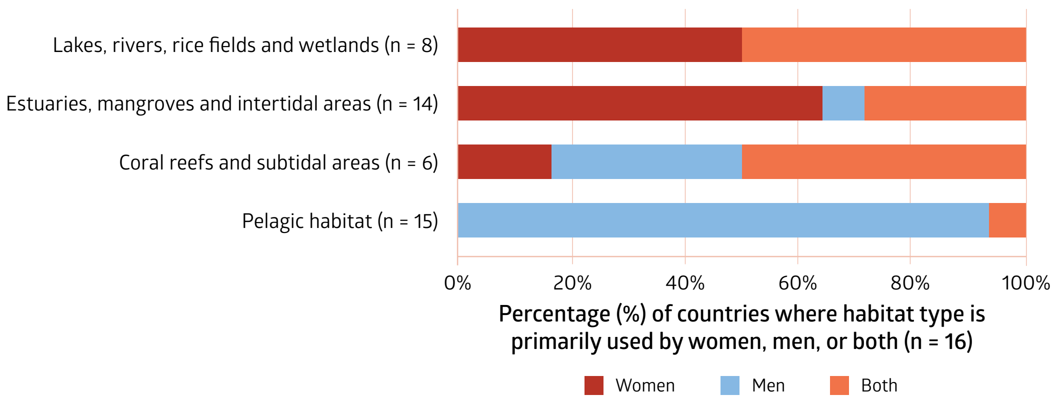
[30] Women's fishing methods, such as gleaning by walking on reef flats, may also cause ecological damage, so it should not be assumed that ecological damage is gendered.

Figure 6.4 Fishing gear used by women and men in 17 IHH country and territory case studies in 2020, by eight gear categories



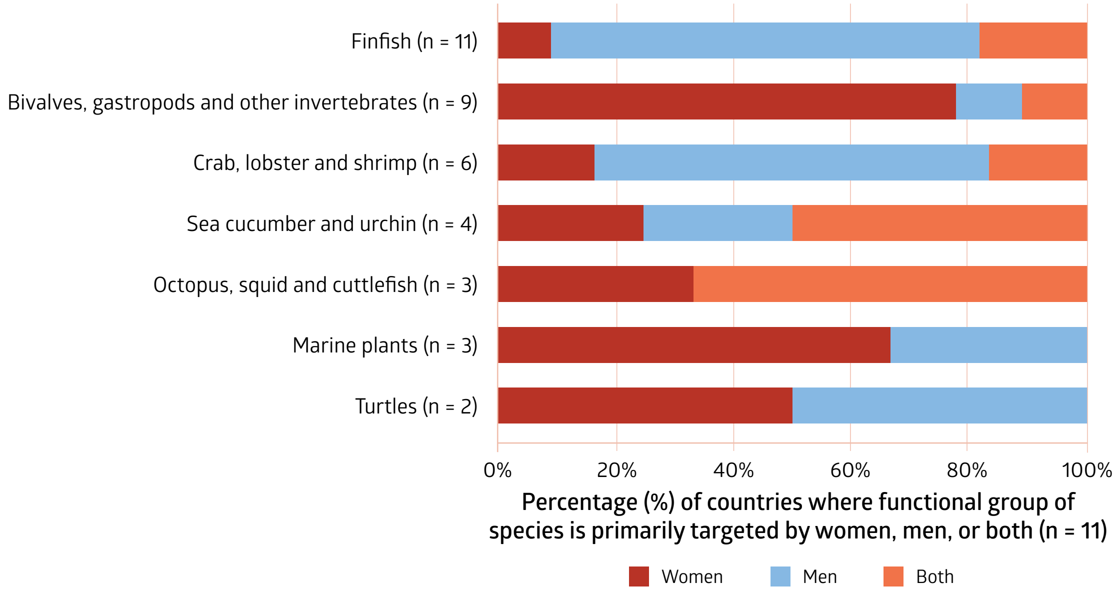
Notes: The sample size for each gear category is the number of countries with gender-disaggregated data on gear use. The information presented here was provided by IHH gender advisors.

Figure 6.5 Fishing habitats used by women and men in 16 IHH country and territory case studies in 2020, by four habitat categories



Notes: The sample size for each habitat category is the number of countries with gender-disaggregated data on fishing habitat. The information presented here was provided by IHH gender advisors

Figure 6.6 Species primarily fished by women and men in 11 IHH country and territory case studies in 2020, by seven functional groups of species



Notes: The sample size for each functional group is the number of countries with gender-disaggregated data on fished species. The information presented here was provided by IHH gender advisors.

6.5 Beyond gender in understanding access to nutritional benefits of small-scale fisheries

Access to small-scale fisheries is not evenly distributed, and a lack of attention to gender and other identity factors in fisheries policy and practice may perpetuate such inequality (Ferguson, 2021). This section provides insights for understanding how social differences influence who has access to – and who subsequently benefits from – small-scale fisheries, illuminating the need to go beyond gender and focus on other aspects of identity when gathering data on small-scale fisheries actors and beneficiaries.

6.5.1 Nutritional benefits from small-scale fisheries

"Hidden hunger" refers to a deficiency in micronutrients often found among women of reproductive age and children under the age of five (O'Meara *et al.*, 2021). The nutritional value of fish, whether obtained from small-scale fisheries or other sources, plays a crucial role in addressing this hunger (see Chapter 7 on nutrition), especially for certain regions of the world (FAO, 2020d; Thilsted *et al.*, 2016) and certain populations (Bennett *et al.*, 2018). Women during certain life stages and young children experience greater nutritional needs than men, yet have insufficient access to fish from which to obtain these vital nutrients (O'Meara *et al.*, 2021), and this can have ripple effects across generations. Some evidence highlighted in this study by the gender advisor for Nigeria indicates that, "compared to women, men characteristically derive more nutritional benefits [from small-scale fisheries] because they are served the greatest portion of the fish in the household" (K. Fakoya, 2020, Gender Advisor, Nigeria), a finding that is in line with an earlier study of intrahousehold fish consumption and distribution in the country (Gomma and Rana, 2007). Previous work has highlighted the variation in nutrient content of fish and aquatic foods (FAO, 2020d), and now there is increased focus on equity issues and access to aquatic foods (Blue Food Assessment, 2021b; Hicks *et al.*, 2019). However, there is still a lack of data on access to the food security and nutritional benefits of small-scale fisheries disaggregated by gender and other identity factors, data which are paramount for developing targeted programmes that can improve women's access to these critical benefits.

6.5.2 Beyond gender in understanding differential access to small-scale fisheries benefits

Insights shared by gender advisors from 17 CCS suggest that access to small-scale fisheries is influenced by gender but also by intersecting identity factors, such as ownership of capital, land or equipment; age; class; ethnicity; education; kinship ties, social networks or cooperative membership; marital status; migration status; religion; and indigenous identity. These factors vary greatly across contexts. For example, in the Gambia, class, ethnicity, marital status, migration status and age are highly relevant in shaping access to fisheries opportunities and their associated benefits (A. Fent, 2020, Gender Advisor, the Gambia). Likewise in coastal Kenya (Matsue, Daw and Garrett, 2014) and Lake Victoria (Medard, 2012), marital status is a factor in employment, as seen in the high proportion of female fish processors who are single, divorced or widowed. In Malawi, less-educated, resource-poor women fish traders are concentrated in smaller rural markets and face greater barriers to obtaining fish (Nagoli, Binauli and Chijere, 2018). Similarly, in Bangladesh, Muslim women fishers from wetland regions have inferior access to semi-urban markets than Hindu women fishers from the coast (Deb, Emdad Haque and Thompson, 2015). Furthermore, a high proportion (80 percent) of marine and inland catch in small-scale fisheries is mediated by licensing (see Chapter 8 on governance), which requires fishers to navigate bureaucratic processes where gendered roles and responsibilities in many cases put women, and especially certain groups of women, at a disadvantage for gaining recognition as small-scale fishers while also fulfilling their domestic responsibilities. In these cases, membership in fisheries organizations may be a critical entry point for overcoming barriers to access.

Taken together, these insights reinforce the need to explore gender further and beyond to understand the multiple, overlapping and compounding factors that differentiate people's abilities to participate in and benefit from small-scale fisheries, including the potential for small-scale fisheries to support food security, and especially to prevent further marginalization of those already at risk of malnutrition.

6.6 Women in small-scale fisheries governance

> *"[W]omen have not had a strong voice in fisheries management and governance, but not for lack of trying."*
>
> *(H. Hapke, Gender Advisor for India, personal communication, 2019)*

As seen in this study, women's access to small-scale fisheries decision-making forums is often limited. The number of women and men participating in decision-making and governing institutions is not often tracked. The IHH governance cluster (see Section A.1.2.3 in Annex A) documented 707 fisheries civil society organizations (CSOs), of which 127 (18 percent) provided gender-disaggregated data on leadership or membership (see Chapter 8). Among these 127, the proportion of women members ranged from < 1 percent to 100 percent (mean = 44 percent, median = 35 percent). However, it may be that gender-disaggregated data is more likely to be collected in institutions that are more gender-inclusive, meaning that these CSOs may not be representative of the other 580 that did not provide gender-disaggregated data.

This study only found a very small amount of quantitative gender-disaggregated data on the representation of women as leaders and members of small-scale fisheries organizations. However, the IHH gender advisors were able to provide qualitative information on the barriers to women's participation as well as their agency in decision-making processes.

At the national level, five of the gender advisors found strong engagement from women in small-scale fisheries governance. In the Philippines, Saint Vincent and the Grenadines, and Spain, women occupy 46–70 percent of national and regional fisheries leadership positions. While no numbers were available for Greenland, "women play a majority role in the management of fisheries and their governments" (H. Snyder, 2019, Gender Advisor, Greenland), which reflects the over-representation of women in Greenland government positions overall. In Peru, women's participation was also described as extensive.

At the subnational organizational scale, numbers from Malawi (43 percent women) also indicate significant levels of participation from women in governance. Likewise, in Nigeria and Ghana women's involvement is concentrated in post-harvest organizations, where they dominate (Aduomih, 2019; Akintola and Fakoya, 2017; Bilecki, Torell and Owusu, 2015). However, in Senegal, women's inclusion in the Local Artisanal Fishery Councils is limited because women's roles, and thereby their right to leadership representation, are limited to the post-harvest segment (USAID, 2017), illustrating that strong representation of women in one segment does not necessarily translate into overall inclusion in small-scale fisheries decision-making overall.

The gender advisors identified several access barriers for women in small-scale fisheries governance. First is the assumption that women do not fish, and are therefore at best peripheral stakeholders in fisheries governance (C. Pedroza, 2019, Gender Advisor, Mexico). This is then reflected in male-dominated fisheries organizations and further reinforced by development policies that are narrowly focused on fisheries production (N. Gopal and H. Hapke, 2019, Gender Advisors, India). Additionally, social and cultural norms can suppress women's voices and hinder their active participation (A. Choudhury, 2019, Gender Advisor, Bangladesh), making it more difficult for them to have an influence on patriarchal systems (S. Mangubhai, 2019, Gender Advisor, Fiji).

In the cases where women are engaged in management and governance processes, this is often in a limited capacity. In Bangladesh, a gender focal point has been appointed to each ministry, but this role does not have decision-making power (A. Choudhury, 2019, Gender Advisor, Bangladesh). Similarly, in Mexico, there are women researchers in the national fisheries institute, but very few in decision-making positions (C. Pedroza, 2019, Gender Advisor, Mexico). Even women who do occupy leadership positions may not have the ability or interest to prioritize policies that support women's involvement in fisheries (J.L. Johnson, 2020, Gender Advisor, Uganda). The lack of women's participation in governance was also noted in Madagascar, where women are peripheral in decision-making processes, and management measures effectively deny them access to their fisheries (Baker-Médard, 2017).

6.6.1 Gender in fisheries policies and implementation

In this study, 17 gender advisors described how gender was included in their national fisheries policies. Of those, nine advisors reported having fisheries policies that were gender-blind, meaning that gender was not mentioned in any way in the document. Gender-blind fisheries policies often are not gender-neutral in their effect on women and men. In many cases this is due to the fisheries that are included under the purview of a given fisheries policy, as some leave out sectors where women most often work (see Chapter 8). For example, in Brazil, unemployment benefits are only given to those who fish, and do not include "fishing support activities" such as fish processing, where women tend to work (L. Hellebrandt, 2019, Gender Advisor, Brazil). This exclusion of women's activities from the scope of fisheries rights and regulations has direct impacts on the benefits women receive. For example, previously in France, women's informal contributions to fisheries, such as administration, repairing fishing gear and selling fish, did not accrue the same state benefits as fishing (Frangoudes and Keromnes, 2008). This was then changed by the Collaborative Spouse Status Act, and women engaged in these activities are now eligible to receive the same retirement benefits as the men who fish. Norway offers another example, where policies to allow for younger entrants into the quota system effectively eliminate women, because women are less likely to have the capital to buy boats until they are too old to meet the age requirements (Gerrard and Kleiber, 2019).

Gender-blind policies can also reinforce a status quo of exclusion. For example, in Mexico, by law women and men have the same rights, but the national fisheries policies are gender-blind, and hence do not include language on gender equity. In many cases men use this omission of gender equity language to exclude women from fishing and governance activities (C. Pedroza, 2019, Gender Advisor, Mexico). In Nigeria, while there is no gender policy specifically

for fisheries, policies targeting women in fisheries are embedded in broader agriculture and food production sectors, such as the Women in Agriculture policy responsible for extension and advisory services. However, these interventions have focused mainly on the post-harvest activities that are assumed to fulfil women's needs. Hence this has only reinforced the status quo of women remaining in their traditional roles and socially acceptable domains, such as that of the household (Fakoya, 2020).

Three gender advisors reported having national fisheries policy documents that included the words "gender" and/or "women", but that failed to provide – and further mandate – for inclusion or equity. For example, in Uganda, the national fisheries policy mentions women six times but only in generalities, as a nod to their needed inclusion. Moreover, the policy does not include any clear guidance as to what is meant by inclusion, nor how it should be achieved (J.L. Johnson, 2019, Gender Advisor, Uganda). This reflects a pattern also found in the Pacific Region where integration of gender commitments within national-scale fisheries policies tends to be diluted, tokenistic and largely aspirational (Lawless *et al.,* 2021).

The remaining five gender advisors reported having national fisheries policies that included language that addresses gender equity or equality. For example, Bangladesh's Department of Fisheries 2006 National Fisheries Strategy has a subsection devoted to gender, and outlines strategies such as targeting women for training and fisheries development opportunities, and in the collection of gender-disaggregated data. In Malawi, the overall government policy aims to include women, youth and men in all spheres of work without any discrimination (Manyungwa, Hara and Chimatiro, 2019). This is reflected in the Department of Fisheries policy, where one priority area is to increase focus on social development and decent employment in small-scale fisheries as well as promote gender equality as a prerequisite for the socioeconomic improvement and empowerment of small-scale fishing communities (Government of Malawi, 2016). In India, the National Policy on Marine Fisheries is the first fisheries-related instrument to make note of gender equity (N. Gopal, 2019, Gender Advisor, India). Finally, in Spain, some local-level policies, such as in Galicia, include artisanal fisheries regulations that are more gender-inclusive, with instruments to address gender violence, reach gender balance, and prioritize access of women to under-represented fishing practices (D. Salgueiro Otero, 2019, Gender Advisor, Spain).

Even in cases where policies address gender equity and equality, systemic and institutional barriers to implementation typically remain (Mangubhai and Lawless, 2021). For example, in Ghana and Malawi, gender strategies and policies have been unable to contend with larger systems of gender inequity. Malawian women do not own assets such as boats, engines and fishing gear, which is largely a result of unequal inheritance and legal rights – even on assets owned by their male relatives (Nagoli, Binauli and Chijere, 2018).

6.7 Committing to gender inclusivity and equality in small-scale fisheries

6.7.1 Moving away from gender-blind approaches to small-scale fisheries

As illustrated in this study, gender-disaggregated fisheries data are still rare, especially in official national-level statistics. Data collection methods are commonly gender-blind or gender-biased, which tends to overlook the contributions of women (Kleiber, Harris and Vincent, 2015). In turn this leads to policies, programmes and management being designed with only men's experiences and roles in mind. For data collection to accurately represent the experiences of the millions of people (men, women and children) involved in and/or dependent on small-scale fisheries, specific, targeted categories are required. The ways in which fisheries activities and workers are defined is critical, as these directly influence where future efforts, energy and resources are to be focused. "Without the right categories, the right data can't be collected. And increasingly, without the right data, there can be no social change" (D'Ignazio and Klein, 2020). The lack of gender-disaggregated data limits opportunities to improve livelihoods, food security and nutrition, and agency in governance, resulting in gender inequalities becoming more deeply entrenched or widened. To advance gender equality and counteract the structural devaluation of women and their contributions, knowledge and priorities, a foundational shift is required to acknowledge and value all small-scale fisheries actors and their management needs.

6.7.2 Reframing small-scale fisheries to include all activities and actors

Using labour force surveys and household income and expenditure surveys from 78 countries, this study found that 44.7 million women worldwide participate in small-scale fisheries value chains or subsistence activities (Table 6.2), representing 39.6 percent of the total number of people employed or engaged in the subsector. The study approach highlighted aspects of small-scale fisheries that are less visible, such as foot fishing and informal trade, which are also dominated by women. In focusing on these activities, the study has helped to rebalance commonly skewed national views of fisheries and food systems so that they include all activities and actors, both women and men. This is a needed precursor to other, deeper changes that would progress gender equality, as is called for by the SSF Guidelines and SDG 5.

6.7.3 Embracing gender-inclusive approaches throughout all dimensions of small-scale fisheries

Prioritizing gender equality in fisheries not only changes how fisheries are understood (e.g. which activities are important, who contributes, who benefits, who gets to make decisions), it also changes how fisheries institutions, research and actions are shaped. This requires acknowledgement of and engagement with existing power structures that currently reinforce the status quo, including gender-blind approaches to small-scale fisheries (Figure 6.2). The shift to a gender-inclusive approach (Figure 6.3) is fundamental to operationalizing the human rights-centred vision of the SSF Guidelines, which provides a leading example of how strong integration of SDG 5 (Gender equality) with all other SDGs is required for the equitable governance of natural resources. While there is no single or "correct" entry point for this shift, several key actions are outlined below that are necessary in making the transition. If acted upon, these actions would accelerate meaningful progress towards gender equality in small-scale fisheries, as articulated in the SSF Guidelines and SDG 5.

1. Start with gender disaggregation as a minimum requirement. The quest to understand the full scope and value of small-scale fisheries is inextricably linked to efforts to uncover, catalogue and quantify the contributions of women and men in this subsector. Gender-disaggregated data is a minimum requirement for quality, complete data, as is recognized in the SSF Guidelines (FAO, 2015). This minimum requirement was reinforced in 2021 by the FAO Committee on Fisheries, which "reaffirmed the importance of FAO's role in collecting, analysing and disseminating statistics on fisheries and aquaculture, including gender-disaggregated data when possible, and requested FAO to inform Members on additional needs to improve data collection systems, in particular for small-scale and artisanal fisheries and aquaculture" (FAO, 2021d). However, gender-disaggregated data are not sufficient to explain the patterns that emerge in how men and women contribute to and benefit from small-scale fisheries. Deeper gender research is also required to identify the (frequently invisible) norms, relations and beliefs held by individuals and societies that constrain or enable women and men differently, including the ability to access, participate in and benefit from fisheries and the management thereof (Lawless *et al.,* 2019; Wosu, 2019). To understand these gendered patterns there is a need to dig deeper into invisible "rules of play". This will require the collection of qualitative data that is sensitive to local circumstances, using standardized but flexible protocols and purposive sampling techniques, and designed and adapted locally by gender experts (Locke *et al.,* 2017). Research approaches should also specifically identify access barriers to resources and governance structures that women and men face along the fisheries value chain (Cole *et al.,* 2020; Kaminski *et al.,* 2020).

2. Re-evaluate how small-scale fisheries are characterized and studied. To ensure that all types of fishing activities are captured in data collection and monitoring processes, it is important to include fishing methods or gear (including foot fishing) that women typically employ (Kleiber, Harris and Vincent, 2015; Kronen and Vunisea, 2009). Likewise, sampling should include the entire fisheries value chain and subsistence activities, which requires the quantification of all pre- and post-harvest segments and activities, whether these are paid or unpaid (Harper *et al.,* 2020). Accordingly, this chapter has highlighted those fisheries activities and actors that are usually hidden from policy- and decision-makers. Yet more work is still needed to uncover the full extent of the employment and subsistence activities involved in small-scale fisheries, including care work, which will require inclusive data sampling strategies in order to succeed. For example, local knowledge should be included in the research design process so that survey questions use correct terminology, and both women and men should be surveyed to prevent gender-biased data collection. In addition, to ensure both women and men are comfortable providing information, both need to be trained as data collectors (Adeokun and Adereti, 2003). Other inclusive data sampling strategies include collecting data from randomly selected individuals or households (again being careful not to only ask men), and discussing with women and men the nature of their pre-, post- and harvesting activities to inform sampling strategy design (i.e. survey timing, respondents, geographics).

3. Enhance capacity for gender-inclusive small-scale fisheries data collection and analysis. While commitments to gender equality and the empowerment of women are increasing (e.g. within the SSF Guidelines and in national fisheries policies), actual gender-inclusive practices within fisheries institutions and organizations remain limited. In order to provide an enabling environment for impactful actions on gender equity and equality, the gender capacity gaps in the institutions and agencies tasked with the management of small-scale fisheries (at multiple scales of governance) need to be addressed, especially in the data collection process. The integration of gender throughout this process requires buy-in and support from the entire institution. Having requirements that all research involving humans include a gender analysis is one way to accomplish this, but this also requires monitoring to verify those requirements are being met. Progress on developing capacity and on commitments to advancing gender equality should be assessed through gender audits that employ institutional reflexivity exercises and processes (Danielsen *et al.,* 2018). For example, the IHH study recorded the gender of its research team, helping to inform improvements on future processes (see Chapter 8). Furthermore, to support the integration of gender into small-scale fisheries research and management, gender experts (both women and men) should be included as part of research, management and practitioner teams. Women hired in other roles (fisheries scientists, economists, etc.) should not be expected to be gender experts, and gender experts should not be expected to focus on internal equity issues. Furthermore, it is essential that these experts be hired at a level where they have enough authority within the organization to successfully advocate for gender inclusion in research.

4. Develop policies and actions that are guided by the ultimate goal of gender equity and equality, as articulated by the SSF Guidelines (FAO, 2017b; Kleiber *et al.,* 2017). The urgency for understanding and addressing gender within the small-scale fisheries subsector is reinforced by commitments made in international, national or subnational policies. Policies that do not mention women or gender at all may still have disproportionate impacts on women or men. Gender-inclusive policy, on the other hand, sets clear priorities and goals for gender equity and equality in terms of the governance and livelihood aspects of small-scale fisheries. This kind of policy aligns with human rights-based approaches, as seen in the SSF Guidelines (FAO, 2015) as well as regional policy guidelines (SEAFDEC, 2018). Ensuring that policies are inclusive and reflect a shift towards greater equity and equality requires clear commitments, principles and strategies. Hence gender equity and equality needs to be made an explicit goal in policy and/or activity design, implementation and evaluation (CGIAR, 2017). Otherwise, there is a risk that gender-inclusive policy will only be considered important if it furthers other goals (Lawless *et al.,* 2021), or that women's inclusion will be compartmentalized – and then ignored. Moreover, making the goal of gender equity and equality explicit increases the likelihood of implementing the necessary actions, strategies and monitoring needed to achieve it.

Required citation for this chapter:

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7.

Contributions of small-scale fisheries to food security and nutrition

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7.1 Key findings and messages

Contributions of small-scale fisheries to nutrition

- The nutrient potential of fish is measured as the sum of the nutrients contained in the catch at the time of landing. In the IHH study the concentrations of iron, zinc, calcium, vitamin A, selenium and omega-3 fatty acids in each functional group of fish were investigated. Understanding nutrient potential provides an important new method to assess the impacts of fisheries policy on nutrition outcomes.

- The analyses used publicly accessible databases and novel methods of predictive modelling to estimate the nutrient potential of global inland and marine fisheries catches.

- While all fish are highly nutritious, the most nutritious species from both inland and marine fisheries are small (< 25 cm body length), pelagic species. For adult women, a 100 g portion of small fish provides on average 26 percent of the recommended nutrient intake (RNI) for calcium and 72 percent of RNI for omega-3 fatty acids, while a 100 g serving of large fish on average provides 12 percent and 51 percent, respectively, for the same nutrients.

- Fish species harvested by large- and small-scale fisheries contain similar quantities of most nutrients, although the average catch from large-scale fisheries contains 25 percent more omega-3 fatty acids than that of small-scale fisheries. This may reflect the relatively high latitude and deep-water focus of large-scale fisheries, where species tend to be richer in omega-3 fatty acids.

- Finfish catches from small-scale fisheries in all regions (but less so in Europe) can play an important role in addressing known nutrient deficiencies. For example, the finfish catch from small-scale fisheries in Africa has the potential to contribute the equivalent of 20 percent of RNI of calcium, selenium, zinc and omega-3 fatty acids to over 50 percent of women (137.0 million) of reproductive age. In Asia, where calcium intakes are estimated to be well below requirements, finfish catch has the potential to contribute the equivalent of 20 percent of RNI of calcium for 25.2 percent of women (271.0 million) of reproductive age.

- Country and territory case studies from Lake Victoria found that a serving of small indigenous *dagaa* (*Rastrineobola argentea*) contains six times the calcium, twice as much iron, three times more zinc, four times more vitamin A and twice the omega-3 fatty acids as an equivalent serving of the introduced Nile perch (*Lates niloticus*).

Loss of fish quality and quantity from inadequate handling, processing and storage frequently reduces the contributions of small-scale fisheries to food security and nutrition. The introduction of appropriate food safety standards and education programmes for fishers, fishworkers and households would contribute to improved nutrition and livelihoods.

Small-scale fisheries and physical and economic access to food: new insights in sub-Saharan Africa

- An analysis of World Bank Living Standards Measurement Study data from the African Great Lakes region found that households living close to small-scale fisheries, and engaging in these fisheries, were less likely to be income-poor (down by 9–15 percent); had increased fish consumption (about twice as often per week and up to three times as much); and had higher rates of household food security (up by 12.6 percent).
- Proximity to small-scale fisheries is also associated with lower inequality in fish consumption (i.e. between wealthy and poor households), by an average of 30 percent. Dried fish is more important to the diets of rural households (by a factor of 1.3 to 1.8) compared to urban households) and those living far from fishing grounds.

Small-scale fisheries and fish consumption during the first 1 000 days of life

- The first 1 000 days of life (from conception to 2 years of age) represent a critical window of child development, when children and their mothers require a nutrient-rich diet to ensure proper growth.
- Proximity to small-scale fisheries increases access to fresh fish by a factor of up to 13 and increases dietary diversity in children. Moreover, small-scale fisheries are an important source of nutrient-rich foods for rural children from 6 to 24 months of age, especially in low- and lower-middle-income countries.

Illuminating the magnitude and distribution of nutritional benefits from small-scale fisheries

- Strategies are needed to ensure the nutritional benefits from small-scale fisheries and fish products are shared across value chains to include vulnerable groups.
- Initiatives are required to ensure that the benefits to health from fish consumption by infants, children and lactating mothers are widely known and incorporated into practice in order for the nutrition benefits from small-scale fisheries within households to be optimized.

Figure 7.1 details the pathways through which small-scale fisheries can impact hunger and malnutrition.

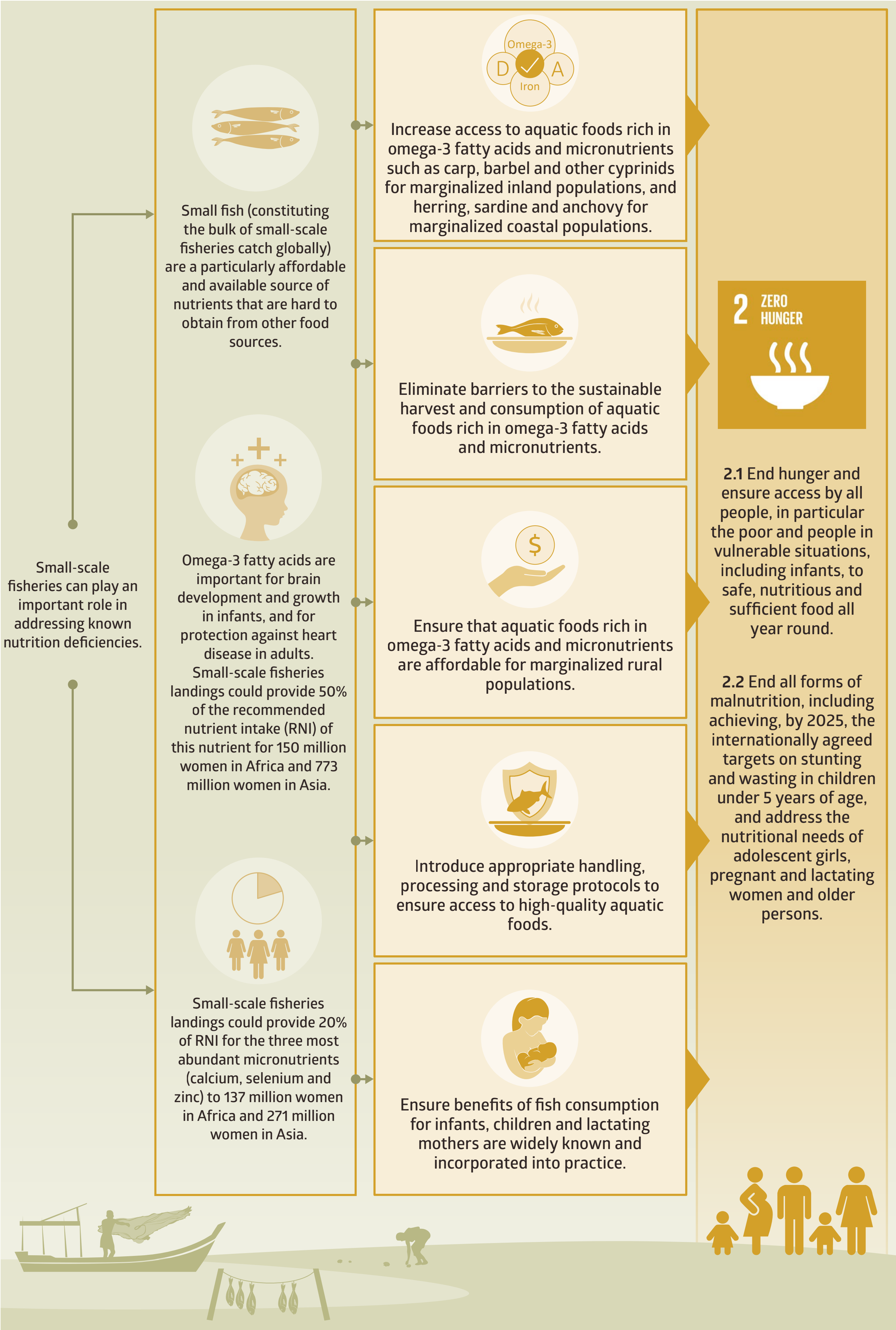
7.2 Introduction

Through a number of global agreements, including the declaration "The future we want" from the 2012 UN Conference on Sustainable Development, the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines), the 2030 Agenda for Sustainable Development (and associated Sustainable Development Goals) and others, the countries of the world have committed to eradicating hunger and improving nutrition for all. The urgency of achieving these goals is clear: an estimated 720 to 811 million people faced hunger in 2020, an increase of approximately 118 million – but possibly as high as 161 million – compared to the previous year. Considering moderate or severe food insecurity, 2.8 billion people (nearly one in three worldwide) did not have access to adequate food in 2020, representing an increase of nearly 320 million people compared to 2019. This is equal to the combined increase over the previous five years. More than half of the undernourished people in the world live in Asia, and more than one-third in Africa (FAO, 2021e).

The global and regional consequences of this food insecurity and malnutrition are profound. For example, an estimated 22 percent of children under the age of 5 were affected by stunting in 2020 and 6.7 percent by wasting, while 5.7 percent were overweight. Again, Africa and Asia accounted for a large majority of those children. Anaemia is another indicator of malnutrition, with 29.9 percent of women between 15 and 49 years of age suffering from anaemia globally (FAO, IFAD, UNICEF, WFP and WHO, 2021).

Sustainable Development Goal (SDG) 2 includes targets to end hunger, achieve food security and improve nutrition. Achieving these targets will not be possible without sustained, strengthened contributions from the aquatic foods sector, and most notably from small-scale fisheries. Accordingly, SDG Target 2.3 aims to double the productivity and incomes of small-scale food producers, including fishers. The vital role of small-scale fishers is also recognized in the SSF Guidelines, which are intended, among other purposes, "to contribute to global and national efforts towards the eradication of hunger and poverty" (Preface, FAO, 2015). Specifically, Objective 1.1a of the Guidelines aims "to enhance the contribution of small-scale fisheries to global food security and nutrition and to support the progressive realization of the right to adequate food". The recognition of this core function highlights the key role played by small-scale fisheries organizations in the development of the SSF Guidelines.

Figure 7.1 Key pathways through which small-scale fisheries can impact hunger and malnutrition



These goals and objectives reflect the fact that for millions globally, including vulnerable people and those living beyond the reach of formal markets, aquatic foods from small-scale fisheries represent a crucial and sometimes irreplaceable source of micronutrients and fatty acids needed for growth and good health. The nutritional benefits from small-scale fisheries accrue directly and indirectly. Direct nutritional benefits are realized by providing nutrient-rich food to families, either from fish eaten by members of fishing households, or from fish acquired through gift, trade or purchase. Indirect benefits accrue through economic pathways (see Chapter 5), with small-scale fisheries providing livelihoods for men and women, and thus income for them to purchase food. A better understanding of the values and functioning of these pathways is central to developing policy actions, programmes and investments that enable a sustainable and equitable future for the small-scale fisheries subsector and the livelihoods it supports. In the decade since the original Hidden Harvest report (World Bank, 2012), the global focus on the SDGs has built momentum towards transforming food systems to provide sustainable healthy diets for all. With this, strengthened efforts to highlight the importance of fish in food systems (Simmance *et al.*, 2022a; Hicks *et al.*, 2019) have spurred an increase in the quantity and quality of data on the nutritional profile of fish (Byrd *et al.*, 2021; Golden *et al.*, 2021).

This chapter leverages these new data and innovative predictive models to illuminate the global, regional and national nutritional contributions from small-scale fisheries. Where data do not yet support large-scale synthesis, a focus on certain data "bright spots" provides examples of how analysis of quality data can highlight entry points and policy directions. These illustrate where and how data and research can change to better understand the contributions of small-scale fisheries to food security and nutrition. Modifications to existing demographic, agricultural or fisheries survey systems that account for the idiosyncrasies of small-scale fisheries can substantially improve the quality and relevance of data for improved fisheries management. Specifically, the chapter focuses on the following questions:

- What is the profile of nutrients important to human health that are found in small-scale fisheries catches?
- How do small-scale fisheries provide physical and economic access to nutritious food for urban and rural people?
- How do small-scale fisheries contribute to the diets and healthy growth of rural children during their first 1 000 days of life?
- How can national fisheries information systems be improved to reflect the nutritional contributions of small-scale fisheries?

7.3 The contributions of small-scale fisheries to nutrition

7.3.1 Fish as an important source of nutrition throughout the life cycle

A new understanding has emerged over the past decade, reinforced by global efforts towards achieving the SDGs, that ending malnutrition will require just and sustainable transformations of food systems (Herrero *et al.*, 2020; Sachs *et al.*, 2019). Yet these transformations are already underway, driven by a diversity of economic, environmental and cultural factors. As small-scale fisheries have increasingly become part of a globalized food system, power imbalances have played out in ways that often do not promote or prioritize local food supply and food justice in general (Cohen *et al.*, 2019; Arthur *et al.*, 2021). Navigating the governance challenges that lie at the heart of reshaping food systems, and optimizing the contributions small-scale fisheries can make within these, will benefit from a deeper understanding of the nutrient potential of aquatic foods. Therefore, to achieve SDG targets in many regions – most notably those targets under SDG 2 (Zero hunger) – it is essential to focus research efforts on the role and function of aquatic foods within food systems, as well as tools to integrate new knowledge into policy and management practice.

Eating aquatic foods supports nutrition through all stages of human life, from foetal development during pregnancy through to adult health. Meeting SDG Target 2.2 – eliminating malnutrition in all of its forms (undernutrition, micronutrient deficiencies, overnutrition) – requires radical improvements in global dietary quality, with aquatic foods playing a significant role in sustainable healthy diets worldwide (HLPE, 2014; Willet *et al.*, 2019; Hallstrom *et al.*, 2019; UN Nutrition, 2021). While long recognized as an important source of protein, aquatic food consumption benefits human health by increasing the diversity and availability of micronutrients in diets, providing one of the few dietary sources of essential omega-3 fatty acids, and displacing consumption of less healthy ASFs such as red and processed meats (Golden *et al.*, 2021). Indeed, aquatic foods are a significant source of key micronutrients including vitamin B12, calcium, vitamin D, iodine and selenium, and of essential fatty acids in the omega-3 family (Byrd, Thilsted and Fiorella, 2020; Hicks *et al.*, 2019), as well as vitamin A, iron and zinc when fish are consumed whole (Roos, Islam and Thilsted, 2003; Hasselberg *et al.*, 2020; Aakre *et al.*, 2020; Reksten *et al.*, 2020). Fish, particularly small fish eaten whole, serve as "brain food" for babies during gestation due to the importance of essential fatty acids, iodine and iron to healthy cognitive development (Bath *et al.*, 2013). In developing countries or areas, fish consumption is associated with lower rates of stunting in children aged 6–23 months (Headey, Hirvonen and Hoddinott, 2017; Marinda *et al.*, 2018), likely due to a high concentration of growth-promoting nutrients, such as bioavailable zinc, iron and protein (Thilsted *et al.*, 2016; Byrd *et al.*, 2021). There is also strong evidence that consuming fish as part of a healthy diet is associated with reduced risk for several cardiovascular diseases (VKM, 2014; EFSA, 2014).

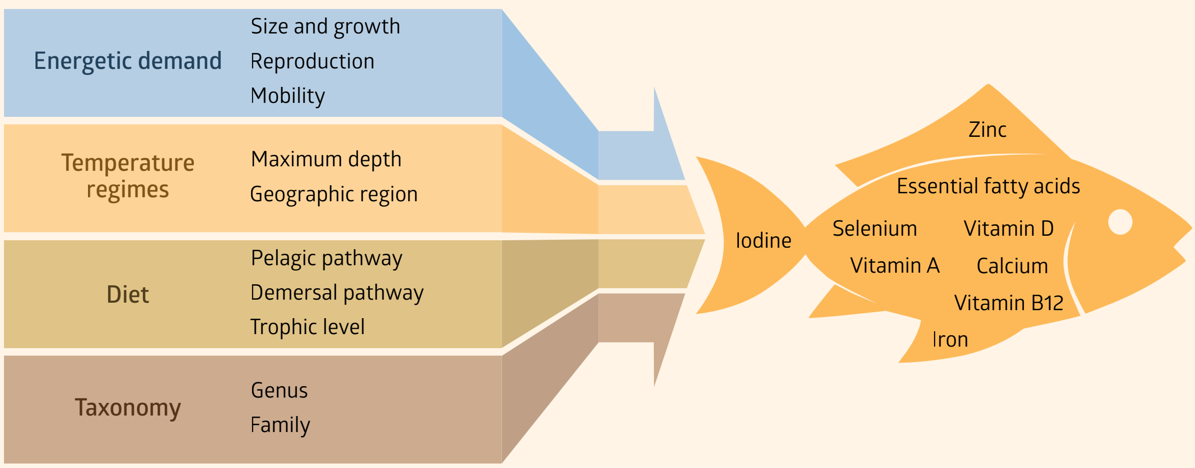
In addition to being nutrient-rich, fish is often the most accessible and affordable form of ASF (Headey and Alderman, 2019). ASFs are particularly beneficial because of the bioavailability (i.e. the potential for absorption by the body) of their nutrients. Thus, compared to plant-based foods, iron and zinc from ASFs such as fish are easier for the body to digest and absorb, making these foods optimal for addressing malnutrition (Sandström *et al.*, 1989; Michaelsen *et al.*, 2009; Sigh *et al.*, 2018). In diets in sub-Saharan Africa and Southern Asia, the most nutritious foods are small fish species, along with foods like chicken liver, beef liver, eggs and meat (Ryckman *et al.*, 2021a, 2021b). However, from this list, fish – particularly dried small fish (Kolding *et al.*, 2019; Kawarazuka, 2010; Bose and Dey, 2007) – is often the easiest to access and the most affordable.

Fish species vary greatly in terms of life strategy, life cycle, diet, habitat and body type, resulting in

Box 7.1

Predicting nutrient values of fish species

All fish are not made nutritionally equal: the composition of nutrients important to human health found in fresh fish varies based on species, season and diet. Directly analysing nutrients in fresh fish samples is prohibitively expensive, which means nutrient composition has only been determined for a small number of important fish species. In 2015, the FishNutrients initiative was begun to complement the established FAO nutrient composition database (the International Network of Food Data Systems, or INFOODS) to collate nutrient data for over five hundred fish species. Using these data, the initiative developed a statistical model[a] that predicts the nutrient composition of a species based on diet, geographic region, size, growth and taxonomy. Launched in 2021 as a function on FishBase (the world's largest online encyclopaedia of fish), the FishNutrients tool provides predictions on the nutritional composition of five thousand different finfish species. The model was first applied to understand the potential of all marine fisheries catches to address nutrient deficiencies of people living in adjacent coastal populations.[b] The integration of the model with FishBase was conducted in parallel with the IHH initiative, thus making it possible to model the nutrient potential of small-scale fisheries catch from both inland and marine waters globally.



Notes: **a** See https://github.com/mamacneil/NutrientFishbase. Based on parameters from Froese, R. & Pauly, D., eds. 2022. FishBase. Updated August 2022. https://www.fishbase.se/search.php **b** Hicks, C.C., Cohen, P.J., Graham, N.A., Nash, K.L., Allison, E.H., D'Lima, C., Mills, D.J. et al. 2019. Harnessing global fisheries to tackle micronutrient deficiencies. *Nature*, 574(7776): 95–98.

strikingly diverse nutrient profiles (Vaitla *et al.*, 2018; Hicks *et al.*, 2019). Understanding the nutrient value of different types of fish, and how each species contributes to the nutrition available from local diets, is an important step towards managing fisheries in a way that optimizes their nutritional benefits.

In this section, a new approach to predicting the nutritional value of fish species (Box 7.1) is used in conjunction with the Illuminating Hidden Harvests (IHH) small-scale fisheries catch data and regional and global extrapolations to shed light on which functional groups of species provide the greatest nutritional benefit, as well as the relative nutritional values of fish from inland, marine, small-scale and large-scale subsectors. Next, a case study of three countries in sub-Saharan Africa allows for a deeper exploration into how increased knowledge of the nutritional contribution of fish can feed into policy development and management practice. Last, key food safety issues that can greatly impact the nutritional benefits accruing from small-scale fisheries catches are outlined, and a suite of mitigation approaches highlighted. These reinforce the central message that improved nutrition outcomes from small-scale fisheries will hinge on action at multiple entry points along value chains (from catch to consumption), and that the idiosyncrasies of these value chains must be accounted for in these actions.

7.3.2 Nutrient value of inland and marine fish

This subsection investigates the concentrations of iron, zinc, calcium, vitamin A, selenium and omega-3 fatty acids in each functional group of species. A list of the nutrient functions in the body and their estimated prevalence of deficiency can be seen in Table 7.1. The most nutrient-rich functional groups (Figure 7.2) for both inland and marine fish catches are those that include small (< 25 cm total length), frequently pelagic species,
which are highly productive and often associate in large schools. These species typically feed on plankton (which are low on the food chain), with phytoplankton providing the dietary source of the omega-3 long-chain fatty acids (Gladyshev *et al.*, 2018; Shovonial, 2018) found in particularly high concentrations in these groups. The inland group of carp, barbel and other cyprinids, which includes both large- and small-sized species, had the highest overall nutrient density score, with notably high concentrations of calcium. Among marine fish, the four most nutrient-rich functional groups are also pelagics, both small and large.

Among the IHH country and territory case studies (CCS), the most nutrient-rich marine functional group of species (herring, sardine, anchovy) had a total catch over twice that of the next-largest group (scad and mackerel). Together, these groups represent around one-third of total global catch and clearly have a very high potential to contribute to global dietary nutrient intake. Notably, the habitat of the former group includes the world's largest fishery: Peru's anchoveta (*Engraulis ringens*), most of which is used for reduction to fishmeal and fish oil.

The preference for large fish species as food among consumers with greater purchasing power (Tsikliras and Polymeros, 2014), in addition to limited markets for small, inexpensive fish and the growing price of fishmeal, have all contributed to a trend of using small, relatively inexpensive fish as feed for larger farmed fish (Cashion *et al.*, 2017; Tacon and Metian, 2009). Nonetheless, these functional groups of inland and marine species remain critical to food security and nutrition in many less developed contexts, with small pelagic species often the most sustainable and nutrient-rich (Cashion *et al.*, 2017; Kolding *et al.*, 2019).

This chapter analysis found that nutrient density was higher in the flesh of small fish species from lower levels in the food chain (Figure 7.3), with higher concentrations of omega-3 fatty acids, calcium and zinc than those found in large, high-trophic species. Note, however, that this analysis is for fish flesh only. Many small fish species are eaten whole, which increases the nutrient potential substantially due to the high nutrient loads of their non-flesh components (Kawarazuka and Béné, 2011). As a result, this analysis underestimates the nutritional contributions of small-fish fisheries are underestimated in this analysis. Comparisons between marine and inland fisheries, and small- and large-scale fisheries (Figure 7.3), reveal some differences at a global spatial scale. Omega-3 fatty acids are found in higher concentrations, on average, in fish caught by marine fisheries and large-scale fisheries. Based on the nutrient models, body size is a strong predictor of omega-3 fat content of a species. The higher omega-3 content of fish from large-scale and marine fisheries is likely due to the higher proportion of small pelagic schooling fish found in these fisheries. Hence, the considerable degree of variability among individual species needs to be considered in interpreting these results.

7.3.3 Global estimates of nutritional contributions of finfish from small-scale fisheries

Regional and global estimates of finfish catch in the IHH study were made by extrapolating catches for functional groups of species from CCS to regional and global scales, and where necessary filling gaps from other data sources (see Chapter 4; Annex A).

This study marks the first time this approach has been used to measure the nutrient potential of small-scale fisheries at a global scale, and the resulting data show that this potential is substantial and regionally variable. To provide a measure that makes conceptual sense, rather than presenting nutrient yield values,

Table 7.1 Key nutrients modelled in this chapter analysis, with notes on their function and related deficiencies concerning the human body

Nutrient	Function	Prevalence of inadequate intake or deficiency
Iron	Iron is important for infant neural development and in the development of red blood cells throughout the life cycle.[a]	Anaemia in many cases is caused by iron deficiency and is a common problem plaguing many populations.[b] Globally, more than 600 million women aged 15–49 years are anaemic.[c]
Zinc	Zinc is an important component in the body's use of macro- and micronutrients and plays a central role in the immune system response.[d]	Many diets globally are predicted to be inadequate in zinc;[e] because of the role in fighting infection, zinc deficiency is a major public health concern. In 2012, an estimated 17% of the global population were at risk of inadequate zinc intake.[f]
Calcium	Calcium provides rigidity to bones and teeth and is involved in a number of cell signalling processes.[g]	Many people in low- and middle-income countries do not consume sufficient calcium to maintain homeostasis, especially during the complementary feeding period.[h] An estimated 3.5 billion people are at risk of calcium deficiency.[i]
Selenium	Selenium is important as an antioxidant and for proper thyroid functioning.j Selenium deficiencies have been associated with multiple sclerosis, cancer and reproductive disorders.[k]	Up to a billion people globally suffer from selenium deficiency, which is associated with soil chemistry unfavourable for its uptake in plants.[l] In many diets globally, fish is the main source of selenium.[m]
Vitamin A	Vitamin A plays a key role in vision and the immune system. In addition, it is essential for growth and development.[n]	While current data are scarce, estimates show that up to 22% of women in some countries have an inadequate intake of vitamin A.[o]
Omega-3 fatty acids	DHA is important for brain development during the prenatal and infancy periods,[p] and EPA has potent anti-inflammatory benefits.[q]	Global estimates of omega-3 fatty acid intakes are varied, but notably, intakes in developing countries or areas are below recommendations, especially during the complementary feeding period.[r]

Notes: Essential omega-3 fatty acids include docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA). **a** Karakochuck, C.D., Whitfield, G.T. & Kraemer, K. 2017. *The biology of the first 1000 days*. New York, USA, CRC Press; WHO & FAO. 2004. *Vitamin and mineral requirements in human nutrition*. Second edition. Geneva, Switzerland, WHO. **b** Chaparro, C.M. & Suchdev, P.S. 2019. Anemia epidemiology, pathophysiology, and etiology in low-and middle-income countries. *Annals of the New York Academy of Sciences*, 1450(1): 15–31. **c** Micha, R., Mannar, V., Afshin, A., Allemandi, L., Baker, P., Battersby, J., Bhutta, Z. *et al*. 2020. *2020 global nutrition report: action on equity to end malnutrition*. Bristol, UK, Development Initiatives. **d** WHO & FAO. 2004. *Vitamin and mineral requirements in human nutrition*. Second edition. Geneva, Switzerland, WHO. **e** Beal, T., Massiot, E., Arsenault, J.E., Smith, M.R. & Hijmans, R.J. 2017. Global trends in dietary micronutrient supplies and estimated prevalence of inadequate intakes. *PLoS ONE*, 12(4): e0175554. https://doi.org/10.1371/journal.pone.0175554 **f** Wessells, K.R. & Brown, K.H. 2012. Estimating the global prevalence of zinc deficiency: results based on zinc availability in national food supplies and the prevalence of stunting. *PLoS ONE*, 7(11): e50568. https://doi.org/10.1371/journal.pone.0050568 **g** WHO & FAO. 2004. *Vitamin and mineral requirements in human nutrition*. Second edition. Geneva, Switzerland, WHO. **h** Ferguson, E., Chege, P., Kimiywe, J., Wiesmann, D. & Hotz, C. 2015. Zinc, iron and calcium are major limiting nutrients in the complementary diets of rural Kenyan children. *Maternal & Child Nutrition*, 11(53): 6–20. **i** Kumssa, D.B., Joy, E.J., Ander, E.L., Watts, M.J., Young, S.D., Walker, S. & Broadley, M.R. 2015. Dietary calcium and zinc deficiency risks are decreasing but remain prevalent. *Scientific reports*, 5(1): 1–11. **j** WHO & FAO. 2004. *Vitamin and mineral requirements in human nutrition*. Second edition. Geneva, Switzerland, WHO. **k** El-Ramady, H., Abdalla, N., Alshaal, T., Domokos-Szabolcsy, E., Elhawat, N., Prokisch, J., Sztrik, A., Fari, M., El-Marsafawy, S. & Shams, M.S. 2015. Selenium in soils under climate change, implication for human health. *Environmental Chemistry Letters*, 13(1): 1–19. **l** Fordyce, F.M. 2013. Selenium deficiency and toxicity in the environment. In: O. Selinus, ed. *Essentials of medical geology*, pp. 375–416. Dordrecht, the Netherlands, Springer. **m** WHO & FAO. 2004. *Vitamin and mineral requirements in human nutrition*. Second edition. Geneva, Switzerland, WHO. **n** Karakochuck, C.D., Whitfield, G.T. & Kraemer, K. 2017. *The biology of the first 1000 days*. New York, USA, CRC Press; WHO & FAO. 2004. *Vitamin and mineral requirements in human nutrition*. Second edition. Geneva, Switzerland, WHO. **o** Harika, R., Faber, M., Samuel, F., Kimiywe, J., Mulugeta, A. & Eilander, A. 2017. Micronutrient status and dietary intake of iron, vitamin A, iodine, folate and zinc in women of reproductive age and pregnant women in Ethiopia, Kenya, Nigeria and South Africa: a systematic review of data from 2005 to 2015. *Nutrients*, 9(10): 1096. **p** Hibbeln, C.J.R., Spiller, P., Brenna, J.T., Golding, J., Holub, B.J., Harris, W.S., Kris-Etherton, P. *et al*. 2019. Relationships between seafood consumption during pregnancy and childhood and neurocognitive development: two systematic reviews. *Prostaglandins, Leukotrienes and Essential Fatty Acids*, 151: 14–36. **q** FAO & WHO. 2010. Fats and fatty acids in human nutrition. Proceedings of the Joint FAO/WHO Expert Consultation. November 10–14, 2008. Geneva, Switzerland. *Annals of Nutrition and Metabolism*, 55(1–3): 5–300. **r** Forsyth, S., Gautier, S. & Salem, N. Jr. 2017. Dietary intakes of arachidonic acid and docosahexaenoic acid in early life – with a special focus on complementary feeding in developing countries. *Annals of Nutrition and Metabolism*, 70(3): 217–227.

Box 7.2

Small fish species from small-scale fisheries

Many small fish species that are important for nutrition are caught primarily or exclusively by small-scale fishers. In the African Great Lakes, for example, three species are vital to meeting local nutrition needs: Rastrineobola argentea (commonly called dagaa, omena or mukene) in Lake Victoria; Engraulicypris sardella (also known as usipa) in Lake Malawi; and Limnothrissa miodon (kapenta), which is endemic to Lake Tanganyika. Kapenta has also been successfully introduced without adverse ecological effects in both natural (Lake Kivu) and human-induced (Kariba and Cahora Bassa) lakes, where it has quickly become the most important part of the catch.[a] In Southern Asia, a particularly nutrient-rich fish consumed whole is mola (Amblypharyngodon mola), which is important as an affordable source of micronutrients in Bangladesh.[b]

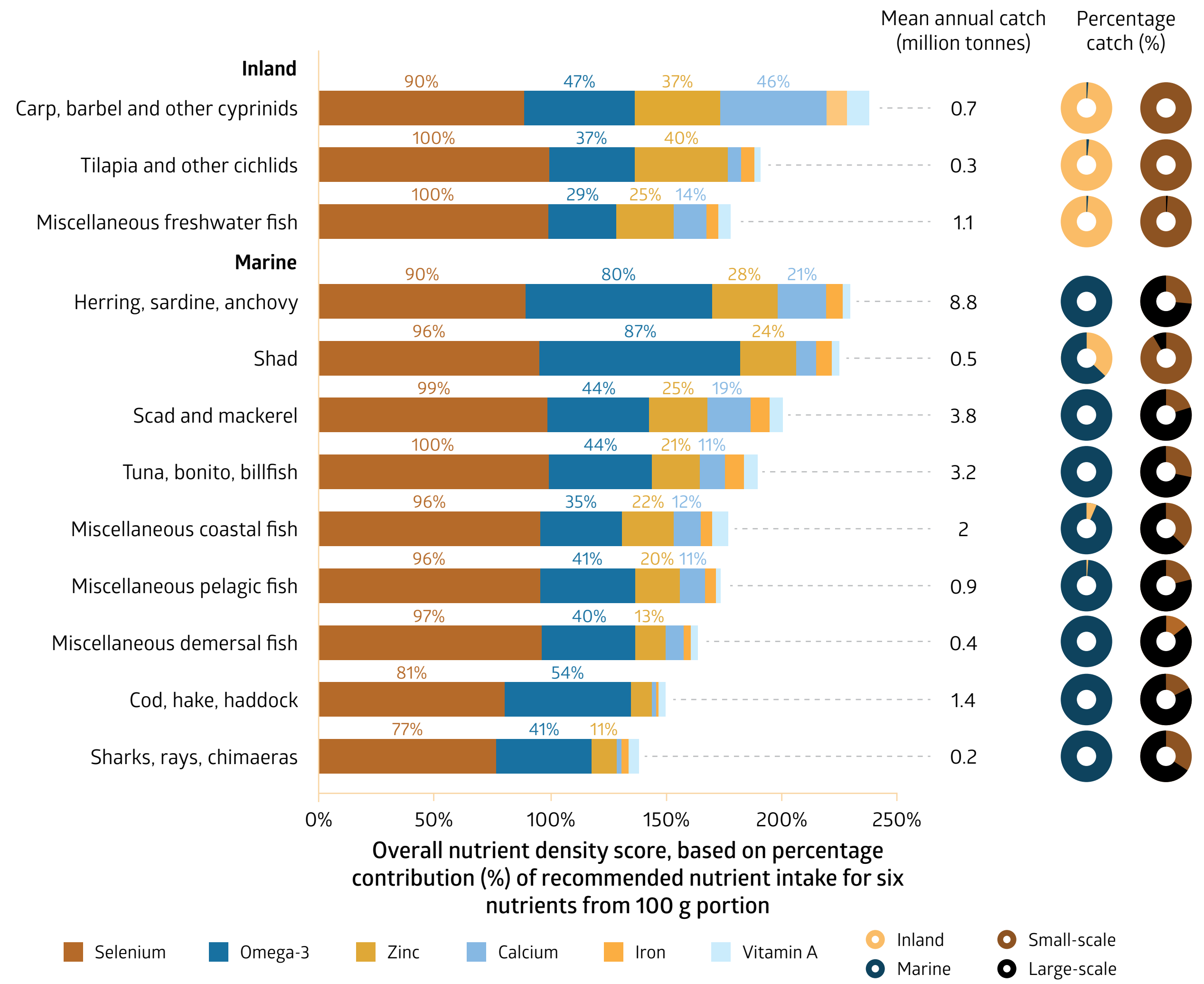
Figure *Kapenta* catch from Lake Malawi

Notes: **a** Kolding, J., van Zwieten, P., Marttin, F., Funge-Smith, S. & Poulain, F. 2019. *Freshwater small pelagic fish and their fisheries in the major African lakes and reservoirs in relation to food security and nutrition.* FAO Fisheries and Aquaculture Technical Paper No. 642. Rome, FAO. https://doi.org/10.4060/ca0843en **b** Bogard, J.R., Farook, S., Marks, G.C., Waid, J., Belton, B., Ali, M., Toufique, K., Mamun, A. & Thilsted, S.H. 2017. Higher fish but lower micronutrient intakes: temporal changes in fish consumption from capture fisheries and aquaculture in Bangladesh. *PLoS ONE,* 12(4): e0175098. https://doi.org/10.1371/journal.pone.0175098 results are presented as a percentage of the female population of reproductive age (UN, 2021a) for whom the small-scale fisheries catch would provide 20 percent of RNI for the six modelled nutrients in this chapter analysis (Table 7.2). This vulnerable group, representing about one-fifth of the global population, is a target for interventions in many development programmes focused on improving nutrition outcomes. The 20 percent level of RNI contribution was selected recognizing that fish should be promoted as part of a diverse diet, and that guidelines suggest a minimum of five food groups should be consumed to meet minimum required dietary diversity.

The results presented in Table 7.2 indicate that marine small-scale fisheries across Africa, Asia and the Americas are a potentially valuable source of the six modelled nutrients, while inland fisheries in Africa and Asia also have potential for substantial population-level contributions.

Selenium is present in high concentrations in marine catches from all regions, and in inland catches from Africa. Up to one billion people globally suffer from selenium deficiency (Fordyce, 2013). Fish can clearly play a role in addressing this deficiency, especially given concerns that selenium uptake through agriculture will decline under current climate change scenarios (Jones *et al.*, 2017).

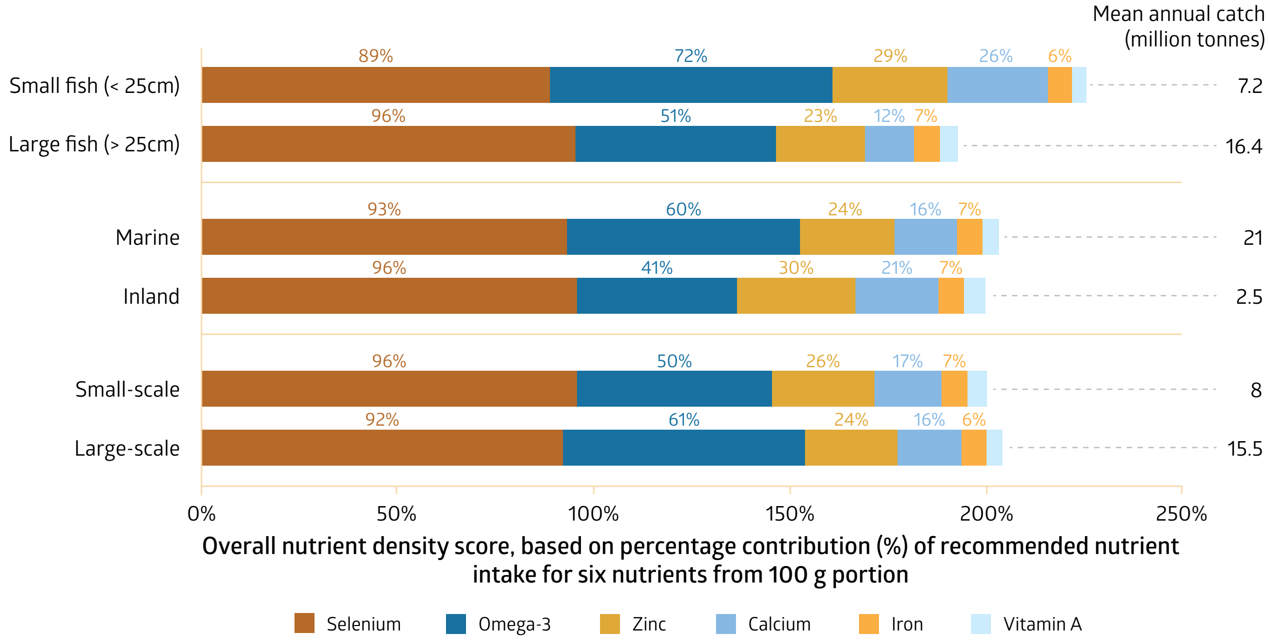
Figure 7.2 Nutritional contribution of various fish species to recommended nutrient intake, based on fisheries data from 44 IHH country and territory case studies (CCS) of least developed and other developing countries or areas



Notes: Bars show the percentage contribution of a 100 g serving of raw muscle tissue from freshwater and marine functional groups of species to recommended nutrient intake (RNI) for six nutrients for adult women. Each bar is the mean RNI contribution across all species that form each functional group, weighted by their contribution to total catch. The nutrient density score (x-axis) is the sum of the percentage contributions for the six nutrients. Where selenium contributions exceeded 100 percent of RNI, values were limited to 100 percent. To the right of each bar is the mean annual catch in millions of tonnes (million t) across all CCS for each group, with donuts indicating the relative catch proportion from marine (blue) and inland (yellow) fisheries and small- and large-scale subsectors (aqua and brown).

Sources: RNI values from WHO & FAO. 2004. *Vitamin and mineral requirements in human nutrition.* Second edition. Geneva, Switzerland, WHO; Lupton, J.R., Brooks, J.A., Butte, N.F., Caballero, B., Flatt, J.P. & Fried, S.K. 2002. *Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids*. Washington, DC, National Academies Press.

Figure 7.3 Comparison of nutrient density scores of catches by species size and fisheries subsector, based on fisheries data from 44 IHH country and territory case studies (CCS) of least developed and other developing countries or areas



Notes: Bars show the percentage contribution of functional groups of fish species to recommended nutrient intake (RNI) for six nutrients for adult women. The nutrient density score (x-axis) is the sum of the percentage contributions for the six nutrients. To the right of each bar is the mean annual catch in millions of tonnes (million t) across all CCS for each group. Note these catch figures do not represent global estimates of catch.

Sources: RNI values from WHO & FAO. 2004. *Vitamin and mineral requirements in human nutrition.* Second edition. Geneva, Switzerland, WHO; Lupton, J.R., Brooks, J.A., Butte, N.F., Caballero, B., Flatt, J.P. & Fried, S.K. 2002. *Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids.* Washington, DC, National Academies Press.

From a policy perspective, past research has shown the value of regional trade in ensuring the benefits of small-scale fisheries are shared (Béné, Lawton and Allison, 2010), but at the risk of obscuring the critical importance of fisheries operating at national and subnational scales that feed directly into local and short value chains. Notably, the low average per capita contributions from small-scale fisheries in Oceania are skewed by the high populations of Australia and New Zealand, yet small-scale fisheries still play a critical role in nutrient provision within Oceania at a subregional and national scale (see high calcium and zinc contributions for Micronesia in Figure 7.4).

Examples of selected subregional analyses for the nutritional contributions from small-scale fisheries (Figure 7.4) highlight the complex interaction between estimations of inadequate nutrient intake and nutritional contribution from small-scale fisheries. Inland fisheries from the African Great Lakes provide notably higher levels of calcium and zinc than iron and vitamin A. At this scale of subregional analysis, these four nutrients may not be found in quantities that would have a substantial impact at the scale of entire populations. Finer spatial scale analyses may tell a different story, with subpopulations heavily reliant on, and benefiting from, these nutrients. In Micronesia, where for most of the population fish is central to their diet, the high availability of zinc in aquatic foods may contribute to the correspondingly low rates of zinc deficiency. However, the analysis also shows that calcium intake is deficient in the subregion, despite the high level of calcium potentially available from aquatic foods. This raises important questions about the calcium supply from aquatic foods as well as food systems in general. The relative lack of understanding of the calcium contributions from aquatic foods may result in calcium intakes being underestimated. Given the importance of calcium for infants and children, research on intrahousehold distributions of calcium intake will also be important.

7.3.4 A "deeper dive" into African Great Lakes fisheries

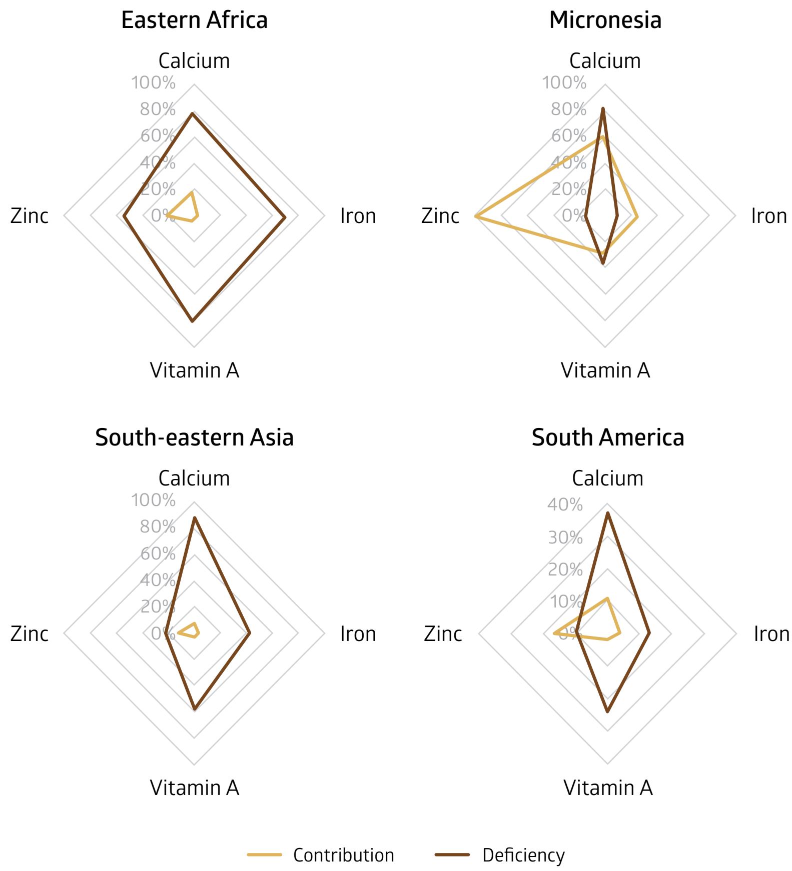
Knowledge of likely or actual changes in nutritional availability as a result of fisheries management shifts or ecological change can be pivotal to aligning fisheries management with nutrition targets. In Eastern Africa, diets are frequently deficient in calcium, iron, zinc and vitamin A (Ferguson *et al.*, 2015; Caswell *et al.*, 2018; Victora *et al.*, 2021), which are all found in fish from small-scale fisheries. In this subregion, inland small-scale fisheries in the African Great Lakes provide the main supply of fish (five times the supply of marine fisheries). In the last few decades, the composition of fish catch has changed progressively to smaller fish; now over 70 percent of inland fisheries catch consists of small pelagic fish species, which are highly abundant but underutilized (Kolding *et al.*, 2019).

Table 7.2 Percentage of the female population of reproductive age (15–49 years) for whom marine and inland small-scale fisheries catches would meet 20 percent of RNI for six nutrients, by region, based on data from IHH country and territory case studies and modelled nutrient values

Region	Ca	Fe	Se	Zn	Vitamin A	Omega-3	Number of women (millions): four nutrients	Number of women (millions): six nutrients
Total								
Africa	50.4%	17.7%	685.4%	75.2%	13.4%	136.5%	137.0	36.4
Americas	25.0%	9.5%	250.3%	40.5%	6.3%	81.8%	60.4	15.2
Asia	25.2%	10.1%	462.5%	44.3%	9.4%	170.4%	271.0	101.0
Europe	3.0%	1.5%	45.8%	7.5%	2.3%	27.3%	5.1	2.6
Oceania	10.5%	9.5%	321.5%	20.0%	6.8%	51.6%	1.0	0.65
Marine								
Africa	15.5%	8.3%	228.8%	26.8%	4.5%	86.8%	42.1	12.2
Americas	22.9%	8.6%	216.1%	35.5%	5.3%	76.2%	55.3	12.8
Asia	18.7%	8.1%	342.6%	32.3%	7.2%	146.5%	201.1	77.4
Europe	2.7%	1.4%	41.9%	7.2%	2.2%	26.1%	4.6	2.4
Oceania	10.1%	9.5%	316.5%	19.5%	6.8%	50.5%	0.9	0.7
Inland								
Africa	34.9%	9.4%	456.7%	48.4%	8.9%	49.8%	94.9	24.2
Americas	2.1%	0.8%	34.2%	5.0%	1.0%	5.6%	5.1	1.9
Asia	6.5%	2.0%	120.0%	12.0%	2.3%	23.8%	69.9	24.7
Europe	0.3%	0.1%	3.9%	0.3%	0.1%	1.2%	0.5	0.2
Oceania	0.4%	0.1%	4.9%	0.4%	0.1%	1.1%	0.0	0.0

Notes: The six nutrients modelled in the analysis are calcium, iron, selenium, zinc, vitamin A and omega-3 fatty acids. The last two columns show the number of women for whom small-scale fisheries would meet 20 percent of recommended nutrient intake (RNI) across four nutrients (calcium, selenium, zinc, omega-3 fatty acids) and all six nutrients.

Figure 7.4 Examples of subregional estimates of inadequate nutrient intake for four nutrients compared with nutritional contribution from selected small-scale fisheries, by subregion



Notes: Estimated inadequate nutrient intakes (orange lines) are displayed as percentage prevalence in the total population. Nutritional contributions (blue lines) are displayed as the percentage of women of reproductive age for whom the subregional catch would provide 25 percent of recommended nutrient intake.

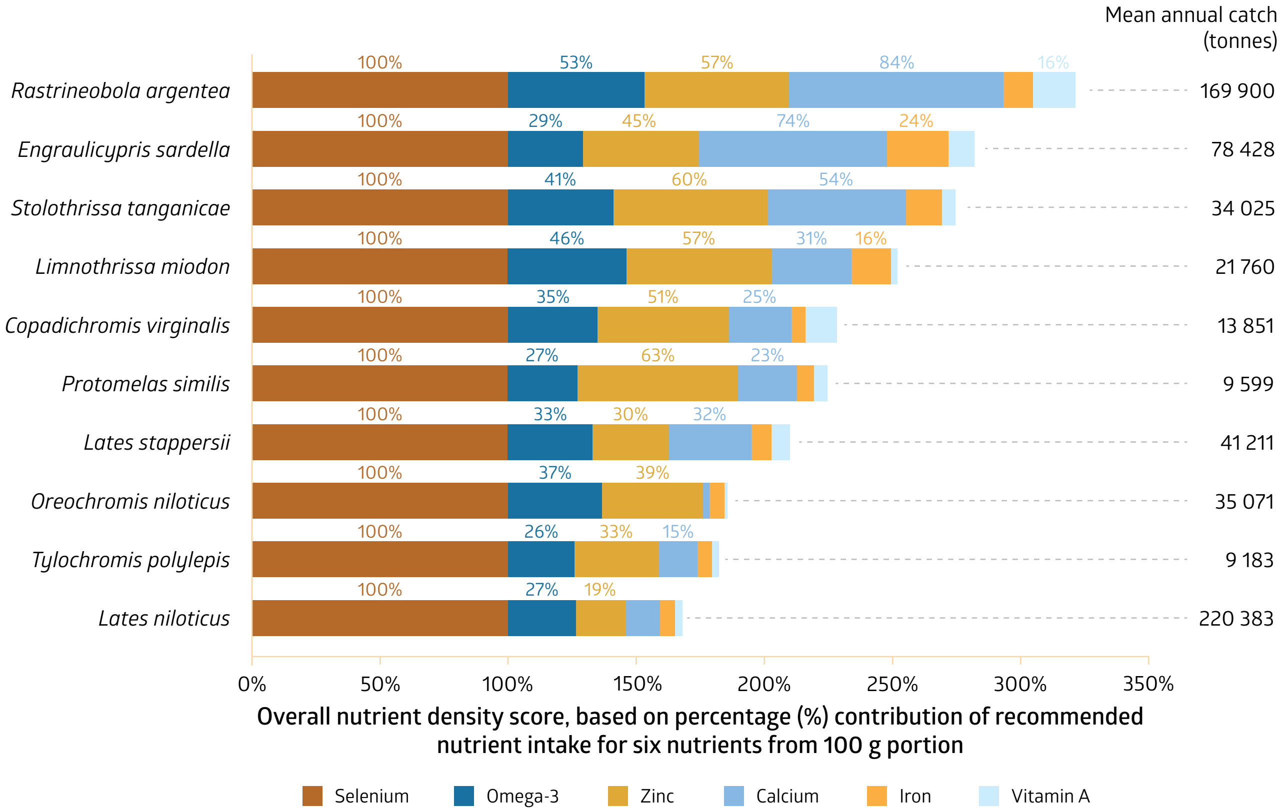
Source: Inadequate nutrition intakes from Beal, T., Massiot, E., Arsenault, J.E., Smith, M.R. & Hijmans, R.J. 2017. Global trends in dietary micronutrient supplies and estimated prevalence of inadequate intakes. *PLoS ONE,* 12(4): e0175554. https://doi.org/10.1371/journal.pone.0175554

Nutrient modelling was undertaken on fish species across four countries in Eastern Africa: Malawi, Uganda, United Republic of Tanzania and Zambia (see Annex A). According to the four CCS, small-scale fisheries catches from the lakes in this region include 38 species, but high-quality, measured nutrient data were available for only four species (*Clarias gariepinus, Engraulicypris sardella,Oreochromis niloticus* and *Lates niloticus*) – hence the utility of the nutrient modelling approach. Among the ten most abundant species reported in the CCS (Figure 7.5), the four with the highest modelled nutrient density scores are all small, schooling pelagic species predominantly from Lake Victoria, Lake Tanganyika and Lake Malawi. The most nutritious of the ten species, *Rastrineobola argentea*, had a nutrient density score twice that of the least nutritious, Nile perch (*L. niloticus*). Concentrations of calcium, zinc and omega-3 fatty acids drive these differences.

Lake Victoria's inland fisheries are among the largest in the world, producing approximately 1 million tonnes per year. Looking deeper into the evolution of Lake Victoria fisheries illustrates how shifts in ecology and management can have a marked impact on nutrient availability, and accordingly where nutrition-sensitive fisheries management can help improve nutrition outcomes. For this analysis, collated regional catch data were used to illuminate the variations in nutrient availability that have occurred as the lake's fisheries have changed.

Until the early 1980s, the fisheries of Lake Victoria were small-scale and locally operated, directly supporting the food supply of the surrounding area. The catch was dominated by both large and small tilapia species and a huge diversity of small fish – mostly from the haplochromine cichlids, a subfamily of tilapia-like species (Aura *et al.,* 2020). However, the introduction of the predatory Nile perch (*L. niloticus*) in the 1960s together with rapidly increasing eutrophication (Kolding *et al.,* 2008) contributed to population declines and extinctions among the haplochromines, along with ecological instability and stark changes in water quality (van Zwieten *et al.,* 2016; Marshall, 2018). Further introductions of other species, including Nile tilapia (*O. niloticus*),

Figure 7.5 Modelled nutrient density scores for the ten most abundant fish species in catches reported in IHH country and territory case studies from Malawi, Uganda, United Republic of Tanzania, and Zambia



Notes: Bars show the percentage contribution of ten fish species to recommended nutrient intake for six nutrients for adult women. The nutrient density score (x-axis) is the sum of the percentage contributions for the six nutrients.

Sources: RNI values from WHO & FAO. 2004. *Vitamin and mineral requirements in human nutrition.* Second edition. Geneva, Switzerland, WHO; Lupton, J.R., Brooks, J.A., Butte, N.F., Caballero, B., Flatt, J.P. & Fried, S.K. 2002. *Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids.* Washington, DC, National Academies Press.

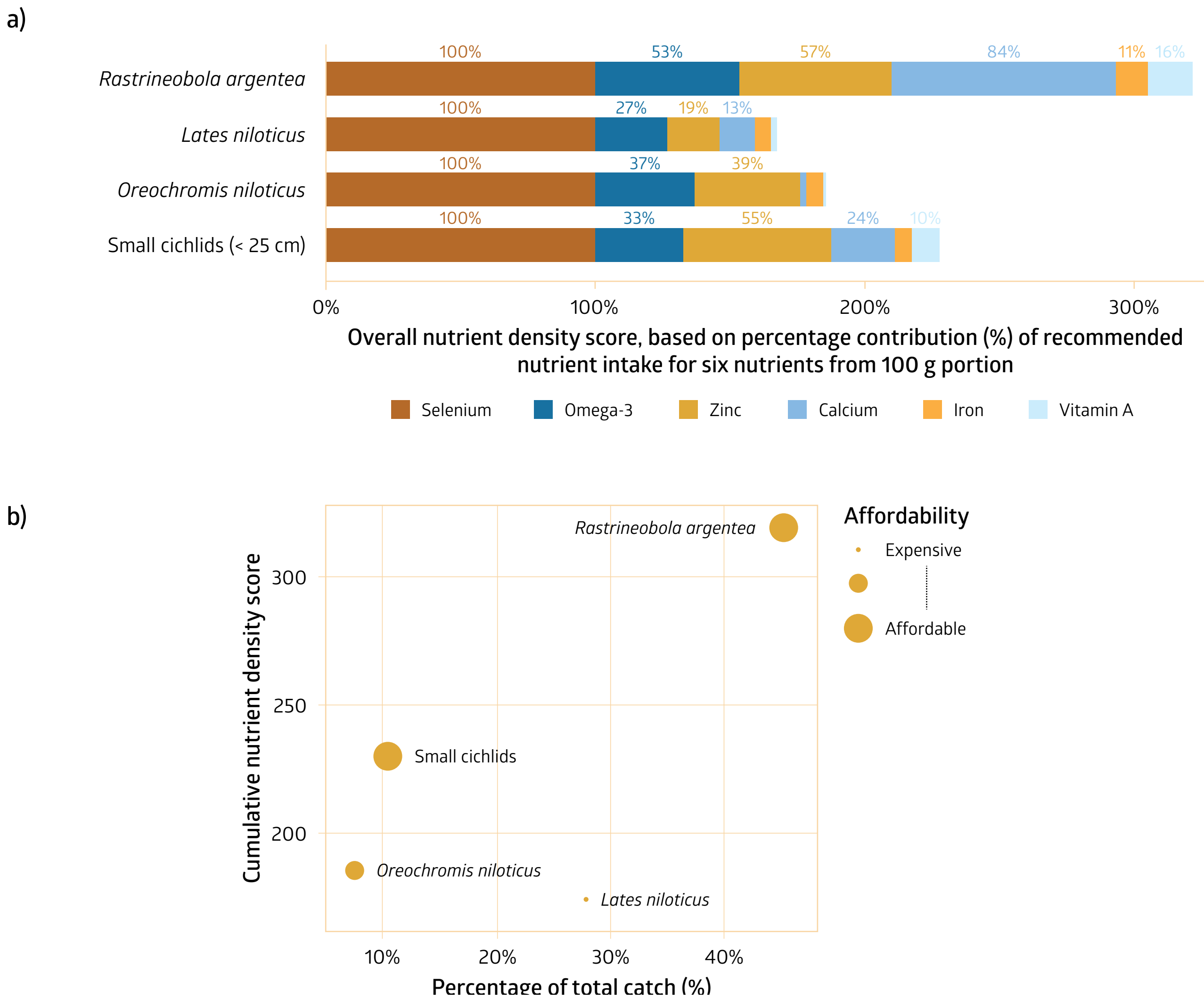
compounded these issues. As the haplochromine population declined, a small pelagic cyprinid (*R. argentea*), locally known as *dagaa* (United Republic of Tanzania), *omena* (Kenya) or *mukene* (Uganda) began to proliferate, after which it became increasingly targeted by local small-scale fishers. By the 1990s, the Nile perch fishery had developed into a multimillion-dollar activity, soon accounting for 90 percent of international fish exports from the countries bordering the lake (Kolding *et al.*, 2014). Later, as demand for fish oil and fishmeal increased, a substantial component of the *dagaa* catch was diverted for reduction to animal feed (Muyodi, Bugenyi and Hecky, 2010). Only 30 percent of *dagaa* production is now used for human consumption, with much of the remaining production going into industrial feed mills for livestock and aquaculture (CAS Regional Working Group, 2015).

Clearly, if household fish consumption had transitioned away from declining indigenous species (mostly consumed whole) towards either Nile perch or Nile tilapia (eaten as fillets), there would have been substantial negative impacts on the nutrient density of a fish-based meal (Figure 7.5; Figure 7.6, panel a). But instead, the focus of much of the local small-scale and subsistence fishers shifted towards *dagaa* (*R. argentea*), which now contributes more than half of the total catch from the lake (CAS Regional Working Group, 2015). *Dagaa* has a modelled nutrient density value that is double that of the average fish in the global database, with a particularly high calcium value that could help address inadequate intake. Considering that *dagaa* is eaten whole, the actual calcium value is likely higher than modelled values for flesh only, although reported values for this species boiled whole (Kabahenda *et al.*, 2011) are very similar to modelled values in this chapter analysis. A recent household survey in a Kenyan fishing community (Fiorella *et al.*, 2016) reported that 39 percent of fish consumed was small Nile perch (*L. niloticus*) and 51 percent was *dagaa*. While the flesh (i.e. fillet) of Nile perch has a relatively low nutrient density (Figure 7.5; Figure 7.6, panel a), it is likely that the increased consumption of highly nutritious *dagaa* in local diets more than compensates for this. The increase in biomass of *dagaa*, and the apparently robust nature of such small pelagic fish stocks, has been borne out in this instance: with only an estimated 10 percent of the annual biological production harvested, the *dagaa* fishery shows no signs of overexploitation (Kolding *et al.*, 2019). The remaining concern is the total volume of fish that is retained for consumption in local communities, with increasing volumes of *dagaa* being diverted instead for fishmeal production.

Visualizing the relationship between fish catch, nutritional value and affordability (Figure 7.6, panel b) is a powerful method for informing policies aiming to improve the nutritional benefits of fisheries. *R. argentea*, being both abundant and highly nutritious, is of particular interest. This species is also highly affordable for local consumers and should thus be a priority for management investment. In contrast, Nile perch has a relatively low nutrient density score and is unaffordable locally (as the fishery is export-oriented, and thus the species has a high landed price). While this species is important for local diets, the locally consumed catch is almost invariably below legal size (Fiorella *et al.*, 2016), so it does not enter formal value chains and is omitted from formal catch data. If included, Nile perch would have a very different pricing structure to the landed price data presented here.

The challenge for management, then, is to balance the economic benefits of the export of Nile perch with the nutritional benefits of this species to local communities. Any attempt to enforce current legal minimum sizes for Nile tilapia and Nile perch would have devastating impacts on their availability for local consumption. Meanwhile, although there are no concerns about the stock status of *dagaa* and of juvenile Nile perch (the latter being the second largest stock in the lake [Natugonza *et al.*, 2016]), policy intervention may be needed to prioritize local consumption over other uses. Analytical approaches as used here are accessible methods for incorporating nutrition outcomes into management goals, and are central in the push to institutionalize nutrition sensitivity as a key pillar of sustainable fisheries management.

Figure 7.6 Nutrient density scores and affordability of small-scale fisheries catch in Lake Victoria, based on IHH country and territory case studies



Notes: Panel a shows nutrient density scores for three dominant locally consumed fish species, plus small cichlids as a group, indicating the percentage contribution of each species to recommended nutrient intake (RNI) for six nutrients for adult women. The nutrient density score (x-axis) is the sum of the percentage contributions for the six nutrients. Panel b compares total nutrient density score (y-axis) with proportion of total catch (x-axis) for the same groups; dot size represents relative affordability.

Sources: RNI values from WHO & FAO. 2004. *Vitamin and mineral requirements in human nutrition*. Second edition. Geneva, Switzerland, WHO; Lupton, J.R., Brooks, J.A., Butte, N.F., Caballero, B., Flatt, J.P. & Fried, S.K. 2002. *Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids*. Washington, DC, National Academies Press.

7.3.5 The impact of food quality and safety on small-scale fisheries contributions to human health and to food security and nutrition

Food quality and safety concerns relate to all types of food, and the potential loss of nutritional value has great implications for human health globally. The nature of the aquatic foods found in aquaculture and capture fisheries give rise to some unique food safety hazards. Small-scale fisheries face challenges linked to land-based contaminants that affect inland and near-shore fish stocks, as well as limited access to quality processing and market chain infrastructure, services and information. As a component of the CCS, national teams were requested to provide information on local food safety concerns in small-scale fisheries. Very few were able to do so but, because of the importance of food safety to improving nutrition outcomes, a brief review is included here to highlight major issues and approaches to their mitigation.

During processing, **spoilage bacteria or protozoans** can be introduced or inadvertently propagated due to inappropriate and unhygienic storage, poor handling, insufficient or dirty ice, and contaminated water. This can result in products with a lower shelf life and nutritional value, and ultimately lower product acceptance among consumers. For example, physical fish losses along small-scale fisheries value chains in Southern Africa are low (4.1 percent) when compared to other regions globally, but losses in quality that increase health risks and reduce nutrition levels can "range between 43 percent and 69 percent depending on the node" (Torell *et al.,* 2020).

Furthermore, some spoilage bacteria convert histidine to histamine (referred to as scombrotoxin), which causes scombroid poisoning. This is a particular concern for scombroid species (mackerel, tuna and bonito), as they have naturally high levels of histidine (Emborg and Dalgaard, 2008; Painter *et al.,* 2013). Scombroid poisoning is especially troublesome because histamine is a heat-stable compound, so once it reaches a high level, there are no mitigation measures (such as cooking) to counteract it. The growth of spoilage bacteria can only be prevented through attention to hygiene, temperature control, careful post-harvest handling, and minimizing transportation time from harvest to consumers (Svanevik *et al.,* 2015).

The contamination of water or surfaces (i.e. in or on fishing gear, handling equipment, storage tanks, landing devices, conveyor belts, filleting machines, dryers, fermenters or smokers) used for processing and handling fish can result in the introduction of pathogenic microorganisms such as *Listeria monocytogenes* (Svanevik *et al.,* 2015; Svanevik and Lunestad, 2011; Huss, 1994); these risks can be exacerbated during extended processes such as sun-drying. Due to the more limited access to higher-quality infrastructure in small-scale fisheries value chains, contamination hazards during handling, processing and storage are disproportionately higher.

Fish and other aquatic species harvested through small-scale fisheries may also occasionally accumulate **pathogenic bacteria and viruses** that are naturally present in aquatic environments (Novotny *et al.,* 2004; Mok *et al.,* 2019). Bivalves are the most frequent carriers of these (Painter *et al.,* 2013; Westrell *et al.,* 2010; Iwamoto *et al.,* 2010; Dewey-Mattia *et al.,* 2018), which they accumulate through filter feeding (Cranford, Ward and Shumway, 2011; Mathijs *et al.,* 2012). Bivalve monitoring programmes that assess the presence of contaminants and microorganisms are important mechanisms for consumer protection, but they are also expensive. In low- and middle-income countries, bivalve fisheries are invariably small-scale, and thus these programmes are often not feasible without substantial public funding (FAO and WHO, 2018).

Concentrations of **heavy metals** (e.g. mercury, lead, cadmium, metalloid arsenic) are found in fish and shellfish, depending on the concentrations in the surrounding water and the bioaccumulation tendencies of different species (Castro-Gonzalez and Mendez-Armenta, 2008). These metals originate from both natural and anthropogenic sources, but coastal areas and freshwater systems close to human populations and activities (particularly mining) tend to have higher levels of heavy metal contamination (Baki *et al.,* 2018). Predatory species, such as sharks, swordfish and tuna, often contain the highest levels of mercury (FAO and WHO, 2010). However, fears of mercury toxicity from such fish may have been overemphasized in the past, as research has shown that correspondingly high selenium levels in these fish actually protect against toxicity (Ralston *et al.,* 2007). Similarly, total arsenic levels can be high in marine fish, bivalves and crustaceans, but in a relatively non-toxic form (Bhattacharya *et al.,* 2007). For instance, lead levels are generally low in finfish fillets, but bones and scales can accumulate higher concentrations (Schmitt and Mckee, 2016). Crustaceans and bivalves, on the other hand, can have high levels of undesirable metals, particularly cadmium (Wiech *et al.,* 2020) and inorganic arsenic (Sloth and Julshamn, 2008).

Chemical contaminants can potentially be introduced during pre- and post-harvest activities. Polycyclic aromatic hydrocarbons are well-known carcinogenic and mutagenic compounds that can be found in high concentrations in smoked products, including fish (Ndiaye, Komivi and Ouadi, 2015; Hasselberg *et al.,* 2020). Fish smoking is a common preservation technique in many small-scale fisheries value chains, notably in Africa, where large volumes of the domestic fish catch of mostly fatty species (which are not suitable for drying) are smoked. Different smoking methods, such as the FAO-Thiaroye technique, have been shown to reduce polycyclic aromatic hydrocarbons and improve the safety of smoked products (Bomfeh *et al.,* 2019).

Other important chemical contaminants include persistent organic pollutants, which are primarily lipophilic (i.e. attracted to fats) compounds that tend to be found in higher concentrations in oily fish. The health risks of human exposure to these pollutants vary, but they include reproductive disorders and carcinogenicity. Unfortunately, data on concentrations in fish and other aquatic foods specifically harvested by small-scale fisheries, as well as dietary exposure on the part of consumers through small-scale fisheries product chains, are sparse.

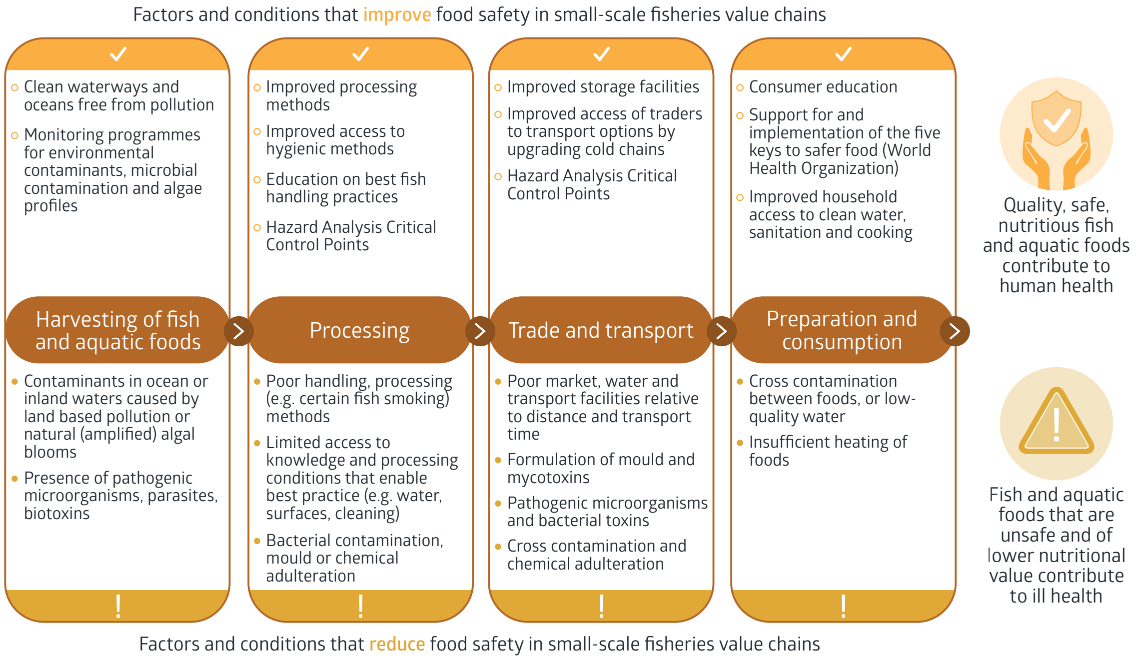
While **algal blooms** are natural phenomena, their intensity and frequency are linked to human-induced impacts on ocean and freshwater chemistry (FAO and WHO, 2020). Certain algal species produce potent biotoxins that can be ingested by shellfish and fish. When consumed by humans they can evoke a variety of physiological, gastrointestinal and neurological illnesses. As with bivalves (above), most low- and middle-income countries do not have the resources to establish monitoring programmes to mitigate the risk of these harmful algal blooms. Fish containing ciguatoxin are responsible for ciguatera poisoning, the most common non-bacterial seafood poisoning globally, which affects digestive, muscular and/ or neurological systems. Ciguatoxin originates in a dinoflagellate that becomes seasonally abundant in the tropical Caribbean and Pacific regions, where rates of fish consumption are very high. The incidence of ciguatera has already led to a ban on capturing predatory fish species such as barracuda, red snapper, moray eel and amberjack, as their feeding patterns lead to bioaccumulation of ciguatoxin (FAO and WHO, 2020). Freshwater algal toxins are less commonly reported, but do arise in waterbodies, especially where there are issues with land-based nutrient runoff.

Finally, fish-borne **zoonotic parasites** pose a significant consumer health hazard worldwide (EFSA, 2010). For example, fresh marine fish are a significant vector for human infection by the larvae of *Anisakis* nematodes (Bao *et al.*, 2019; Cipriani *et al.*, 2018; Guardone *et al.*, 2018). Other parasites of concern include the liver flukes *Opisthorchis viverrine* and *Clonorchis sinensis*, which are responsible for several million human infections each year, especially in South-eastern and Eastern Asia (Chai, Murrell and Lymbery, 2005; Sunday and Ada, 2020). Although there is limited understanding of associated morbidity, the potential for an allergic reaction to the *Anisakis* parasite (still possible even when the fish is thoroughly cooked) may pose an additional threat to consumers.

There are opportunities within small-scale fisheries value chains to address food safety concerns and human health costs, including improved landing and processing infrastructure; improved access to clean water; availability of adequate facilities for cooling, drying or smoking; and improved access to and development of storage, transport and trading processes and technologies (Figure 7.7). It may be difficult to meet global best practice standards in all contexts in which small-scale fisheries and their value chains operate, but alternatives can be explored.

For example, potable water is the safest choice for processing, cleaning and ice-making. But if this resource is limited, then measures can be taken to reduce microbial risk. Limiting microbial growth will lead to increased shelf life, improved quality and reduced post-harvest losses (FAO and WHO, 2019) – all of which represent substantial pathways within

Figure 7.7 Summary of factors affecting food safety in small-scale fisheries value chains



Source: Garrido Gamarro, E., Smith Svanevik, C., Lundebye, A.K., Sanden, M., D'Agostino, E., Kjellevold, M., Pincus, L. & Pucher, J. 2023. Challenges in the implementation of Food Safety and Quality Assurance Systems in small-scale fisheries. *Food Quality and Safety*, 7: 1–9.

small-scale fisheries to improve food security and nutrition and human health outcomes.

The food safety concerns that arise from land-based pollution of waterways are likely to be mitigated by the actions of governments and the private sector. Consumers have some agency in addressing food safety issues by demanding safer food from actors higher up the value chain, and also by implementing hygienic food preparation and storage options in wet markets and households. Programming to educate consumers can include information on the five keys to safer food: 1) keep food clean; 2) separate raw and cooked food; 3) cook food thoroughly; 4) keep food at a safe temperature; and 5) use safe water and raw materials (WHO, 2006). The Code of Conduct for Responsible Fisheries (FAO, 1995) includes provisions (11.1.2, 11.1.3) on post-harvest practices and trade that encourage states to protect consumer health; establish and maintain effective national quality and safety assurance systems, with minimum standards that are effectively applied throughout the value chain; and promote the implementation of the international food safety standard Codex Alimentarius (also called the Food Code). Low- and middle-income countries face challenges in engaging in Codex Alimentarius processes, and as much as implementation of the Alimentarius is needed, so too is adjustment of the code to better reflect opportunities to improve food safety in small-scale fisheries food systems. Moreover, the international community needs to assist with building capacity to improve the participation of developing countries or areas in international standard-setting processes within the Codex Alimentarius, so that the views and practices of the small-scale fisheries subsector are included.

7.4 Small-scale fisheries, poverty, and food security and nutrition: quality data provide new insights in sub-Saharan Africa

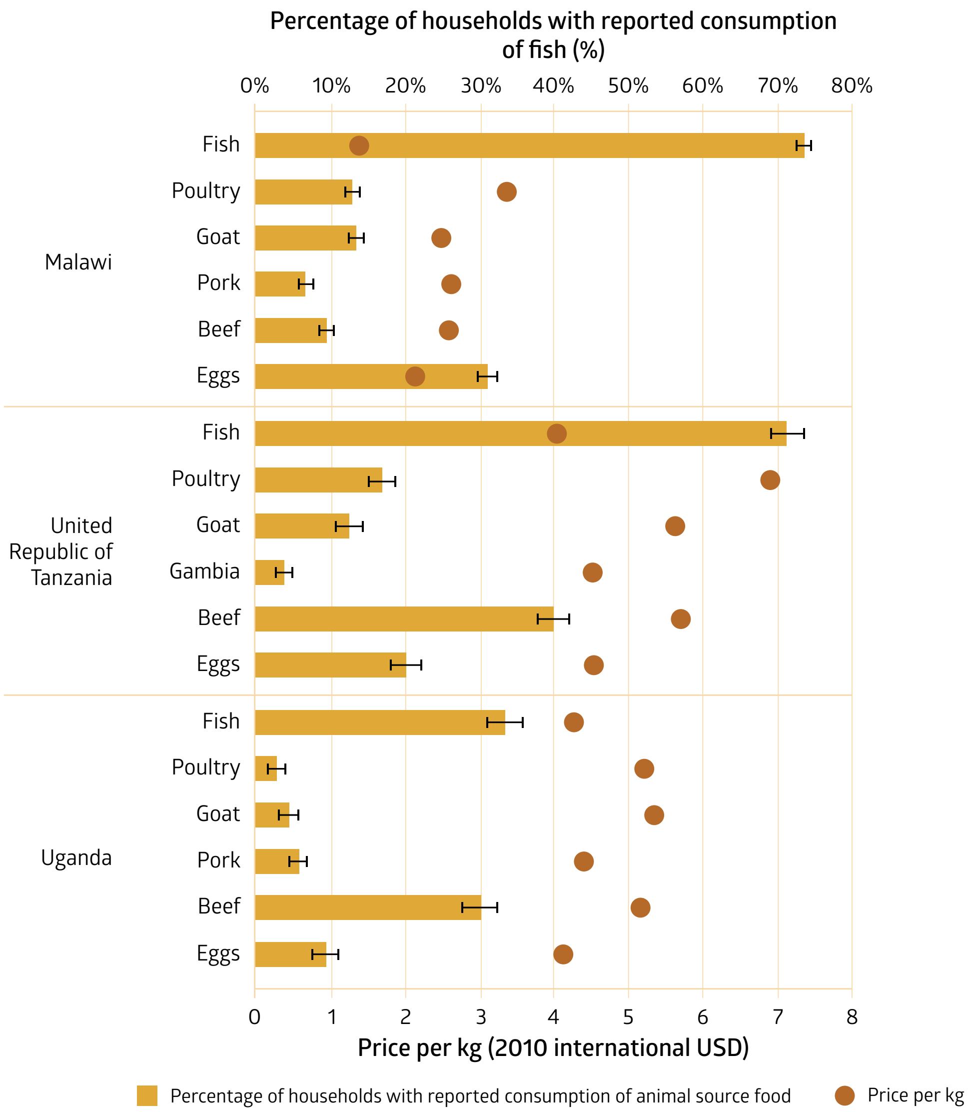
Sub-Saharan Africa has some of the highest rates of poverty, food insecurity and malnutrition in the world, with predictions that this will worsen in the years ahead due to drivers including climate change and increased competition for natural resources (FAO, IFAD, UNICEF, WFP and WHO, 2020). Small-scale fisheries provide the main supply of fish for people in this region and will continue to do so in the coming decades (Chan *et al.*, 2019). The nutrient potential of these fisheries in Africa is the highest of any global region (see Table 7.2).

High-resolution data linking fisheries livelihoods, food security and nutrition and poverty status over large geographic scales are rare, but can provide powerful insights for making impactful policy choices. The World Bank's Living Standards Measurement Study and Integrated Surveys on Agriculture (LSMS-ISA), a nationally representative survey undertaken in sub-Saharan Africa, is unique in that it provides data on poverty and food security and nutrition linked to fish consumption and fisheries livelihoods. A fishery module appended to the survey was designed by fisheries researchers to address key questions for the small-scale fisheries subsector (Béné *et al.*, 2012). Survey data included fish consumption by quantity and form (dried, fresh and smoked) and household engagement in livelihoods related to small-scale fisheries (harvesting, processing and trade activities). Georeferenced data were used to compare rural and urban environments and the impacts of living in proximity to waterbodies where small-scale fisheries operate.

LSMS-ISA data from Malawi, Uganda and the United Republic of Tanzania were used to investigate the flow of benefits from the abundant inland (African Great Lakes) and marine (coastal Western Indian Ocean) small-scale fisheries found in sub-Saharan Africa. Detailed spatial data on livelihoods (small-scale fisheries, agriculture or neither), fish consumption, food consumption profile (as measured by the World Food Programme's food consumption score) and monetary poverty (based on national poverty line) were analysed to understand how distance from waterbodies affects households' physical and economic access to fish (see Annex A) (Simmance *et al.*, 2022b). The food consumption score provides a measure of adequate food consumption, which acts as a proxy for energy sufficiency (Leroy *et al.*, 2015; WFP, 2008). Data availability on fish and fisheries was similar across country surveys, except for Uganda where data on livelihoods were limited to fishing activities only, not extending to the post-harvest segment of small-scale fisheries value chains. These data are used in the following subsections to determine where, and for whom, fish and small-scale fisheries are most important at the subnational level.

In rural and urban contexts across all three countries, more households consume fish than any other ASF (Figure 7.8). In the analysis, the price of fish was almost always lower than other ASFs (except for eggs in Uganda), a likely driver of relatively high fish consumption. More households reported consuming fish (33–73 percent) than other ASFs (< 40 percent for eggs and beef; < 20 percent for poultry, goat or pork); this predominance was most evident in Malawi, but much less so in Uganda. Fish is particularly important in the diets of rural and poor (i.e. living below the national poverty line) households, which consume few

Figure 7.8 Household consumption and purchase price of animal source foods (ASFs) in three sub-Saharan countries



Notes: Percentage of households consuming common ASFs during the seven-day recall period (left axis), and the average price per kg (2010 international USD) of each ASF (right axis).

Sources: World Bank Living Standards Measurement Study – Integrated Surveys on Agriculture (LSMS-ISA) for Malawi (2016–2017), Uganda (2010–2011) and United Republic of Tanzania (2014–2015), available at www.worldbank.org/en/programs/lsms/initiatives/lsms-ISA#40 .

other ASFs. For example, in Malawi, while 63 percent of poor households ate fish in the recall period, only 2 percent ate beef and 3 percent ate pork. In contrast, non-poor households showed a higher diversity of ASF consumption: 82 percent ate fish, 16 percent ate beef and 9 percent ate pork. The national average quantities of fish consumed per year (10 kg/capita in the United Republic of Tanzania, 11 kg/capita in Malawi and 13 kg/capita in Uganda) meet the EAT-Lancet fish consumption recommendations for a healthy diet: 28 g of fish per day, equivalent to 10 kg/year (Willett *et al.,* 2019). However, inequalities exist in access to fish for population subgroups, and malnutrition and food insecurity remain high due to inadequate overall diets and health vulnerabilities. The collection of gender- and age-disaggregated data on ASF (including fish) consumption should be a high priority given the metabolic and health benefits of nutrients available from these foods.

7.4.1 Increased fish consumption due to proximity to waterbodies with small-scale fisheries operations

Households living within 5 km of waterbodies supporting small-scale fisheries eat fish about twice as frequently per week as those living at a distance (by a factor of 1.9 in Malawi and the United Republic of Tanzania, and a factor of 2.1 in Uganda). This applies in both urban and rural settings across countries, but particularly in rural areas. The average quantity of fish consumed is also higher in rural households living close to small-scale fisheries in all three countries (by a factor of 1.1 in Uganda, 2.6 in Malawi and 2.9 in the United Republic of Tanzania), although only fractionally in Uganda (Figure 7.9).

Figure 7.9 Distribution of fish consumption by households living near waterbodies in Malawi, Uganda and the United Republic of Tanzania

Borders of Uganda (top), United Republic of Tanzania (middle) and Malawi (bottom)

Inland waterbodies and coastlines

Households with reported fish consumption

Notes: Brown dots show spatial distribution of fish consumption reported by households living near inland waterbodies and coastlines in Malawi, Uganda and the United Republic of Tanzania. Analysis is of 18 715 households and a sample population of 87 879, framed to be representative of the total population of each country (93.8 million across the three countries).

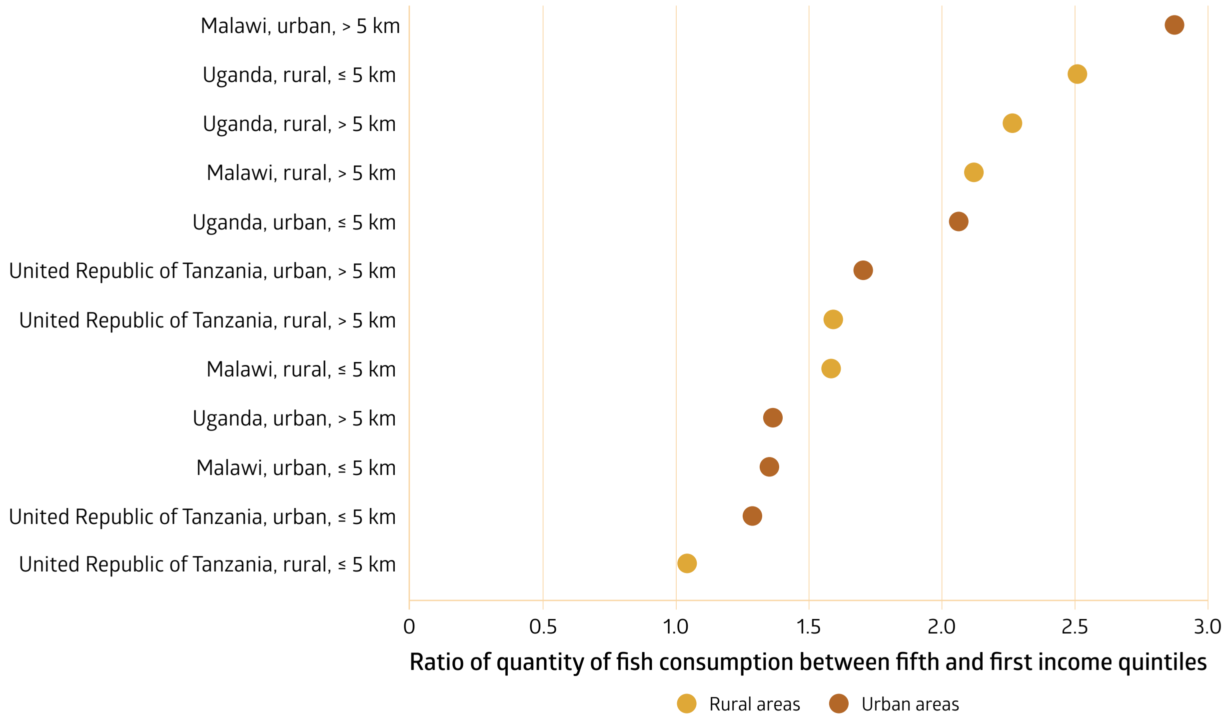
Sources: World Bank Living Standards Measurement Study – Integrated Surveys on Agriculture (LSMS-ISA) for Malawi (2016–2017), Uganda (2010–2011) and United Republic of Tanzania (2014–2015), available at www.worldbank.org/en/programs/lsms/initiatives/lsms-ISA#40; World Wildlife Fund. 2004. Global Lakes and Wetlands Database (GLWD). In: *World Wildlife Fund*. Washington, DC. Cited 15 October 2021. www.worldwildlife.org/pages/global-lakes-and-wetlands-database; European Space Agency & UCLouvain. 2010. GlobCover 2009 (Global Land Cover Map). In: *European Space Agency*. ESA GlobCover 2009 Project. Cited 15 October 2021. http://due.esrin.esa.int/page_globcover.php

In this analysis, the increased access to fish from small-scale fisheries through proximity to fished waterbodies reduced inequalities in fish consumption between wealthy and poor households (measured as the highest and lowest quintiles, respectively, in national income distributions) by an average of 30 percent (Figure 7.10). For example, in Malawi the difference in the quantity of fish consumed between richest and poorest households dropped from 3.0 kg/household/week for households living more than 5 km from fished waterbodies, to 1.5 for households living within 5 km. Unsurprisingly, engagement in small-scale fisheries livelihoods also positively influences fish consumption patterns: fishing households consume greater quantities of fish compared to non-fishing households (by a factor of 2.8 in Malawi, 3.2 in the United Republic of Tanzania, and 1.9 in Uganda). However, agricultural livelihoods dominate in all three countries, and fish is predominantly acquired through purchase (92–96 percent), further highlighting the importance of trade and markets. Small-scale fisheries improve consumption of fish as food by providing a relatively affordable food source compared to other ASFs, but this consumption decreases for those who live farther away from fishing grounds. If the food security and nutrition benefits of small-scale fisheries are to become more widespread, value chain enhancements that reduce fish loss and waste and enable distribution networks to extend to locations that are distant from fished waterbodies will be a key part of the solution.

The form in which fish is consumed (i.e. fresh, dried, other) varies among and within countries, and is again linked strongly with proximity to fished waterbodies. A large share of households reported consuming dried fish: 71 percent in Malawi, 46 percent in the United Republic of Tanzania and 64 percent in Uganda. Consumption of fresh fish is particularly high in the United Republic of Tanzania (71 percent of households), with lower levels in Malawi and Uganda (28 percent and 51 percent, respectively). In all three countries, a higher share of rural households living near small-scale fisheries consume fresh fish than those distant from small-scale fisheries (by a factor of 1.4 in the United Republic of Tanzania, 2.1 in Uganda and 4.6 in Malawi). Conversely, a higher share of rural households living distant from small-scale fisheries consume dried fish (by a factor of 1.3 in the United Republic of Tanzania, 1.5 in Malawi and 1.8 in Uganda) than those living near small-scale fisheries.

Small fish are exclusively processed by sun-drying, and represent 70 percent of total inland fish catch in the region. The predominant species are *usipa* (*Engraulicypris sardella*) in Malawi and *mukene* (*Rastrineobola argentea*) in Uganda (Kolding *et al.*, 2019). The informal trade of dried small fish from small-scale fisheries in the region is vast, which helps explain its dominance as the form of fish consumed (Kolding *et al.*, 2019). Although some nutrients are lost in the drying process, notably vitamin A (HLPE, 2014), in the absence of refrigeration, dried fish remains

Figure 7.10 Difference in fish consumption (kg/household/week) between richest and poorest households, by rural and urban area and proximity to fished waterbodies



Notes: Difference in fish consumption is expressed as the ratio (y-axis) between that of the highest and lowest income quintiles. Dark shading represents less than or equal to 5 km from fished waterbodies; light shading represents greater than 5 km from fished waterbodies.

Source: LSMS-ISA data from Malawi, Uganda and the United Republic of Tanzania.

a highly affordable and nutrient-dense food (Byrd *et al.*, 2021; Simmance, 2017). This highlights the importance of the dried fish trade in improving physical and economic access to nutritious food for remote rural populations living far from small-scale fisheries.

7.4.2 Increased frequency of adequate food consumption via increased access to fish as food

Fish consumption contributes notably to food security in sub-Saharan Africa, as it is the main ASF consumed in the region. Across all three countries analysed, households living adjacent to fished waterbodies had higher rates of adequate food consumption compared to those living distant (by 12.6 percent). Similarly, rural households engaged in fishing livelihoods had higher rates (by 9.8 percent) of adequate food consumption compared to non-fishing rural households. The association between small-scale fisheries livelihoods and food security varies by context: it is strong in rural areas of Malawi and the United Republic of Tanzania, whereas in rural Uganda, fishing households are more likely to be food insecure than agricultural households. This could be a result of inequity in the flow of benefits from the fisheries sector, due to the greater priority given to export-oriented fisheries value chains in Uganda (Fiorella *et al.*, 2014; Fulgencio, 2009).

7.4.3 Fisheries livelihoods and poverty reduction

Food security is underpinned by livelihoods, and the benefits obtained from small-scale fisheries extend beyond increased access to food. Among the three sub-Saharan countries analysed, small-scale fisheries were found to be associated with reduced rates of income poverty. Households living within 5 km of fished waterbodies were 15.2 percent less likely to be income-poor compared to those distant, and fishing households were 9 percent less likely to be poor compared to agricultural households. In the United Republic of Tanzania and Uganda, however, fishing households were on average poorer than households engaged in neither fishing nor agriculture, showing that small-scale fisheries livelihoods remain vulnerable to poverty, and that greater development efforts are needed to support small-scale fishing communities. By contrast, in Malawi, small-scale fisheries households were on average better off than both agricultural and non-agricultural households, showing that the contribution of small-scale fisheries to income poverty is also highly context-specific. The analysis also found, consistent with other empirical studies, that land access and asset wealth vary by small-scale fisheries context (Cinner, McClanahan and Wamukota, 2010; Fisher *et al.*, 2017), and small-scale fishers are often marginalized from economic services such as access to agricultural markets and infrastructure that supports improved food safety outcomes (Béné and Friend, 2011).

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7.5 Small-scale fisheries and fish consumption during the first 1 000 days of life

Where malnutrition is pervasive, young children are among the most vulnerable in terms of both immediate and lifelong impacts of poor diets (Leroy *et al.*, 2020). The critical window of growth and development from conception to two years of age is commonly known as the first 1 000 days of life. During this period, infants and young children require a higher ratio of nutrients per kilogram of bodyweight than at any other time in their lives (Adu-Afarwuah, Lartey and Dewey, 2017). Once children start to eat complementary foods they require foods that are nutrient-rich, as their small stomachs dictate a higher concentration of nutrients per gram of food and per calorie (WHO, 2008). Poor nutrition during this time can lead to irreversible negative health impacts that persist into adulthood (Victora *et al.*, 2008; Leroy *et al.*, 2020). Pregnant or breastfeeding women also require a nutrient-rich diet because they are the only source of nutrition for infants *in utero* and during the exclusive breastfeeding period from birth to 6 months of age (Figure 7.11) (Adu-Afarwuah, Lartey and Dewey, 2017).

In low-income countries, diets tend to be monotonous, consisting of a large portion of a starch-rich staple food, a small selection of vegetables, and (in some areas) a small amount of flesh foods, including fish (Popkin, 2004). Fish is often one of the most nutrient-rich components of diets in communities that live near lakes, rivers or the ocean (Alva *et al.*, 2016; van Vliet *et al.*, 2018; O'Meara *et al.*, 2021; Albert *et al.*, 2020); many of these waterbodies are home to small-scale fisheries (FAO, 2020b). Whole, small fish species are often among the most affordable and accessible ASFs in many least developed countries or areas. When dried and crushed into fish powder they are highly nutrient-rich, and can often be purchased in small, affordable portions. This makes them ideal during the first 1 000 days of life (Byrd, Thilsted and Fiorella, 2020) and, due to their preservation as a powder, a secure source of fish throughout the year (Kawarazuka and Béné, 2011).

Various country examples attest to the nutritional advantages of fish in the diets of women and children. In one study in Kenya, adding 3–5 servings per week of small pelagic *omena* (*Rastrineobola argentea*) to the diets of children aged 6–23 months optimized intake of vitamin B12, iron, zinc and calcium (Ferguson *et al.*, 2015). In the small islands of Maldives, where the national per capita fish consumption is among the highest in the world (91 kg/year in 2017, compared to the global average of 20 kg/year [FAO, 2020b]), fish contributes to adequate intakes of riboflavin, vitamin B6, vitamin A and protein in women and children under 3 years of age (Golder *et al.*, 2001).

Similar results are seen in Bangladesh, where women and children who regularly consume small, indigenous pelagic fish are more likely to have adequate nutrition (Bogard *et al.*, 2015a). In Pacific Island countries, high rates of vitamin B12 intake – a vitamin only found in ASFs – have been attributed to the high fish consumption in Samoa, Solomon Islands, Kiribati and the Marshall Islands (EPPSO, FAO and SPC, 2021; SBS and FAO, 2019; FAO and SPC, 2020; KNSO, FAO and

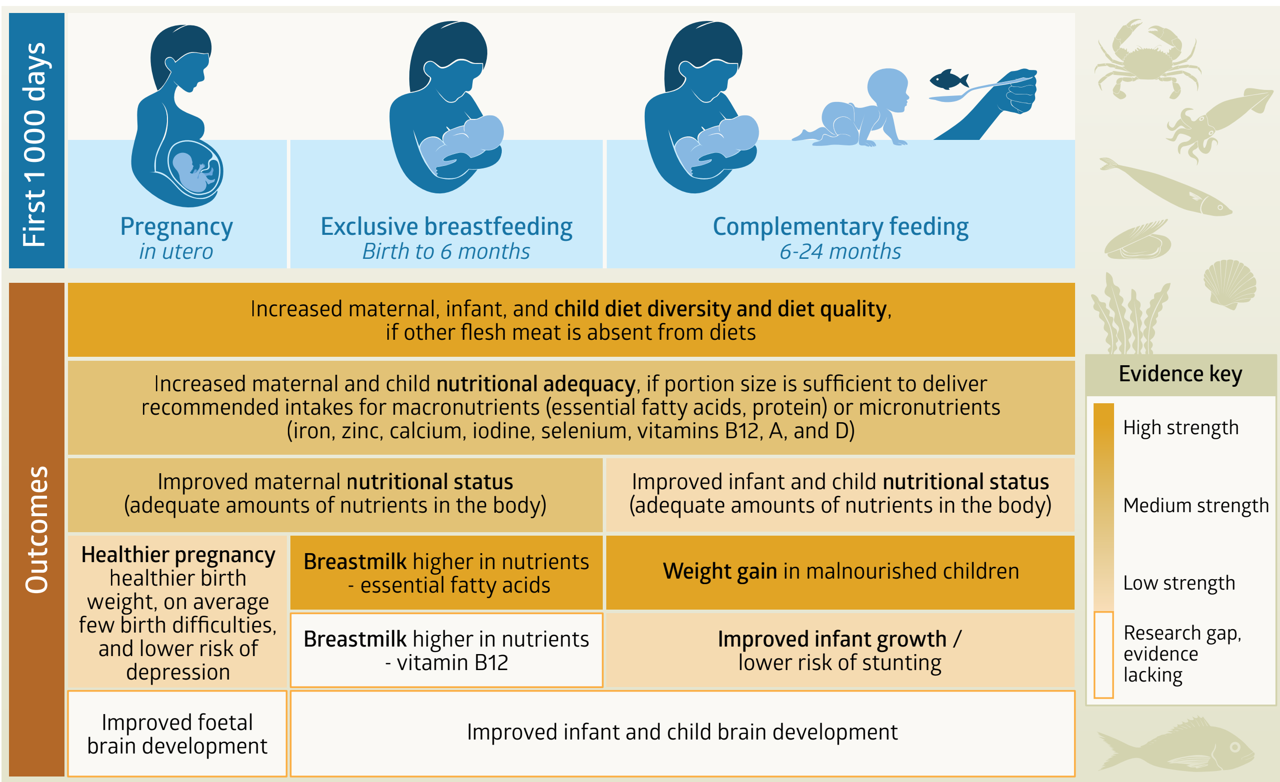
SPC, 2021), all countries where the fish consumed locally comes predominantly from small-scale fisheries.

During pregnancy, fats from fish and seafood (i.e. omega-3 fatty acids, in particular DHA and EPA) are beneficial to both mothers and their children when consumed as part of a healthy diet containing diverse foods (Imhoff-Kunsch *et al.*, 2012). However, while evidence from Inuit mothers in Canada and the Faroe Islands shows that DHA is associated with longer pregnancies and increased gestational age (Grandjean *et al.*, 2001; Lucas *et al.*, 2004), high EPA concentrations in maternal and cord blood are also associated with reduced birthweight (Grandjean *et al.*, 2001). Though the mechanism for the association between EPA and low birthweight is not known, caution around high fish intake (> 3 times per week) or fish oil supplementation during pregnancy is warranted. Nevertheless, fish intake remains important for foetal cognitive development during gestation. A synthesis of results across multiple studies (Hibbeln *et al.*, 2019) showed that fish consumption from as low as 4 oz (112 g) per week on up to 100 oz (2.8 kg) per week was associated with improved measures of neurocognition in children, with no evidence of harm from intakes at that level. Improved cognitive development means that children are more likely to be healthier mentally and physically and, in turn, more likely to do well at school and later in life (Victora *et al.*, 2008; Leroy *et al.*, 2020).

Fish intake also improves the nutrient content of breastmilk, which is the main source of nourishment for infants during the exclusive breastfeeding period from birth to 6 months of age. Specifically, mothers who consume wild fish in various regions around the world are more likely to have high levels of polyunsaturated fatty acids in their breastmilk (Fiorella *et al.*, 2017; Kuipers *et al.*, 2005; Martin *et al.*, 2012; Yakes Jimenez *et al.*, 2015).

In low-income countries, children under 5 years suffer high rates of stunting compared to higher-income countries (UNICEF, 2019). Stunting is a serious manifestation of chronic malnutrition, due in part to poor diets. Thus it can be avoided by eating a diverse diet which includes nutrient-rich foods such as fish, which is high in zinc, calcium and other nutrients. In a global sample of over 112 000 children aged six months to two years, fish consumption in 46 countries was associated with a reduced risk of stunting (Headey, Hirvonen and Hoddinott, 2017). These findings suggest that fish intake in low-income countries could protect against stunting, especially among rural children during the complementary feeding period.

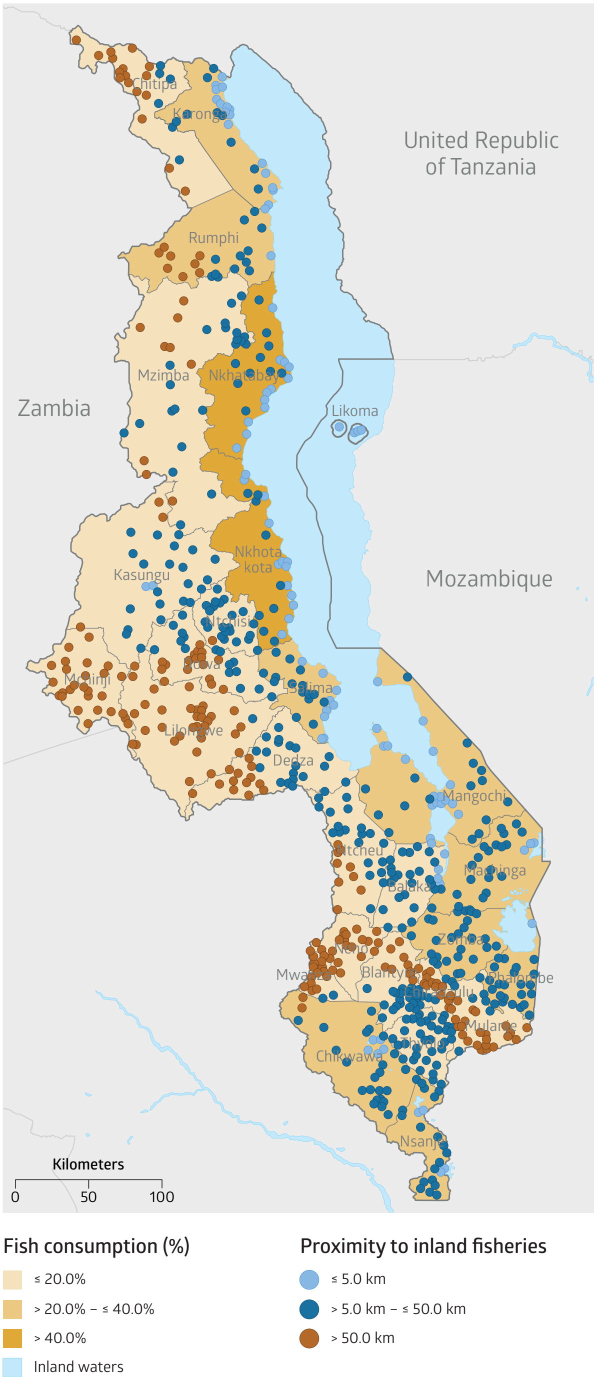
Figure 7.11 The benefits of fish consumption in three stages of the first 1 000 days of life



Notes: The complementary feeding stage (6–24 months) indicates a period when breastfeeding remains important, but solid foods are increasingly added to the diet. The evidence key represents the strength of research evidence from current literature supporting each benefit represented.

Source: Reproduced with permission from Byrd, K.A., Shieh, J., Mork, S., Pincus, L., O'Meara, L., Atkins, M. & Thilsted, S.H. 2022. Fish and fish-based products and nutrition and health in the first 1,000 days: a systematic review of the evidence from low and middle-income countries. *Advances in Nutrition,* 1–30. https://doi.org/10.1093/advances/nmac102

Figure 7.12 Prevalence of fish consumption in Malawi in children aged six months to two years, by district



Notes: Green shading represents percentage of children that consumed fish in the previous 24 hours. Yellow dots represent children living near a waterbody where fisheries are known to operate. Yellow dots may obscure smaller waterbodies due to scale of image.

Sources: National Statistics Office Malawi & ICF. 2017. *Malawi Demographic and Health Survey 2015–16;* World Wildlife Fund. 2019. Global Lakes and Wetlands Database (GLWD). In: *World Wildlife Fund.* Washington, DC. Cited 15 October 2021. www.worldwildlife.org/pages/global-lakes-and-wetlands-database; European Space Agency & UCLouvain. 2010. GlobCover 2009 (Global Land Cover Map). In: *European Space Agency.* ESA GlobCover 2009 Project. Cited 15 October 2021. http://due.esrin.esa.int/page_globcover.php

7.5.1 Contribution of inland small-scale fisheries to diet quality of young children in sub-Saharan Africa and South-eastern Asia

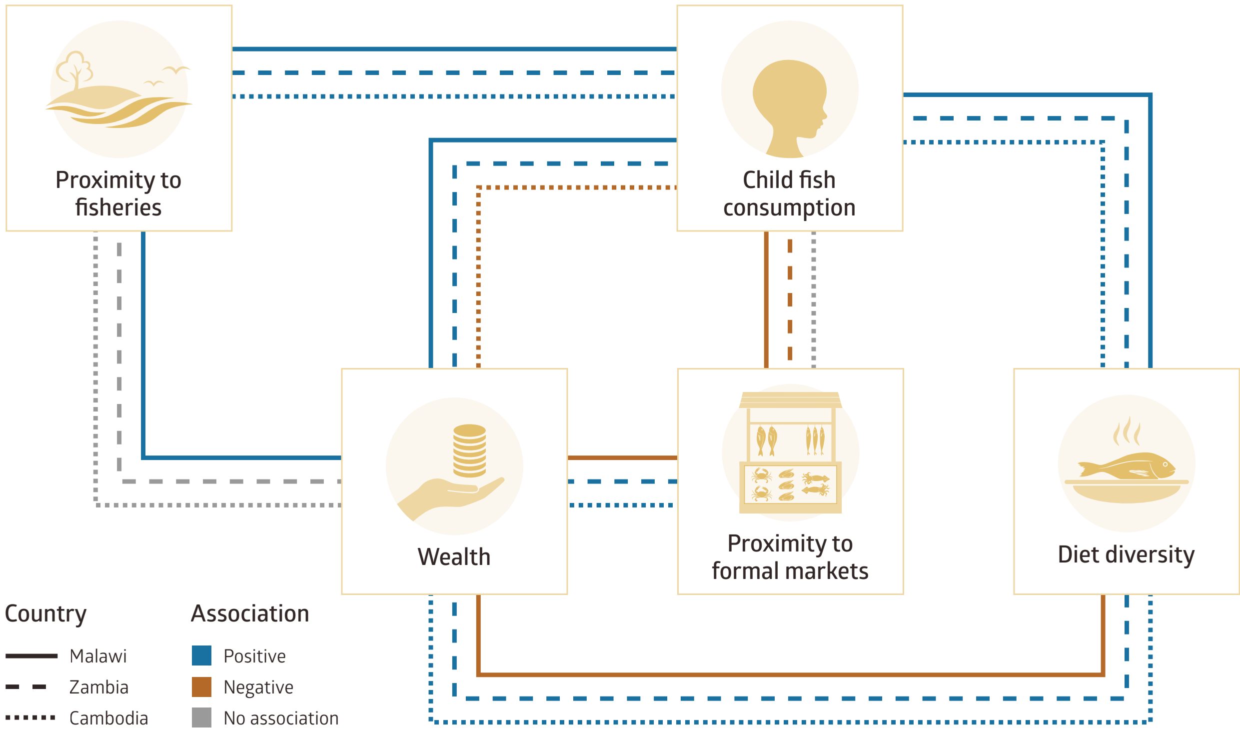
Evidence on the contribution of small-scale fisheries to the diets of children in the first 1 000 days of life at representative scales is limited, particularly in vulnerable regions where food insecurity is high. To address this gap, this subsection presents the first focussed assessment of the contribution of inland small-scale fisheries to fish consumption and diet quality of children during the complementary feeding period in sub-Saharan Africa and South-eastern Asia. As with the earlier analysis of livelihoods and distribution of fisheries benefits (Section 7.3), this assessment utilized secondary data, in this case from demographic and health surveys.[31] These surveys provide information on frequency of fish consumption, dietary diversity, and nutrition and health status of children and women in rural areas. The assessment examined the spatial distribution of fish consumption among rural children in Cambodia, Malawi and Zambia relative to inland waters where small-scale fisheries are known to operate.

Fish intake by children in the previous 24 hours varied considerably by district. However, rural children in all three countries living closer to inland fisheries were significantly more likely to eat fish (Figure 7.13). Similar to the findings in the broader analysis of fisheries benefits in Section 7.3, a higher share of children living closer to inland waters (such as lakes and rivers) reported consuming fish. For example, Lake Malawi skirts the eastern edge of Malawi (Figure 7.12) where indigenous small pelagic fish are common. These consist of sardines (*Engraulicypris sardella*), known locally as *usipa*, and also various small cichlid species: small demersal haplochromines known locally as *kambuzi*, and small pelagic haplochromines known locally as *utaka* (Funge-Smith, 2018; Kolding *et al.*, 2019). In the Ntchisi district, which is far from any fishery, only 6 percent of children consumed fish in the day preceding the survey. By contrast, in Likoma, Nkhotakota and Nkhata Bay districts, over 82 percent, 47 percent and 43 percent of children (respectively) living near the lake ate fish in the day preceding the survey – an increase of 7 to 13 times compared to the Ntchisi district. Clearly, market and distribution networks show a limited capacity to redistribute the nutritional benefits of fisheries to areas distant from their source.

Similarly, in Zambia, the highest percentage of children aged 6–24 months who consumed fish in the past 24 hours was found in Western (38 percent of children) and Luapula (34 percent) provinces, which are rich in fish from the Zambezi River in the west and the wetlands of lakes Mweru and Bangweulu in the north. Mweru fisheries provide small, indigenous pelagic fish called *chisense* (*Poecilothrissa*

[31] See: https://www.dhsprogram.com/

Figure 7.13 Associations between inland small-scale fisheries and childhood nutrition during the first 1 000 days of life for three countries in sub-Saharan Africa and South-eastern Asia



Note: Associations are reported as significant at $p < 0.05$.

Source: National Statistics Office Malawi & ICF. 2017. *Malawi Demographic and Health Survey 2015–16;* Central Statistics Office MoH Zambia & ICF. 2014. *Zambia Demographic and Health Survey 2013–14;* National Institute of Statistics, Directorate General for Health & ICF. 2015. *Cambodia Demographic and Health Survey 2014;* World Wildlife Fund. 2019. Global Lakes and Wetlands Database (GLWD). In: *World Wildlife Fund.* Washington, DC. Cited 15 October 2021. www.worldwildlife.org/pages/global-lakes-and-wetlands-database; European Space Agency & UCLouvain. 2010. GlobCover 2009 (Global Land Cover Map). In: *European Space Agency.* ESA GlobCover 2009 Project. Cited 15 October 2021. http://due.esrin.esa.int/page_globcover.php

mweruensis) that are nutrient-rich (Funge-Smith, 2018; Kolding *et al.,* 2019). In comparison, the lowest share of children consuming fish (6 percent) was found in the eastern district, where there are almost no inland waterbodies supporting fisheries.

In Cambodia, the inland fisheries of Tonlé Sap and the vast Mekong Delta region are the largest in the world, boasting hundreds of fish species (Funge-Smith, 2018). A higher share of children had consumed fish in the past 24 hours in the districts of Kampong Chhnong (85 percent) and Kampong Thom (71 percent) on the southern end of Tonlé Sap, and in the districts of Takeo (73 percent) and Prey Veng (69 percent), covering the large Mekong Delta region. A lower share of children consumed fish in Banteay Mean district (31 percent) which is in north-eastern Cambodia, far from any waterbodies.

7.5.2 Dietary diversity in children and proximity to inland fisheries

Fish consumption was a driver of higher dietary diversity among children in all three countries in the analysis, regardless of other ASF intake (Figure 7.13).

Furthermore, in Malawi, households living closer to inland fisheries were more likely to be wealthier, suggesting the fisheries-related livelihoods that predominate may be an important source of income for rural households in the country. This association was not found in either Zambia or Cambodia. Notably, proximity of rural populations to formal markets[32] did not have an impact on fish consumption in the low-income countries studied. Indeed, in this analysis, children in rural Malawi and Zambia living closer to formal markets were less likely to consume fish than the rural children who lived further from formal markets. This supports previous observations that inland small-scale fisheries play an important role in food security and nutrition in rural environments in low-income countries in sub-Saharan Africa, where markets are informal and communities are more reliant on wild and subsistence food sources (Luckett *et al.,* 2015). As highlighted in Section 7.4, most food purchased is from the region rather than traded from elsewhere; hence wild foods, particularly fish from small-scale fisheries, are an important contributor to formal and informal markets. These findings highlight the importance of local small-scale fisheries in supporting food security and nutrition.

[32] Formal markets have permanent infrastructure and are often composed of businesses and enterprises that are taxed by governments.

However, the analysis also revealed that markets typically fail to distribute fish to areas distant from fished waterbodies, as already highlighted in Section 7.4. At the same time, intrahousehold distribution of fish and social norms around children eating fish can mean limited or delayed introduction of fish to children's diets (Bogard *et al.*, 2015a; Gibson *et al.*, 2020). These results support the ongoing need for interventions and management approaches that target improvements in fish distribution to leverage fisheries to improve food security and nutrition of children during the first 1 000 days of life. But it should be cautioned that local availability does not ensure access; the multiple dimensions that shape access to food – physical, economic and sociocultural – must also be considered.

7.6 Improving data quality to illuminate the magnitude and distribution of nutritional benefits from small-scale fisheries

Increasingly, the importance of small-scale fisheries as a vital source of nutrition in regions where deficiencies are commonplace is being recognized. Understanding both the magnitude and distribution (both spatially and among groups in society) of nutritional benefits from small-scale fisheries is fundamental to improving the management and sustainability of the subsector.

Shifting fisheries management towards incorporating nutrition indicators (or perhaps indicators of healthy diets) presents a challenge, but this goal is important to optimize the contribution of small-scale fisheries to SDG 2. As the most comprehensive global data effort on the diverse benefits of small-scale fisheries, the IHH initiative had ambitions to provide new data on a range of key nutrition indicators, synthesized across broad geographies. While a number of these exercises ultimately provided only limited new data, they offer important lessons for improving nutrition data for small-scale fisheries management.

7.6.1 Understanding national fish consumption

As a component of the CCS, national teams were requested to provide available data on consumption of fish from small-scale fisheries at representative scales (national and subnational), disaggregated by social groups vulnerable to undernutrition (e.g. women and children, the poor) (see Annex A for a more detailed description of case selection criteria and data collected). None of the 58 CCS provided consumption data specific to small-scale fisheries at scales beyond single communities or locations. Only 8 of 58 CCS teams were able to provide nationally representative consumption data for fish, obtained from national or subnational consumption surveys administered through governments or international organizations. Further, none provided data disaggregated by source (small- or large-scale fisheries, aquaculture, imports).

Where national-scale consumption data do not exist, *fish supply* is often used to calculate apparent fish consumption; accordingly, several CCS teams provided this in place of consumption data. Fish supply is calculated from fish production statistics, adjusted for international trade (import and export) and in some cases for non-food use. In this way, it provides what is often the best estimate of the quantity of fish available per capita for consumption. Although fish supply estimates provide a universal standardized metric to assess fish availability, they can be an inaccurate proxy for consumption due to challenges in monitoring and reporting of fish production and trade (e.g. informal and unregulated); losses along value chains prior to consumption that are not accounted for in calculations; and inequities in access, particularly among disadvantaged population groups (Box 7.3). Monitoring issues in particular become acute for small-scale fisheries (Desiere *et al.*, 2018; Fluet-Chouinard, Funge-Smith and McIntyre, 2018), where quality statistics are most needed. This is primarily due to the dispersed catch of these fisheries, as well as a lack of financial incentives to invest in monitoring (de Graaf *et al.*, 2011). As a result, the full contribution of small-scale fisheries to fish supply is not well known, and the subsector is substantially undervalued in global and national assessments of healthy and sustainable diets (Halpern *et al.*, 2019b).

7.6.2 Fish consumption among vulnerable population groups

Consumption data disaggregated by vulnerable group provide a critical input for better managing fisheries and meeting the targets of SDG 2, in particular ensuring that no one is left behind. Again, very few CCS teams were able to provide these data. Where available, disaggregation was by one or more of the following categories: sex, income, pregnant/lactating women, rural/urban women, and age (Box 7.4).

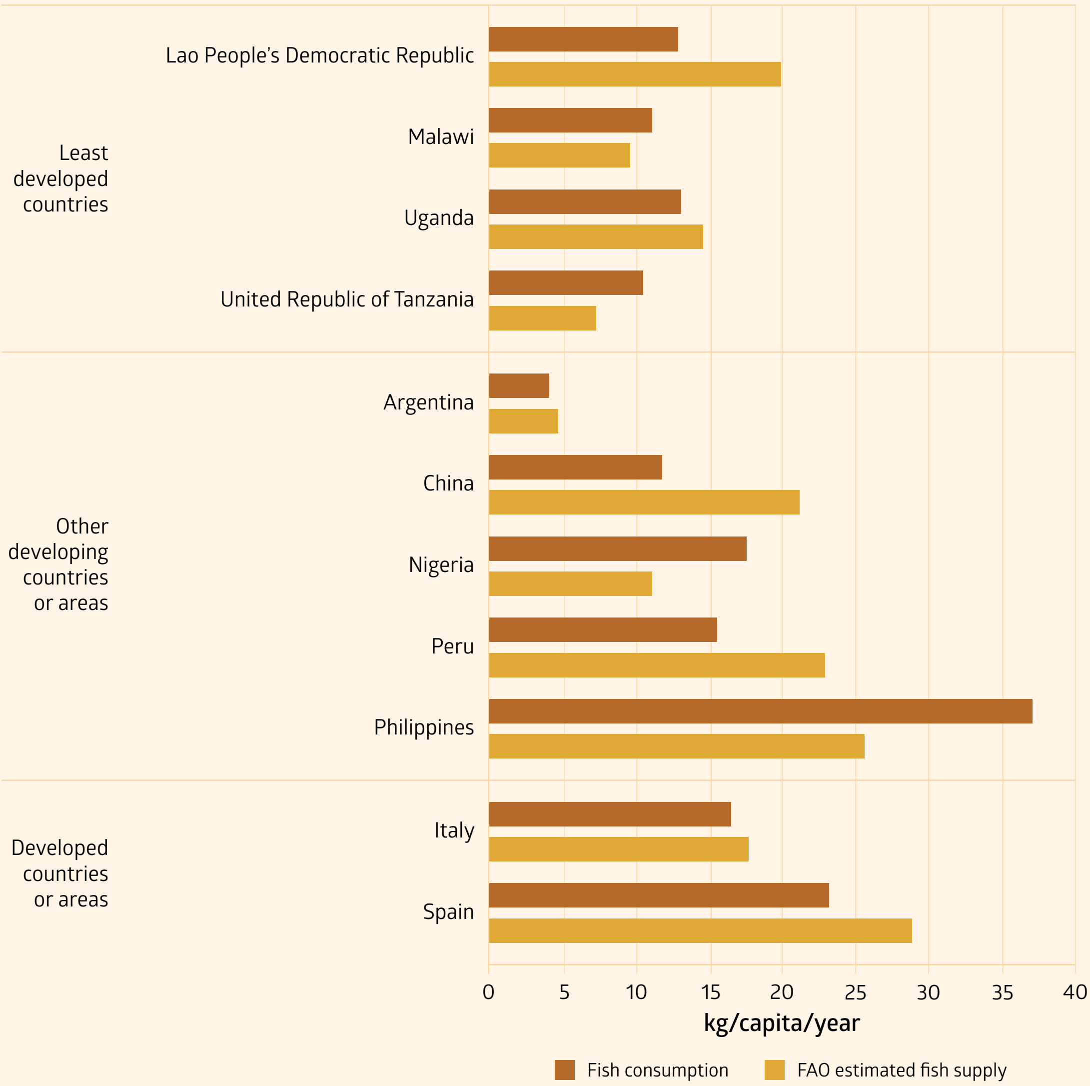
Box 7.3

Limitations of estimating consumption from supply statistics

To better understand the complexities of using supply data to estimate fish consumption, nationally representative finfish consumption data from the IHH country and territory case studies were compared with fish supply estimates from FAOSTAT (see figure below). As supply data used here are unadjusted for the portion of a fish that is edible and for post-harvest losses, it would be expected that per capita consumption figures would be lower than per capita supply.

However, in the 11 countries analysed, measured consumption was higher than supply in 4 countries, and lower in the remaining 7. In the Philippines, measured fish consumption was 40 percent higher than supply estimates, implying there may potentially be 1.1 million tonnes (minimum) of edible fish that are unaccounted for in production and trade figures. These differences are likely due to methodological issues with measuring fish consumption at national scales.

Figure. Comparison of fish supply and consumption (kg/capita/year) in countries for which nationally representative consumption data were available, by development context



Box 7.3 Cont

Notes: Development context for countries or areas is broken down according to United Nations categories (least developed, other developing and developed). Numbers indicate the quantity of fish (kg/capita/year). Supply and consumption figures are for the same year in most instances, and for the closest available year in others. Country consumption data were obtained from IHH country and territory case studies (n = 8) and the FAO/WHO Global Individual Food consumption data Tool (GIFT) (n = 3), where fish consumption was reported from national representative consumption surveys. FAO fish supply data were obtained from FAOSTAT Food Balance Sheets. Fish supply was calculated by summing supply calculations for freshwater fish, demersal fish, pelagic fish and marine fish (other).

Sources: FAO & WHO. 2017. National Food Consumption Survey Lao PDR 2016–2017. In: *Global Individual Food consumption data Tool*. Rome, FAO; FAO & WHO. 2013. Subnational consumption survey in Rosario, Argentina, 2012–13. In: *Global Individual Food consumption data Tool*. Rome, FAO; FAO & WHO. 2006. National food consumption dataset in Italy from 2005–2006. In: *Global Individual Food consumption data Tool*. Rome, FAO; FAO. 2021. Database for fish and animal protein supply quantity. In: *FAOSTAT New Food Balances*. Rome. Cited 15 October 2021. https://www.fao.org/faostat/en/#data/FBS

7.6.3 Opportunities for improving quality of consumption data

The CCS highlighted the difficulties associated with obtaining fish consumption data that provide the required detail to be instrumental in developing policy and shaping management approaches focused on optimizing nutrition outcomes. The international scientific literature contains a diversity of output from research programmes that provide some localized data of the type required. That CCS expert teams were often unable to access these data should be a clarion call to the research and development communities to improve communication of research findings and availability of data. Data and associated analysis published only in international scientific journals are often inaccessible, and therefore of little value, to managers and even scientists in less developed countries. Recognizing data and information formats and analytical presentations that are accessible and usable in management is central to advancing science-based decision-making in management.

The inability in most instances to identify fish consumption data disaggregated by source (small- and large-scale fisheries, aquaculture, imports) limits the ability to enact policies that are relevant to the conditions and needs of small-scale fisheries. As illustrated in the examples here and elsewhere (Bogard *et al.*, 2017; Marinda *et al.*, 2018; Needham and Funge-Smith, 2015), appropriately designed and targeted dietary surveys can shed light on the variation and inequities in fish consumption, and thereby provide important entry points for policy decisions. Additionally, high-quality consumption data disaggregated by source can be used to estimate fish catch, which is particularly important for small-scale fisheries in remote areas where catch monitoring is expensive (Allison and Mills, 2018; Fluet-Chouinard, Funge-Smith and McIntyre, 2018).

There are opportunities to build on existing survey instruments to obtain data highly relevant to improving nutrition-sensitive management, and ultimately the nutrition outcomes from small-scale fisheries (see analysis in Section 7.4; also Chapter 9). A select few national-level household surveys conducted in parts of sub-Saharan Africa (Béné *et al.*, 2012) and Asia (Needham and Funge-Smith, 2015) illustrate approaches that can be adopted to obtain the type of data required. The World Bank's LSMS conducted in sub-Saharan Africa (see Section 7.4) provides an excellent, adaptable fishery module for tackling data gaps (Béné *et al.*, 2012). Uniquely, this module collects consumption data on fish looking at form consumed (e.g. dried or fresh), household livelihood engagement and household location, allowing for in-depth analysis of geographical factors influencing fish consumption (e.g. proximity to fisheries) and subsistence fishing. In Bangladesh, nationally administered household income and expenditure surveys gather information on fish consumption by species. Together with fish production data, this information allows for the disaggregation of fish catch by source – i.e. from capture fisheries or aquaculture. This facilitates the evaluation of the relative contribution that each sector makes to nutrition over time (Bogard *et al.*, 2017), which is important in shaping policy.

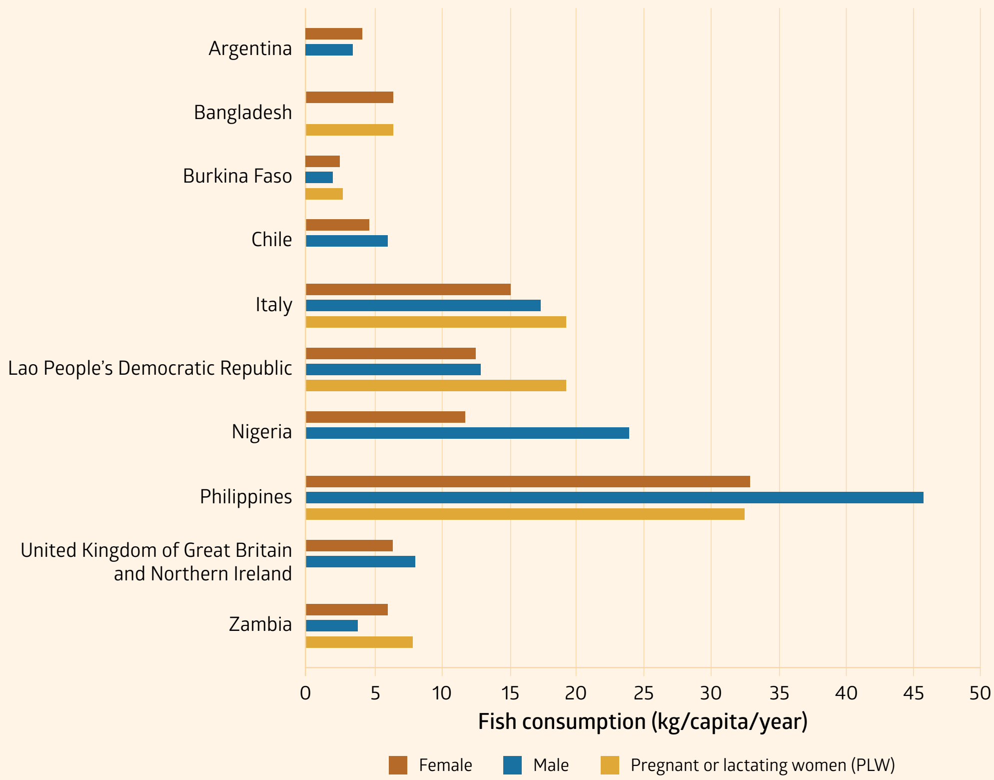
The development of specific fishery modules appended to existing national household or agricultural survey instruments, as well as reporting on disaggregated fish consumption in individuals, presents a plausible pathway to improved data quality. The examples given here are illustrative of approaches to survey design that, if adopted more broadly, would substantially improve the precision of national, regional and global accounts of the role of fish in diets and food systems (Halpern *et al.*, 2019b). Linked to nutrition indicators as part of nutrition-sensitive fisheries management approaches, these data can become a powerful tool in optimizing the nutritional contributions of aquatic foods.

Box 7.4

Sex-disaggregated fish consumption data from IHH country and territory case studies

Women and men have different nutrition needs, and fish can be particularly important to the nutrition needs of pregnant or lactating women.[a] Gender-disaggregated fish consumption data were available for only 9 of the 58 IHH country and territory case studies. In six of these, women consumed lower quantities of fish than men. This disparity was highest in Nigeria and the Philippines, where women consumed 1.5–2 times less fish than men – the greatest difference being by 12 kg/capita/year in Nigeria. Data on fish consumption in pregnant or lactating women were available in six countries. In Italy, Lao People's Democratic Republic and Zambia, fish consumption by pregnant or lactating women was higher than the average for all women, while for Burkina Faso, the Philippines and Bangladesh, the two groups consumed equal amounts.

Figure .[b] Fish consumption (kg/capita/year) for women, pregnant or lactating women (PLW) and men, in countries where data were available



Notes: **a** Grandjean, P., Bjerve, K.S., Weihe, P. & Steuerwald, U. 2001. Birthweight in a fishing community: significance of essential fatty acids and marine food contaminants. *International Journal of Epidemiology*, 30(6): 1272–1278; Imhoff-Kunsch, B., Briggs, V., Goldenberg, T. & Ramakrishnan, U. 2012. Effect of n-3 long-chain polyunsaturated fatty acid intake during pregnancy on maternal, infant, and child health outcomes: a systematic review. *Paediatric and Perinatal Epidemiology*, 26(s1): 91–107; Lucas, M., Dewailly, É., Muckle, G., Ayotte, P., Bruneau, S., Gingras, S., Rhainds, M. & Holub, B. 2004. Gestational age and birth weight in relation to n-3 fatty acids among inuit (Canada). *Lipids*, 39(7): 617–626.
b Country data in this figure were obtained from IHH country and territory case studies (n = 4) and the FAO/WHO Global Individual Food consumption data Tool (GIFT) (n = 6) from national or subnational representative consumption surveys, as follows: FAO & WHO. 2013. Subnational consumption survey in Rosario, Argentina, 2012–13. In: *Global Individual Food consumption data Tool*. Rome, FAO; FAO & WHO. 2010. Food consumption survey in two provinces of rural Burkina Faso. In: *Global Individual Food consumption data Tool*. Rome, FAO; FAO & WHO. 2006. National food consumption dataset in Italy from 2005–2006. In: *Global Individual Food consumption data Tool*. Rome, FAO; FAO & WHO. 2017. National Food Consumption Survey Lao PDR 2016–2017. In: Global Individual Food consumption data Tool. Rome, FAO; Gomna, A. & Rana, K. 2007. Inter-household and intra-household patterns of fish and meat consumption in fishing communities in two states in Nigeria. *British Journal of Nutrition*, 97(1): 145–152; FAO & WHO. 2009. The 2009 Food consumption and Vitamin A status survey in Zambia. In: *Global Individual Food consumption data Tool*. Rome, FAO; FAO & WHO. 2008. HarvestPlus Bangladesh Dietary Survey. In: *Global Individual Food consumption data Tool*. Rome, FAO.

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8.

Global patterns of management and governance of small-scale fisheries:

contributions towards the implementation of the SSF Guidelines

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8.1 Key findings and messages

The management of small-scale fisheries and governance of tenure

- The analysis of small-scale fisheries in this chapter showed that management rights are formally granted to fishers in nearly 75 percent of countries included in the study,[33] governing more than one-third of the marine (35 percent) and inland catch (39 percent) reported for these countries.

- Co-management policies and the amount of catch governed by them were analysed for 55 percent of the estimated global small-scale fisheries catch. Results show that at the national level, 40 percent of the catch comes from fisheries with formal co-management provisions, but according to experts' perceptions, only half of these involve a high level of fisher participation in co-management arrangements. Co-management is more common at the local level but, nevertheless, while 90 percent of the catch comes from fisheries with local co-management provisions that are formal, only 40 percent are perceived to involve a high level of fisher participation.

- In order to further strengthen the role of fishers in decision-making processes, more effort is needed to create local enabling conditions for them to be able to exercise their tenure rights. This can be accomplished through local supporting institutions, such as civil society organizations (CSOs) and decentralized fisheries agencies with clear roles and responsibilities.

- Combining management rights with the rights of exclusion and transferability can also increase fishers' empowerment to manage their fisheries, as long as processes and the outcomes for exclusion and transfers respect the principles of fairness and equity in line with the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines). This fuller form of devolved rights is currently very limited in formal small-scale fisheries laws and regulations, governing less than 5 percent of catch.

- For most fishers, there is often a lack of clear mechanisms for participation in national decision-making processes. The majority of formal small-scale fisheries policies that grant management rights to fishers only have jurisdiction in small geographic areas, not throughout the entire country. As a consequence, fishers' ability to

[33] Similar results were found by an independent survey conducted by FAO in 2020, where 81 percent of FAO Member Nations (n = 92) reported involvement of fishers in fisheries management (FAO, 2021g).

participate in and influence national-level decision-making processes is likely to be limited. Developing national-level spaces for the participation of fishers, their organizations and their supporters could help to address current limitations.

- State policies have often failed to protect indigenous fishers' tenure rights, who have as a result experienced loss of rights to access, harvest and manage resources, thus threatening the survival of their culture and way of life. Attempts to correct colonial legacies have prompted some states to take measures distinguishing indigenous fishers from non-indigenous small-scale fisheries, and to legally recognize indigenous rights to land and water. Although six countries in the Illuminating Hidden Harvests (IHH) dataset reported fisheries laws that acknowledge distinct rights for indigenous fishers, these laws are rarely implemented; yet their existence creates leverage for indigenous fishers.

Factors influencing governance and management effectiveness

- Social and cultural identity plays a vital role in the viability and day-to-day organization of small-scale fisheries, determining who is part of a group and who is not. This influences how management and governance is locally received, shaped or resisted, and ultimately how effective it is. Incorporating social and cultural identity into small-scale fisheries policy research requires complementing quantitative and technical research with qualitative and interpretative studies of how small-scale fisheries work in practice, as well as acknowledging fishers and fishing communities themselves for the valuable insights they can give.

Civil society organizations

- The analysis of the goals of more than 424 producer organizations shows that there is high alignment between the goals of fishers and the goals of the SSF Guidelines, indicating fishers are active contributors to SSF Guidelines implementation and not passive recipients of state action.
- The analysis also shows that most fishers' organizations see high compatibility between sustainable fisheries management and human well-being, as practically all of them expressed goals related to harvesting and sustainable fisheries management, with about 60 percent also expressing goals related to human well-being, labour rights, food security, or to human and environmental health.

Contributions to the Sustainable Development Goals (SDGs), in particular Target 14.b

- An analysis of coastal preferential access areas for small-scale fisheries showed they are a commonly used spatial tool in all regions of the world for marine fisheries. In a sample of 52 countries the median coverage of such areas was 3 percent of the exclusive economic zone (EEZ). While coverage varies between countries, this median shows that preferential access for small-scale fisheries globally is very low. As small-scale fisheries are likely to be the largest employer in the ocean economy, greater attention to securing access to resources for small-scale fisheries through preferential access areas could also be an important mechanism towards achieving SDG 1 (No poverty).
- Licensing is the most commonly used tool in legislation for regulating access to resources for small-scale fishers. While licensing regulations govern about 70 percent of marine and inland small-scale fisheries catch, only about 45 percent of the catch they govern is paired with devolved rights. Licensing on its own is least likely to empower fishers and fishworkers, and thus their ability to participate in decision-making processes concerning their fisheries is limited. With some less commonly used access strategies such as place of residence or history of use, tenure rights are devolved in more than 95 percent of cases, thereby making them better suited to contribute to SDG Target 14.b ("Provide access for small-scale artisanal fishers to marine resources and markets"). Yet, currently these alternative management approaches govern less than 30 percent of marine and inland small-scale fisheries catch.

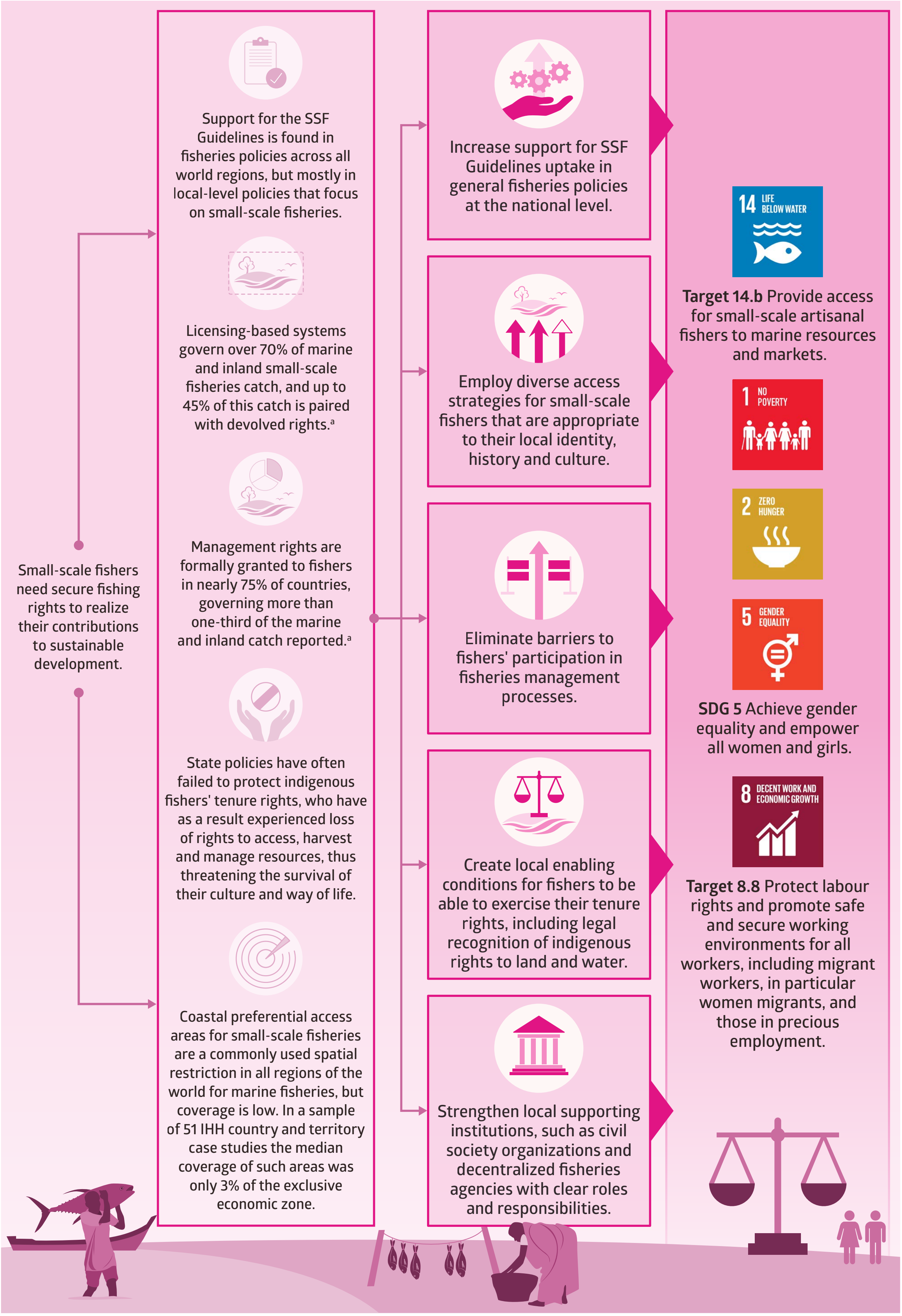
Figure 8.1 describes the ways in which small-scale fishers can secure fishing rights, ultimately supporting their contributions to sustainable development.

8.2 Introduction

Governance has been a fundamental component of societies since the beginning of human civilization, but in recent decades the concept of governance has been discussed more and more frequently as the world grapples with the many challenges of sustainable development at local, national and global levels. The importance of good governance cannot be overestimated: it has been described by the United Nations as being "perhaps the single most important factor in eradicating poverty and promoting development" (UN, 1998).

From these discussions, many definitions of governance have been put forward by organizations and individuals, including FAO (FAO, 2021f), the World Bank (Ringold *et al.*, 2012) and the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP, 2008), among others. The definition used for the purposes of this chapter can be summarized as, "the formal policies in place to manage small-scale fisheries through interaction between governments and the public in particular regarding access to and use of fishing resources..."

Figure 8.1 Key pathways through which securing rights to fishing resources for small-scale fishers can contribute to sustainable development



Note: **a** Based on 52 IHH country and territory case studies.

In essence, governance involves the means and processes by which decisions are made and put into practice. Good governance therefore requires the existence of effective and efficient institutions to facilitate those processes. Depending on several factors (e.g. the scope of the governance), the institutions may be formal, legislated entities, or informal systems based on social relationships. Critically, they should be accepted by society as being legitimate; in turn, society should participate in and be empowered by them. From this starting point, good governance can be broken down into eight primary elements. It should be participatory; adhere to the use of legal frameworks that are fair and just; be transparent in making and implementing decisions; be responsive to stakeholders; involve mediation between different groups and consensus-building; be equitable and inclusive; function effectively and efficiently; and be accountable to its stakeholders and the public (UNESCAP, 2008).

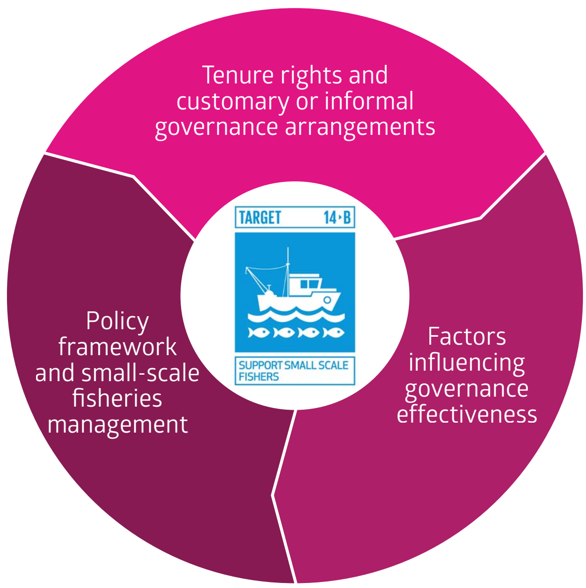
These eight elements are encompassed in the Guiding Principles (Chapter 3) of the SSF Guidelines, which go into greater detail on what is required for governance, with an emphasis on vulnerable and marginalized groups. Thus, for example, the principles reference the need to respect human rights and dignity, ensure gender equality and promote justice, alongside the importance of consultation, social responsibility and the rule of law.

The considerations embodied by the modern ideas of governance are a result of a transition that occurred during the later decades of the twentieth century, away from the more limited conceptualization of conventional fisheries management towards this broader, holistic understanding of governance. The earlier approaches to fisheries management were strongly influenced by natural scientists and managers, and thus they tended to focus on biological sustainability. Social and economic considerations were typically taken into account separately, usually through top-down or informal processes (Garcia and Cochrane, 2009; Berkes, 2015). The failings of these approaches are well known (e.g. Hardin, 1968; FAO, 2003), and have prompted a growing awareness of the importance of all the elements of good governance for securing sustainable development (Ostrom, 1990).

This chapter explores the characteristics and scope of governance in small-scale fisheries, and also how this differs between countries and fishery units. In particular, the chapter considers three distinct but interacting components of fisheries governance (Figure 8.2): i) the policy framework and management of small-scale fisheries in relation to environmental, social and economic objectives; ii) the status of tenure rights in fisheries, including the role of customary or informal governance arrangements, especially community-based management; and iii) factors influencing governance and management effectiveness. In this way, the chapter addresses the following key research questions: What does the policy framework governing small-scale fisheries look like, and how well aligned is it with the SSF Guidelines? What are the main management tools used to govern small-scale fisheries, and how much catch is governed through them? How is access governed in small-scale fisheries? What formal rights do fishers have to manage small-scale fisheries, and how much catch is governed through the devolution of rights to fishers?

The chapter is organized to provide the reader with assessments of the different components of governance from case studies that, in combination, represent about 55 percent of the reported global small-scale fisheries catch. The assessments are based on policies that have been formalized in writing, not (unless explicitly noted) on evaluations of whether and how the diverse governance arrangements are implemented. After a brief description in Section 8.3 of the methods employed in the chapter, Section 8.4 describes the prevalent policy frameworks in small-scale fisheries. Section 8.5 then analyses the management of the subsector, focusing on the most frequently used strategies to grant access to small-scale fisheries and the most common harvesting management measures in place. It also examines which measures are empirically associated with more devolution of rights to fishers, and which are associated with less. Section 8.6 focuses on governance of tenure for both formally and customarily governed small-scale fisheries. The issue of devolution of rights is further explored here, as well as how scale of operation and income of fisheries affect the nature of governance. Section 8.7 summarizes important factors *influencing* governance and management effectiveness, including the participation of fishers in co-management.

Figure 8.2 The three components of small-scale fisheries governance



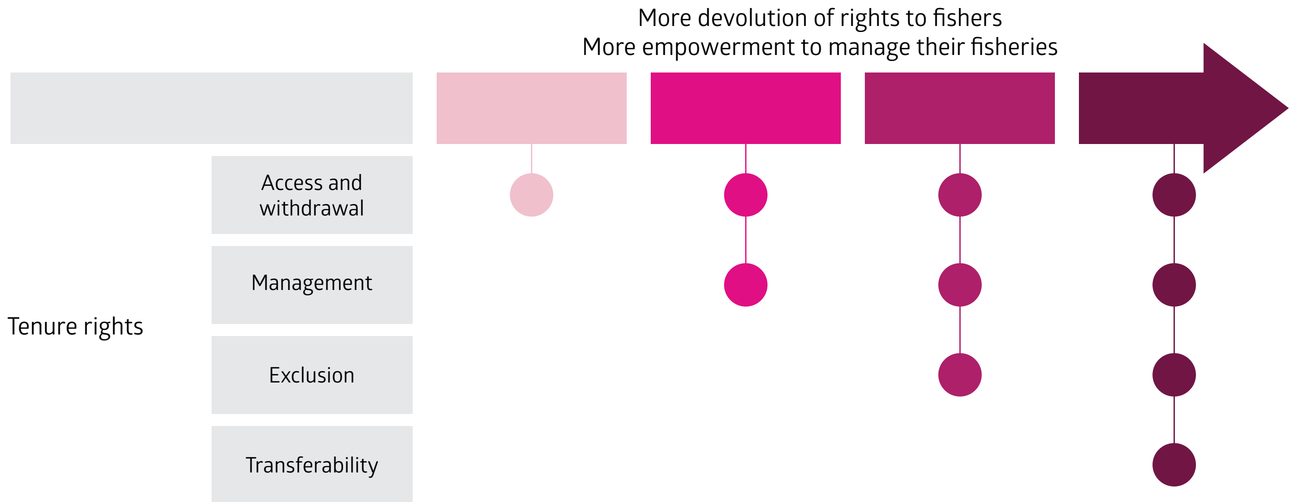
Section 8.8 brings to light the usually overlooked but key role of CSOs in small-scale fisheries governance, providing some initial snapshots of global patterns of CSO alignment with the SSF Guidelines and SDGs. Last, Section 8.9 ties together the main findings from the chapter with the contributions that small-scale fisheries governance systems can make to the SDGs, in particular Target 14.b in regard to securing access to fishing areas.

The nature, status and impacts of tenure rights in the different fishery units considered in the Illuminating Hidden Harvests (IHH) study form a central theme in this chapter. It is generally accepted that long-term sustainability will not be secured under open-access regimes (Berkes, 2015), and hence small-scale fishers and fishing communities require secure access to resources. However, at present, access to many small-scale fisheries remains unregulated (Arthur, 2020; FAO, 2020b). Tenure rights (sometimes referred to as property rights) limit access by authorizing who can use resources and the conditions under which those resources can be used (Figure 8.3). They can also include rights concerning management of resources, typically through some form of co-management with the government, as well as the rights of exclusion and transferability (FAO, 2015; Schlager and Ostrom, 1992; World Bank, 2012). Tenure rights are therefore at the heart of governance. There have been both successes and failures with different systems of rights, and the details of the approaches need to be tailored to each fisheries context. Still, the available evidence indicates that a suitable system of tenure rights that provides users with adequate control in decision-making through devolution and decentralization of authority and management, as well as the enforcement of regulations, also provides the incentives to strive for responsible management and sustainable use of resources (Agrawal and Ostrom, 2001; Berkes, 2015; Ostrom, 2009; Schlager and Ostrom, 1992).

In order to be effective, devolution and decentralization measures require the capacity, at the devolved level, to fulfil the necessary obligations and functions of authority and management. This is often a challenge for fisheries of all types, typically requiring support from government fisheries authorities to supplement and complement stakeholder capacity as required. These authorities are often relatively well equipped and experienced in providing support to national, commercial fisheries through systems of co-management, but less so when it comes to small-scale fisheries, which are typically more diverse in the species they target and gear types they use. Insufficient and inappropriate management, made worse in some cases by disruption of customary practices in tenure, have failed to address the ecological, social and economic crises that confront so many small-scale fishers.

As this management problem has been increasingly recognized, there has also been growth in the use of co-management[34] approaches in small-scale fisheries worldwide. This is not a guarantee of success, but research has demonstrated that where important attributes are present, such as suitable institutional frameworks, strong leadership and social cohesion, co-management can lead to improved ecological, social and institutional

Figure 8.3 Different types of tenure rights often granted to fishers



Source: Modified from Schlager, E. & Ostrom, E. 1992. Property-rights regimes and natural resources: a conceptual analysis. *Land Economics,* 68(3): 249–262.

[34] Co-management constitutes a partnership arrangement in which government, the community of local resource users (fishers), external agents (non-governmental organizations, research organizations), and sometimes other fisheries and coastal resource stakeholders (boat owners, fish traders, credit agencies or money lenders, tourism industry, etc.) share the responsibility and authority for decision-making over the management of a fishery. See full definition and references in the glossary.

Box 8.1

Devolution rights index

The devolution rights index considers three levels of devolution based on rights of management, exclusion and transferability: **partially devolved**, when any one of these rights is devolved to fishers; **mostly devolved**, when any two are devolved; and **fully devolved**, when all three rights are devolved at the same time in a fishery.

outcomes (Cinner *et al.,* 2012b; d'Armengol *et al.,* 2018; Gutiérrez, Hilborn and Defeo, 2011). The relationship between rights-based natural resources management and the devolution and decentralization of authority, as well as the factors influencing governance and management effectiveness, are therefore also addressed in this chapter.

Providing fishers with tenure rights of access and withdrawal (e.g. the right to access fishing areas and the right to harvest fish from them) constitutes the basis for just and effective small-scale fisheries management. But when fishers are also devolved the rights of management, exclusion and transferability,[35] coupled with supportive institutional structures, they become significantly more empowered to manage their fisheries. To synthesize and summarize the large diversity of tenure rights found in small-scale fisheries around the world, the tenure rights classification system (Figure 8.3) of Schlager and Ostrom (1992) has proven useful. By paying attention to five different broad types of tenure rights (i.e. access, withdrawal, management, exclusion and transferability) granted by governments through legislation or through national, subnational or local policy, it has been possible to measure the devolution of rights across the thousands of fisheries included in this report. To that end, a simple "devolution rights index" is used throughout the analysis in this chapter (Box 8.1).

In the analysis, it was assumed that the more different types of rights are devolved, the more empowered fishers are to manage their fisheries.[36] Fishers are then more likely to contribute to social and ecological objectives, because of the range of control they have over the fishery process (Ostrom, 2005). Linking the devolution of rights to management also provided a proxy to evaluate the potential contributions of a fishery unit to the SDGs. In particular, in this chapter attention is paid to progress towards Target 14.b: "Provide access for small-scale artisanal fishers to marine resources and markets." This target is also addressed in the economic and gender chapters (Chapters 5 and 6), given the important role women play in the value chain.[37]

The nature and role of policy frameworks in the governance of small-scale fisheries is another aspect explored here. The SSF Guidelines call for policies and management measures compatible with a human rights framework to be developed through consultation with small-scale fishers (FAO, 2015), which implies the need for local-level policies that reflect the realities and context of these fishers and their communities (Allison and Ellis, 2001), including differences between marine and inland fisheries. How well these needs are being met is examined by considering the impacts of different types of policies on small-scale fisheries governance and, particularly, differences between policies that address the fisheries sector as a whole and those aimed specifically at small-scale fisheries. Other factors likely to impact on governance are also examined, including the scale of operation of fisheries and national income level.

Policies, laws and regulations are important for fisheries governance, but social relationships – especially in small-scale fisheries – also play an important part. Well-connected networks, trust and cohesive communities have been found to be key factors contributing to effective co-management (Gutiérrez, Hilborn and Defeo, 2011). The role of social relationships in governance, and the importance of taking these relationships into account in developing and implementing formal governance systems and arrangements, is therefore also an important component of this chapter.

[35] As per Schlager and Ostrom (1992), management is the right to regulate internal use patterns and transform the resource by making improvements. Exclusion is the right to determine who will have an access right, and how that right may be transferred. Transferability (or alienation) is the right to sell or lease either or both of the above collective choice rights.

[36] It is always possible that one right (e.g. management) could allow for most or all control over a fishery, and therefore the addition of other rights (e.g. exclusion and transferability) would have little or no additional effect. However, in general, because these rights have different functions, the more different types of rights are devolved to fishers, the more in control they will be of their fisheries.

[37] The focus of this chapter is on the access to marine resources component of SDG Target 14.b. Access to markets is addressed in Chapter 5.

8.3 Methods

The analyses provided in this chapter were mostly based on three independent sources of data. The first source was the IHH governance dataset, consisting of 976 formal policies from the IHH case studies of 52 countries and territories,[38] plus the associated catch (in tonnes) and other metadata related to these policies. All of these policies influence the management of the 2 169 fishery units around the world covered in this study. The IHH approach has made it possible, for the first time, to link policies to small-scale fisheries catch as a way to estimate the relative importance of different policy types.[39] A detailed description of country and territory case study (CCS) selection criteria and the general IHH methodology is provided in Annex A (with specific caveats and methodological nuances described in footnotes throughout this chapter, as relevant). Altogether, the policies analysed formally govern about 83 percent of the reported small-scale fisheries catch, representing 55 percent of estimated global catch. The second data source for this chapter was the FAOLEX fisheries legislation database.

The database was consulted throughout 2019 and 2020, mostly to verify and complement the policy information obtained through the CCS (for example, 38 of the CCS were missing policies). This review also resulted in the addition of inland countries to the analysis, which is noted in the text where relevant. To build confidence that the most complete dataset on small-scale fisheries policies was being analysed, the entire body of fisheries policies found in FAOLEX was coded for the 19 top producing countries (in terms of catch).[40] The third data source was a global database of 717 fisheries CSOs compiled by Duke University, consisting of CSO characteristics (type of organization, location, main goals, membership, etc.) captured through an online survey. The survey was deployed in English, French and Spanish through a network of Duke and FAO contacts, using a "snowball" sampling approach. In addition to these data sources, thematic studies on social and cultural identity in small-scale fisheries and on indigenous small-scale fisheries were undertaken by experts in these fields.

8.4 Small-scale fisheries policy framework

The small-scale fisheries policy framework refers to the laws, regulations, policies, plans or strategies (hereafter referred to as "policies") governing small-scale fisheries: i.e. concerning what, where, when and how to fish. The diversity and complexity of these policies cannot be overstated. Different national, subnational and local fisheries policies can have jurisdiction over the same fishery at any given time, sometimes regulating different components or sometimes governing the same activity. The issue can be confounded when multiple authorities have jurisdiction over the same areas of fishing activity, as it can be with energy generation, shipping or protected areas (for inland fisheries cases, see Song *et al.*, eds., 2017).

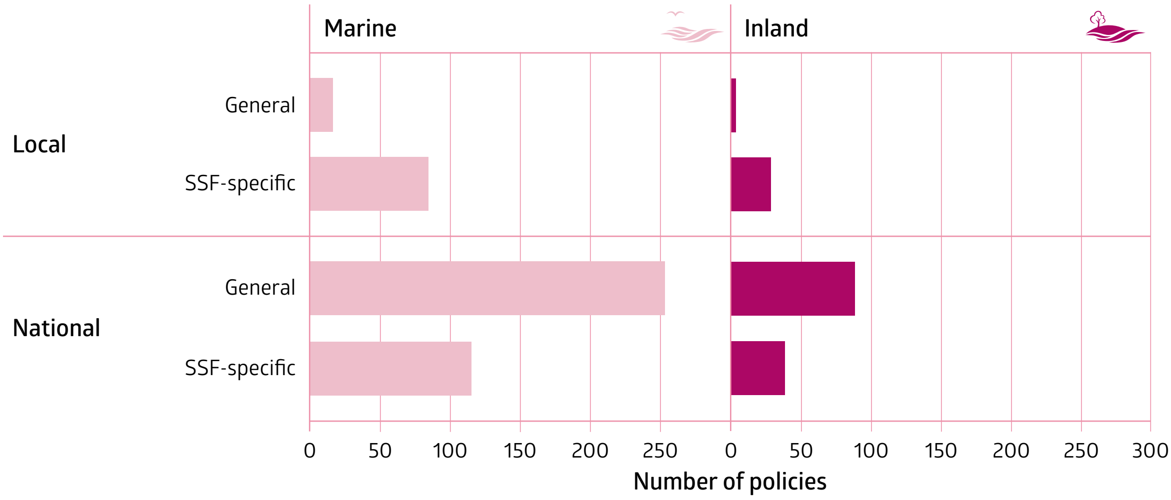
While it was not possible to attend to all the complexity surrounding the governance of small-scale fisheries, this section contributes to the development of an initial, basic understanding of the characteristics of marine and inland small-scale fisheries frameworks by identifying three major characteristics of policies affecting governance: (i) policy focus – whether policies apply to all fisheries or only to small-scale fisheries; (ii) policy level – whether policies apply to all national waters or only to local jurisdictions; and (iii) policy integration – whether policies focus only on production or incorporate other considerations that affect fishers' livelihoods, in line with the aims of the SSF Guidelines (e.g. social, environmental and economic sustainability, or participation in management). Finally, the amount of

[38] Six countries did not provide governance data. However, including the 58 IHH countries and territories was appropriate for certain analysis. The number of countries included in each analysis is indicated where appropriate.

[39] Important caveats: It was assumed that the entirety of a fishery unit was governed by an arrangement. As such, an arrangement was assumed to apply to the full spectrum of particular attributes of the fishery unit (its catch, the species included, etc.) that it governed. Given that countries define fishery units in different ways, it is likely that some governance arrangements in the study did not apply to entire fishery units: for example, when the arrangement covered an area smaller than the fishery unit, or when the arrangement was restricted to only some species caught or to certain types of gear used in that unit. In these cases, the analyses possibly led to the overestimation of the catch governed by certain arrangements. It is also important to note that not all fishery units had available catch data. Therefore, all results that took catch into consideration should be understood in terms of reported catch. In addition, for 17 percent of this global reported catch there was no information on governance arrangements. However, this catch was still included as the denominator of calculations for "percent of total catch". For this reason, the amount of governed catch is likely an underestimation. Given the sources of overestimation and underestimation, no artificial weights were implemented in the estimations of governed catch to account for these issues.

[40] FAOLEX is a natural resources policies database maintained by FAO for all Member Nations. It is the most comprehensive depository of fisheries legislation to date. While it cannot be guaranteed to contain the most up-to-date legislation for all Member Nations, it is to our knowledge the best source available to complement the governance arrangements provided by the CCS.

Figure 8.4 .Distribution of marine and inland small-scale fisheries (SSF) policies (in absolute numbers) by policy level and focus, based on 625 policies from 44 countries and territories



catch governed by each type of policy was used as a measure of the relative importance countries give to these policies.

Policy focus was determined using two categories: general fisheries policies, and those specific to small-scale fisheries (for brevity, referred to as "SSF-specific"). General fisheries policies are those that refer to fisheries without explicitly distinguishing between small-scale and large-scale fisheries. SSF-specific policies are those that make explicit reference to only small-scale fisheries in the description of the policy provided by the CCS authors or coded from the FAOLEX database. When policies explicitly refer to both, they have been categorized as general fisheries policies.

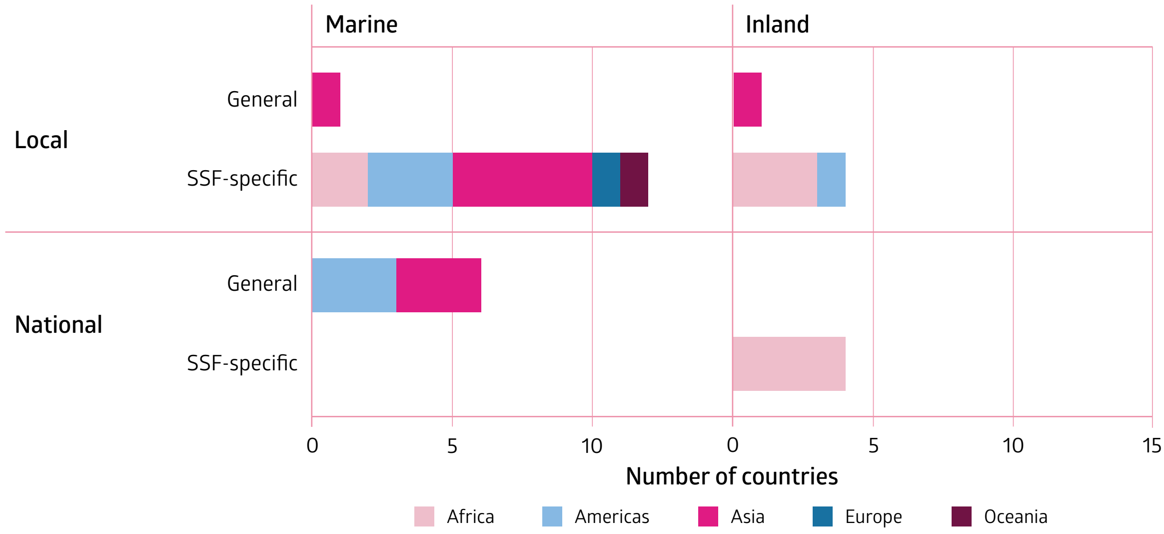
Figure 8.4 provides a first look at the distribution of small-scale fisheries policies based on their different characteristics. It shows that at the national level, there is a larger number of general fisheries policies than policies that focus solely on small-scale fisheries, while at the local level the opposite is true. These general patterns apply to both marine and inland fisheries.

In the analysis, it was encouraging to find that most countries around the world have developed national and local policies that specifically target small-scale fisheries. This finding is supported by recent national-level analyses in Kerezi *et al.*, eds. (2020) on a number of selected countries, as well as a recent FAO 2020 Code of Conduct questionnaire indicating that about 70 percent of Member Nations have small-scale fisheries policies in place.[41] Yet, the existence of SSF-specific policies cannot necessarily be taken as an indication they are well suited to support the responsible use of fisheries resources and the sustainable socioeconomic development of small-scale fishers and fishworkers (FAO, 2015). Even more concerning are the general fisheries policies based on revenue-generation and commercialization models – inspired by large-scale fisheries and "classical" natural resource harvesting paradigms – which, although they do not have the non-production functions, needs and characteristics of small-scale fisheries in their purview (e.g. food security and nutrition), are still used to govern small-scale fisheries (e.g. Twongo, Reynolds and Mwene-Beyanga, 1991; Berkes *et al.*, 2001; Bavington, 2002; Malasha, 2003; Hortle, Lieng and Valbo-Jorgensen, 2004; Bavinck, 2005; Opondo, 2011; Kolding, Béné and Bavinck, 2014; Tezzo *et al.*, 2018; Smith and Basurto, 2019). Inland fisheries experts have also described instances where colonial authorities have conceptualized fisheries only as revenue extraction activities that focus on species of economic value rather than also considering their value for local food security and livelihoods (Kolding and van Zwieten, 2011; Singh and Gupta, 2017; Kolding *et al.*, 2019). Experts argue that this tendency has persisted in those larger inland fisheries that can be operated along commercial lines, with the management approach often borrowing heavily from marine stock management models (Hickling, 1953; Kolding and van Zwieten, 2011; Kolding *et al.*, 2019).

As an initial approach to assess the degree to which general and SSF-specific fisheries policies might promote the contribution of small-scale fisheries to responsible fisheries management and sustainable development (Part 2 of the SSF Guidelines) and ensure an enabling environment and supporting implementation (Part 3 of the SSF Guidelines), the analysis in this chapter counted the number of countries whose policies included mentions of themes from Part 2 and Part 3 of the SSF Guidelines. For example, themes included the responsible governance of tenure; sustainable resource management; social development, employment and decent work; gender equality; and disaster risks and

[41] Table 77 of the 2020 FAO questionnaire asked respondents to state yes or no to the existence of laws, regulations, policies, plans or strategies that specifically target or address the small-scale fisheries subsector. See FAO, 2021g.

Figure 8.5 Distribution of countries by world region that have fisheries policies which mention topics in support of the SSF Guidelines. Based on an analysis of 52 countries and territories, with 30 found to have such policies (5 in the Americas, 14 in Africa, 8 in Asia, 1 in Europe and 1 in Oceania)



Note: Policies are organized based on two main characteristics: political jurisdiction (national or local) and fisheries focus (general or specific to small-scale fisheries [SSF]).

climate change.[42] The results (Figure 8.5) show that topics in support of the SSF Guidelines are mentioned more often in local-level SSF-specific fisheries policies than in national-level general fisheries policies, and more regions of the world are represented in marine than in inland fisheries.

The above findings do not account for the possibility that the social, economic, environmental, gender and governance dimensions of small-scale fisheries might be addressed through policies outside of the fishing sector, as investigating non-fisheries policies was outside of the scope of this chapter. These findings suggest the need for better alignment between national, general fisheries policy frameworks and the SSF Guidelines. See also Kerezi *et al.*, eds. (2020) for some country-level examples.

Finally, the importance of fisheries policies was quantified in terms of the percentage of catch they govern. Figure 8.6 shows catch governed by general fisheries policies, SSF-specific fisheries policies, or both. While in marine small-scale fisheries 68 percent of catch is governed by both general and SSF-specific fisheries policies, in inland systems this proportion is only 32 percent, with the highest proportion of catch (43 percent) governed by general fisheries policies only. This difference is important, given that it was found that general fisheries policies are the least likely to incorporate SSF Guidelines objectives (see Figure 8.5), while SSF-specific policies are the most likely. Therefore, catch governed simultaneously by general and SSF-specific fisheries policies could provide the opportunity for SSF-specific policies to inform general fisheries frameworks. This opportunity for feedback between the two policy types in a way that is coherent with the aims of the SSF Guidelines is much higher for marine fisheries than for inland fisheries, evidencing the need for further local policy development that is specific to the needs and characteristics of inland fisheries.

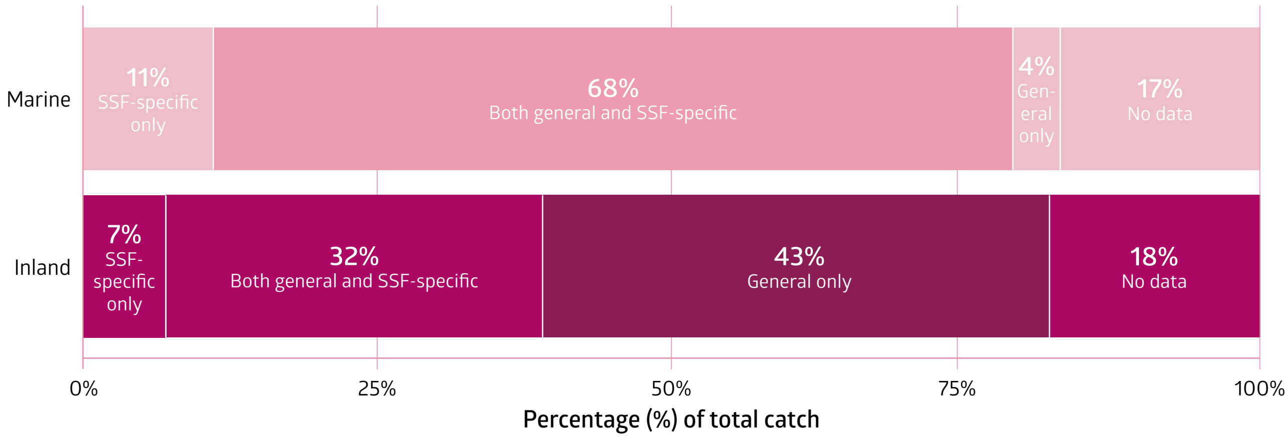
The amount of catch governed by policies operating at different jurisdictional levels was also estimated, disaggregated by management type (with or without co-management). Findings show that most estimated global catch is governed through national-level policies without co-management arrangements (Figure 8.7). In contrast, less than half of marine and inland catch falls within the mandate of local policies that are predominantly characterized by co-management arrangements and are therefore likely to be better aligned with the aims of the SSF Guidelines. The percentage of co-management is particularly low for subnational policies, which mostly include those with state or provincial political jurisdictional levels or biophysically defined regions (management plans for river basins, a watershed, a coastal region, etc.) in the dataset of this analysis. In some of these instances, this might be due to subnational policies being subsumed under national-level policies in their authority to devolve rights to fishers (e.g. those that represent river basins, watersheds or other large biophysical regions).

[42] Examples of keywords coded as representative of Part 2 and Part 3 of the SSF Guidelines include: "participation" and "co-management", coded as examples of Chapter 5a (Responsible governance of tenure); "sustainable use of resources" and "conservation", coded as examples of Chapter 5b (Sustainable resource management); and "human rights", "livelihood sustainability" and "equality", coded as examples of Chapter 6 (Social development, employment and decent work). "Food security" was also coded as a cross-cutting theme for the Guidelines and not particularly associated to one particular section in the document. For an in-depth analysis refer to Koehn *et al.* (2021).

In any case, these findings suggest that local governance and policies disproportionately contribute to the devolution of management rights to small-scale fisheries. Examples of local policies include those governing fisheries closures of bays, estuaries or reefs where often local fishers are involved in their monitoring and enforcement, and whose jurisdiction is limited to these particular closures and waterbodies.

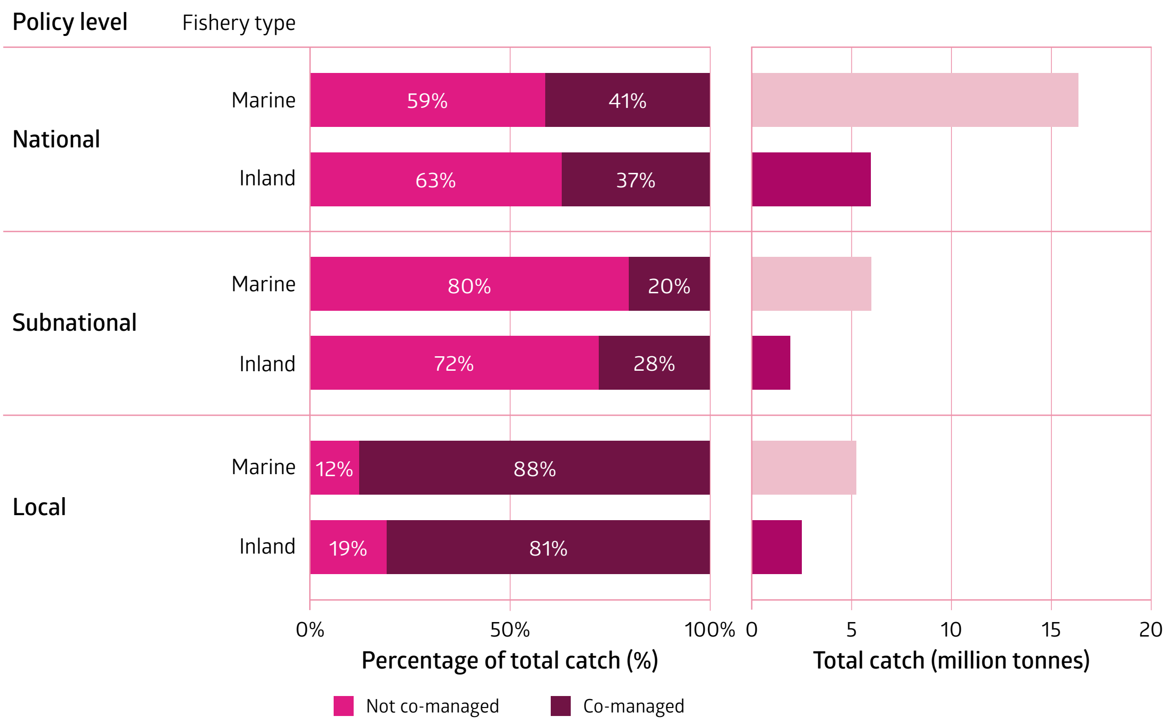
Local-level policies, while governing less catch, are most important for the devolution of management rights to fishers because when catch is governed with input from these policies, it is much more likely to involve devolved management rights (Figure 8.7). In fact, over 80 percent of both marine and inland catch governed by local arrangements involves devolved management rights.

Figure 8.6 Percentage of marine and inland small-scale fisheries (SSF) catch governed by general and SSF-specific fisheries policies, based on marine catch data from 51 countries and territories and inland catch data from 42 countries and territories



Note: For 17 percent of marine catch data and 18 percent of inland catch data, no governance data were provided by country and territory case study authors, or they could not be reliably associated to governance and therefore were not included.

Figure 8.7 Governance of marine and inland small-scale fisheries catch, by policy level and type (with or without co-management), based on analysis of policies from 43 marine and 38 inland countries and territories



Note: The calculation of total catch involves double-counting because the same fishery can be concurrently governed by policies at different levels.

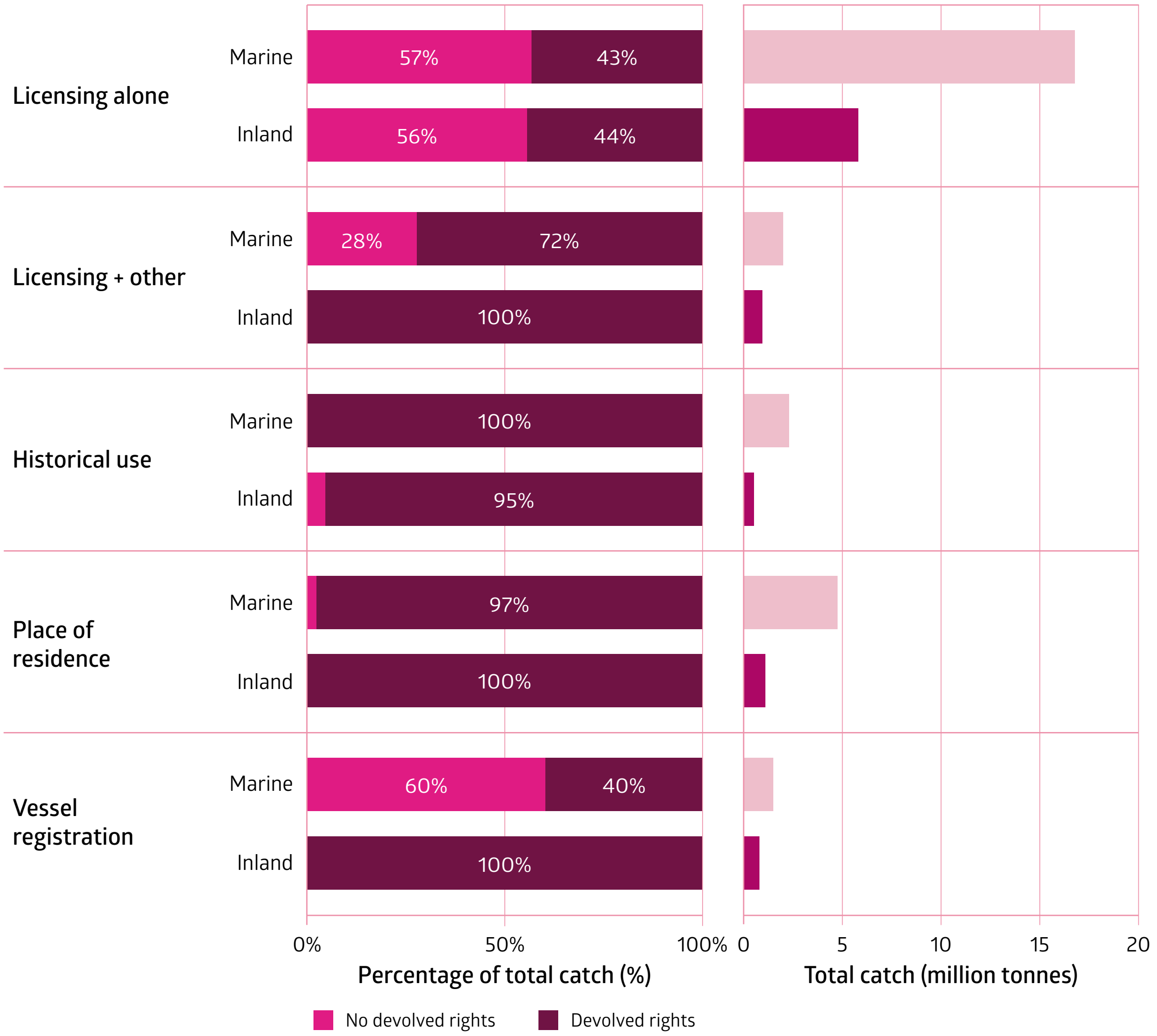
8.5 Access and harvesting management in small-scale fisheries

Many fishers, fishworkers and their communities, including vulnerable and marginalized groups, are directly dependent on access to fisheries resources (FAO, 2015). The importance of this access to sustain small-scale fisheries livelihoods has also been recognized in SDG Target 14.b. The diverse ways in which small-scale fishers access resources, as well as the challenges they face, have been amply documented in the literature (e.g. Jentoft and Chuenpagdee, eds., 2015). Yet, providing a global estimate of the main access strategies used remains elusive, due in part to the informality of the subsector. It is possible, however, to provide a global snapshot of the formal or de jure policies on access that countries have put in place.[43] This section provides such a snapshot as a first step towards improving understanding of how access is managed in small-scale fisheries. The importance of different access strategies is quantified using the amount of catch (in tonnes) governed under each strategy. In addition, the percentage of devolved rights associated with each access strategy is also reported, providing an indicator of the involvement fishers can have in the management of access recognized by the state.

Achieving adequate access to small-scale fisheries constitutes an important aim of the SSF Guidelines. Of the countries and territories analysed, 85 percent acknowledged not having formal access controls in place for all their small-scale fisheries. For those that are formally managed, it was assumed that the four main categories or criteria used around the world to manage access are licensing, vessel registration, place of residence and historical use. Figure 8.8 (right panel) shows licensing is the most important formal strategy for controlling access in small-scale fisheries in terms of the amount of catch governed. This is not particularly surprising; it is significant, however, that less than half of these licences involve the devolution of rights to fishers. This means that most of the time, fishers have no say in decision-making concerning various characteristics of access covered by the licences, such as type of species, areas of operation, and when harvesting can take place. In contrast, other criteria such as "place of residence" and "historical use" are associated with a much higher proportion of devolved rights (> 95 percent of catch). Yet, these access criteria govern a significantly smaller portion of the total marine and inland small-scale fisheries catch (Figure 8.8, right panel).

[43] The analysis in this section does not distinguish between access granted to specific areas or territories and that granted to resources, or between access granted to communities/organizations and that granted to individuals, because these different dimensions are not independent.

Figure 8.8 Main criteria for granting access to small-scale fisheries and the extent of devolved rights associated with each access strategy, based on analysis of policies from 43 marine and 38 inland countries and territories

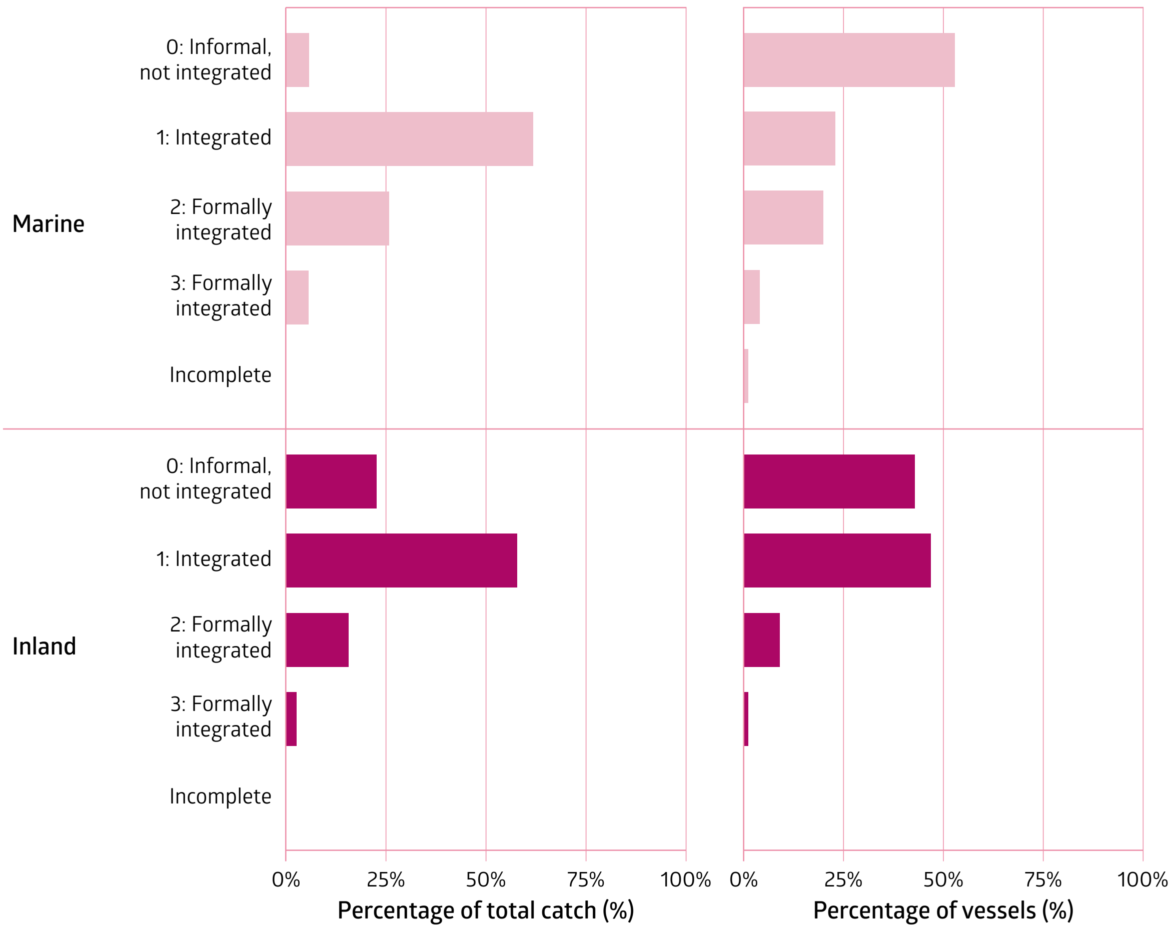


Notes: Given the importance of licensing in managing access to small-scale fisheries, a comparison of licensing used alone and in combination with other strategies is included. Most catch for inland "vessel registration" is associated with the African Great Lakes region (e.g. Malawi, United Republic of Tanzania, and Zambia). Note there is double-counting in the calculation of total catch because the same fishery can be concurrently governed by different access strategies.

Licences around the world differ in their aims and functions, but in Figure 8.8 they are bundled into a single category for the purpose of comparison with other access strategies. Licensing is also often used in combination with certain strategies. For instance, some fisheries in Indonesia and Maldives combine licensing and place of residence by issuing licences through provincial officers, an increasingly common practice in decentralized fisheries management regimes. In other cases, national licensing systems may provide access to fisheries resources while local management councils grant access rights based only on residence. Interestingly, data in Figure 8.8 (coloured panel) show that when licensing is combined with other access criteria it is much more likely to involve devolved rights than when it is used alone, highlighting the importance of combining different access strategies according to the local social, cultural and environmental context.

Finally, an analysis using the characterization matrix described in Chapter 3 provides insight as to the degree to which fishing resources are accessed through informal mechanisms. This analysis shows that a significant proportion of inland small-scale fishery vessels (43 percent) are informally integrated into management and taxation systems, but their catch comprises only 23 percent of the total (Figure 8.9). A slightly larger proportion (47 percent) are registered (i.e. integrated) and account for 58 percent of the total inland catch. Formally integrated inland fishing with landing fees or licensing and taxation accounts for only 10 percent of vessels and 19 percent of the total catch. In marine small-scale fisheries, the catch is predominantly (~93 percent) from fisheries that are formally integrated into management and regulatory frameworks (this includes the three different degrees of integration), but this represents only 47 percent of the vessels. The remaining vessels (53 percent) operate in the informal setting, but their aggregate

Figure 8.9 Degree of integration of small-scale fisheries into fisheries management and taxation systems, based on data for 58 countries and territories



Notes: 0 = informal, not integrated (occasional, no fees required); 1 = integrated (registered/recognized fisher, untaxed); 2 = formally integrated (licensed fisher, landing fees and/or personal taxes paid); 3 = formally integrated (registered, licensed, taxed as a commercial concern); Incomplete = invalid or incomplete information.

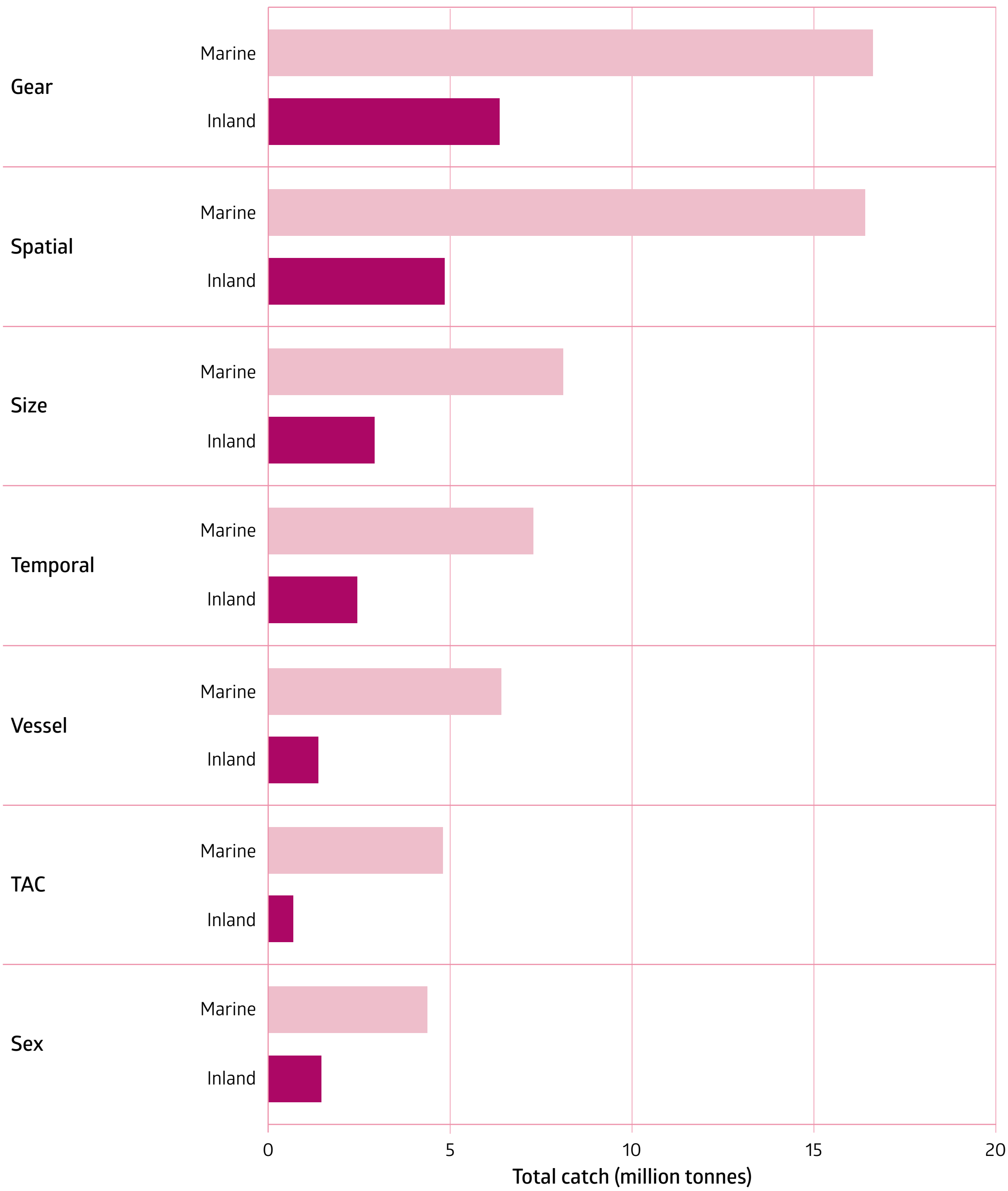
catch is remarkably low and estimated at less than 6 percent. This suggests that either the informal sector catches relatively little fish, or that at least some catch remains hidden, presumably a result of the limited amount of management and monitoring dedicated to this group. These results indicate a need to develop new management methods that enable documentation of catch not associated to a licence or to a vessel, such as those used to study household socioeconomic well-being (for an example see Chapter 5).

In addition to access management, the analysis for this chapter also identified the most common harvesting management measures formally in place around the world and measured their relative importance in terms of the amount of catch each harvesting restriction regulates. Findings show most reported catch is governed by gear and spatial restrictions (Figure 8.10). Restrictions on gear are often associated with particular places and seasons: different types of gear will have different impacts depending on where and when they are used, among other associated conditions. Certain net types (e.g. beach seines), mesh sizes and hook sizes are permitted or forbidden depending on habitat conditions, biology and species targeted. Trolling might be forbidden in shallow areas unless the net size, motor size or trolling procedure meets certain requirements, and the location of fixed nets may be forbidden in nursery or migratory sites at particular times of the year. In general, the use of particularly destructive methods is forbidden, such as dynamite or certain poisons. As for spatial restrictions, preferential access areas are an important example of this measure, and are discussed later in this section.

Other common harvesting management measures are also presented in Figure 8.10. Total allowable catch (TAC) is usually associated with large-scale fisheries because of its high costs of implementation, due to the significant technical assistance and close monitoring of landings required. In this chapter analysis, 20 developed and developing countries or areas reported having fisheries with TAC management measures. Some of those measures are likely part of a given country's quota within regional fisheries management organization (RFMO) agreements. Such TAC systems are established by RFMOs and not at the level of the local small-scale fisheries. This is the case for some of the small-scale fisheries catch reported to be under TAC systems for Indonesia and the Philippines, which are part of the Indian Ocean Tuna Commission (IOTC) and the Western and Central Pacific Fisheries Commission (WCPFC), respectively. These two countries, together with Chile and Sri Lanka, accounted for 73 percent of overall catch by small-scale fisheries under TAC systems reported here. The rest was distributed among 16 countries from all world regions. The diversity of harvesting management measures used, including TAC systems, illustrates the complexity of governance arrangements involved in the management of small-scale fisheries, and the need to better understand differences between small-scale fisheries at various scales of operation (see Chapter 3).

In general, it is likely that the more frequent use of gear and spatial restrictions compared to other harvesting management measures is related to how well they align with livelihood issues (e.g. while temporal closures such as closed seasons are common management measures in large-scale fisheries, they might be less common among small-scale fisheries because of the subsistence role these fisheries play) or to their lower costs of implementation (compared to TAC systems, for instance). The low monitoring and enforcement costs of implementing gear and spatial restrictions relative to other options makes these restrictions a common feature of customary self-

Figure 8.10 Small-scale fisheries catch categorized by type of harvesting management measure applied, based on analysis of policies from 43 marine and 38 inland countries and territories



Notes: "Size" and "Sex" refer to restrictions on the size or sex of harvested species, respectively; "TAC" refers to total allowable catch.

governed systems in a diversity of geographies and cultural contexts (Cinner *et al.*, 2006, 2012b; Johannes, 1978, 2002). Indeed, low implementation costs are an important enabling condition of self-governance systems according to Ostrom (1990).

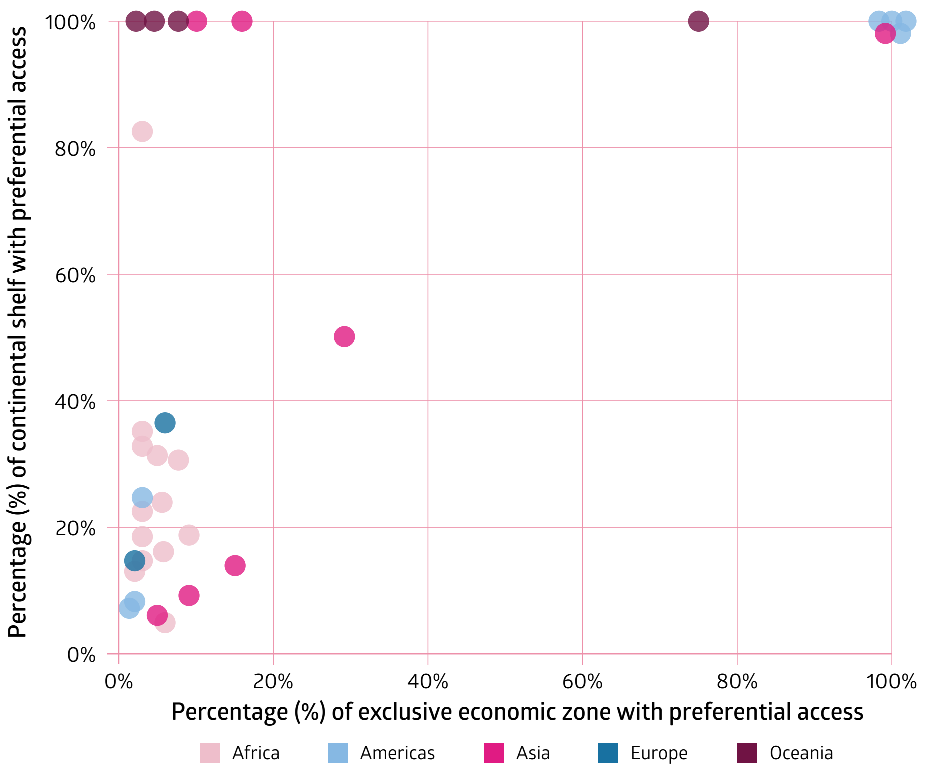
A type of spatial restriction that may be particularly important for small-scale fisheries, as indicated by the extent it is used within national jurisdictions, is that of preferential access areas for marine small-scale fisheries, where, for instance, activities from large-scale fisheries or certain types of gear (such as trawls) are prohibited. An analysis of formal legislation and expert consultations in 52 countries and territories showed that preferential access areas of this type are common in coastal waters in all regions around the world. These access areas are identified in formal national, regional or local legislation either by designating areas of the sea that are restricted (or that give preference) to small-scale fisheries, or through regulations that implicitly or explicitly favour small-scale fisheries by mandating moratoriums on the operation of large-scale vessels in those areas. Areas of the sea that are de facto exclusive to small-scale fisheries, by nature of the absence of large-scale fleets, are also included.

On average, countries have designated a median of 3 percent of their EEZs as preferential access areas for small-scale fisheries (average is 17 percent). Assuming the median holds for the world's EEZs, and these are the areas most used by small-scale fisheries, it would be possible to conclude that less than 5 percent of the worlds' EEZs overall are reserved by law to support most of the direct employment and income in the ocean, and therefore make the highest contributions toward SDG 1 (No poverty). This assumption is based on findings from this report (see Chapter 5 for details) suggesting that small-scale fisheries are likely to provide most of the direct employment and income as compared to other employers of the ocean (large-scale fishing, shipping, and oil and gas), which are likely to occupy or occur in larger areas of EEZs.

Given that most small-scale fishers fish close to shore on the continental shelf (see characterization matrix in Chapter 3), assessing the amount of continental shelf with preferential access provides a rough, but useful, metric of the potential size of preferential access areas for small-scale fisheries. The median proportion of continental shelf with preferential access designation for small-scale fisheries worldwide is 18 percent. This suggests that the area that could potentially be reserved for small-scale fishers is considerably larger than that currently designated as preferential access areas. However, the feasibility of exploitation by small-scale fishers typically declines as depth increases, at least for some fisheries (e.g. demersal), which is an important consideration that affects competition among fishers with diverse types of gear.

Figure 8.11 shows that most countries and territories in this chapter analysis, particularly those in the African continent (soft pink dots in lower-left quadrant in figure), have a low percentage of preferential access areas in relation to the size of their continental shelf,

Figure 8.11 Distribution of 33 countries and territories by world region, by percentage of exclusive economic zone with preferential access for small-scale fisheries plotted against percentage of continental shelf with preferential access



indicating that if these areas were increased they could potentially benefit small-scale fisheries by reducing competition with large-scale fisheries. The other two clusters of countries shown in the figure have designated their entire continental shelf area as preferential access for small-scale fisheries, but differ in how much it represents of their EEZ. The cluster of Small Island Developing States (SIDS) mostly from the Oceania region (upper-left quadrant in Figure 8.11) have small continental shelfs; therefore small-scale fishers cannot use the rest of the EEZ under current technology (because of its depth), so this portion is used by large-scale fishing fleets. The cluster of several SIDS mostly from the Americas (upper-right quadrant in Figure 8.11) have large, shallow continental shelfs, which is reflected in their provision of preferential access to small-scale fisheries in 100 percent of the ocean in their national jurisdiction. These countries seem to have no or very limited large-scale fishing fleets.

One of the challenges to fulfilling the potential that preferential access areas offer to small-scale fisheries is the lack of adequate management of access. A study of 33 African maritime countries and territories bordering the Atlantic and Indian Oceans (but not the Mediterranean) cited enforcement as a particular governance challenge. Using satellite technology to predict fishing operations by large-scale fleets, it found these fleets spent 3–6 percent of their fishing time within preferential access areas during 2012–2016 (Belhabib *et al.,* 2020). Even without competition from large-scale fleets, without adequate management these preferential access areas can suffer from overexploitation from small-scale fishers themselves.

8.6 Governance of tenure in small-scale fisheries

The SSF Guidelines advocate the empowering of men and women in small-scale fishing communities to participate in decision-making processes and to assume responsibilities for sustainable use of fisheries resources (FAO, 2015). Over the past 50 years, the devolution of tenure rights (i.e. management, exclusion and transferability)[44] has been central to policy reforms shifting fisheries governance away from command-and-control approaches and toward co-management or community-based management of the use of natural resources (d'Armengol *et al.,* 2018; Evans, Cherrett and Pemsl, 2011; Sen and Nielsen, 1996). This section provides an initial global overview of the devolution of formal rights, followed by a comparison between formal and customary governance systems and analyses of the effects of income and scale of operation. It also includes a subsection on customary governance and management in indigenous fisheries.

8.6.1 Devolution of formal rights

The analysis of small-scale fisheries in this chapter showed that management rights are formally granted to fishers in nearly 75 percent of countries,[45] governing more than one-third of the marine (35 percent) and inland (39 percent) catch reported for these countries (Figure 8.12). For the portion of catch that has devolved rights, most of it involves "mostly devolved" rights (meaning that fishers have been granted two out of the three types of tenure rights), accounting for 19 percent of marine and 22 percent of inland catch (Figure 8.13).

Fishers enjoying fully devolved rights have been granted all management, exclusion and transferability rights over the catch. This implies that they are involved in management, but not necessarily in full control of it. In some settings, transferability rights (i.e. the right to transfer management, exclusion and transferability rights to someone else) constitute the defining element for private property. This does not usually apply to small-scale fisheries, and while a more nuanced analysis of how transferability rights operate in these fisheries is beyond the scope of this chapter, findings reveal that these rights have a very limited application in the subsector, as most of the marine (9 percent) and inland (8 percent) small-scale fisheries catch comes from only six countries (Figure 8.12).

8.6.2 Customary governance systems

The SSF Guidelines call on states and all other parties, in accordance with their legislation, to respect and protect all forms of legitimate tenure rights, taking into account (where appropriate) customary rights to aquatic resources, land and fishing areas (FAO, 2015). When fishers and their communities have tenure rights, the various harvesting management restrictions (i.e. spatial, temporal, gear, species and access) they implement are often designed to manage conflict, improve equity of access, or prevent the most environmentally egregious forms of fishing, among others (Berkes, ed., 1989; Cinner and Aswani, 2007; Johannes, 1978, 2002; McCay and Acheson, 1987; Ruddle, 1994). These multifaceted management objectives are more closely aligned with the aims of the Guidelines, in contrast with management objectives that are focused almost exclusively on production and rent extraction (see Figure 8.5).

[44] Enforcement and enforcement rights fell outside the scope of this chapter.

[45] Similar results were found by an independent survey conducted by FAO in 2020, where 81 percent of FAO Member Nations (n = 92) reported involvement of fishers in fisheries management (FAO, 2021g).

Figure 8.12 Percentage of marine and inland small-scale fisheries catch for which fishers are granted management, exclusion and transferability tenure rights, based on analysis of policies from 43 marine and 38 inland countries and territories

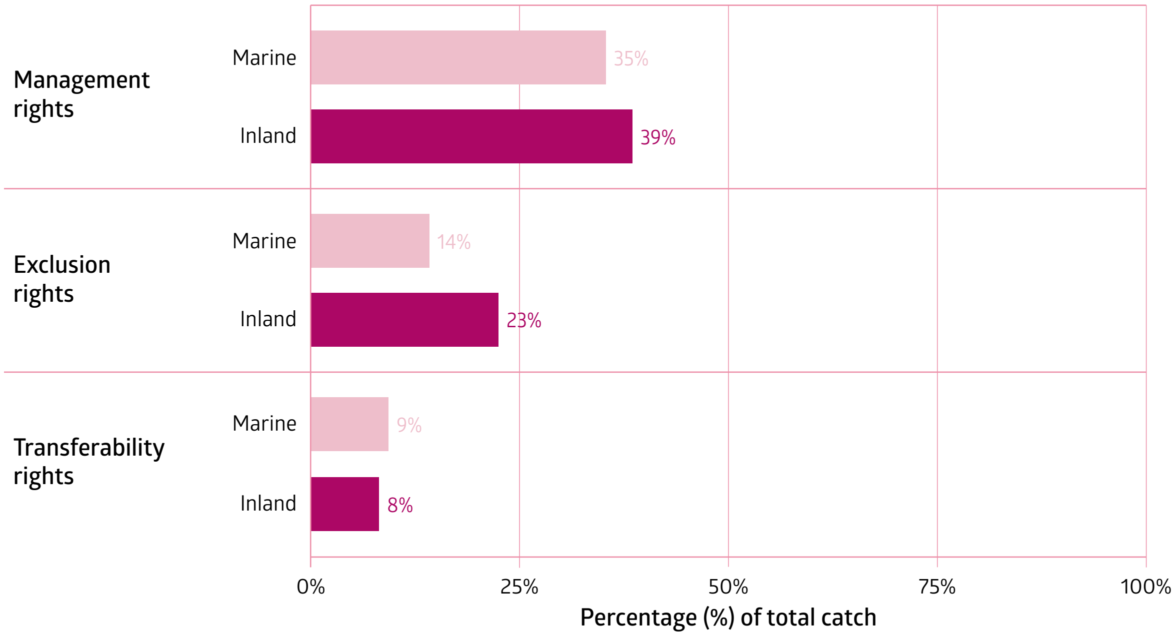
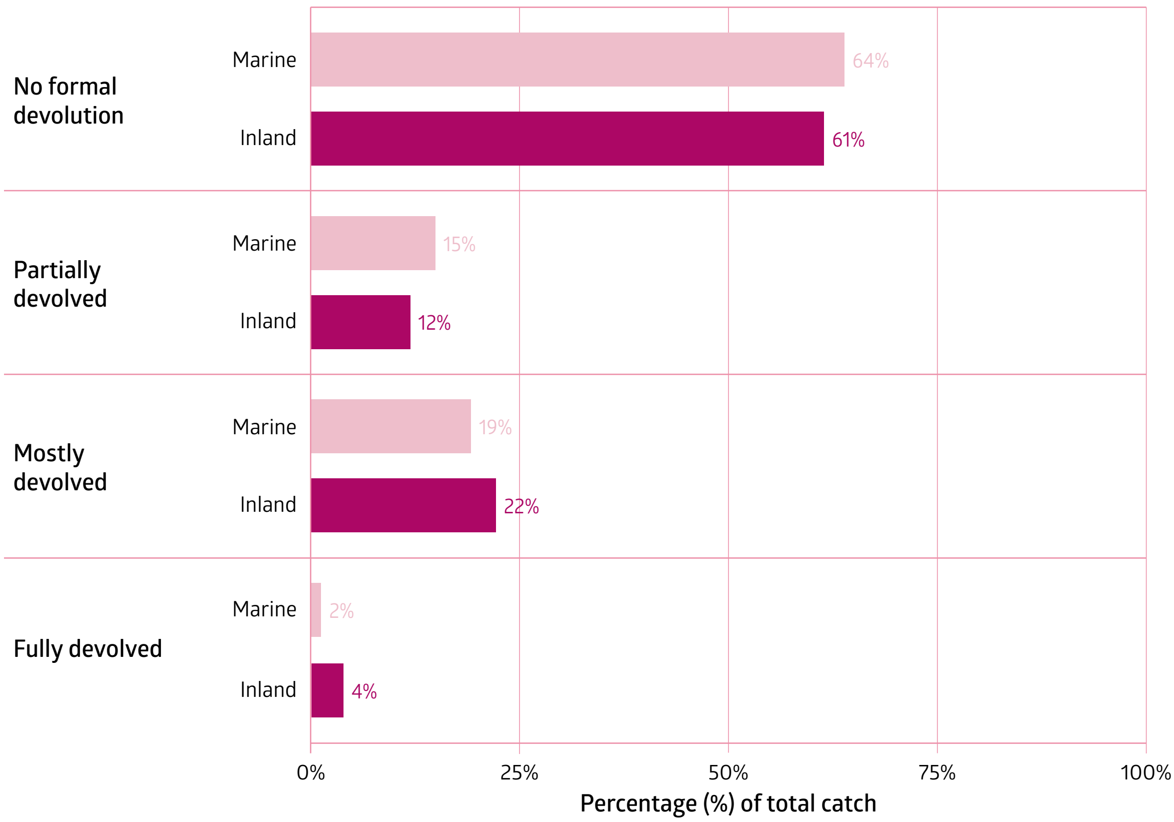


Figure 8.13 Percentage of marine and inland catch with different levels of rights devolution in formally governed small-scale fisheries, based on analysis of policies from 43 marine and 38 inland countries and territories



Notes: Partially devolved = when any single right is devolved to fishers; mostly devolved = when any two rights are devolved; fully devolved = when all three rights are devolved at the same time. This analysis only included devolved rights formally recognized in laws, regulations, policies, plans or strategies. It did not include governance regimes with informally devolved rights, which are recognized to be important around the world but for which data and analysis are not currently available or feasible at a global scale.

The legalization and formalization of customary governance systems is an important challenge for small-scale fisheries, but there is a risk of oversimplifying management strategies such that they become rigid institutional structures, which would threaten small-scale fishers' adaptive capacity (Cinner and Aswani, 2007). When formalization processes do not take into account the interaction of legal and customary rules or build the necessary linking institutions, they can result in reduced governability and associated social losses (Carlisle and Gruby, 2019; Lau *et al.*, 2020; Rohe *et al.*, 2019). Approaching these issues will require the following: (i) aligning "legal pluralism" through proper inclusion of customary knowledge holders, (ii) carefully defining roles, (iii) developing a shared understanding of the process and desired outcomes, and (iv) addressing conflicts early on, among other important considerations (Jentoft and Bavinck, 2014; Kolding, Béné and Bavinck, 2014).

It is important to deepen the understanding of how customarily governed small-scale fisheries can develop productive interactions with fisheries authorities. For instance, from this chapter analysis it was learned that in countries such as Chile, India, Peru and Sierra Leone, fishers have organized under different co-management systems to establish and enforce gear restrictions, sometimes informally collaborating with government institutions to monitor fishing efforts. In Sierra Leone these organizations are called co-management associations. In cases like these, customarily governed small-scale fisheries may devolve management and exclusion rights to formally organized groups of fishers such as cooperatives, *cofradias*, syndicates and other types of associations, rather than to individual fishers. In these instances, groups of fishers make collective decisions and determine fisheries access and harvesting rules through membership.

8.6.3 Comparing formal and customary governance systems

This subsection provides a limited comparison between formal and customary governance systems in relation to how access is granted and tenure rights are devolved. Comprehensive data about either system at a global level were not available. Yet, as part of this chapter analysis a small database was assembled consisting of 37 customarily governed small-scale fisheries from 12 countries in Asia, Africa and South America (a subset of the entire IHH database).[46] Despite the potential limitations on the external validity of the comparison, it was deemed

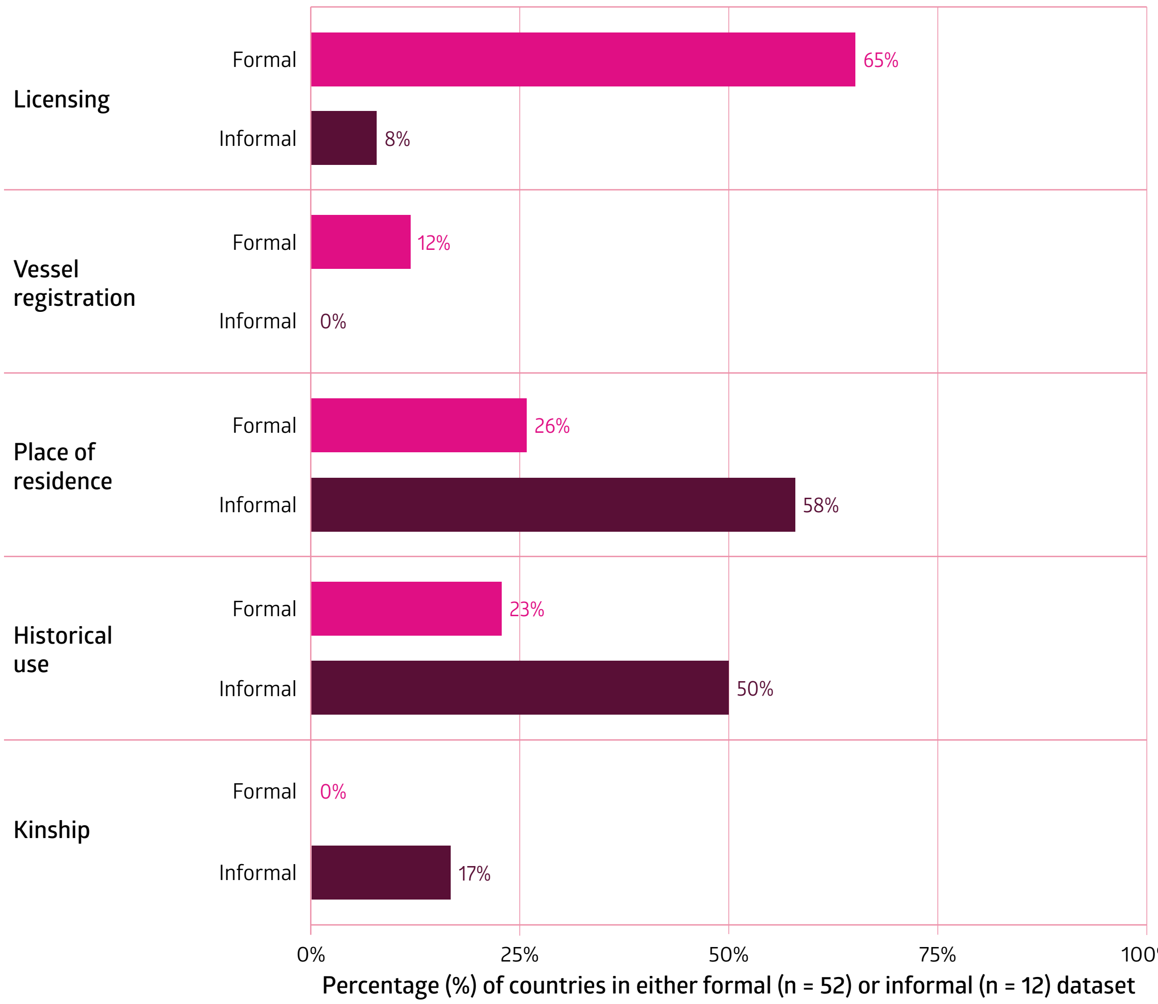
[46] The 12 countries were Bangladesh, Brazil, Chile, Congo, Ghana, India, Indonesia, Madagascar, Nigeria, Peru, Sierra Leone and Sri Lanka. The subset does not constitute an exhaustive list of customarily governed small-scale fisheries, only those the CCS authors considered to be most important or for which they had information from their countries. See Annex A for a more detailed description of case selection criteria and the general methodological approach to this chapter.

useful to show similarities and differences between both governance regimes regarding access and devolution of rights. Figure 8.14 shows that formal and customary governance systems grant access to fishers very differently. In customary regimes, place of residence and historical use are the most common criteria for granting access. Licensing is also used in customary regimes as a criterion but does not feature as prominently as in legislation of formally governed small-scale fisheries. Findings from the 12 countries analysed here suggest that when local fishers are involved in governance, they overwhelmingly choose place of residence or historical use over licensing.

Place of residence or historical use can serve in some cases as a basis to develop tenure rights linked to geographic areas in coastal environments, also known as territorial use rights in fisheries (TURFs) (Christy, 1982). TURFs are often informally held, yet management regimes can emerge in these areas (Orensanz *et al.,* 2013). For instance, customarily governed small-scale fisheries in Peru and India have set restrictions banning gear types associated with stock decline or habitat destruction in specific shallow-water areas. TURFs can also allow informally governed fisheries to adapt to changing conditions based on local knowledge, as has happened in Brazil where clam harvesters use weather patterns to determine seasonal and temporal restrictions. The existence of low-mobility aquatic foods such as benthic crustaceans or molluscs facilitates the accumulation of knowledge among fishers and the predictability of future resource availability by the simple fact of them being more easily and frequently observable (Ostrom, Gardner and Walker, 1994), expediting adaptation to socioecological change (Castilla and Defeo, 2001; Gelcich *et al.,* 2010).

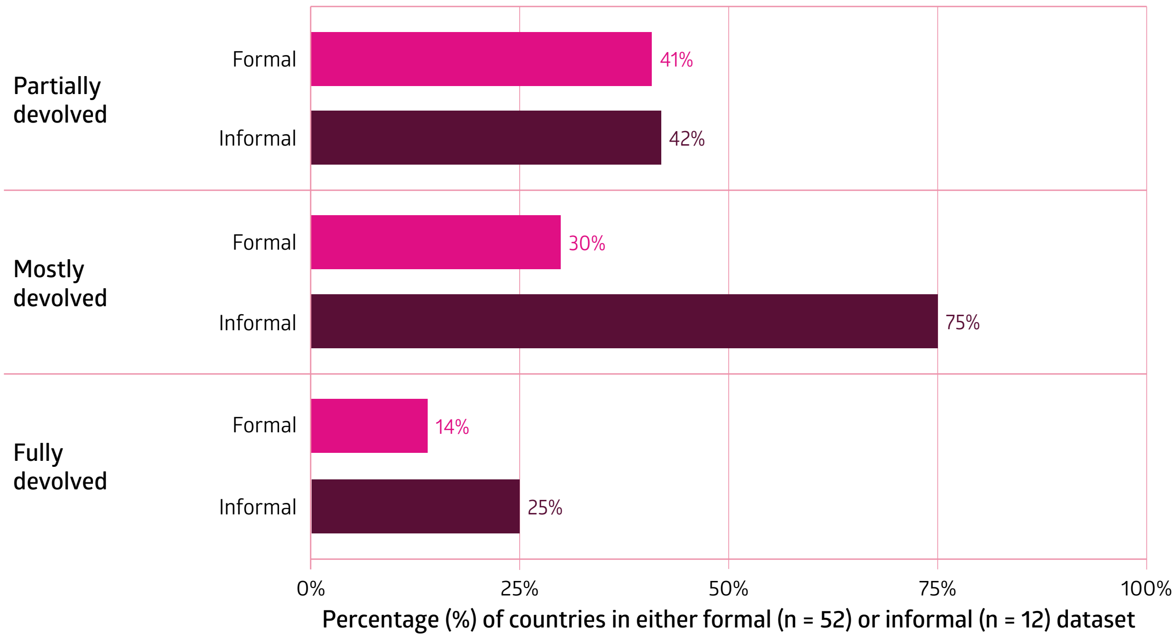
While a large number of customary governance arrangements in the IHH dataset were tied to benthic or sedentary species, examples have also been documented for non-benthic species. In the north of New Caledonia, some migratory species have been associated with the exclusive harvesting of particular clans among the Nemea people. Harvesting historically took place at precise times of the year based on known migratory routes, and the species considered sacred were not harvested

Figure 8.14 Comparison of main access strategies between customarily governed and formally governed small-scale fisheries, by percentage of countries and territories using each type of access strategy



Notes: For each country, strategies were included if at least one fishery in the country used them. More than one access strategy could apply to each country, which is reflected in the percentages not adding up to 100.

Figure 8.15 Percentage of formally and customarily governed small-scale fisheries with different levels of rights devolution



Notes: Partially devolved = when any single right is devolved to fishers; mostly devolved = when any two rights are devolved; fully devolved = when all three rights are devolved at the same time. Devolved rights were included if at least one fishery in the country used them. More than one level of devolved right could apply to each country, which is reflected in the percentages not adding up to 100.

for commercialization. The use of poisoning and other particularly destructive harvesting techniques required the authorization of the chief, who gave it only rarely, such as during times of famine (Teulières, 1992). In inland fisheries, the use of customary norms and taboos to protect fish spawning areas or deep pools used during fish migration is well documented for the Lower Mekong Basin (Baird and Flaherty, 2005). These pools serve as fishing refuges during the dry season. Many have been formalized into fishery conservation zones, and under the right conditions can benefit highly migratory species (Baird, 2006).

Around the world, customary governance regimes exhibit a rich diversity of measures combining access criteria and harvesting management (Johannes, 1978; Ruddle, 1994). One way in which they combine is through TURFs. For the analysis in this chapter, 29 countries reported almost 1 500 instances of formal and informal TURFs, including arrangements such as the Indonesian *adat*, which establishes gear and spatial restrictions, or the Malagasy *dina,* which combines customary harvesting restrictions with exclusion rights that act as informal TURFs. Ghana, India, Sierra Leone and Sri Lanka (among other countries) use temporal restrictions tied to customary days of rest, celebration or mourning. In many countries, such rules are arbitrated and enforced by traditional authority figures or institutions that tie fisheries governance to larger social and political institutions extending into broader community affairs. Other examples of formally established TURFs include 28 federal and provincial Marine Extractive Reserves in Brazil and more than 700 marine areas of Chile's National Benthic Resources TURF Program.

Many more unrecorded traditional TURFs can be found in inland waters around the world, such as in the Lake Chad Basin. In these environments TURFS are often temporary, based on seasonal flooding and the rainy season, such as in the land-tenured Congolese floodplains, among other areas.

Looking at the level of devolution of rights, there are some differences between the two types of governance regimes in small-scale fisheries. Not surprisingly, fewer tenure rights are devolved to fishers in formally governed fisheries than in customarily governed fisheries (Figure 8.15). Interestingly, both are relatively similar at the level of devolving only one tenure right ("partially devolved"), usually the right of management (a prevalence of 42 percent and 41 percent, respectively). Yet, formally governed small-scale fisheries fall behind on the devolution of two or more rights: "mostly devolved" tenure rights are found in 75 percent of countries with customarily governed small-scale fisheries, as opposed to 30 percent of countries with formally governed small-scale fisheries.

Continued movement towards more participatory governance approaches will require looking beyond the devolution of management rights and improving understanding of what enabling conditions are needed for local fishers to be able to act effectively on their devolved rights. Also, when multiple rights are devolved to fishers as is common in customary systems, the likelihood increases that fisheries governance will take broader community contexts and values into consideration (Fabinyi, Foale and Macintyre, 2015; see also Chapter 6 on gender). For instance, equity and resource distribution are common concerns in

Box 8.2

Institutional Diversity in Small-scale fisheries

Small-scale fisheries display considerable diversity in their characteristics, with some stark differences between regions. In Europe, for instance, 92 percent of marine small-scale fisheries are formally integrated into the economy, whereas in Asia the figure is only 3 percent. And in inland fisheries, more than 50 percent of fishery units are engaged in seasonal employment, compared to less than 17 percent among marine fishery units. However, there are also some remarkable similarities between marine small-scale fisheries in developing and developed countries or areas, namely in the proportion of owner/operators (58 percent and 61 percent, respectively), the typical one-day length of fishing trips (70 percent and 73 percent), and the proportion of non-motorized vessels (18 percent and 19 percent).

reports on customary small-scale fisheries governance arrangements in the IHH dataset. In Peru, some fishers' associations have established a "last call" on catch, ensuring members sell their fish simultaneously and therefore receive fair and uniform prices. In Sri Lanka, the informal *raula kapanawa* practice sets norms for the redistribution of catch at shore, ensuring fishers who have a bad day do not go home empty-handed. And in Congo, as in many other places, informal rules delineate financial responsibilities for fishing trips and equitable income distribution among fishers.

It is important to note that, according to the literature, not all customary governance regimes are fair. Community leaders often keep the best fishing areas for their kin, or require "informal tariffs" from members of the community or outsiders in exchange for granting access to communal fishing areas. The processes that emerge from the negotiation and handling of these inequities can lead to either resource overexploitation or long-term sustainable use, depending on the particularities of communal social relations and local values (Basurto and Garcia Lozano, 2021). A fuller treatment of the role of values and identity in small-scale fisheries is provided in Section 8.7.1.

8.6.4 The effects of scale of operation and income

The SSF Guidelines recognize the great diversity of small-scale fisheries (see Box 8.2), and thus do not prescribe a standard definition for the subsector, nor do they prescribe how they should be applied in a national context. The Guidelines also recognize that to assure transparency and accountability in their application, it is important to ascertain which activities and operators are considered small-scale. In light of this, the characterization matrix presented in Chapter 3 was developed in order to better disentangle different scales of operation within small-scale fisheries and harness their diversity (Short *et al.*, 2021). This subsection illustrates what can be learned from disaggregating data by scale of operation and income level. Findings show that for small-scale fisheries in general, the larger the scale of operation[47] or the higher the country income level, the greater the diversity of management approaches used (i.e. access strategies and harvesting management measures).

Figure 8.16 shows that the larger the scale of operation of a fishery, the greater the diversity of harvesting restrictions used to govern it. When the data are looked at in aggregate, spatial and gear harvesting restrictions dominate globally (Figure 8.10). Yet, when the data are disaggregated into the four scales of operation, the dominance of spatial and gear harvesting restrictions becomes less evident. For the largest marine and inland small-scale fisheries (Category 4 scale of operation), no particular harvesting management measure dominates. Marine fisheries at this scale of operation use six harvesting measures to govern at least 70 percent of marine catch, with similar heterogeneity for inland fisheries. At smaller scales of operation, the management measures in inland fisheries are much more homogeneous, with the most noticeable contrast seen between marine and inland "smallest" (Category 1) fisheries. In this category, while marine fisheries use all seven harvesting management measures to govern their catch, inland fisheries almost exclusively use gear, spatial and size restrictions to govern their fisheries.

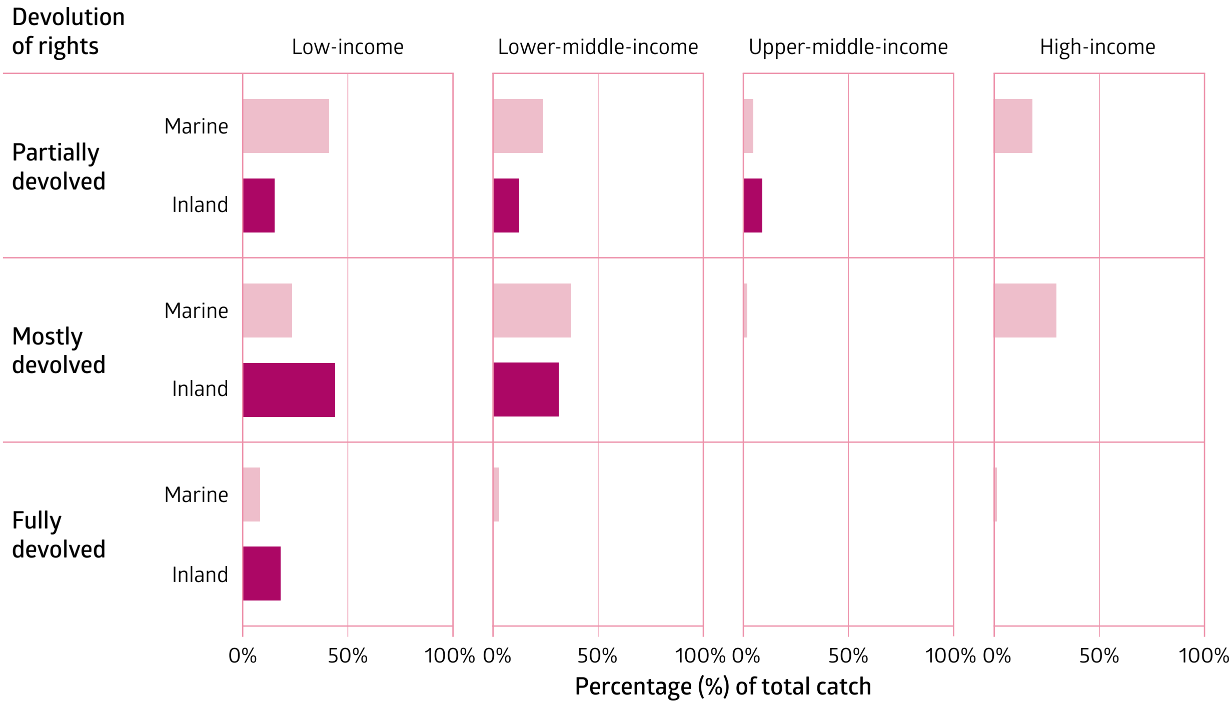
The above interpretations need to be considered together with an understanding of which countries dominate the catch in each category, as this may have a disproportionate effect on the overall results. In Category 1, 82 percent of marine reported catch

[47] Determination of scale of operation is based on the characterization matrix described in Chapter 3. Fisheries with low characterization scores indicate a small scale of operation; their scores increase as the scale of operation increases. For this analysis, catch was categorized into four scales of operation based on the fishery characterization scores, from smallest (Category 1) to largest (Category 4). Category 1, for example, includes fisheries that employ gleaning and most artisanal and non-motorized methods, while Category 4 includes fisheries with highly motorized boats and the capacity for multi-day trips, making these fisheries border on the large scale.

Figure 8.16 Relationship between type of harvesting management measure employed and scale of operation in marine and inland small-scale fisheries, by proportion of total catch, based on analysis of policies from 43 marine and 38 inland countries and territories

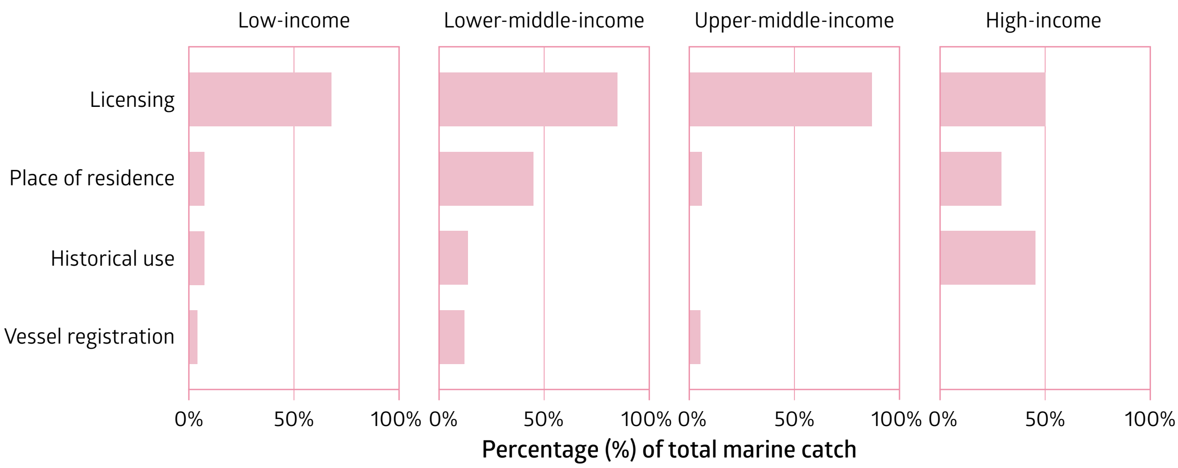
Notes: "Size" and "sex" refer to restrictions on the size or sex of harvested species, respectively; "TAC" refers to total allowable catch.

Figure 8.17 Relationship between the level of devolution of rights and country income group in marine and inland small-scale fisheries, by proportion of total catch, based on analysis of policies from 43 marine and 38 inland countries and territories



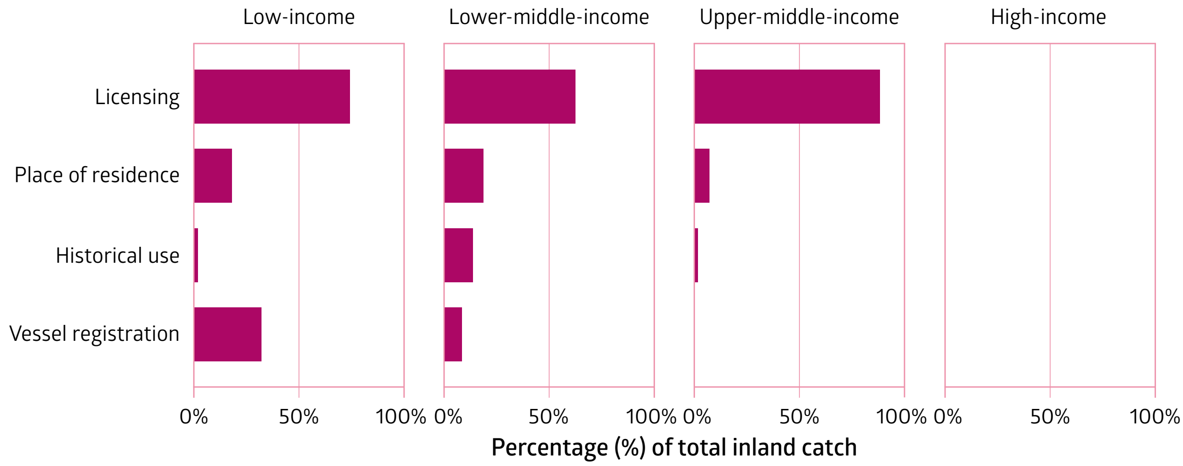
Note: World Bank income group classification is used.

Figure 8.18 Relationship between access strategy and country income group, as a percentage of total catch in marine small-scale fisheries, based on analysis of policies from 43 countries and territories



Note: World Bank income group classification is used.

Figure 8.19 Relationship between access strategy and country income group, as a percentage of total catch in inland small-scale fisheries, based on analysis of policies from 38 countries and territories



Note: World Bank income group classification is used.

comes from the Philippines and India, with the rest coming from 16 countries from all world regions. For inland reported catch, 89 percent comes from Bangladesh and China and the rest from 14 countries from all regions except Europe. Category 2 includes 35 countries for marine and 31 for inland. For this category, 69 percent of marine and 44 percent of inland reported catch comes from China, with the rest distributed among countries in all regions of the world. Category 3 includes fisheries from 39 countries. For the marine reported catch, 28 percent comes from Chile, Indonesia and Viet Nam, with the rest distributed among all regions of the world. For the inland reported catch, 62 percent comes from the Democratic Republic of the Congo, Malawi, Uganda and the United Republic of Tanzania, with the rest distributed among 14 countries in Africa, the Americas and Asia. In Category 4, marine catch is only represented by seven countries; 62 percent comes from Indonesia and the rest from six countries in Europe, Africa, the Americas and Asia. Inland catch is represented by five countries, with 93 percent of the reported catch coming from the United Republic of Tanzania, and the rest from four countries in Africa and the Americas.

National income is also associated with how small-scale fisheries are governed, and findings show low-income and lower-middle-income countries feature the highest proportions of catch involving formally devolved rights (Figure 8.17). Marine small-scale fisheries in high-income countries also have catch involving devolved rights, but at lower proportions in the aggregate than low-income and lower-middle-income countries.

When it comes to access strategies, findings for marine fisheries show that the higher a country's income, the more diverse the criteria it uses to grant access to small-scale fisheries. Licensing is normally the dominant criterion used worldwide, but in high-income countries it only governs 50 percent of marine small-scale catch, while historical use is used to govern 45 percent (Figure 8.18). Notably, place of residence governs almost half of the catch among lower-middle-income countries, including Bangladesh, India, Indonesia, the Philippines and Viet Nam, among others. For inland fisheries, the reverse pattern is found: the higher the income, the lesser the diversity of access strategies used. In upper-middle-income countries licensing dominates, while in low-income and lower-middle-income countries a diversity of access criteria is found (Figure 8.19).

The low-income category used in Figure 8.18 and Figure 8.19 uses small-scale fisheries catch from nine marine countries, of which the Democratic Republic of the Congo, Guinea, Mozambique and Sierra Leone account for 81 percent, with the rest distributed among five other African countries; and ten inland countries, where the Democratic Republic of the Congo, Malawi, Uganda and the United Republic of Tanzania account for 76 percent of overall reported catch, with the rest distributed among six other African countries. The lower-middle-income category is based on catch from 16 marine countries, of which Bangladesh, India, Indonesia, the Philippines, Sri Lanka and Viet Nam account for 75 percent, with the rest distributed among ten countries in Africa and Oceania; for the inland catch in this category, Bangladesh, Egypt, Indonesia, Nigeria and the Philippines account for 74 percent, the rest being distributed among countries mostly in Africa and Asia. The upper-middle-income category uses catch from 18 marine countries, with China and Peru combined representing 80 percent and the rest distributed among 16 countries in all regions of the world. For inland fisheries catch in this category, Brazil and China combined represent 84 percent, the rest being distributed among seven countries in all regions of the world. The high-income category is based on catch from nine

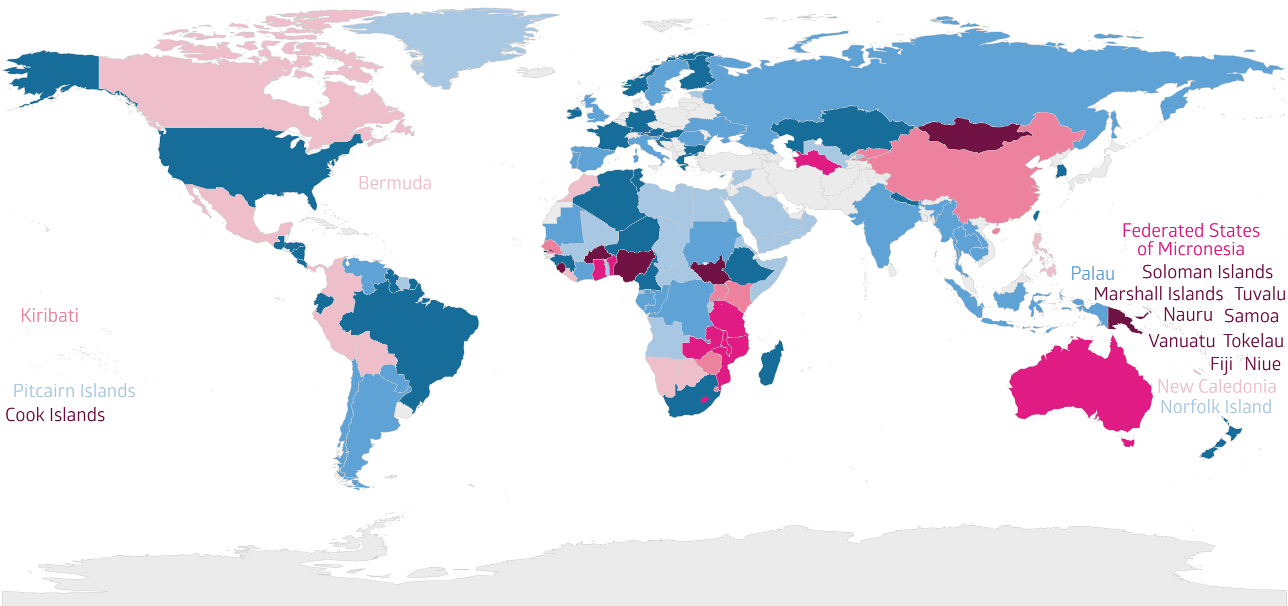
BOX 8.3

Indigenous Peoples in the UN legal framework

- The 1989 Convention of the International Labour Organization (ILO 169)[a] and the 2007 UN Declaration on the Rights of Indigenous Peoples (UNDRIP)[b] have progressively advanced the recognition of indigenous rights.
- UNDRIP introduced the right of free, prior and informed consent, an essential mechanism for protecting indigenous rights to participation and self-determination.
- The UN Permanent Forum on Indigenous Issues (UNPFII)[c] was established in 2000 to engage with indigenous issues related to social and economic development, culture, environment, health, education and human rights.
- The 2014 World Conference on Indigenous Peoples produced an action-oriented document with major commitments to advance indigenous rights.
- The UN 2030 Agenda for Sustainable Development Goals specifically calls for Indigenous Peoples' empowerment, inclusion and access to quality education, as well as their engagement in implementing the Agenda.

Notes: **a** International Labour Organization (ILO), Indigenous and Tribal Peoples Convention, C169, 27 June 1989, C169. **b** UN General Assembly, United Nations Declaration on the Rights of Indigenous Peoples: resolution adopted by the General Assembly, 2 October 2007, A/RES/61/295. **c** UN Permanent Forum on Indigenous Issues (UNPFII), Permanent Forum on Indigenous Issues: report on the 12th session (20–31 May 2013), 31 May 2013, E/2013/43–E/C.19/2013/25.

Figure 8.20 Percentage of national lands under Indigenous Peoples' tenure and acknowledged by the government, according to the LandMark global platform



Percentage (%) of national landmass acknowledged as indigenous territory

No data | 0% | > 0% – ≥ 5% | > 5% – ≥ 20% | > 20% – ≥ 40% | > 40 – ≥ 60% | > 60% – ≥ 80% | > 80% – 100%

Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. Final boundary between the Sudan and South Sudan has not yet been determined.

Source: Adapted from Dubertret, F. & Wily, L.A. 2015. Percent of Indigenous and Community Lands. In: *LandMark – Global Platform of Indigenous and Community Lands*. www.landmarkmap.org/data/

marine countries, with Chile and the United States of America accounting for 81 percent, and the rest distributed among countries in all regions, with the exception of Asia and Oceania. For inland fisheries catch, only Spain is found in this category in the sample of countries and territories analysed, and its reported catch is rounded down to zero.

8.6.5 Customary governance and management in indigenous fisheries

No single culture or language defines Indigenous Peoples, and no common image, gear or species can represent the full variety of indigenous fisheries. Their fishing methods range from hook and line, spears and various traps to mechanized gear. The fishers themselves range from nomadic sea-faring peoples in tropical waters to marine mammal hunters in the Arctic, and from coastal gleaners to inland river and lake fishers.

Aquatic foods are key sources of nutrition for Indigenous Peoples, and are also critical to their food security. Cisneros-Montemayor *et al*. (2016) have found that Indigenous Peoples consume only about 2 percent of the world's marine fisheries catch, but up to 15 times more fish than non-indigenous populations. Other studies reveal similar evidence of indigenous dependence on inland aquatic foods as well, making fisheries a pillar of their food systems (Franz *et al.,* 2015; Bennett *et al.,* 2021; FAO, 2016). But increasing extractive pressures at local and global scales have limited indigenous fishers' access to aquatic foods, as have climatic upheavals and other threats. This weakens the diversity of indigenous food systems and exacerbates economic, political and ecological hardships.

This story is not limited to indigenous fishers,[48] and these fishers aren't alone in claiming a strong sense of place in relation to their fisheries, or in voicing experiences of marginalization, rights violations and dispossession. Yet indigenous fisheries are unique: they feature a variety of fishing techniques, languages and cultures, embedded in centuries-long histories of localized resource management, all resulting in very particular relationships with nature. However, these factors create especially high stakes for indigenous fishers in seeking recognition of their rights to access and manage resources (see Box 8.3). At the same time, these fishers may have legal recourse or access rights that are unavailable to non-indigenous groups, which may create special opportunities for indigenous sustainability while sometimes creating conflicts with non-indigenous small-scale fishers.

Indigenous fisheries are products of long-developed relationships between people and the environment. Through millennia of interactions with the aquatic world, Indigenous Peoples have developed an astounding diversity of fishing technologies including vessels, baskets, traps, nets, harpoons, spears, hooks, poisons, and body techniques not requiring tools. These highly specialized technologies reflect lasting bonds between indigenous fishers and their aquatic ecosystems. Despite these strong links between indigenous fishers, their cultural identity and sustainable resource management, disruption has also been a central experience for many of their fisheries, including infringements of rights.

In light of these rights infringements, as well as more general attempts at correcting colonial legacies, some states have taken measures to distinguish indigenous fisheries from non-indigenous small-scale fisheries. A large portion of the world's countries legally recognize indigenous rights to land and water in some capacity (Figure 8.20). In fact, six countries in the IHH dataset reported fisheries laws that acknowledge distinct rights for indigenous fishers. Though these laws are rarely implemented to the full protection of these fishers, their existence gives them leverage. That said, laws distinguishing indigenous fisheries from non-indigenous small-scale fisheries may spark resentment and even conflict among non-indigenous fishers who themselves feel marginalized (Mackey, 2005; Burnett, 1996; Wilmer and Alfred, 1997). It is therefore important to recognize indigenous fishers and non-indigenous small-scale fishers as overlapping groups who share some defining features and common concerns, but who differ in their histories, food system contexts and legal options. For this very reason policy discourse should distinguish between Indigenous Peoples and other local communities, rather than combining them as a single constituency. This distinction acknowledges the interests that separate indigenous fishers and the rights they have fought for at national and international scales (ICC, 2020).

Ancestral ties connect indigenous fishers to their territories and set a foundation for sustainable fishing practices. Many Indigenous Peoples "consider all the earth to be sacred and regard themselves as an integral part of this holistic and living landscape" (Buggey, 1999). This binds fishers to their ecosystems and makes fishing grounds central to indigenous identity, even beyond the harvest (Collignon, 2006; Ingersoll, 2016). The multigenerational relationships between indigenous fishers and their territories have given rise to customary laws that support sustainable fishing (see Box 8.4).

[48] For the purposes of this chapter, indigenous fishers (or fisheries) are considered to be small-scale.

BOX 8.4

Indigenous customary fisheries management

To maintain ties to their territory, indigenous fishers have often established rules guiding the use of rivers, lakes and coastlines. Cinner (2008)[a] found four categories of traditional restrictions, or *fady*, in Madagascar which limit coastal resource exploitation: spatial restrictions, temporal restrictions, gear restrictions and species restrictions. Such management tools are common around the world. In parts of Australia, for example, customary marine tenure divides sea property by island, community, clan and lineage.[b] Tenure is backed by collective and individual access rights which allow for adaptive management even amid conflict, and which support the reasoned regulation of stocks.[c] The displacement of Indigenous Peoples and erosion of their culture disrupts these protective measures.

The links between indigenous land, identity and fishing practices are perhaps clearest in the relationships between fishers and the aquatic species they harvest. Many Indigenous Peoples develop personal and cultural bonds with particular species. The Baniwa and Enawene of the Amazon rainforest, for example, understand fish as ancestral kin whose artistic, ritual and social life mirrors that of humans.[d] These close ties inform fishing prohibitions when sacred species are targeted. In the Congo Basin, the Bakwele apply 25 such restrictions on 46 fish species.[e] According to these customs, eating or even touching restricted species can bring sickness or disorder to pregnant women and their families. Prohibitions like these can protect vulnerable species, define tenure, and set the foundation for both food security and equitable resource distribution.[f]

Recent research shows that these traditional restrictions contribute to conservation as well.[g] When customary sea turtle bans were lifted in Madagascar, for example, turtle populations declined significantly.[h] Some conservation programmes have included indigenous values in a bid to strengthen their impact.[i] In Eastern Polynesia, the restoration of ancient *rahui* access restrictions has increased the richness and biomass of fish species.[j] These examples show how much policymakers and fisheries managers can learn from the practices, beliefs and values that shape indigenous fisheries.

Notes: **a** Cinner, J. 2008. Le rôle des tabous dans la conservation des ressources côtières à Madagascar. Ressources marines et traditions. *Bulletin de la CPS*, 22: 15–23. **b** Lalancette, A. 2017. Creeping in? Neoliberalism, indigenous realities and tropical rock lobster (kaiar) management in Torres Strait, Australia. *Marine Policy*, 80: 47–59. **c** Peterson, N. & Rigsby, B., eds. 2014. *Customary marine tenure in Australia*. Sydney, Australia, Sydney University Press; Johannes, R.E. 2002. The renaissance of community-based marine resource management in Oceania. *Annual Review of Ecology and Systematics*, 33(1): 317–340; Vaughan, M.B., Thompson, B. & Ayers, A. 2017. *Pāwehe Ke Kai a'o Hā'ena*: creating state law based on customary indigenous norms of coastal management. *Society & Natural Resources*, 30(1): 31–46. **d** Garnelo, L. 2007. Cosmologia, ambiente e saúde: mitos e ritos alimentares baniwa. *História, Ciências e Saúde*, 14: 191–212; Mendes dos Santos, G. & Mendes dos Santos, G. 2008. Men, fish and spirits: the fishing ritual of the Enawene-Nawe. *Tellus*, 8: 39–59. **e** Oishi, T. 2016. Ethnoecology and ethnomedicinal use of fish among the Bakwele of southeastern Cameroon. *Revue d'ethnoécologie*, 10. **f** Colding, J. & Folke, C. 2001. Social taboos: "invisible" systems of local resource management and biological conservation. *Ecological applications*, 11(2): 584–600; Coté, C. 2017*. Spirits of our whaling ancestors: revitalizing Makah and Nuu-chah-nulth traditions*. Seattle, USA, University of Washington Press; Leblic, I. 2008. *Vivre de la mer, vivre avec la terre … en pays kanak. Savoirs et techniques des pêcheurs kanak du sud de la Nouvelle-Calédonie*. Travaux et documents océanistes. Paris, Société des Océanistes. **g** Alexander, L., Agyekumhene, A. & Allman, P. 2017. The role of taboos in the protection and recovery of sea turtles. *Frontiers in Marine Science*, 4: 237; Foale, S., Cohen, P., Januchowski-Hartley, S., Wenger, A. & Macintyre, M. 2011. Tenure and taboos: origins and implications for fisheries in the Pacific. *Fish and fisheries*, 12(4): 357–369; Jones, J.P., Andriamarovololona, M.M. & Hockley, N. 2008. The importance of taboos and social norms to conservation in Madagascar. *Conservation biology*, 22(4): 976–986; Shalli, M.S. 2017. The role of local taboos in the management of marine fisheries resources in Tanzania. *Marine Policy*, 85: 71–78. **h** Cinner, J. 2008. Le rôle des tabous dans la conservation des ressources côtières à Madagascar. Ressources marines et traditions. *Bulletin de la CPS*, 22: 15–23. **i** Evans, K.E. & Klinger, T. 2008. Obstacles to bottom-up implementation of marine ecosystem management. *Conservation Biology*, 22(5): 1135–1143; Kaplan, I.M. & McCay, B.J. 2004. Cooperative research, co-management and the social dimension of fisheries science and management. *Marine Policy*, 28(3): 257–258. **j** Bambridge, T. 2017. Le «rahui» polynésien au secours de l'environnement. In: *The Conversation*. Cited 9 March 2017. https://theconversation.com/le-rahui-polynesien-au-secours-de-lenvironnement-73382

8.7 Factors influencing governance and management effectiveness

Active, free, effective, meaningful and informed participation of fishers, fishworkers and their communities constitutes one of the Guiding Principles of the SSF Guidelines. This section begins with an overview of how social and cultural identity is important to governance, then provides a global overview of the level of participation of fishers in management processes, according to the CCS authors. It then responds to the call in the SSF Guidelines for overcoming barriers to participation by briefly highlighting three examples of these: power imbalances in the value chain, gender inequality, and the privilege afforded to certain forms of knowledge over others. (For a fuller exploration of gender, please refer to Chapter 6.)

8.7.1 Social and cultural identity

Small-scale fisheries play an important role in the formation of social and cultural identities, particularly for Indigenous Peoples (see Box 8.5). Identity formation is a fundamental element of social and cultural practice, as it revolves around how people understand themselves and are seen by others (Béland, 2017). Identity influences what people do, how they interact, and where they feel they belong. While it is subject to change, identity may nevertheless be perceived as the essence of who one is, and hence be used to sustain collectivity, or rather to emphasize differences instead.

It is in this dynamic of sameness and difference, and of stability and change, that identity plays a vital role in the viability and day-to-day organization of small-scale fisheries. The practice of fishing as well as pre- and post-harvest activities sustain a diversity of specialized skills and knowledge systems connected to coastal, marine and freshwater environments. Hence, the value of small-scale fisheries for both fishers and the broader society extends beyond livelihoods and food security to include heritage and well-being. Moreover, how and where fishers and fishing communities feel they do or do not belong affects how approaches to fisheries governance are locally received or resisted, making identity also relevant for policymaking. In turn, customary governance and management arrangements in these fisheries can also affect and shape identities and cultural practices related to fishing.

Nevertheless, the value of small-scale fisheries in terms of identity and heritage has often remained hidden. It is hardly quantifiable, which is probably a major reason for it not being given due attention. Yet,

BOX 8.5

The unique characteristics of indigenous fisheries

Though no definition can sufficiently encompass the vast diversity of peoples who identify as indigenous, international policy frameworks have established practical and inclusive criteria. Based on these, the FAO Policy on Indigenous and Tribal Peoples[a] lists four main attributes of Indigenous Peoples: i) priority in time, with respect to occupation and use of territory; ii) voluntary perpetuation of cultural distinctiveness, including language, social organization, spirituality, modes of production, laws and institutions; iii) self-identification, as well as recognition by other groups or states, as a distinct collectivity; and iv) experience of subjugation, marginalization, dispossession, exclusion or discrimination, whether or not these persist. Indigenous fishers are those who fit these criteria and rely on the harvest of aquatic fauna for some combination of food, livelihood, identity and cultural heritage.

Indigenous fishing practices are often central to larger food systems and cultural identities. For indigenous fishers, fishing is rarely limited to a livelihood or profession. Rather, it is typically understood as part of a biodiverse food system that may include hunting, cultivating and gathering. Often, fishing is also a key component of identities grounded in family, traditions, language and spirituality. The ancestral continuity of many indigenous fishing practices and of the environments they steward is a testament to the links between indigenous fisheries, indigenous identities, and the ecosystems in which Indigenous Peoples live.[b]

Notes: **a** FAO. 2010. *FAO Policy on Indigenous and Tribal Peoples*. Rome. **b** Woodley, E., Crowley, E., Dey de Pryck, J. & Carmen, A. 2006. *Cultural indicators of Indigenous Peoples' food and agro-ecological systems*. Rome, FAO.

identity and heritage must still be taken into account in the design of governance measures to ensure they foster well-being, sustainability and equity in these fisheries (Allison *et al.*, 2020).

Below are three aspects of identity in small-scale fisheries that are factors in governance and management:

- **Diverse communities of practice:** Small-scale fisheries contribute to sociocultural diversity, and there is a significant positive association between their diverse fisheries practices and the resilience and well-being of coastal and inland water communities. At the same time, small-scale fishing communities are also vulnerable to processes of displacement, exclusion and stigmatization. Particularly in locations where there are mixed livelihoods, people may not be recognized as fishing communities even if they engage in fishing activities. What constitutes a "fishing community" is not necessarily geographically or administratively defined. As different cases show, fishers, traders and fish processors often sustain "communities of practice" among people living in different places (Clay and Olsen, 2008).
- **Cultural heritage:** Given humanity's long history of living with (and off) the sea as well as inland waters, coastal, riparian and maritime societies usually harbour a rich cultural heritage related to fishing, fish trade and seafaring (e.g. King and Robinson, eds., 2019). The translocality (i.e. presence in multiple locations) of these practices has generated shared identities and a sense of belonging across places, but cultural heritage in small-scale fisheries is also often tied to specific geographical locations. Thus it can have political consequences, but also an important role in structuring community life.
- **Self-definition and self-determination:** There is growing recognition of the value of small-scale fishers' knowledge and experiences in fisheries management. But to effectively and equitably involve these fishers in governance processes (i.e. co-management), it is important to take seriously not only their worldviews, but also how they identify themselves (both as fishers and as groups in society). Furthermore, this must be done without stereotyping, as this can hinder effective and just governance when the categories and proposed measures in policymaking are at odds with the social realities on the ground or at sea (Steins, 2006; see also Box 8.6).

8.7.2 Fisher participation in fisheries management

CCS authors for the countries and territories involved in the IHH study were asked to provide their expert knowledge about fisher participation in the co-management of their fisheries. Participation was defined to encompass a broad spectrum of involvement: fishers being passive recipients of information shared by the government concerning decisions it plans to make; government and fishers cooperating as equal partners in decision-making, data collection, and monitoring and surveillance; and fishers making most decisions and advising the government, with said government then endorsing such decisions (Sen and Nielsen, 1996). Responses indicated that more than 60 percent of the small-scale fisheries catch with at least partially devolved rights involves participation from "some" or the "majority" of fishers (Figure 8.21).[49]

These findings are consistent with the positive relationship between co-management and participation found in the literature (Cinner *et al.*, 2012b; Cohen *et al.*, 2021; d'Armengol *et al.*, 2018; Evans, Cherrett and Pemsl, 2011; Gutiérrez, Hilborn and Defeo, 2011). Looking at co-management and participation disaggregated by region (Figure 8.22), this positive relationship is evident in some regions (especially Oceania), but not so much in others. Africa in particular has a large gap between catch with co-management provisions and catch where co-management is perceived by CCS authors to have a high level of engagement from fishers.

Debate is ongoing about the direction of the causal relationship between co-management and participation, or whether participation is a necessary but nonetheless insufficient condition for co-management effectiveness (Béné and Neiland, 2006; Nunan and Cepić, 2020; Speer, 2012).

BOX 8.6

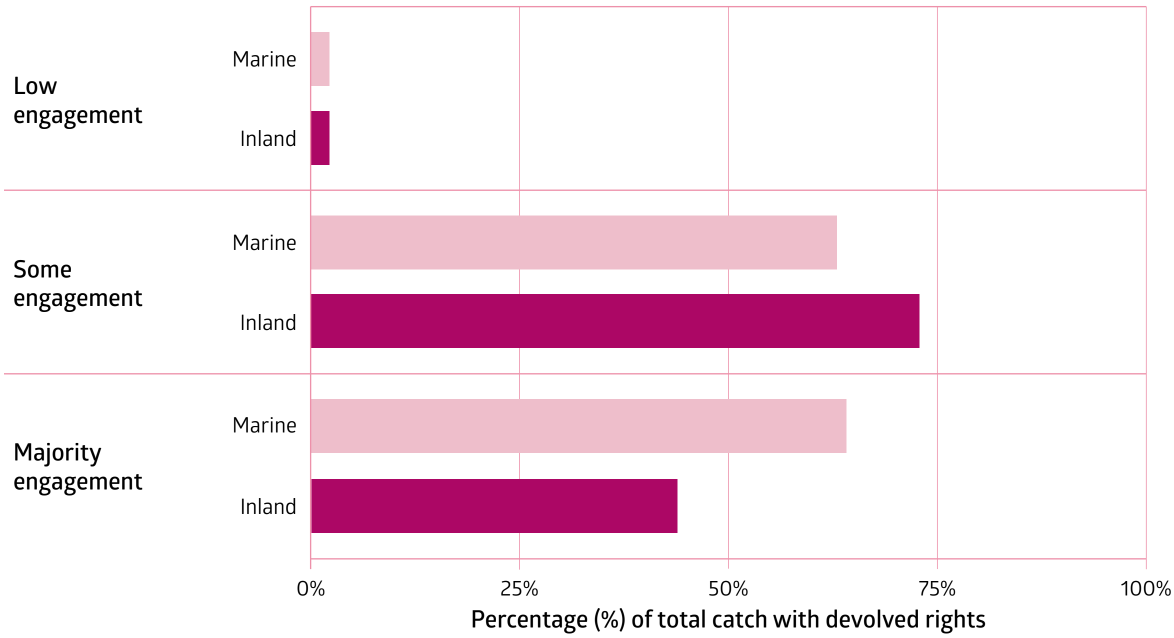
Co-management, self-determination, and participation in decision-making

It is the responsibility of governments to enable the co-management process, ensuring that it is fair and just.[a] Cultural differences can be a constraining factor and fuel conflict.[b] Identity, however, can be a motivating and enabling factor that supports collectivity and meaningful representation, most clearly demonstrated by the emerging recognition and legal anchoring of Indigenous Peoples' right to self-determination and to intellectual and cultural property.[c] Furthermore, fishers' ability to participate at different levels is an important prerequisite for effective co-management. This is not just linked to resource availability and individual skills, but also to the ability to organize collective political action.[d] Such community organization requires, and sustains, a sense of belonging and moral obligation, and is shaped by specific (local) power dynamics.[e] In designing policies and institutional arrangements, state and other authorities need to be responsive to such social realities and emergent forms of organization in fisheries management.[f] Due to their community bonds and particular heritage, small-scale fishers have socially distinguishing features, including different understandings, views, values and skills. This makes them different – as individuals or groups – from each other and from other stakeholders, which then affects their engagement in political processes.[g] While this distinctiveness of small-scale fishers becomes visible in the process of decision-making, and their particularity is often recognized, the ways in which their identity affects governance processes often remain unaddressed.

Notes: **a** Jentoft, S. 2005. Fisheries co-management as empowerment. *Marine Policy*, 29(1): 1–7. **b** Natcher, D.C., Davis, S. & Hickey, C.G. 2005. Co-management: managing relationships, not resources. *Human Organization*, 64(3): 240; Trimble, M. & Berkes, F. 2015. Towards adaptive co-management of small-scale fisheries in Uruguay and Brazil: lessons from using Ostrom's design principles. *Maritime Studies*, 14(1): 14. **c** Burri, M. 2019. Cultural heritage and intellectual property. In: F. Francioni & A.F. Vrdoljak, eds. *The Oxford handbook of international cultural heritage law*, pp. 459–482. Oxford, UK, Oxford University Press. **d** Jentoft, S. 2005. Fisheries co-management as empowerment. *Marine Policy*, 29(1): 1–7; Pomeroy, R.S. & Berkes, F. 1997. Two to tango: the role of government in fisheries co-management. *Marine Policy*, 21(5): 465–480. **e** Gehrig, S., Schlüter, A. & Jiddawi, N.S. 2018. Overlapping identities: the role of village and occupational group for small-scale fishers' perceptions on environment and governance. *Marine Policy*, 96: 100–110; Jentoft, S. 2005. Fisheries co-management as empowerment. *Marine Policy*, 29(1): 1–7; Nightingale, A. 2013. Fishing for nature: the politics of subjectivity and emotion in Scottish inshore fisheries management. *Environment and Planning A: Economy and Space*, 45(10): 2362–2378. **f** Glaser, M., Baitoningsih, W., Ferse, S., Neil, M. & Deswandi, R. 2010. Whose sustainability? Top-down participation and emergent rules in marine protected area management in Indonesia. *Marine Policy*, 34(2010): 1215–1225. **g** Fearon, J.D. 1999. *What is identity (as we now use the word)?* Working paper. Palo Alto, USA, Stanford University. https://web.stanford.edu/group/fearon-research/cgi-bin/wordpress/wp-content/uploads/2013/10/What-is-Identity-as-we-now-use-the-word-.pdf; Turnhout, E., Van Bommel, S. & Aarts, N. 2010. How participation creates citizens: participatory governance as performative practice. *Ecology and Society*, 15(4): 26; Bennett, N.J., Whitty, T.S., Finkbeiner, E., Pittman, J., Bassett, H., Gelcich, S. & Allison, E.H. 2018. Environmental stewardship: a conceptual review and analytical framework. *Environmental Management*, 61(4): 597–614.

[49] The opinions of respondents were based on their own experience of co-management in their countries and that of the rest of their CCS team, which often included one or more staff working in government, academia or CSOs, therefore representing a diversity of perspectives and experiences regarding small-scale fisheries. Average team size was 5 members, with a minimum of 1 and a maximum of 17, for a total of 248 interviewees.

Figure 8.21 Comparison of different levels of fisher participation (as perceived by key respondents) for marine and inland small-scale fisheries catch with at least partially devolved management rights (based on 43 countries reported to have devolved rights)



Notes: Percentages in marine and inland categories exceed 100 percent, given that the same catch can involve different levels of participation when it is under the influence of different policies (i.e. different policies can contribute to different participation levels). The opinions of respondents were based on their own experience of co-management in their countries and that of the rest of their country and territory case study team, which often included one or more staff working in government, academia or civil society organizations, therefore representing a diversity of perspectives and experiences regarding small-scale fisheries.

A number of other enabling conditions are mentioned in the literature as necessary for co-management to be effective. These include the presence of central fisheries agencies capable of developing equitable participatory processes and reliable support for the implementation of devolved fishing rights, as well as commitments to downward accountability, provision of access to information and learning, and culturally appropriate processes of engagement (Armitage *et al.,* 2018; Barratt, Seeley and Allison, 2015; Trimble, de Araujo and Seixas, 2014). Without commitment from the state, as well as enhanced capacity for local organizations that create these enabling conditions for fishers to exercise their devolved rights, devolution typically fails, at times resulting in the reappropriation of indigenous resources, proliferation of management ideas incompatible with communal livelihoods, and the subsequent creation of other undue burdens on small-scale fishers (Carothers and Chambers, 2012; Davis and Ruddle, 2012). Three barriers that reduce fishers' incentives for participation and weaken overall governance and management effectiveness are outlined below.

8.7.3 Power imbalances in the value chain

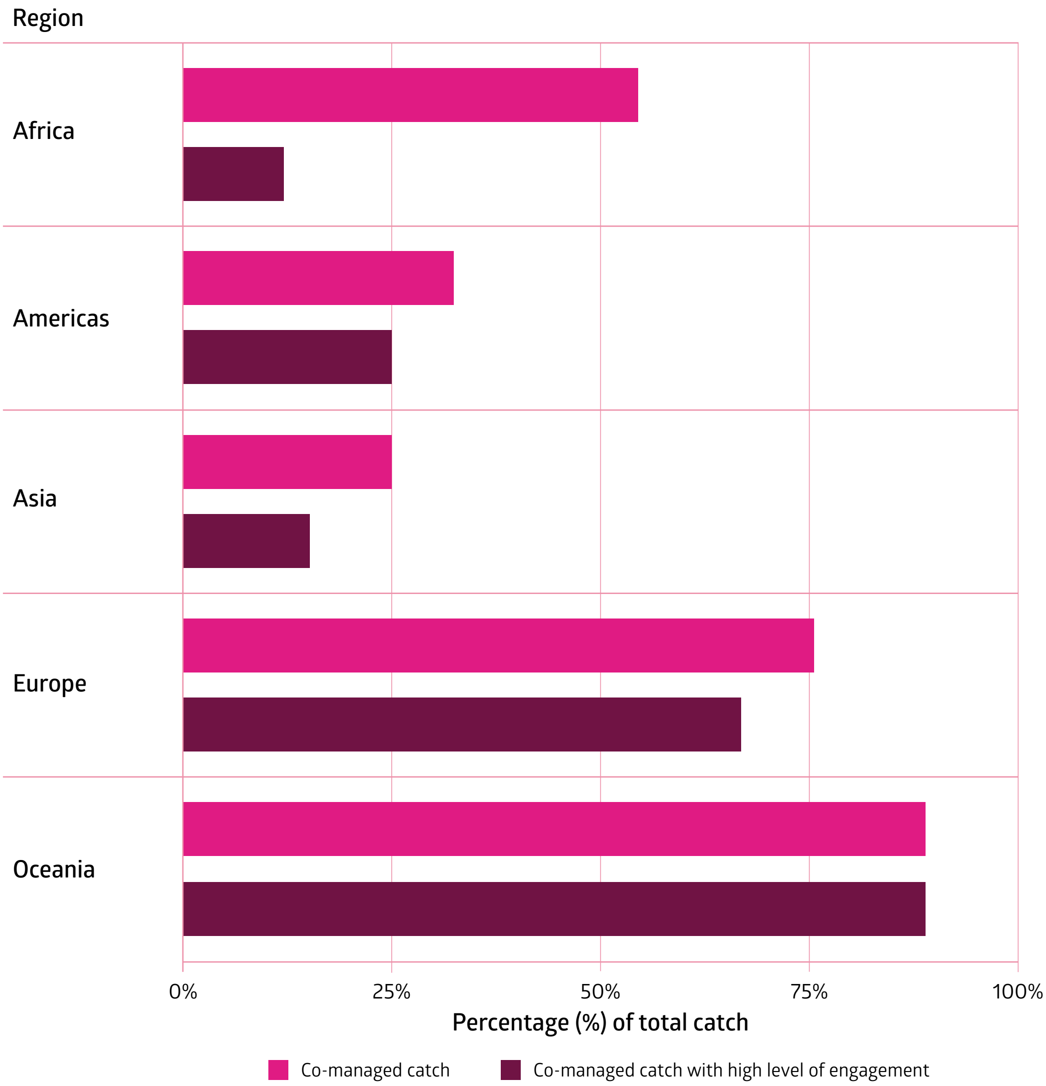
Fish buyers or traders constitute important actors with significant influence over the effectiveness of small-scale fisheries governance, but they have not received enough attention in the design of governance and management systems. In many settings, fish buyers form patron–client relationships with fishers that dictate the de facto rules determining how, where and when to harvest, and these can be more influential than formal mandates established by the state. Patrons can accumulate power and influence by gaining control of the means of fishing production, fishing licences and/or commercialization channels, requiring fishers to contract with them in order to engage in fishing activities. Fishers in good standing with these patrons can receive a number of services that they often cannot access in any other way, such as monetary loans, health care access, education and political backing (Pelras, 2000; Wolf, 2004; Ruddle, 2011; Sudarmono and Bakar, 2012; Basurto *et al.,* 2020). While most fishing patrons are men, in Western Africa "fish mammies" constitute an example of women patrons who have gained good financial stature by forming rotating savings/credit and labour organizations. These organizations share labour and profits, regulate market prices for fish inputs, and mobilize protests against activities that might diminish their incomes (Browne, 2001; O'Neill, Asare and Ahato, 2018). Patrons can emerge via leadership roles within fishing communities but may also arise from elsewhere, operating outside formal local institutions or customary leadership roles – and effectively challenging them. In some settings, patrons have consolidated enough power to control the structure of markets and access to global supply chains, as in the case of the Mahi artisanal fisheries in Ecuador and Peru. They can also have considerable influence in defining target species, facilitating access to fishing gear, limiting the capacity of fishers to organize, and even subverting formal governance or enforcement institutions (Johnson, 2010; Nurdin and Grydehøj, 2014; Pauwelussen, 2015; Steenbergen *et al.*, 2019).

8.7.4 Gender in decision-making

The role of gender in decision-making has similarly not received enough attention from small-scale fisheries policymakers, despite the fact that gender shapes many aspects of the subsector such as fishing practices, social life, livelihoods, division of labour, resource access and power dynamics (FAO, 2017b). More extensive evaluation of the role of gender in small-scale fisheries is provided in Chapter 6.

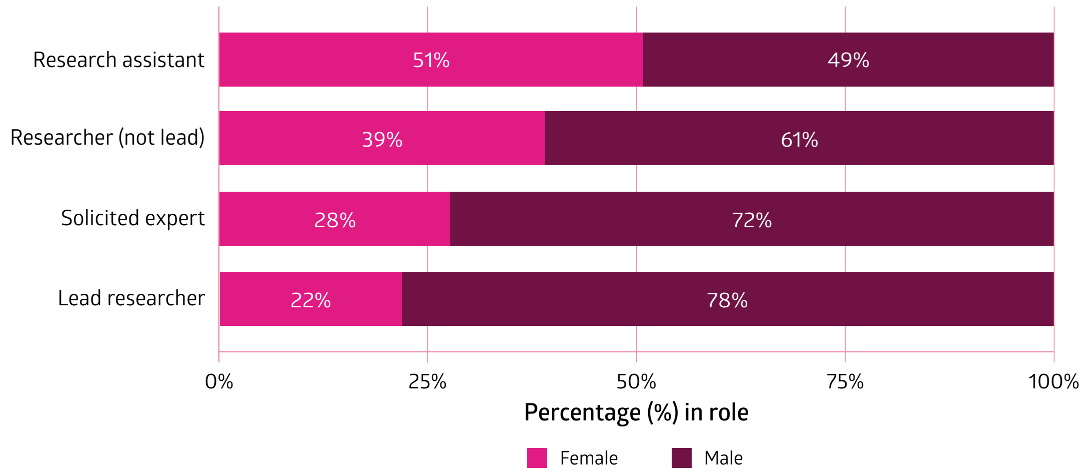
Despite the number of women actually involved in small-scale fisheries value chains – women whose unpaid reproductive, caregiving and domestic labour are the mainstay of small-scale fishing communities – the subsector's governance systems and policies typically overlook intrahousehold dynamics (Williams, 2008; Kleiber *et al.*, 2017). Male identities dominate the conceptualization of fishing, not only among managers but among fishers themselves, and this affects fishing behaviour. For example, the hypermasculine idea of toughness can encourage illegal and dangerous fishing techniques as "a form of group socialization that celebrates masculine values of courage, independence, and bravery" (Fabinyi, 2007, p. 525). This socialization creates pressure for fishers – especially younger and poorer fishers – to be "manly" and exposes them to ridicule if they turn to other economic endeavours (Turgo, 2014). Lobster or sea cucumber divers in Central America and

Figure 8.22 Regional distribution of small-scale fisheries catch formally governed under co-management, and catch governed under co-management with a high level of fisher engagement (reported for 43 countries: 6 in the Americas, 5 in Africa, 6 in Asia, 2 in Europe, 1 in Oceania)



Note: High level of engagement refers to the perception by country and territory case study experts that the majority of fishers engage or participate in co-management.

Figure 8.23 Research roles by gender within IHH case study teams from 53 countries and territories



Mexico, for instance, choose to risk their lives not only because the fisheries are profitable, but because "that is what men are supposed to do". Similarly, strong gender stereotypes about what "women are not supposed to do" can result in increases in domestic violence when women diverge from or challenge existing gender norms. Turgo (2015) has documented how increased incomes for women from new market opportunities in fishing is often associated with domestic violence, illustrating the challenges that remain regarding women's increased participation in commercialized fishing activities within existing gender structures. Other dynamics can also contribute to women's marginalization in fisheries. For instance, exclusively male access to fisheries that are farther from shore may cause gendered income inequalities, and the hypermasculine norms that encourage risky behaviour can have grave impacts on women in fishing households. Though the topic still warrants more study, masculine norms have been shown to increase environmentally destructive fishing, bolster resistance to conservation efforts, and hinder engagement in fishers' organizations (Siegelman, Haenn and Basurto, 2019; Fabinyi, 2007).

The influence of gender goes beyond fishers and fishing communities. For instance, male dominance in fisheries research and management institutions has long influenced the type of data available, the factors prioritized in decisions, and the outcomes of fisheries management (Kleiber, Harris and Vincent, 2015; Harper *et al.*, 2020; Fröcklin *et al.*, 2013; Munk-Madsen, 1998). This has too often led to siloed fisheries agencies and institutions that lack the expertise and data to prioritize pressing socioecological concerns through gender-focused programming (Kleiber *et al.*, 2017; Mangubhai and Lawless, 2021). As Figure 8.23 shows, the present IHH report is no exception. Despite making gender a central cross-cutting theme, there was a consistent overrepresentation of men in IHH country-level research, especially in leadership positions. These inequalities are likely to have resulted in data gaps as research teams lacking gender expertise struggled to find effective strategies for collecting gender-disaggregated data, underscoring the importance of commitments to diversity and inclusion in fisheries agencies and institutions (see Chapter 6).

Fisheries research and policymaking will benefit from further examination of the impact of gender-related factors on small-scale fisheries governance. These include the disadvantages and stigma women face, the stereotyping of women's roles, gender imbalances in participation in governance, the emphasis on male identities, and exclusionary institutions in fisheries and fisheries management (Cornwall and Rivas, 2015; Siegelman, Haenn and Basurto, 2019).

8.7.5 Privileged forms of knowledge

Fisheries management has tended to prioritize the knowledge and preferences of biologists, conservation scientists and economists. This has weakened the effectiveness of small-scale fisheries governance because often these experts are not sensitive to, or equipped to answer, important questions about socioecological impacts, community interests, gender relations and power dynamics in small-scale fisheries, which are essential considerations for management and governance (Bromley, 2009; Armitage *et al.*, 2009; Fabinyi, Foale and Macintyre, 2015). With these limited perspectives, scientists and policymakers have frequently failed to account for the ways in which fishers self-organize, and how this influences fisheries outcomes (Campbell *et al.*, 2016; Arias-Schreiber *et al.*, 2017). In addition, a lack of attention to gender in fisheries research and management has contributed to data gaps concerning women's roles in small-scale fisheries, with resulting impacts on the ability to provide gender-responsive interventions (Kleiber, Harris and Vincent, 2015; Leisher *et al.*, 2016; Harper *et al.*, 2020).

This is not to suggest that knowledge of natural science and economics is bad for management of small-scale fisheries; it is indeed necessary, but insufficient

BOX 8.7

Indigenous languages and knowledge

Indigenous languages are important as repositories of memory, knowledge and beliefs that help sustain fisheries. These languages communicate ecological information, fishing techniques and management practices.[a] For example, the Marovo in Oceania describe the characteristics of entire groups of animals at a given moment, rather than individual species, using over 400 words for fish and 100 for shells.[b] The term used for aquatic creatures depends on collective traits including the shape of the group, its apparent purpose, its movements, and the behaviours of individuals within the group. In this case and others, indigenous language offers information essential to the sustainable harvest of these ecological communities. This knowledge extends beyond target species, and has been recognized as important for an ecosystem approach to fisheries.[c]

Mollusc fisheries in South-eastern Asia provide an excellent example of the intricate knowledge embedded in indigenous language. While English is often limited to vague terms like "shellfishing", "gleaning" and "gathering", the Mentawai of this region use an array of terms to denote target species and specific harvesting techniques. Their vocabulary is precise enough to describe features of the mangrove environment including tidal influence, water salinity, soil characteristics and forest type.[d] Paired with Mentawai toponyms, this lexicon helps fishers locate resources and describe changes in distribution or abundance. In this way, the Mentawai language facilitates communication within the fishery and informs decisions about future fishing grounds and target species.

Though knowledge transmission is important for all fisheries, indigenous oral traditions have been especially susceptible to erosion. For example, South-eastern Asian Mandar fishing songs have traditionally demarcated customary tenure, but district courts have stepped in to override this form of fishery management.[e] The songs outline complex customary rights based on gear, target species, geography and historical access, and also communicate Mandar spiritual beliefs and fishing knowledge that guide resource management. The disregard for such traditions is especially regrettable because indigenous knowledge can set a foundation for sustainability. Long-practiced oral traditions and the knowledge they convey offer expert insights into the state of aquatic ecosystems, changes over time, and the proper adaptive responses for sustainable harvesting. These make indigenous fishers' language and knowledge critical sources of information for understanding climate change, modelling resilience, conserving aquatic resources and upholding collective rights.[f]

Notes: **a** Johannes, R.E., Lasserre, P., Pliya, J., Nixon, S.W. & Ruddle, K., 1983. *Traditional knowledge and management of marine coastal systems: report of the Ad Hoc Steering Group, IABO-UNESCO*. Report No. 4. http://hdl.handle.net/102.100.100/286080?index=1; Henderson, J.K. & Nash, D., eds. 2002. *Language in native title*. Canberra, Aboriginal Studies Press; UNESCO. 2019. *Strategic outcome document of the 2019 International Year of Indigenous Languages*. General Conference, 40th session, Paris. https://en.iyil2019.org/wp-content/uploads/2019/11/strategic-outcome-document_iyil2019_eng.pdf. **b** Hviding, E. 1996. *Guardians of Marovo Lagoon: practice, place, and politics in maritime Melanesia*. Honolulu, USA, University of Hawai'i Press. **c** Foale, S. 1998. What's in a name? An analysis of the West Nggela (Solomon Islands) fish taxonomy. *SPC Traditional Marine Resource Management and Knowledge Information Bulletin*, 9: 3–20. Nouméa, Pacific Community; May, D. 2005. Folk taxonomy of reef fish and the value of participatory monitoring in Wakatobi National Park, southeast Sulawesi, Indonesia. *SPC Traditional Marine Resource Management and Knowledge Information Bulletin*, 18: 18–35. Nouméa, Pacific Community; Moesinger, A. 2018. Catching names: folk taxonomy of marine fauna on Takuu Atoll, Papua New Guinea. *SPC Traditional Marine Resource Management and Knowledge Information Bulletin*, 39: 2–14. Nouméa, Pacific Community; Indigenous People Major Group. 2019. *Global report on the situation of lands, territories and resources of Indigenous Peoples*. www.iwgia.org/en/resources/publications/3335-global-report-on-the-situation-of-lands-territories-and-resources-of-indigenous-peoples **d** Burgos, A. 2016. Savoirs naturalistes et stratégies de collecte de Geloina erosa, Geloina expansa et Polymesoda bengalensis dans la mangrove de l'île de Siberut (Indonesia). *Revue d'ethnoécologie*, 9; Burgos, A. & Dillais, P. 2012. Les femmes, les coquillages et la mangrove: collecte *d'Anodontia philippiana* et *Austriella corrugata* à Siberut (Indonésie). *Techniques & Culture*, 59: 326–337. **e** Zerner, C. 2003. Sounding the Makassar Strait: the poetics and politics of an Indonesian marine environment. In: C. Zerner, ed. *Culture and the question of rights: forests, coasts, and seas in Southeast Asia*, pp. 56–108. Durham, USA, Duke University Press. **f** Indigenous People Major Group. 2019. *Global report on the situation of lands, territories and resources of Indigenous Peoples*. www.iwgia.org/en/resources/publications/3335-global-report-on-the-situation-of-lands-territories-and-resources-of-indigenous-peoples when underlying values and assumptions related to the socioecological systems being considered go unquestioned. While local and traditional knowledge has been understood to include a subjective component, incorporating values, norms and beliefs from the larger social context, this knowledge also consists of important facts and historic understanding (Berkes, 2015). Yet, too often, scientific knowledge is still treated as superior, and sufficient by itself to guide management decisions. This type of knowledge is poorly suited to most fisheries and especially small-scale fisheries, where there tends to be deep and comprehensive ties between the harvesting of resources and local social contexts. As such, meeting the objective of sustainability requires learning from a diversity of knowledge types and recognizing multiple worldviews (Berkes, 2017; Reid *et al.*, 2021). Scientific knowledge is a key part of the information and insight required, but it may omit important questions and thus provide misleading or incomplete information to managers. Incorporating local knowledge can allow managers to better account for and correct shortcomings. In some instances, researchers have found more effective and equitable management solutions where they have heeded local knowledge, including indigenous knowledge and fishers' customary rule-making processes (Hauzer, Dearden and Murray, 2013b; Allison *et al.*, 2020; Reid *et al.*, 2021; see also Box 8.7).

8.8 Civil society organizations

In this report, CSOs mostly refer to fisher and fish harvester organizations including producers, non-state supporters, hybrid federations or platforms, and private corporations. These organizations have a strong role to play in the development of enabling conditions that will allow fishers to secure and exercise tenure rights, protect their human rights, increase their participation in decision-making processes and, overall, become central actors in the implementation of the SSF Guidelines (Jentoft and Chuenpagdee, eds., 2015). Yet there is little basic systematic knowledge about their characteristics and capabilities available, particularly from a global perspective.

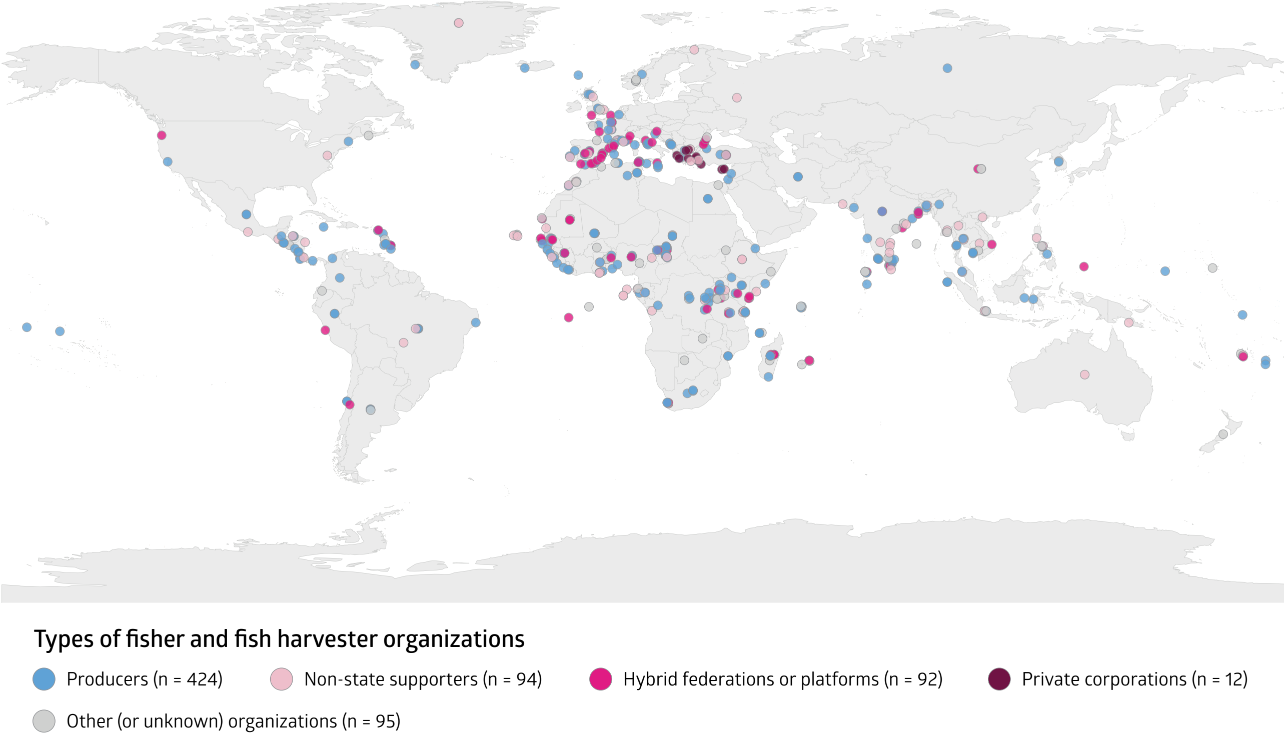
To this end, this report conducted a global survey of 717 CSOs in three languages: English, Spanish and French. Organizations were selected using a "snowball" sampling approach, with FAO as the initial source of information. When large hybrid federations or platforms were identified, such as the African Confederation of Artisanal Fisheries Professional Organizations (CAOPA) or the International Collective in Support of Fishworkers (ICSF), their assistance was requested to survey their members or affiliates. Other surveys were also deployed through networks of non-state supporter contacts, such as the Oak Foundation's network of grantees. The global distribution of the CSOs surveyed (Figure 8.24) indicates that 40 percent are found in Africa, 20 percent in Asia, 19 percent in Europe, 18 percent in Latin America and the Caribbean, 3 percent in Oceania and 0.6 percent in Northern America, with the remaining 0.3 percent consisting of organizations that categorize themselves as global.

As an initial exploration of the potential role for CSOs in the governance of small-scale fisheries and the implementation of the SSF Guidelines, the stated objectives of producer organizations were identified and mapped against important SSF Guidelines themes (Table 8.1).[50] Of the 424 producer organizations surveyed, only 151 provided information about their stated objectives. Overall, findings show that small-scale fishers form producer organizations with varied and multiple objectives, not only for production or fisheries management motivations. Findings cannot be considered representative of the subsector, as some regions such as Africa are likely to be overrepresented, and others like the Americas underrepresented. Often, organizations listed more than one objective; each objective was counted only once per organization and coded under the SSF Guidelines theme considered most applicable. All objectives were assumed to have the same importance within the organization. With these caveats taken into consideration, the findings provide some initial understanding of what issues fishers themselves consider to be important and worth organizing for.

Given that this assessment pertained to producer organizations, it should not be surprising that SSF Guidelines themes most related to harvesting and fisheries management were mentioned by almost all organizations (n = 149). These themes are most closely aligned with SDG Target 14.b, highlighting the priority producer organizations put on having adequate access to fishing resources and markets. SSF Guidelines themes related to various dimensions of well-being were mentioned by fewer organizations (n = 90), but this still helps illustrate that the goals of producer organizations go beyond harvesting and fisheries management. For instance, the theme of "social development, employment and decent work" was mentioned by 73 organizations, ranking third out of all themes mentioned.

[50] Using a coding book developed with definitions for each theme, three coders independently coded the data with at least 85 percent of intercoder reliability. Table 8.1 findings represent the average results for the three coders.

Figure 8.24 Location of civil society organizations surveyed



Source: United Nations Geospatial. 2020. Map geodata [shapefiles]. New York, USA, United Nations, modified by the authors.

Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. Final boundary between the Sudan and South Sudan has not yet been determined.

Some specific examples of objectives most related to harvesting and fisheries management, as stated by the producer organizations themselves, include the following:

- "To make the government sufficiently sensitized to the need of a National Policy on Inland Fisheries and also to ensure that the concerns mentioned above are incorporated in it."
- "To ensure representation and promotion at the regional level of the general interests of professionals engaged in sea fishing."
- "To defend a localized approach to management."
- "Policy research and advocacy to support interests of artisanal fishers."
- "To fight, lobby and advocate for a subsidy to strengthen the local industry."
- "To promote good fish handling practices in order to produce quality products at their fish market and command premium prices."
- "Sustainable management of fishing resources."
- "To provide an open forum for its member cooperatives in which ideas on achieving best practices are discussed and encouraged."

Objectives related to well-being were expressed in a variety of ways, including:

- "Provides social services, financial assistance, treatment benefits and in-kind loans to vessel owners participating in the association."
- "To compensate fishers [in case of] loss of life and belongings."
- "To provide health care facilities for fishing villages."
- "To promote and organize collective protection actions, including the establishment of mutual societies or supplementary social security and health funds for assisting members."
- "To improve the living conditions of fishers and their families."
- "To ensure women take an active role in fisheries management and improve their conditions of work."

The alignment between producer organizations' objectives and the SSF Guidelines and the SDGs cannot be attributed to influence from narratives about the Guidelines or the SDGs: 95 percent of the organizations analysed were created before the SSF Guidelines were published in 2014, and the SDGs were publicly presented in 2016.

Table 8.1 SSF Guidelines themes mentioned in the objectives of a global sample of producer organizations (n = 151)

Themes	Number of organizations	Relevant SDGs and targets
SSF Guidelines themes most related to harvesting and fisheries management		
Policy coherence, institutional coordination, and collaboration	99	• Access to fishing resources and markets (Target 14.b)
Sustainable resource management (and use)	79	
Value chains, post-harvest and trade	50	
Capacity development	48	
Responsible governance of tenure	45	
Information, research and communication	27	
At least one of these themes was reported in 149 out of 151 producer organizations total (99%)		
SSF Guidelines themes related to well-being		
Social development, employment and decent work	73	• Reduce poverty (SDG 1) • Safety at sea (SDG 8.8) • Support the role of women (SDG 5) • Life underwater (SDG 14) • Zero hunger (SDG 2)
Gender equality	16	
Conservation of ecosystems	15	
Food sovereignty and nutrition security	10	
Cultural heritage	10	
Disaster risks and climate change	4	
Implementation support and monitoring	4	
Indigenous rights	4	
At least one of these themes was reported in 90 out of 151 producer organizations total (60%)		

Notes: Findings are organized by SSF Guidelines themes most related to harvesting and fisheries management, and those themes related to various dimensions of well-being. Organizations often mentioned more than one theme. Findings represent the average obtained by three independent coders.

8.9 Contributions of governance systems to the SDGs, in particular Target 14.b

The varied analyses conducted in this chapter shed some light on the contributions that small-scale fisheries governance systems can make in regard to securing access to fishing areas (Target 14.b). To link governance with Target 14.b it is assumed that the more different types of rights are devolved (see Figure 8.3), the more empowered fishers are to govern their fisheries, and hence the more likely they are to ensure rights of access for their fishers.

The first observation is that the current policy frameworks under which small-scale fisheries are governed generally hinder the achievement of the SDGs. The analysis of these frameworks suggests that most small-scale fisheries are governed under general fisheries policies that are not sufficiently tailored to their characteristics. Future policy design for the subsector must have a broad enough national scope and provide the necessary enabling conditions so that subsidiary policies and regulations can be drafted at the local level (or the level appropriate to specific small-scale fisheries) to address the diverse needs and community objectives of particular marine or inland fisheries in relation to important livelihood issues, such as food security and nutrition (SDG 2), poverty alleviation (SDG 1) and life underwater (SDG 14), to name a few.

The analyses of access strategies provide a more direct measure of the contribution of small-scale fisheries governance systems to Target 14.b. They show that licensing is the dominant access strategy governing most of the global catch, yet it is the least likely to involve the devolution of rights to fishers in comparison with access strategies based on place of residence or historical use. The latter two are used to manage access for more than 95 percent of catch with devolved rights, yet overall represent less than half of the overall marine and inland small-scale fisheries catch (Figure 8.8). When conditions for access are associated with the devolution of rights to fishers, it is more likely that local fishers can develop governance arrangements in a way that benefits their livelihoods, while also benefiting the conservation of their fishing resources, and therefore their potential contribution to Target 14.b. A number of ethnographic (Basurto *et al.,* 2012; Johannes, 1978) and wide-scale studies of customary governance regimes support these claims (Cinner *et al.,* 2012b).

Furthermore, there are two drawbacks most likely to be associated with licensing systems (which are mentioned in the literature) that can hinder the contributions of small-scale fisheries to Target 14.b. The first is that licences (or regulations) can lock fishers into a single gear type, species, or taxonomic group regime. Limiting the ability of these fishers to switch between gear type and target species can limit their adaptive capacity to ecological and socioeconomic changes (Coulthard, 2008; Finkbeiner, 2015; Stoll, Fuller and Crona, 2017). Rather, devolving rights to small-scale fishers gives them greater flexibility, which should increase their adaptive capacity. For example, this allows them to devise socially and ecologically appropriate combinations of gear – i.e. combinations that are not destructive to key habitats, while at the same time are well-tailored to local species assemblages, local weather patterns and culturally appropriate fishing techniques. The second drawback is that payments for licences may not be reinvested in local management. Often, this revenue is centralized and spent elsewhere, instead of being reinvested in the local small-scale fisheries activities that generated it (Silver and Stoll, 2019). When this happens, the geographically dispersed or lower-value small-scale fisheries (especially those that are inland), where such investments are usually most needed, are the most negatively affected.

Similarly, the potential contribution of spatial restrictions, such as preferential access areas, to Target 14.b is currently hindered by the lack of devolved tenure rights, which represent less than half of catch caught under these restrictions. Managers must better understand the enabling conditions required for fishers to be able to exercise devolved rights, as well as the barriers to devolving tenure rights, and when these can generate undesirable outcomes (e.g. Cohen, Cinner and Foale, 2013; Gelcich *et al.,* 2006). When fishers can participate in governance and decision-making, institutional arrangements that might increase the effectiveness of local access restrictions are more likely to emerge. For instance, fishers are often willing to become local monitors of their fishing grounds, because the unauthorized entry of other fishers can have negative effects on their income and overall livelihoods. As it has been well documented, the use of local monitors then has positive effects on the health of common-pool resources due to the local knowledge of these monitors2, which allows for the design of monitoring and enforcement schemes that are more effective than those designed by authorities from outside a given fishery (Coleman, 2009).

Required citation for this chapter:

Basurto, X., Siegelman, B., Navarro, M. I., Mancha-Cisneros, M.M., Artaud, H., Burgos, A., Kraan, M., Pauwelussen, A., Toonen, H. 2023. Global patterns of management and governance of small-scale fisheries: contributions towards the implementation of the SSF Guidelines. In: FAO, Duke University & WorldFish. 2023. *Illuminating Hidden Harvests: the contributions of small-scale fisheries to sustainable development.* Rome, FAO; Durham, USA, Duke University; Penang, Malaysia, WorldFish.

9.

The way forward:

turning challenges into opportunities for securing the role of small-scale fisheries in sustainable development

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9.1 Acting on policy commitments in a changing world

The Illuminating Hidden Harvests (IHH) study was undertaken to deepen understanding of the rich and diverse benefits derived from small-scale fisheries. The study has generated new information and knowledge on these fisheries in terms of species targeted; the diversity of the subsector across operational, economic and technological characteristics; gender aspects; contributions to nutrition and other livelihood dimensions; and governance mechanisms. The findings presented in the report underscore how foundational small-scale fisheries are to the livelihoods and culture of an extensive and diverse component of humanity. These fisheries employ the large majority of women and men who work in the fisheries sector, particularly in developing countries or areas, thereby playing a vital role in the provision of fish in all its forms, not only locally but also worldwide This chapter reflects on the findings of the study and considers some of the fundamental changes required in policies and practice to secure and enhance the role of small-scale fisheries in sustainable development.

The endorsement of the SSF Guidelines by Members of the FAO Committee on Fisheries (COFI) in 2014 was a recognition of the immensely important role that small-scale fisheries have to play in the context of the fight against hunger and poverty. The Guidelines constitute a milestone in acknowledging the role of these fisheries in sustainable development, and in providing an agreed policy framework for realizing their potential contributions towards the 17 Sustainable Development Goals (SDGs) of Agenda 2030. Now, efforts and actions need to be accelerated in support of small-scale fisheries to achieve these goals, calling for innovative, holistic and multidisciplinary solutions underpinned by principles of fairness, equity and inclusiveness.

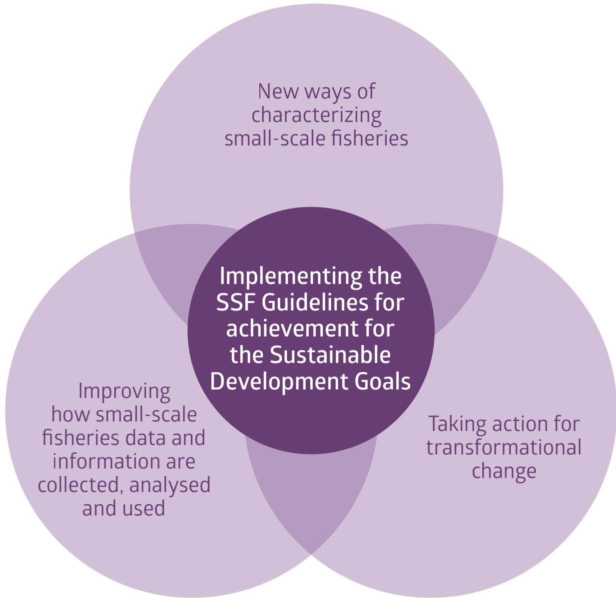
The IHH study offers a new, broader perspective on small-scale fisheries data in support of the implementation of the SSF Guidelines as a pathway to achieving the SDGs. This report provides quantifiable evidence and motivation for policymakers – not only in the fisheries sector but also those dealing with food systems, sustainable development and livelihoods more broadly – to give greater attention to small-scale fisheries. It offers input to inform decision-making, and also points to knowledge gaps and weaknesses in information systems that need to be addressed to ensure these fisheries do not remain "hidden" or marginalized.

Addressing the challenges faced by small-scale fisheries and capitalizing on related existing and potential opportunities will require changes in perceptions and attitudes, both within and outside the subsector. These changes should be guided by a focus on achieving sustainable livelihoods, food security and nutrition, gender equality and effective resource management. This requires multidisciplinary solutions, as well as an understanding of the causes and effects of these feedback loops to inform decision-making.

Appropriate actions are needed at global, national and local levels to ensure that small-scale fisheries fully realize their contributions to the SDGs. The engagement of all stakeholders is critical, but the long-term sustainability of these fisheries will largely depend on whether government-led interventions provide adequate recognition of and support to the subsector, and at appropriate scales. With the SSF Guidelines providing the overall policy framework and global direction, the IHH study findings can be used as a basis for making the necessary decisions.

This chapter discusses the various ways the IHH study results can be used to catalyse the required transformational change, together with new ways of characterizing small-scale fisheries and improved methods for collecting small-scale fisheries data and information. These three pathways towards realizing the contributions of small-scale fisheries to sustainable development are summarized in Figure 9.1.

Figure 9.1 Pathways to fully realize the contributions of small-scale fisheries (SSF) to sustainable development, using IHH study findings



9.2 Taking action for transformational change

9.2.1 The IHH study findings

By collating and analysing the best evidence available, the IHH study set out to demonstrate the importance of supporting small-scale fisheries to fully realize their contributions to sustainable development. The key findings, embracing harvesting and production, livelihoods and economic value, gender, governance, nutrition and other important features and properties, are summarized in Figure 9.2 and each area is discussed further to indicate actions that can be taken.

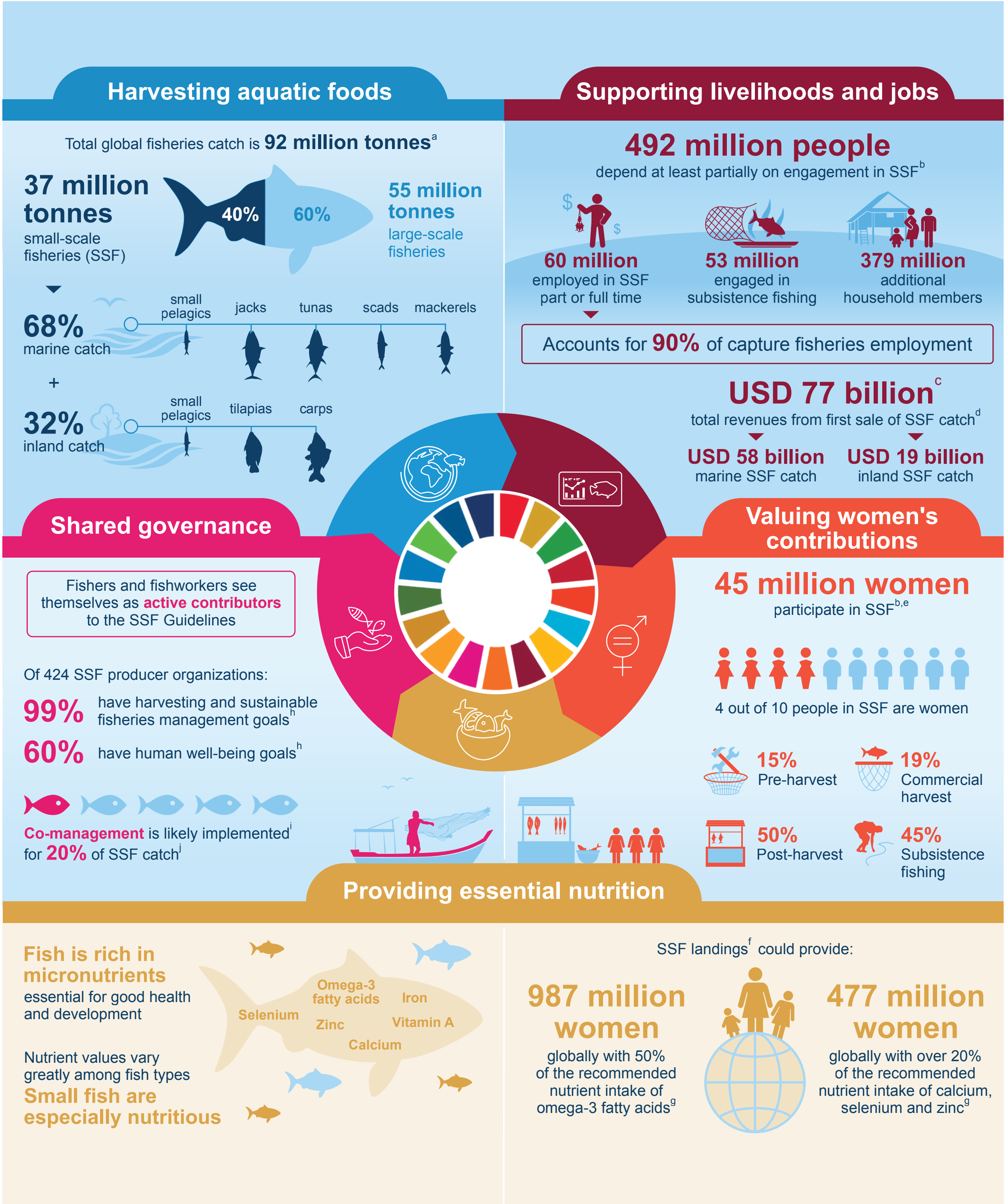
9.2.2 Harvesting aquatic foods

Small-scale fisheries are a significant component of global capture fisheries, reaching around 40 percent of global production. According to the IHH study, the subsector contributes an estimated 36.9 million tonnes of catch, corresponding to around one-third of global marine catch and nearly the entire inland catch. While these numbers alone are already significant, it should be remembered that they have almost certainly been underestimated, particularly on the inland fisheries side, due to the limited information available for subsistence and smaller-scale fisheries in more remote areas.

The findings of the IHH study highlight the importance of small-scale fisheries to global fisheries production. Although production varies across regions (Figure 9.3) and national economic classifications, it can be quite significant in some areas: for example, a large majority (83 percent) of total capture production in least developed countries comes from small-scale fisheries. With reference to species composition, small pelagics and tuna, bonito and billfish are highly represented in marine small-scale fisheries catch, and likewise cyprinids and tilapia for inland catch.

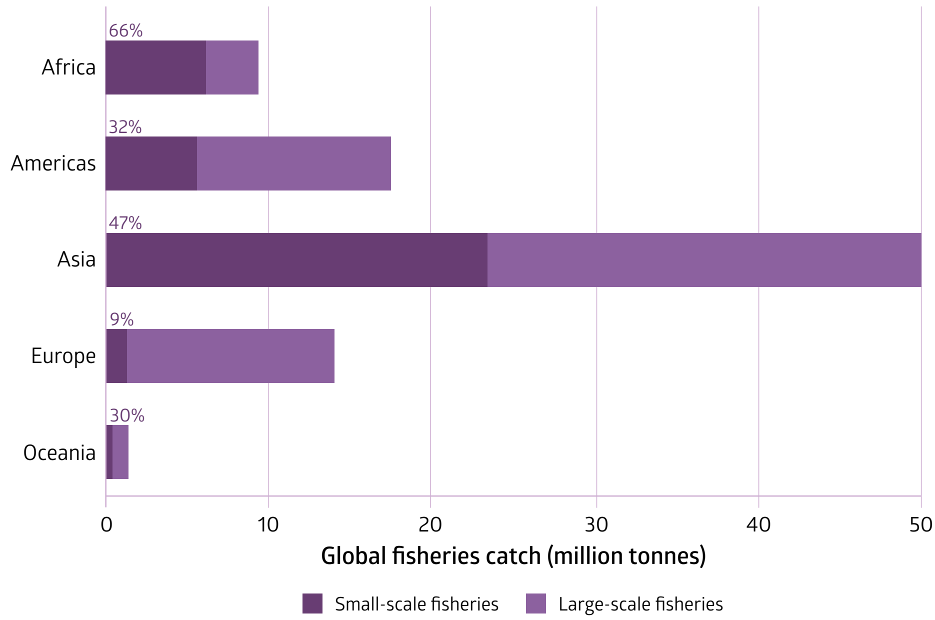
The environmental interactions of small-scale fisheries vary according to the nature of each fishery, with some having among the lowest footprints across all types of food production. These interactions depend on various factors: for example, gear type, intensity of fishing operation, and the particular environment in which the fisheries operate. Coupled with local and global environmental changes (including climate change) that are imposing unprecedented challenges at a broad scale, these interactions have consequences for future small-scale fisheries catches and production systems, and the benefits that these create. While small-scale fisheries could, by definition, have a lower impact on the environment than large-scale fisheries, there is not sufficient evidence to conclude what their aggregate impact is.

Figure 9.2 Key findings of the IHH study



Notes: **a** Average in 2013–2017 extrapolated from 58 IHH country and territory case studies. **b** Extrapolation from 78 national household-based surveys for 2016, including full- and part-time employment along the value chain (numbers rounded). **c** Extrapolated from 58 IHH country and territory case studies. **d** From first sale of SSF catch (2013–2017). **e** Supported by knowledge and insights of 28 gender advisors. **f** Landings include only fish retained by fishers for consumption, sale or trade, whereas catch includes all fish caught. **g** Based on predictive nutrient modelling by the IHH team and partners. **h** Based on global IHH survey of 717 SSF organizations. **i** Based on perceived high participation of fishers, which is used as a proxy for implementation. **j** Based on governance data on marine and inland catch for 58 countries and territories, representing about 55% of the global catch.

Figure 9.3 Estimated contributions of small-scale fisheries (SSF) and large-scale fisheries (LSF) to global catch, by region



Note: Percentages refer to proportion of catch contributed by small-scale fisheries.

The pressures and drivers, both cumulative and in isolation, need to be understood if they are to be remedied, mitigated or adapted to. At the same time as the environmental interactions of small-scale fisheries need to be understood and considered, the food security and nutrition and livelihood roles of small-scale fisheries need to be acknowledged in environmental and biodiversity conservation policies so that the trade-offs between environmental, social and economic goals, especially in situations of poverty, food insecurity and malnutrition, can be identified and included in related policies.

While the reported volumes of small-scale fisheries catch are significant in themselves for better understanding the overall importance of the subsector, there is also great value in understanding how this information is incorporated in policies, strategies and decisions relating to fisheries governance, food systems, livelihoods and poverty eradication. Understanding catch volume and species composition at appropriate scales is also critical for effective fisheries management. In combination with qualitative information gathered from fishers, processors and managers (among others), data on catch and species trends can be used in quantitative or qualitative approaches to assess the state of fish stocks. This information is important to the implementation of adaptive management measures to ensure biological sustainability, in line with SDG Target 14.4 (i.e. "effectively regulate harvesting and end overfishing"). Moreover, additional data on fishing effort, fleet characteristics and gear types, as well as information on market trends and climate change, are essential in reducing uncertainties and improving the assessment and management of small-scale fisheries.

The use of a range of information from different sources is also in line with the SSF Guidelines, which recognize the importance of sustainable resource management and adopting measures for long-term sustainable use of fishery resources and securing the ecological foundation for food production. Appropriate management systems should be implemented, taking into account the particular requirements and opportunities presented by small-scale fisheries (paragraph 5.13). For this, the SSF Guidelines also recognize the need for governments to "establish systems of collecting fisheries data, including bioecological, social, cultural and economic data relevant for decision-making on sustainable management of small-scale fisheries" (paragraph 11.1).

As small-scale fisheries often target and harvest species that are also exploited by large-scale fisheries, information on catch provenance and composition and the functioning of production systems is needed not only to inform management and governance of the small-scale subsector but also to establish where these fisheries fit within broader fisheries management frameworks. This knowledge has implications for overarching decisions on fisheries sustainability and ecosystem effects at all scales. If data on small-scale fisheries catch are missing or inadequate, there can be significant ramifications for fisheries management that also affect the large-scale subsector. This widespread problem can be seen, for example, in small-scale tuna fisheries, whose activities and harvests have implications for stock assessments and harvest quotas. Some regional fisheries management organizations and stakeholders acknowledge that they require far more detailed information on small-scale fisheries catch to effectively manage some or all the species for which they have competence. Thus, filling this data and information gap would allow for improved monitoring and management of these resources across the harvesting segment of the value chain.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9.2.3 Supporting livelihoods

Small-scale fisheries constitute one of the main employers in the world's oceans and inland waters. According to IHH study estimates for 2016, 120.4 million people were either employed within the value chain in capture fisheries or engaged in subsistence activities at some point in the year. Small-scale fisheries accounted for 93.9 percent (113.0 million) of these people. Globally, considering dependents, at least 515.8 million people depend fully or partly on the capture fisheries sector for their livelihoods; of these, 491.7 million people – or 95 percent – depend fully or partly on the small-scale fisheries subsector. Small-scale fisheries also contribute extensively to local and national economies, including through trade, generating a significant portion of the economic value of the world's capture fisheries harvests. The estimated total revenues from the small-scale fisheries harvesting segment are comparable to the total revenues generated by some of the larger industries in the ocean economy. In international trade, the IHH study found that exports are a significant feature of small-scale fisheries: in 22 of the country and territory case studies (CCS), on average almost 26 percent of the marine small-scale fisheries catch by volume was exported, and in 9 of the CCS just over 16 percent of the inland catch was exported.

Small-scale fisheries employment and incomes, as stated by the SSF Guidelines (Preface), "often underpin the local economies in coastal, lakeshore and riparian communities and constitute an engine, generating multiplier effects in other sectors". However, these economic contributions are often hidden within national statistics or narrowly measured around single objectives, and therefore frequently overlooked or underestimated. This can result in perverse policy outcomes, such as prioritizing export-oriented fisheries over domestic interests for livelihoods and food security and nutrition. While the sale of fishery products in global markets can provide benefits through higher revenues and national export earnings, there are also possible costs in terms of reduced availability and higher prices for local consumers and greater incentives for overexploitation.

In addition, there are other important contributions to livelihoods that go beyond the economic value of fisheries catch. The IHH study findings highlight the significant extent of engagement in small-scale fisheries for subsistence, amounting to an estimated 52.8 million people, which can function as a safety net in many low-income countries. This highlights the often hidden role of small-scale fisheries in helping vulnerable populations cushion the effects of shocks by pursuing multiple occupations, as well as absorbing excess rural labour – all part of preventing or alleviating poverty. Insights such as these further reinforce the importance of securing tenure rights and access for small-scale fisheries to help reduce vulnerability and alleviate poverty, as stated in the SSF Guidelines (e.g. paragraph 5.4) and SDG Target 14.b ("provide access of small-scale artisanal fishers to marine resources and markets").

By confirming the importance of small-scale fisheries in terms of employment and subsistence, the IHH study results also provide a rationale and entry point

for gaining deeper insights into the quality of these activities at country and household level, including working conditions (e.g. compliance with international decent work standards and good practices) and the nature of subsistence activities (e.g. level of livelihood dependency, gender relations, nutritional contributions), to inform context-specific policy measures and related activities in line with the SSF Guidelines. Similarly, the advances in knowledge on the contributions of small-scale fisheries to global trade and value chains demonstrate the need for continued analysis of the distribution of monetary, nutritional and social benefits. Finally, it is critical to recognize that the importance of small-scale fisheries goes beyond their economic value, and hence their multidimensional contributions cannot be considered in isolation from each other.

9.2.4 Valuing women's contributions

Among those participating in small-scale fisheries supply chains or engaging in subsistence activities worldwide, an estimated 44.7 million – or 39.6 percent – are women. While women participate in all stages of the small-scale fisheries value chain, they are highly concentrated in the post-harvest segment and in subsistence activities, which combined account for 88 percent of their engagement in the subsector. Globally, 49.8 percent of the people employed part or full time in the post-harvest segment of small-scale fisheries and 45.2 percent of people engaged in subsistence activities are women.

Despite the significant engagement of women in small-scale fisheries, they are rarely visible in decision-making; in addition, they tend to have less access to small-scale fisheries than men. Increasing their access would benefit them greatly, with broad, positive societal implications for food security and nutrition and poverty alleviation. Achieving this will require greater and more equitable participation and shifts in power and decision-making authority, at all levels of governance. It should be noted that policies that do not mention women, or gender at all, may still have disproportionate impacts on women or on men. In the SSF Guidelines, gender equality is a cross-cutting theme, and specific provisions are included on the need for securing women's equal participation in relevant decision-making processes, referring to the Convention on the Elimination of All Forms of Discrimination against Women (CEDAW) (e.g. Guiding Principle 4 and Chapter 8).

Gender disaggregation of small-scale fisheries data should be the minimum standard for all monitoring and research, as gender-blind data or biased data collection methodologies can overlook or conceal the engagement and roles of women in fisheries. Substantial changes may be required in surveys and monitoring to ensure the gender disaggregation of survey questions, sampled populations and sampling strategies. This will require re-evaluating what is counted as small-scale fisheries to include the entire value chain (including pre- and post-harvest activities), enhancing capacity for gender-inclusive data collection and developing policies that include gender equality as a goal.

9.2.5 Providing essential nutrition

For millions globally, including vulnerable people and those beyond the reach of formal markets, aquatic foods from small-scale fisheries represent a crucial and sometimes irreplaceable source of micronutrients and fatty acids important for growth and good health, including calcium, zinc, selenium, iron, vitamin A and omega-3 fatty acids. Good nutrition is particularly important for the development of children, as the first 1 000 days of life (from conception to 2 years of age) constitute a critical window when mothers and children require a nutrient-rich diet for proper growth. Omega-3 fatty acids in particular are important for brain development and growth in infants and for protection against heart disease in adults, and fish are one of the few food sources for these acids.

The most nutritious fish from both inland and marine fisheries are small (< 25 cm body length) pelagic (mid-water dwelling) species, constituting a major part of the volume of small-scale fisheries catch. A 100 g portion of small fish provides on average 26 percent of the recommended nutrient intake (RNI) for adult women of calcium, and 72 percent of RNI for omega-3 fatty acids, while equivalent figures for large fish are 14 percent and 47 percent, respectively. Furthermore, modelling projections from the IHH study estimate that small-scale fisheries landings could provide 50 percent of RNI for omega-3 fatty acids to 150 million women in Africa and 773 million women in Asia.

Knowledge of likely or actual changes in nutrient availability resulting from changes in fisheries management or ecological conditions can be a pivotal input to aligning fisheries management with nutrition targets. For example, in Lake Victoria, there is a need to achieve a balance between the economic and livelihood benefits of the export fishery for Nile Perch, which was introduced to the lake in the 1960s, and its role in directly meeting local nutrition needs. There are also potential nutritional benefits from policy interventions to prioritize local consumption of the small cyprinid *Rastrineobola argentea*, an important species for local small-scale fishers, over its use for fishmeal production and export. Analytical approaches as used in the IHH study provide accessible tools for incorporating nutrition outcomes into management, and are central in the drive to institutionalize nutrition sensitivity as a key pillar of sustainable small-scale fisheries management.

Reinforcing points in the SSF Guidelines on post-harvest losses and waste (e.g. paragraphs 7.3 to 7.5), the study also found that loss of quality and quantity of fish due to inadequate handling, processing and storage reduces the contributions of small-scale fisheries to food security and nutrition and human health. The introduction of appropriate food safety standards, and education programmes for fishers and fishworkers as well as consumers and households, provide opportunities to improve nutrition and livelihood outcomes. Addressing loss and waste represents an important opportunity to increase fish supplies and the potential of small-scale fisheries to contribute to nutrition.

Indeed, enhancing the contribution of small-scale fisheries to food security and nutrition is one of the objectives of the SSF Guidelines, as seen for example in paragraph 7.7 (balancing exports and local nutritional needs) and paragraph 10.1 (regarding food security and nutrition policies). Policies concerning food systems, employment and poverty eradication, in particular at a local level, need to be underpinned by an understanding of nutrition potential and its different components. With improved understanding and monitoring of the nutritional value of the important harvested species, targeted policies and actions benefitting nutrition and health can be defined. This is also pertinent to, for example, economic and gender aspects explored in the IHH study, as strategies are needed to leverage the benefits of small-scale fisheries and fish products across supply chains to vulnerable groups, and to improve intrahousehold distribution of fish.

9.2.6 Shared governance

Governance has been a fundamental part of societies since the beginning of human civilization, embodying the making of rules and the process of implementing management actions related to those rules. In the IHH study, measures of governance were investigated mainly focusing on the formal or de jure policies in place to manage small-scale fisheries through varying degrees of interaction between public and private actors, including co-management arrangements. It was found that most policies that directly address and support small-scale fisheries have only local-level jurisdiction, and apply only in marine environments. Most fisheries policies at the national level do not specifically address small-scale fisheries and, where they do, they tend to focus on marine fisheries. While those local-level policies are important, broader implementation of the SSF Guidelines will require attention to small-scale fisheries in more national-level policies, also addressing the distinct needs of inland fisheries.

The SSF Guidelines call for promotion of co-management and the role of fishers and others engaged in the value chain in promoting responsible fisheries (paragraphs 5.15 and 5.18). But the study found that only about 40 percent of global small-scale fisheries catch comes from fisheries that formally require or allow for co-management, with only about half of these involving a high level of fisher participation.

The IHH study also revealed that greater attention needs to be given to enabling fishers to exercise their tenure rights, in line with Chapter 5a of the SSF Guidelines. It was noted that combining the right to be engaged in management with other tenure rights (i.e. the right of exclusion and transferability) would increase empowerment and the incentives for fishers to manage their fisheries responsibly. The processes and the outcomes for exclusion and transfer within those rights should respect the principles of fairness and equity in line with the Guidelines. The study also found that mechanisms to increase the provision of preferential access areas for small-scale fisheries, which are currently very limited, would have substantial benefits for the subsector. Preferential access to fishery resources for small-scale fishers is supported by both the SSF Guidelines (paragraph 5.7) and the Code of Conduct for Responsible Fisheries (Art. 6.18). SDG Target 14.b addresses the need for small-scale fisheries to have access to resources (and markets), which in turn could play an important role for achieving other goals such as SDG 1 (No poverty).

The IHH study found that the goals of the fisheries organizations surveyed were generally well aligned with the SDGs, reinforcing the importance of strengthening small-scale fisheries organizations and supporting fishers and fishworkers – both men and women – to participate in governance processes. In this context, it is essential to recognize that social and cultural identity plays a vital role in the viability and day-to-day organization of small-scale fisheries, determining who is part of the same group and who is not, which in turn influences how management and governance is locally received, shaped or resisted, and ultimately how effective it is.

It is therefore crucial that fisheries governance and development systems consider the social and cultural identity and values of their constituents at all scales. The importance of this is made clear in the SSF Guidelines, where the need to respect the cultures in these fisheries, including those of Indigenous Peoples and ethnic minorities, and to promote justice, fair treatment and equal enjoyment of human rights for all people (Guiding principles 2 and 5), is emphasized.

Compared to large-scale fisheries, small-scale fisheries have distinctive social and cultural aspects. Their activities are often not just economic, but also a way of life, centred around knowledge that has been passed down through generations. Incorporating social and cultural identity in small-scale fisheries policies and decisions requires appreciating fishers, fishworkers and fishing communities for the valuable insights they can give and the knowledge they can coproduce for socially and environmentally sustainable small-scale fisheries. Accordingly, fisheries policies should explore and build on approaches and frameworks that incorporate these aspects as central to development, such as the well-being approach, the Buen Vivir movement or the Human Development Index, among others.The issue of social and cultural identity is particularly important in the context of indigenous fisheries. Indigenous fisheries' sustainability is typically built on knowledge developed through centuries of territorial tenure and encompasses a diversity of techniques, denominations and human–environment interactions that need to be specifically addressed while collecting, assessing and analysing data, and developing policies related to small-scale fisheries. Violations of indigenous fishing rights threaten all these elements, just as encroachment on indigenous cultural sovereignty threatens the habitats in which indigenous fishers live. Support for indigenous fisheries begins with explicit recognition and implementation of indigenous rights, as outlined in guiding international agreements like the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), Convention 169 of the International Labour Organization and the SSF Guidelines, to set a path by which managers, scientists and policymakers can seek informed consent and invest in indigenous expertise as a key component of decision-making.

9.3 New ways of characterizing small-scale fisheries

The scale of fishing operations exists along a continuum (from foot fishers to large-scale vessels) and can look different in different settings and geographical locations. As a result, there is no universal definition of the small-scale fisheries subsector, nor any agreed cutoff separating small-scale from large-scale operations. Most countries have their own informal or formally recognized operational definitions, but problems can arise when these are based on a limited set of quantitative metrics. Simplistic assumptions may exclude legitimate small-scale fishers or enable large-scale vessels to be included as part of the small-scale fleet, leading to misguided policy decisions with unintended consequences.

There are attributes that can be used to distinguish between the different scales of small-scale fishing operations and which allow the multidimensional and interlinked contributions of small-scale fisheries to sustainable development to be recognized. Using these attributes to identify and categorize various data on fisheries helps illuminate the important role of small-scale fisheries, demonstrating the need to prioritize them (according to the specific context) through better-informed policies and management decisions. Categorizing the information means that the characteristics and distinct contributions of the subsectors to sustainable development can be defined, including *inter alia* how small-scale fisheries value chains are integrated in local economies and livelihood strategies, their mode of operation, and their role in food security and nutrition.

Figure 9.4 Types of characteristics included in the marine and inland characterization matrices

Current data collection and analysis systems tend to be constrained in distinguishing operational scale, which then limits or prevents the cross-sectoral and multidisciplinary analyses required for better understanding small-scale fisheries. The characterization matrix applied in the IHH study uses a larger set of attributes, allowing for a more comprehensive understanding of small-scale fishing activities (Figure 9.4). The method has proven to be a useful, cost-effective tool in facilitating the differentiation of fishery units between large- and small-scale fisheries and enabling comparisons between different fisheries at national and regional levels. From a global perspective, however, a universal definition of small-scale fisheries will remain elusive, because there are no prescribed or globally agreed scoring cutoffs that could be used at that level to separate small-scale fisheries from large-scale fisheries.

Nevertheless, in line with the SSF Guidelines, it is important to identify which activities and operators are considered small-scale in different contexts at national, subregional and regional levels, as appropriate. This identification should be "guided by meaningful and substantive participatory, consultative, multilevel and objective-oriented processes so that the voices of both men and women are heard" (paragraph 2.4). Using a systematic analytical approach such as this characterization matrix can help to improve the understanding of what small-scale fisheries are (and what they are not), how they operate, and what policy measures are appropriate. As this report shows, strengthened policies to support and manage small-scale fisheries are required in many cases, hence it is important to ensure that eligible small-scale fisheries are not excluded, and likewise ineligible large-scale fisheries are not unfairly included.

A key overarching message from the IHH study is the need to consider small-scale fisheries from multiple angles to understand the role of the subsector and how it should be governed and supported. This report explores a number of those angles. It not only shows how much of the global capture fisheries catch comes from small-scale fisheries, but also provides information on the composition of this catch and how it contributes to food security and nutrition. It also examines how small-scale fisheries production supports livelihoods, as well as the importance of women in the subsector. Moreover, looking into the governance and management of the subsector, it sheds light on the extent and nature of the involvement of people dependent on small-scale fisheries.

The pathway to a better future needs to take this holistic perspective. It is only by putting all the pieces together that the real contribution of small-scale fisheries, the strengths and weaknesses in policy and management, and the challenges and opportunities of the subsector can be understood and acted upon. Integrating good quality data and knowledge within a multidisciplinary approach into national and regional statistical and information systems is urgently needed. Moreover, the information needs to be contextualized in the areas of food security and nutrition, livelihoods, fisheries management and stewardship. The SSF Guidelines set out ambitious objectives that cover all of these aspects.

9.4 Improving how small-scale fisheries data and information are collected, analysed and used

The IHH study included 58 CCS which collected data on a broad set of indicators covering the environmental, economic, gender, nutrition and governance dimensions of small-scale fisheries. These data were compiled and analysed to arrive at the results presented in this report, but there is still a wealth of national-level data that can be further analysed and used, including ample scope for further multidisciplinary analyses at the country level, e.g. by bringing together the data collected on vulnerable species, gender implications, nutritional values, employment, governance structure and other aspects.

By better integrating data already collected through CCS and expanding their application, there is potential for uncovering and then monitoring important dimensions that are currently poorly measured. Also, CCS data can be linked to other publicly available data, such as censuses, surveys or remote-sensing datasets. For example, specific indicators collected through the CCS (e.g. catch by species or employment) were typically geo-referenced (e.g. geospatial data on waterbodies and location of fishery units), which allows them to potentially be matched with spatial remote-sensing data capturing rainfall and temperature, or with biophysical data measuring environmental drivers such as sea-level rise or saltwater intrusion of freshwater resources. Some indicators can be explored through thematic linkages, for example by integrating small-scale fisheries areas into poverty maps derived from survey data. Better integration of available data on and relevant to small-scale fisheries can not only provide additional information needed for policymakers on a more frequent basis, but it can also make currently unused but relevant data sources part of the small-scale fisheries statistical system.

Despite the goals of the IHH study and the great effort involved, it is clear from the results that much data on small-scale fisheries are still missing. On average, 80 percent of the total catch from the CCS was obtained by compiling official information. Given the nature and complexities of small-scale fisheries and the limited human and financial resources for data collection, particularly in developing countries or areas where most of these fisheries operate, it is almost certain that small-scale fisheries are under-represented in national information systems. To mitigate this, the IHH study used expert judgement to better understand the extent at national level of this under-representation, and values were estimated accordingly in an attempt to achieve a more representative figure for small-scale fisheries catch globally.

In order to improve on what is now recognized to be still limited data coverage of small-scale fisheries, it is critical to look at the individual country data collection processes in order to identify the best approaches to fill these gaps. Conventional data collection systems based on censuses or sampling protocols are not always cost-effective to operationalize, particularly in the context of how some small-scale fisheries operate (e.g. involving activities in sparse locations and remote areas and/or in streams and small rivers). Conventional systems therefore need to be complemented with approaches that are operationally effective in places that are harder to reach and monitor, including drawing on expert judgement, local and traditional knowledge, and other sources of quality data (e.g. labour force surveys). Modelling approaches should also be developed and used in order to improve such estimates at appropriate spatial and temporal scales.

Implementing systematic collection of reliable and comprehensive small-scale fisheries data and information is critical for evidence-based assessment and management as well as for a proper understanding of the contribution of the subsector to sustainable development. It is also important for fisheries management, where small-scale fisheries data need to be combined with large-scale fisheries data to provide the full picture. The current structures and processes for data collection, analysis and decision-making will need to be transformed to allow for improved coverage of fisheries, disaggregation where needed (e.g. by gender, scale of operation, species), and multidisciplinarity and cross-sectoral linkages. In particular, it needs to be recognized that collecting data on women is more difficult than collecting data on small-scale fisheries in general. Appropriate strategies for addressing this weakness include ensuring data collection focuses not only on fishing but also on the whole value chain. Collaboration between government departments, researchers and small-scale fisheries actors should be promoted so that environmental, economic, gender, nutrition and governance information can all be part of the data available and used in governance of these fisheries.

For this change to take place, the technical capacity to develop and implement rigorous and cost-effective data and information systems needs to be strengthened at the local, national and regional levels, with an emphasis on participatory, gender-sensitive data collection programmes (see SSF Guidelines Chapter 11 on information, research and communication) together with data management, curation and analysis capacity in order to maximize the use of the available information. Moreover, the science–policy dialogue needs to be improved by developing capacity in communicating and translating data and information into science-based management, governance and policies.

9.5 The way forward

Each chapter of this report includes findings and key messages, including actions and support needed to achieve the objectives of the SSF Guidelines and as a pathway to achieving the SDGs. The following are some of the major steps and actions that have been identified through the IHH study that are needed to secure sustainable small-scale fisheries and enhance their contributions to sustainable development.

Further explore and build on the CCS data

The richness of information that has been collected through the CCS should be further explored to enhance knowledge and construct indicators that can help monitor the diverse small-scale fisheries dimensions, guiding policymakers in prioritizing key areas of intervention and informing those interventions. Moreover, the comprehensive set of innovative methods used by the IHH study can be replicated and built on in order to acquire enhanced knowledge in the future, at national, regional and global levels.

Reconsider how small-scale fisheries are characterized and defined

There are a number of reasons why it is important to be able to identify small-scale fisheries and distinguish them from their larger-scale neighbours (and often competitors), ranging from local management to implementation of global instruments focused on the subsector. The characterization matrix developed and applied in the IHH study provides a standardized tool that can be readily used for this purpose. Use of the tool at local, national and international levels can show where a fishery lies along the range from small- to large-scale, enabling appropriate management and policy interventions to be made with greater certainty. Scale is a determining characteristic of the subsector, but characterization and understanding must go beyond to also consider the full nature of these fisheries and the benefits they provide across the value chain – such as livelihoods and incomes, nutrition, and cultural values, among others – if those benefits are to be sustained and improved as intended in the SSF Guidelines.

Incorporate the multidimensional contributions of small-scale fisheries across policies and actions

Small-scale fisheries should be conceptualized and governed as multidimensional livelihood portfolios that provide the enabling environment for sustainable development, and not just as an economic activity. Strategies are needed to leverage the full range of benefits of small-scale fisheries and fish products across value chains, particularly for vulnerable groups, including improving intrahousehold distribution of fish. Within these strategies, policies beyond the fisheries sector, in particular with regard to food security and nutrition and local economies, should incorporate the actual and potential contributions of the small-scale fisheries subsector in their goals and actions.

Incorporate nutrition and other livelihood outcomes into management decisions and design

Ensuring that fisheries are sustainable is fundamental to ensuring the sustainability of their benefits, but management and governance need to go further: namely, adopting policies and implementing management measures that strive towards optimizing the benefits from small-scale fisheries for fishers, fishworkers and their communities, as well as for society at large. These should include, for example, taking into account the nutrition potential of species and optimizing the contribution of small-scale fisheries to food security and nutrition and human health; ensuring equitable access of women to resources and leadership; and respecting and protecting the sociocultural values of small-scale fishers.

Recognize the needs and benefits of effective participatory approaches, and put them into practice

The knowledge, culture, traditions and practices of small-scale fishing communities are clearly important and must be recognized and supported, including particular attention to Indigenous Peoples, by enabling them to participate effectively in decisions concerning their livelihoods. This will require greater and more equitable participation in all aspects of management of those involved in the small-scale fisheries value chain and will necessitate shifts towards greater institutional diversity, accompanied by changes in power and decision-making authority, at all levels of governance. Fishers and fishworkers in small-scale fisheries – both men and women – and their organizations should be empowered and provided with the space to co-lead in national, regional and international fisheries governance and management decision-making settings.

Improve data and information for promoting SSF Guidelines implementation

The SSF Guidelines provide a clear and comprehensive framework "to support the visibility, recognition and enhancement of the already important role of small-scale fisheries and to contribute to global and national efforts towards the eradication of hunger and poverty" (Preface, SSF Guidelines), which will also enhance the contribution of these fisheries to the achievement of the SDGs. To implement the Guidelines there must be continued efforts to fill the knowledge gap and improve the understanding of the nature and

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contributions of the small-scale fisheries subsector, which will require a substantial shift in how different information systems and sources are integrated and linked, and how small-scale fisheries and their role are defined and monitored.

Build on the IHH study approaches and methods to improve data collection and analysis, moving beyond the limitations of "business as usual"

The IHH study developed approaches and collected data in support of SSF Guidelines implementation, the results of which demonstrate the need for monitoring and decision-making systems and processes at country level to be further developed or adapted if the multiple objectives for small-scale fisheries are to be effectively secured. Building on the study's findings and methods, data collection and analyses at all levels should be strengthened, including:

- Disaggregating data and information on both small- and large-scale fisheries to allow for governance and management decisions that are adapted to the multidimensional characteristics of small-scale fisheries;
- Applying participatory and innovative approaches, including drawing on traditional and local knowledge and expert insight;
- Applying multidisciplinary and multisource approaches, encompassing all interlinked dimensions of small-scale fisheries and their contributions, and creating integrated information systems;
- Making better use of surveys not specifically directed at fisheries, e.g. household-based surveys and those of the World Bank Living Standards Measurement Study, as well as integrating fisheries-specific modules with such surveys.

Collect information to help recognize the role of women and ensure their visibility and participation

Women play an important role in small-scale fisheries value chains, but their role is often not recognized, and they continue to face challenges based on gender inequality. This needs to be changed by re-evaluating how the subsector is characterized to include the entire value chain, and through concerted broad-based efforts towards gender equality. With regard to data and information, it is important to ensure that data collection activities actively seek and include meaningful gender-disaggregated information to enable decisions that, for example, provide women with equal access to resources and decision-making processes in recognition of their many contributions across the value chain.

Build capacity and partnerships

Capacity building, partnerships and joint efforts by governments, small-scale fishers, fishworkers and organizations, researchers, development agencies and other stakeholders will be required to secure sustainable small-scale fisheries. This includes strengthening the coproduction of knowledge to fully uncover the hidden contributions of small-scale fisheries and to unleash their potential for supporting SSF Guidelines implementation and the achievement of the SDGs.

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Glossary

Term	IHH Definition
Apparent consumption	A proxy measure to indicate the supply of food available in a country for an indicated reference period. For a given food commodity, it refers to a country's total production plus imports, minus exports and non-food uses, and can be further adjusted for food in storage. It differs from actual consumption, which is measured through household or individual food consumption surveys. Apparent food consumption per capita is obtained by dividing national consumption by population size (based on FAO, 2022a).
Aquatic food	In the context of the results presented in this report, aquatic foods include finfish, crustaceans, molluscs, tunicates and echinoderms that are harvested from the water.
Catch	Catch figures within the IHH report refer to "nominal catch", which is defined as the live weight equivalent of the landings (i.e. landings on a round, fresh basis; landings on a round, whole basis; or landings on an ex-water weight basis), excluding discards (based on FAO, 1990).
Civil society organizations (CSOs)	In this report, CSOs mostly refer to fisher and fish harvester organizations including producers, non-state supporters, hybrid federations or platforms, and private corporations. More broadly, a civil society organization (CSO) or non-governmental organization (NGO) is any non-profit, voluntary citizens' group which is organized on a local, national or international level. Task-oriented and driven by people with a common interest, CSOs perform a variety of services and humanitarian functions, bring citizens' concerns to governments, monitor policies, and encourage political participation at the community level. Typically, they are organized around specific issues, such as the UN pillars of peace and security, human rights, and development (based on UN, 2021b).
Co-management	A partnership arrangement in which government, the community of local resource users (fishers), external agents (NGOs, research organizations), and sometimes other fisheries and coastal resource stakeholders (boat owners, fish traders, credit agencies or money lenders, tourism industry, etc.) share the responsibility and authority for decision-making in the management of a fishery, particularly as it relates to the access and/or withdrawal of fishing resources. For co-management to take place the state has to be willing to devolve management, exclusion and/or transferability or alienation rights to individuals, groups and communities. Thus co-management encompasses various types of partnering arrangements and degrees of power-sharing, and can be instructive, consultative, cooperative or delegated (based on FAO, 2013; Berkes *et al.*, 2001; Sen and Nielsen, 1996; Schlager and Ostrom, 1992).
Country and territory case study (CCS) authors	National and international small-scale fisheries experts who conducted the IHH country and territory case studies. In this report, the terms CCS authors and CCS experts are used interchangeably.
Customarily managed small-scale fishery	"Customary management" is defined as "local practices that are designed to regulate the use, access, and transfer of resources". Applied here, this would indicate a small-scale fishery that is governed or self-governed by fishers, their leaders, or other local stakeholders usually outside of a management framework determined by the state (based on Berkes, ed., 1989; Cinner and Aswani, 2007; Johannes, 1978).

Term	IHH Definition
Dependent livelihoods	Partially dependent livelihoods: all members of a household where at least one member is employed in small-scale fisheries or engaged in subsistence fishing. Fully dependent livelihoods: the total number of household members who are solely dependent upon employment in small-scale fisheries, calculated as the proportion of employed household members who are participating in small-scale fisheries, multiplied by the total number of household members (based on ICLS, 2013; WCED, 1987; Chambers and Conway, 1991).
Devolution of tenure rights	Refers to when fishing authorities grant management, exclusion and/or alienation rights to individuals, groups and/or communities over the catch or any other aspect of the fishery as well (based on Schlager and Ostrom, 1992).
Devolution rights index (DRI)	An index that measures the strength of the devolution of rights to fishers, which increases the likelihood fishers will find incentives to invest in the future of the resource. The DRI assesses three levels: partially devolved, mostly devolved and fully devolved (based on Schlager and Ostrom, 1992).
Discards	The part of the catch that is not retained on board and is returned at sea, dead or alive. This may include target species or any other species (both commercial and non-commercial) discarded at sea (FAO, 2019).
Employment (full-time, part-time, occasional)	All persons of working age who, during a short reference period (typically the week prior to a survey interview), were engaged in any activity to produce goods or provide services for pay or profit. This covers (i) employed persons "at work", i.e. who worked in a job for at least one hour during the reference period; and (ii) employed persons "not at work" due to temporary absence from a job, or to working-time arrangements (such as shifts in work, flexitime and compensatory leave for overtime). The definition includes both part- and full-time employment in order to capture seasonal variation. Employed persons are typically engaged in market-oriented activity, selling the majority of the product (though in some cases consuming a portion of their catch) (based on ICLS, 2013; WCED, 1987; Chambers and Conway, 1991).
Employment in the harvesting segment of fisheries	All persons employed (as per definition of "employment") in activities connected to harvest fishing. Harvest fishing activities are identified according to the International Standard Industrial Classification of all Economic Activities (ISIC) standards agreed for use by UN Member States by which measures of economic activity can be compared (in the System of National Accounts). According to the ISIC, harvesting activities include capture fisheries, i.e. the hunting, collecting and gathering activities directed at removing or collecting live wild aquatic organisms (predominantly fish, molluscs and crustaceans) from oceanic, coastal (marine fisheries as per ISIC code 0311) or inland waters (as per ISIC code 0312) (UN, 2008).
Employment in the pre-harvest segment of fisheries	All persons employed (as per definition of "employment") in activities connected to pre-harvest fishing, such as (i) building of ships and floating structures (ISIC code 3011) and (ii) repair of other equipment, which includes repair of fishing nets (including mending), as per ISIC code 3319 C (UN, 2008).
Employment in the post-harvest segment of fisheries	All persons employed (as per definition of "employment") in activities connected to post-harvest fishing, such as (i) processing and preservation of fish, crustaceans and molluscs (ISIC code 1020); (ii) wholesale of food, beverages and tobacco (which includes wholesale of fishery products), as per ISIC code 4630; and (iii) retail sale of food in specialized stores, including fish, other seafood, and products thereof (as per ISIC code 4721) (UN, 2008).

Term	IHH Definition
Fishery unit	The unit of assessment for recording CCS data. Fishery units were defined by CCS authors based on characteristics relevant to the country's small-scale fisheries subsector. Depending on the country, the definition of fishery units may (or may not) rely on one or more of the following elements: • Target fish species, groups of species, or stock (including geographic area or location); • Fishing method, gear and/or vessel type; • Fishing fleet / groups of vessels or individual fishing operators pursuing the fishing operation(s) • Management units
Food consumption score (FCS)	A household-level dietary diversity score measuring frequency and diversity of food items consumed over a seven-day recall period, according to relative nutritional value (based on Leroy *et al.,* 2015; WFP, 2008).
Formal co-management	Formal co-management refers to the existence of written policy, law and regulations explicitly mandating a systematic inclusion of the voices of stakeholders in management. A consultative process can be considered formal co-management if there is an expectation that it may result in management action, even if this is not always the outcome. Policies can explicitly mention the devolution of management, exclusion or transferability rights to fishers – or policies can be quite general and lack specificity about who, where and when. For this designation, policies do not need to be implemented on the ground and can only exist on paper (based on Sen and Nielsen, 1996).
Functional group (of species)	A group of species sharing ecological, taxonomic and/or economic characteristics. IHH functional groups were based on a combination of pre-existing species classification schemes (ISSCAAP Division, ISSCAAP Group, FAOSTAT Group of Commodities, and Central Product Classification) and some individual adjustments, where necessary, to add or remove species from a functional group, based on IHH team expert opinion.
Gender	Refers to socially defined roles, responsibilities and behaviours that are assigned to women and men (FAO, 2007a).
Gender analysis	Gender analysis is the study of the different roles of men and women in order to understand what they do, what resources they have, and what their needs and priorities are. It provides the basis for informing policies, programmes and projects that address inequalities (FAO, 2017b).
Gender equality	Refers to when women and men have equal rights, opportunities and entitlements in civic and political life, in terms of access, control, participation and treatment (FAO, 2017b).
Gender equity	Refers to fairness and impartiality in the treatment of women and men in terms of rights, benefits obligations and opportunities. At times, special treatment / affirmative action / positive discrimination is required (FAO, 2017b).
Gender inclusivity	Gender inclusivity is the process of improving the terms of participation by gender across society, particularly for women and gender minorities – who are often marginalized – through enhancing opportunities, access to resources, voice and respect for rights. In the context of fisheries, this means engaging with gender in fisheries management, policy and the overall valuation of the sector, through explicit commitments and strategies to implement gender-inclusive approaches and appropriate accountability mechanisms (Mangubhai and Cowley 2021; Mangubhai and Lawless 2021).

Term	IHH Definition
Gross value added (GVA)	GVA is an economic measure of the value of goods and services produced in a region, industry or sector of an economy (UN, 2003). It measures the increase in income after deduction of the costs of intermediate inputs in production. GVA of an economic sector = total sector revenue – intermediate consumption (e.g. initial costs) (UN, 2003).
Hybrid federations or platforms	Organizations composed of both producer organizations and non-state "supporters".
IHH country and territory case studies (CCS)	Data collection instruments for estimating measures for the key indicators to accurately describe small-scale fisheries at country or territory level. The CCS provided the basis for disaggregation between small- and large-scale fisheries, as well as for global extrapolations of key indicators. These case studies harnessed existing data from the best available sources at national, subnational and/or local levels, and ensured comparability across countries and territories.
Landed economic value	Landed weight of fish multiplied by the ex-vessel price. This is often called "landed value", which however does not account for many other values that the catch may have for people.
Local norms and values	Refers to the different de facto types of rules and social relations that generate incentives for fishing behaviour and are embedded in livelihood and fishing practices among individuals, groups or communities.
Local policy	A particular rules system, governance arrangement, or regulation that only has jurisdiction over a small geographical scale within national boundaries. The jurisdiction of a local small-scale fisheries policy can be determined by the boundaries of a municipality, village, a particular waterbody, a set of geographical coordinates, or another type of geographically delimited area.
Minimum dietary diversity for infants and young children	Minimum dietary diversity for infants and young children is expressed as the proportion of infants/children who consumed at least five out of eight food groups in the previous 24 hours. It is used as a proxy indicator to predict nutrient adequacy in populations, and is one dimension of the minimum acceptable diet (MAD) indicator (WHO, 2021).
Minimum dietary diversity for women	Minimum dietary diversity for women is expressed as the proportion of women who consumed at least five out of ten food groups in the previous 24 hours. It is used as a proxy indicator to predict nutrient adequacy in populations (FAO, 2021h).
National policy	A particular rules system, governance arrangement, or regulation to which the entire country is equally subject. The jurisdictional boundaries are usually determined by the delimitations of the exclusive economic zone or territorial seas.
Nominal value	Unadjusted rate or current price, without taking inflation or other factors into account.
Nutrient potential	The nutrient potential of fish is measured or estimated as the sum of the nutrients contained in the catch at the time of landing.
Non-state supporters	Organizations that do not directly represent small-scale fishers and fishworkers but that represent the interests of small-scale fisheries (e.g. NGOs that do not have fishers/fishworkers as members).
Patron–client relationship	A relationship between two actors where one acts as a patron and the other as a client. The patron is usually in control of the fishing means of production, property rights of the fishery, or commercialization channels, and contracts with the fisher who contributes labour to land catch (based on Basurto *et al.*, 2020).

Term	IHH Definition
Producer organization	An organization whose members are primarily or all fishers and/or fishworkers, or their organizations.
Purchasing power parity (PPP)	PPP is a spatial price deflator and currency converter to control for price level differences between countries, thereby allowing volume comparison of different monetary metrics such as GDP, consumption, etc. (based on International Comparison Program, World Bank; World Development Indicators database, World Bank; Eurostat-OECD PPP Programme).
Scale of operation	Refers to the technological, economic, operational and organizational characteristics of small-scale fisheries. It is used by the IHH characterization matrix to categorize different fisheries.
Sexist data	Data resulting from the omission of certain identity groups (i.e. based on gender or other identity characteristics such as age, class, ethnicity) that creates, maintains and/or reinforces social inequalities (based on D'Ignazio and Klein, 2020).
Small-scale fisheries	The definition of small-scale fisheries varies considerably in different countries, but generally includes low-technology, low-capital, labour-intensive fishing practices. Often, the term artisanal is used to refer to small-scale fisheries. In the context of this report, the term small-scale fisheries refers to the whole value chain of pre-harvest, harvesting and post-harvest activities, including subsistence fisheries and excluding recreational fisheries. For the purpose of CCS data collection, the most common definition (e.g. legal or operational) for small-scale fisheries in each country or territory was used.
Social inclusivity	Involves the removal of institutional barriers that maintain unequal opportunities, thereby accessing development outcomes and introducing changes at the system level (Barclay *et al.*, eds., 2019).
Subnational policy	A particular rules system, governance arrangement, or regulation that has a jurisdiction determined by the boundaries of a state, province or other biophysically defined regional scale (e.g. a river basin or watershed).
Subsistence fisheries activities	Also defined as "working for own consumption": individuals of any sex and age that carry out an activity at least once over the last 12 months in order to produce and process fish for their own final use, with no transaction occurring in the marketplace. By definition, considered here as small-scale fisheries (based on ICLS, 2013; WCED, 1987; Chambers and Conway, 1991). In this report, this is used interchangeably with "subsistence fishing" and "subsistence activities".
Target species	Those species that are primarily sought by the fishers in a particular fishery, through a directed fishing effort. There may be primary as well as secondary target species (Cochrane, ed., 2002).
Tenure rights	In accordance with the Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security, tenure rights refer to rules and norms that determine who can use which resources, for how long, and under what conditions. These systems may be based on written policies and laws, as well as on unwritten customs and practices. They determine how people, communities and others are able to acquire rights and associated duties to use and control fisheries (based on FAO, 2022b).

Annex A.

Methods

A.1 Overall approach

A.1.1 Background and initial scoping of the study

The new IHH initiative responded to a call for better understanding of the contributions of small-scale fisheries to sustainable development. Towards this end, an inception workshop to update the initial Hidden Harvest study took place in June 2017. The workshop hosted by FAO in Rome, Italy, gathered about 40 external experts from around the world and FAO staff from a diversity of departments. A result from this workshop was a refined "wish list" of indicators and available datasets on potentially relevant contributions of small-scale fisheries to sustainable development and the challenges faced in maintaining those contributions. The wish list focused on the three dimensions of sustainable development: i.e. social, economic and environmental, while also including food security and nutrition and governance issues around small-scale fisheries.

A.1.2 Methodological tapestry of approaches

A.1.2.1 Different approaches for different types of data

The indicators were assessed according to data availability and feasibility of operationalization through a systematic review of the scientific literature (covering the period from 2012 to 2017), technical reports, ad hoc searches and expert queries, as described in the FAO Workshop Proceedings (FAO, 2017a). The indicators were associated with three types of data: global/regional (e.g. FAO Food Balance Sheets), subregional (e.g. national fisheries accounting datasets, labour force surveys, household income and expenditure surveys), and local or context-specific (e.g. local case studies).

The association of these small-scale fisheries indicators with the three types of data was necessary to approach the challenges of using multiple types of data for a global study (e.g. rich data at the subregional level for a sample of countries could be exploited when utilized in concert with other national-level data, or as a baseline for extrapolation). To best access the richness available through these available data, a tailored methodology for data collection, validation and analysis (hereafter IHH methodology) was designed and implemented to ground the IHH report (Figure A.1).

The inception workshop recognized that comprehensive datasets covering global small-scale fisheries holistically as socioecological systems across the world would not be available, in part due to the difficulty in disaggregating small-scale and large-scale fisheries data. The workshop concluded that considerable information did exist but in a fragmented manner, and that the use of an approach using country and territory case studies (hereafter CCS) would be necessary to collect this information. The goal of these CCS was to collect and collate the information and data available at national level for the estimation of key indicators, disaggregated by marine and inland small-scale fisheries. The CCS were conducted by national and international small-scale fisheries experts through the compilation of existing secondary sources of data (with a few exceptions where primary data collection was deemed essential).

Results were corroborated with available global databases and used as the basis for extrapolation to the global level for certain key indicators (more in Section A.3.2). For triangulation and corroboration, an ad hoc questionnaire was distributed by FAO to all Members for collection of official national-level data on an abridged set of indicators (more in Sections A2.1.4 and A2.2).

To highlight important topics for which global, quantitative figures were not available or where available figures were not relevant, a series of thematic studies conducted by experts in these subjects was implemented. These studies provided syntheses of certain key topics and a grounded and textured narrative about the multifaceted nature of contributions of small-scale fisheries to sustainable development (more in Section A.2.3).

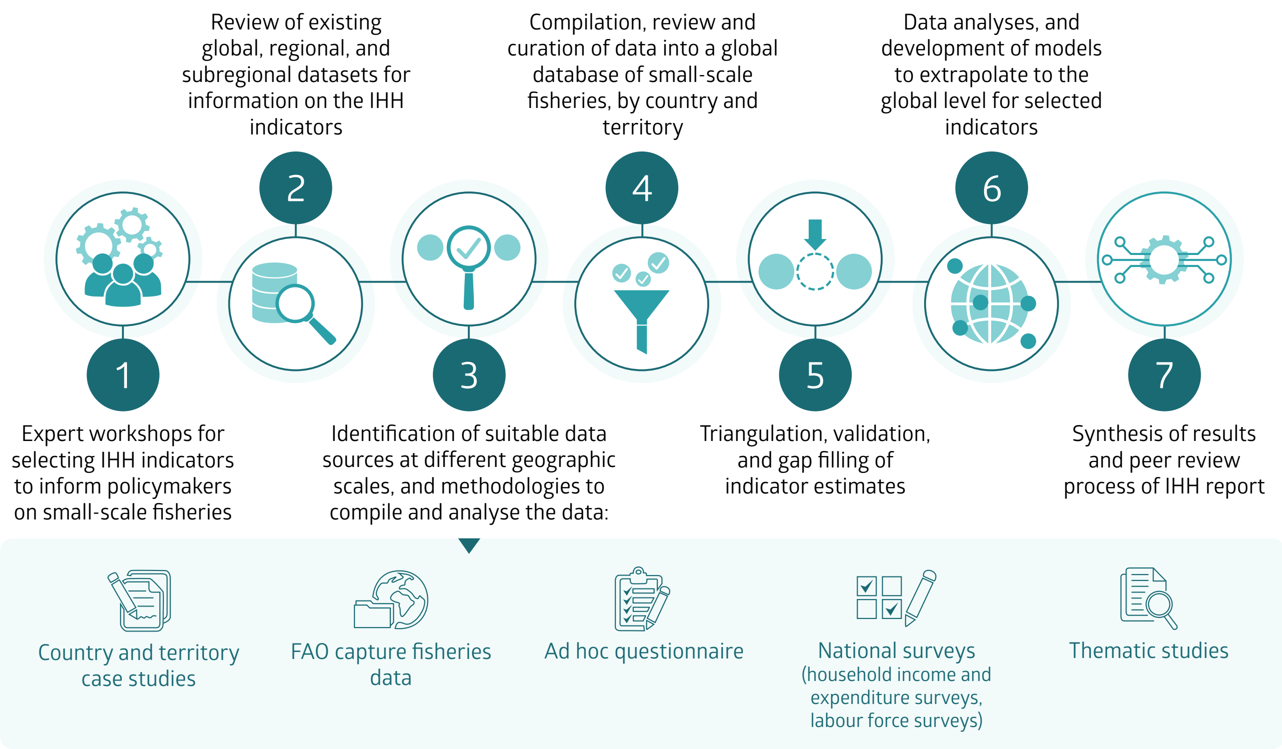
A.1.2.2 Selection of indicators

The final list of indicators to be measured was decided during a second expert workshop that took place in May 2018 at the University of Washington with 12 experts from multiple disciplines specializing in small-scale fisheries from around the world. This process solidified the emerging research strategy for the IHH study and helped identify and prioritize resources, methodologies and strategies for data collection efforts on each indicator, as well as criteria for selecting countries for data collection. Table A.1 provides the final list of the indicators highlighted in the IHH report for marine and inland small-scale fisheries, and full details on the research strategy are explained in Section A.2.

A.1.2.3 IHH Workflow organization and Technical Advisory Group

Environmental, economic, social, nutrition and governance experts within the IHH team were identified and organized into thematic clusters to develop and implement tailored methodologies for data collection and analyses around each dimension of sustainable development. Experts in each thematic cluster provided input for data collection on their

Figure A.1 Overall process of the IHH initiative



respective indicators according to their data needs, as well as feedback throughout the data collection process. Gender was considered a cross-cutting theme throughout the whole IHH initiative. Therefore, gender experts provided feedback to all clusters to ensure the data collection process considered a gender perspective for collecting available gender-disaggregated data and identifying gender data gaps.

A Technical Advisory Group (TAG) was formed in August 2018 with the participation of 13 experts on the different aspects of small-scale fisheries from around the globe, including participants from academia, intergovernmental organizations and independent researchers (see Acknowledgements). The role of the TAG was to provide general counsel and technical advice to the different clusters at different junctures of the initiative and related to their own area of expertise, including strategies for analysis of the data compiled through thematic studies and CCS. The results of the cluster analyses and chapter drafts of the IHH report were peer reviewed by IHH team members, TAG members and internal FAO experts prior to the culmination of the final IHH report.

A.2 Data collection process

A.2.1 Country and territory case studies

Country and territory case studies (CCS) were the most important data collection instruments for estimating measures for the key indicators to accurately describe small-scale fisheries at country or territory level. These CCS provided the basis for disaggregation between small- and large-scale fisheries, as well as for global extrapolations of key indicators. The IHH methodology was carefully designed to harness existing data from the best available sources at national, subnational and/or local levels, and ensure comparability across countries and territories. The CCS also provided an opportunity to develop and document methodologies that are suitable for each country's context and data availability to assess the contribution of small-scale fisheries to sustainable development, and that can be replicated and improved in future studies.

A.2.1.1 Country and territory selection criteria

Resources for CCS were allocated prioritizing those countries and territories where the fisheries sector played an important role in terms of production of capture fisheries (especially small-scale fisheries), employment, and nutrition according to existing databases including FAO data, the Sea Around Us database (Zeller and Pauly, 2016) and Watson's Global Marine Catch database (Watson, 2017). Those countries are shown in Figure A.2. In particular, prioritization considered countries where: i) the absolute contribution of fisheries to the global figures for production and employment was high, and ii) the relative importance of the fisheries sector within the individual countries was high (i.e. looking at production and employment per capita). Those countries where fish was an important source of protein in people's diet (according to FAO data) were also prioritized.

Table A.1 Indicators for the IHH report and their

Indicator	Definition
Social Indicators	
Gender and small-scale fisheries	The roles of women and men in relation to the economic, environmental, social and nutrition, and governance dimensions of small-scale fisheries.
Social and cultural identity in small-scale fisheries	The identity of small-scale fishers and communities, as recognized by their diversity and resilience, their cultural heritage, and self-definition and self-determination in fisheries governance.
Indigenous Peoples in small-scale fisheries	The state of indigenous small-scale fisheries: their features, values and practices; challenges they face; strategies pursued to better secure sustainable food systems; sustainable resource management opportunities; and policies supporting their shared interests.
Food And Nutrition Indicators	
Fish supply from domestic small-scale fisheries	The volume of fish available for human consumption from domestic small-scale fisheries over a period for a specific population.
Omega-3 fatty acid contribution from small-scale fisheries	The supply of omega-3 fatty acids from fish over a specific period for a specific population.
Micronutrient contribution from small-scale fisheries	The supply of micronutrients (specifically vitamin A, calcium, iron, zinc, and selenium) from fish over a specific period of time for a specific population.
Food safety concerns	Food safety concerns around small-scale fisheries products (e.g., disease, food contamination).
Distribution of nutritional benefits	The proportion of the supply from fish (or protein and/or micronutrients from fish) available to segments of the population that are vulnerable in terms of income level and gender.
Production and Environmental Indicators	
Catch	Volume of fish (in tonnes) caught by fishing operations and landed, at the species level and disaggregated between marine, inland, small- and large-scale fisheries. Catch defined as nominal catch: the live weight equivalent of the landings (i.e. landings on a round, fresh basis; landings on a round, whole basis; or landings on an ex-water weight basis, excluding discards).
Environmental interactions of small-scale fisheries	Interactions, both direct and indirect, occurring across the full spectrum of levels of influence that species and habitats experience when small-scale fishing activities take place.
Impacts of climate change on small-scale fisheries	Challenges related to climate change effects and their related stressors (e.g. sea level rise, warming, acidification, extreme events) affecting small-scale fisheries.
Economic Indicators	
Employment	All persons of working age who engage in any activity to produce goods or provide services for pay or profit, including harvesting (e.g. removing or collecting live wild aquatic organisms from oceanic, coastal or inland waters), pre-harvest (e.g. building of ships and floating structures, repair of equipment) and post-harvest activities (e.g. processing and preserving of fish, crustaceans and molluscs; wholesale of fishery products; and retail sale of aquatic products). This includes both part- and full-time employment in order to capture seasonal variation.

Table A.1 Cont

Indicator	Definition
Subsistence fishing	Also defined as "working for own consumption": individuals of any sex and age who carry out an activity at least once over the previous 12 months to produce fish for their own final use, with no transaction occurring in the marketplace. By definition, subsistence fishing is considered here to include only small-scale fisheries.
Dependent livelihoods	Total dependent livelihoods (partial): all members of a household where at least one member is employed in small-scale fisheries or engages in subsistence small-scale fisheries. Total dependent livelihoods (full): the total number of household members who are solely dependent upon employment in small-scale fisheries.
Landed economic value	The first sale value of the catch, calculated by multiplying the ex-vessel price by landed catch weight (essentially capturing an average of product quality for the catch).
Price of catch	Ex-vessel prices (USD), i.e. the prices that fishers receive for their catch (per tonne), or the price at which fish are sold when they first enter the seafood supply chain, for commercially exploited fish stocks.
Small-scale fisheries exports	Catch exported (volume and value) per year at the national level, as well as the proportion of small-scale fisheries catch that goes to export at the species level.
Value added from small-scale fisheries	The contribution of one or more small-scale fisheries value chains to the growth of a national economy, calculated by subtracting the value of inputs (intermediate consumption of goods and services produced by agents considered to be operating outside of the value chain, e.g. fuel and food for fishing trips; vessel repair and maintenance costs; insurance; and the cost of handling, processing and selling fish, such as purchasing ice) from the final market value of production (total revenues from the final sale of fish).
Governance Indicators	
Policy formality	Formal policies refer to governance arrangements that can be in the form of laws, regulations, policies or plans/strategies. Informal policies are those recognized by customary authorities and usually practiced in customary regimes; they might be recognized by other types of authorities or not.
Access strategies	Governance arrangements with which fishers can formally gain access to fishing grounds (i.e. licences, place of residence, history of use, vessel registration).
Harvesting management measures	Governance arrangements with which fishing authorities manage harvesting by fishers. These include measures addressing gear, spatial arrangements, size, times or seasons, vessels, total allowable catch (TAC), sex of catch.
Devolution rights index	The devolution rights index considers three levels of devolution based on rights of i) management, ii) exclusion and iii) transferability: partially devolved, when any one of the above rights is devolved to fishers; mostly devolved, when any two of the above rights are devolved; fully devolved, when all three rights of management, exclusion and transferability are devolved at the same time in a fishery.
Policy focus	Policies are categorized as "general fisheries policies" or "SSF-specific policies" (i.e. specific to small-scale fisheries). General fisheries policies are defined as those that refer to fisheries without explicitly distinguishing between small-scale and large-scale fisheries, between marine and inland, or when they explicitly refer to both (i.e. marine and inland or small-scale and large-scale). SSF-specific policies explicitly make reference to small-scale fisheries in the description of the policy provided by the case study authors or the FAOLEX database.
Policy level	The political jurisdiction at which the policy applies. National policies apply over the entire nation, subnational policies apply to a large region or province, and local policies apply to a specific locality.

Table A.1 Cont

Indicator	Definition
Governance Indicators	
Policy integration	Whether the policy mentioned other objectives besides production, such as social, economic, environmental or governance objectives.
Preferential access areas	Preferential access areas within national jurisdictions for small-scale fisheries that establish some kind of preferential use for small-scale fisheries. They can imply the complete exclusion of other types of fishing (e.g. large-scale) from the fishing area or just the restriction of certain types of gear used by large-scale fisheries (e.g. trawls)..
Participation	Perceived levels of participation among fishers are categorized as "no engagement", "low engagement", "some engagement", and "majority of fishers participated in the management of their fishery". Participation is defined to encompass a broad spectrum of involvement: from fishers being passive recipients of information shared by the government about decisions they plan to make; to government and fishers cooperating as equal partners in decision-making, data collection, monitoring and surveillance and control; to fishers making most decisions and advising government, which then endorses such decisions.a
Involvement of fishing organizations	Involvement of fishing organizations (either national organizations or national/ subnational offices of international organizations) engaging with fisheries and fisheries management activities.

Note: [a] Sen, S. & Nielsen, J.R. 1996. Fisheries co-management: a comparative analysis. *Marine Policy*, 20(5): 405–418.

Countries and territories were ranked according to these sets of selection indicators using available data and categorized into four tiers, from countries ranked as having the highest importance (Tier 1) to those of lower importance. Additional selection criteria to refine the final list of candidate countries were added to help retain a balanced representation according to geographic diversity and the Human Development Index, which summarizes average national achievement encompassing average conditions of life expectancy, education, and a decent standard of living (UNDP, 2019). Expert knowledge was also used to make sure that important countries not categorized as Tier 1 by the data-based selection (e.g. for limitations related to data availability/quality) were still included in the study. If conducting a CCS within Tier 1 was not possible, countries within Tiers 2 were prioritized, followed by those in Tier 3 and finally Tier 4, based on availability of researchers.

Considering both total catch and small-scale fisheries catch allowed for the inclusion of countries where marine fisheries constitute a very important subsector and are responsible for most biomass removals, as well as countries where total catch might not be that important, but small-scale fisheries catch is. Availability of researchers to conduct a CCS due to time, logistic or organizational matters also had some influence in the final list of countries to be included, and meant that some countries, although ranked high in priority according to the selection criteria, were unfortunately not included as part of the CCS data collection.

The final set of case studies consisted of 58 countries and territories (32 for marine and inland fisheries, 6 for inland only, and 20 for marine only), spanning a range of economic status and geographic locations. These selected countries and territories represented (according to FAO FishStat data, average values for 2013–2017) about 69 percent of the world's marine catch, 63 percent of inland catch, 73 percent of marine fishers, and 54 percent of inland fishers (Figure A.2). Table A.2 shows the coverage of the percent catch that the CCS provided for the different regions of the world and according to development status, considering the most currently available global fisheries capture data. When combined with external databases and the ad hoc questionnaire issued by FAO, the CCS became the backbone of the global estimates for the IHH initiative.

A.2.1.2 Conducting country and territory case studies

CCS were conducted by in-country and international experts in small-scale fisheries for each of the countries and territories selected. This was achieved through the collection and/or estimation of small-scale fisheries data using the best available sources of information at national, subnational and/or local levels. While the core requirement was expertise in small-scale fisheries in their country, CCS experts were diverse in terms of professional sector (including academia, non-profit and civil society organizations, government officials, and independent researchers) and gender composition. The total number of IHH experts was 259, where 63 percent were male and 37 percent were female participants, including lead authors, non-lead authors and research assistants. In addition, over 543 additional experts were consulted for the completion of the case studies (70 percent male, 30 percent female).

CCS were conducted over the course of 3 to 12 months, starting in December 2018 and all completed by the end of 2019, including methodology training sessions, CCS revisions and data consolidation. Each CCS team completed a methodological training session with the IHH Technical Team via an individual video conference prior to initiating the CCS work. The training session introduced the IHH methodology and an accompanying set of data collection spreadsheet templates, and addressed any questions, concerns or suggestions from the CCS team. The spreadsheet templates were organized by dimension (i.e. environmental, economic, governance, social and nutrition).

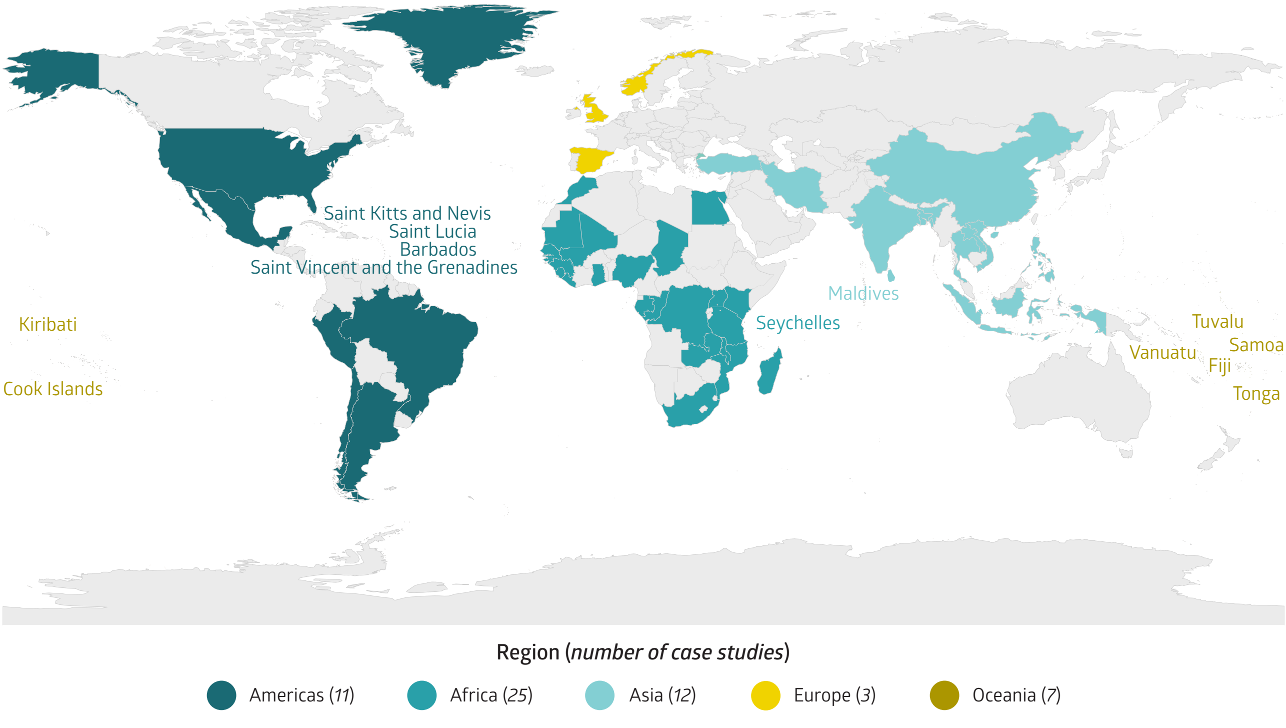
Following the methodology training session, CCS experts were in constant communication with the IHH Technical Team to answer any questions. Drafts of the case studies went through a thorough screening and revision process by a five-person data screening team, with one primary data reviewer, and one to two other data checkers to spot check the primary data reviewer's feedback. The revision process ensured data quality, completeness, and clear explanations of the source and validity of the data, methodologies and data analyses. Incomplete, illogical or problematic data were identified by the review team and addressed with the CCS experts in an iterative process. Through this CCS revision process, and after multiple internal data retreats and TAG meetings, IHH cluster leaders and TAG members provided feedback on specific case studies, as well as suggestions on prioritizing indicators within case studies.

A.2.1.3 Case study methodology

General case study protocol

To achieve the highest scientific rigor and transparency, a good basis for synthesis, and overall robustness of the IHH initiative, detailed instructions and data collection suggestions were provided for CCS experts to follow. This ensured comparability across CCS of the

Figure A.2 Country and territory case studies conducted in the IHH study



Source: United Nations Geospatial. 2020. Map geodata [shapefiles]. New York, USA, United Nations, modified by the authors.

Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. Final boundary between the Sudan and South Sudan has not yet been determined.

Note: Colours represent the five different continental regions. Africa: Chad, Congo, Democratic Republic of the Congo, Egypt, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia (marine only), Madagascar, Malawi, Mali, Mauritania (marine only), Morocco (marine only), Mozambique, Nigeria, Senegal, Seychelles, Sierra Leone (marine only), South Africa, United Republic of Tanzania, Uganda and Zambia; Americas: Argentina, Barbados, Brazil, Chile, Greenland, Mexico, Peru, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines and United States of America (marine only); Asia: Bangladesh, China, India (marine only), Indonesia, Iran (Islamic Republic of), Lao People's Democratic Republic, Maldives, Philippines, Sri Lanka, Thailand, Türkiye and Viet Nam (marine only); Europe: Norway (marine only), Spain, and United Kingdom of Great Britain and Northern Ireland (marine only); Oceania: Cook Islands, Fiji, Kiribati, Samoa, Tonga, Tuvalu and Vanuatu.

Table A.2 Coverage of the percent catch included in IHH country and territory case studies for inland and marine fisheries, by region and development status

	Percent catch corresponding to IHH CCS*	
Region	**Inland**	**Marine**
Africa	85%	74%
Americas	75%	85%
Asia	56%	76%
Europe	1%	29%
Oceania	14%	19%
Development status	**Inland**	**Marine**
Developed countries or areas	1%	39%
Least developed countries	61%	54%
Other developing countries or areas	69%	84%

Source: FAO. 2020. Fishery and Aquaculture Statistics. Global capture production 1950–2018 (FishStatJ). In: *FAO Fisheries Division*. Rome. Updated 2020. www.fao.org/fishery/statistics/software/fishstatj/en

estimations for the key IHH indicators. The instructions included the final list of selected indicators (and their definitions), along with data collection spreadsheet templates for each dimension.

CCS experts were instructed to use the best available information to report on all the IHH indicators through:

- **Official or unofficial databases:** engagement with governments, management agencies, non-profit organizations and civil society organizations, to access official public or unofficial and/or confidential databases and archives.
- **Literature review:** review of independent studies at the national and subnational levels (including grey and primary peer-reviewed literature).

CCS experts were also expected to avoid data of dubious quality or that was mostly incomplete and be creative and resourceful in finding and accessing sources of better quality where needed. In cases where no (or patchy) data were available from the above-mentioned data sources, alternative approaches were expected to be adopted, including:

- **Identification of available proxies:** use of alternative variables known to be associated with the indicator of interest.
- **Extrapolation of available data:** to fill any data gaps, providing an explanation of how the extrapolation was done and why it is deemed as valid.
- **Expert elicitation:** consultation with fishery experts and stakeholders within a country, e.g. one-on-one conversations with highly knowledgeable individuals to capture their technical opinion (based on their long-term observation of the fishery) about issues for which there is no quantitative data available.
- **Field data collection through surveys**: only in extraordinary cases where no other information was available for key indicators and after discussion and approval by the IHH Technical Team.

Disaggregation of fisheries data between small-scale and large-scale fisheries was a minimum output of the CCS. If available fisheries data were not originally disaggregated between small-scale and large-scale fisheries and the CCS comprised both types, CCS experts had to provide clear documentation on the procedure and proxies used to disaggregate the data (e.g. the use of common proxies such as fishing assets, boat size, species or catch). For some key indicators, data for large-scale fisheries were requested for comparison with small-scale fisheries, but emphasis was placed on prioritizing the small-scale fisheries component with as reliable data as possible.

The CCS intended to cover the whole small-scale fisheries subsector at the national level through the synthesis and/or appropriate extrapolation from subnational level data. Data for specific sub-case studies at the subnational, local, or even fishery level were allowed if carefully used to produce national-level estimates of high quality. When following this approach, CCS experts provided their selection criteria for the small-scale fisheries (or subnational or local regions) that were chosen (i.e. the sub-case study), and the methodology followed for the extrapolation of sub-case study data to the national level. CCS experts were encouraged to prioritize better coverage of fisheries as long as the level of uncertainty or accuracy of the data was well documented. In other words, the aim was to account for fisheries (or their components) that are not currently counted and attempt to estimate their parameters, rather than producing the same estimates for a few fisheries that were already known, however accurate these analyses might be.

Due to time and resource constraints, CCS experts were instructed to focus on readily available sources of information (official statistics, scientific and grey literature, etc). In exceptional cases, the IHH study was able to support very limited primary data collection to overcome a systematic lack of small-scale fisheries information. The methods chosen by the CCS experts to compile the data were clearly documented within the data collection spreadsheet templates (often at the level of single data points), as well as in a detailed methodology report. Experts also provided a complete reference library and original sources, where possible, for the data used to complete the case study.

Definitions of small-scale fisheries and levels of data aggregation

The IHH methodology did not prescribe a standard definition of small-scale fisheries due to the vast diversity and complexity of the subsector in different countries. Instead, CCS experts provided the most common definition (e.g. legal or operational) for small-scale fisheries adopted in their country or territory. This allowed flexibility for CCS experts to determine which fisheries would be covered in the case study and how data would be best organized at the fleet level to suit the country's context (i.e. based on geographic location, ecosystem type, gear or vessel types, or species targeted). While case studies aimed to cover all small-scale fisheries in the country or territory, in most cases the information available did not cover 100 percent of, for example, the catches, particularly for the inland subsector. Thus, CCS experts estimated how much of the total national catch for the small-scale fisheries subsector was represented by the data available and reported this within each CCS.

Once the fisheries to be included in the case study were bounded within each country's definition of small-scale fisheries, data for different indicators were compiled at different levels of disaggregation to enable cluster-specific analyses at three levels: species, fishery unit (see Section A.2.1.3.3) and national. CCS experts were explicitly instructed on which level of disaggregation data was required for each indicator (Figure A.3). All data were requested to be disaggregated for marine and inland fisheries for the most recent available year after 2013.

Fishery unit-level data

The CCS used the concept of a "fishery unit" as a unit of assessment for specific indicators for which data exist aggregated at or above species level. Fishery units were defined according to type of management and available information, and these could be composed of single or multiple fisheries that varied from one another in characteristics relevant to the country's small-scale fisheries subsector (e.g. location name, gear type or fishing method primarily used, vessel type, species or group of species) or because they differed on how catch data were originally aggregated (e.g. by fishing fleet).

The organization of species and fleet data into fishery units was determined by each CCS team at their own discretion, following the characteristics that best suited the goal of the case study and the restrictions in their data. The units were classified as marine or inland within each CCS. There was no general rule for distinguishing fishery units occurring in estuarine and other brackish areas (which can include species associated with marine or inland waters, or both in the case of diadromous fish). Consequently, fisheries occurring in these areas were classified as either inland or marine by CCS experts, depending on the local definitions and knowledge of the fisheries within each CCS. Hence, there are a number of species with catches occurring in both inland and marine waters.

Depending on the country or territory, fishery units could refer to one or more of the following:

- Target fish *species*, groups of species, or *stock* (including its geographic area or location);
- Fishing *method*, *gear* and/or *vessel type*;
- Fishing *fleet / groups* of vessels or individual fishing operators pursuing the fishing operation(s).

Individual fishery units constituted the second smallest unit of assessment (after species level) for selected indicators. Fishery units were also the basis for implementing a characterization approach that enabled comparison across case studies and the whole IHH dataset by addressing the complexity of small-scale fisheries in a systematic and objective manner (see Chapter 3). The approach applied a scoring matrix that included a broad range of technological, economic, operational and organizational characteristics to all fishery units included in the case study, using both quantitative and qualitative descriptions for the measures in each characteristic (see Table A.3 for marine fisheries and Table A.4 for inland fisheries). Authors used this "characterization matrix" to describe the multiple marine and inland small-scale fisheries separately, through the following steps:

- **Step 1: Define the country's small-scale fisheries and determine the disaggregation of fishery units.** All the fishery units that constituted the country's small-scale fisheries subsector, and for which quality data were available, were scored using the marine and/or inland matrices. Most often, CCS experts carried out the characterization exercise themselves, and in some cases consulted with in-country experts.
- **Step 2: Assess each individual fishery unit through application of the matrices.** For each of the 13 to 14 characteristics within the marine and inland matrices, respectively, the scoring option (between 0 and 3) which most closely described the fishery unit was selected, with only one scoring option allowed per characteristic. The selection was done following the description of each characteristic provided in the matrices. The total overall score for each fishery unit was then calculated by adding up the scores for all the characteristics in each matrix.

A.2.1.4 Case study data processing

Catch data cleaning and harmonization

The dataset at the species level constituted the lowest possible level of disaggregation of the entire CCS data (though sometimes data were only available at higher taxonomic levels, such as order or family). For the indicators on nominal catch and ex-vessel price, data were requested for the five most recent years (from 2013 to 2017, if possible). This dataset was the basis for the calculation of the catch, landed economic value, and nutrient potential indicators at the national level, and the basis for their extrapolation to the global level.

Once all CCS were completed, data were consolidated into several compound datasets according to the different levels of aggregation. The compound datasets including catch and ex-vessel price at the species level went through a thorough diagnostic process to detect outlier data points, assessment of identified discrepancies, gap filling when reasonable, and corrections when necessary. For the compound datasets at the species level, a cleaning process was implemented to harmonize and correct species names across countries and ensure that each species name was categorized in the same functional grouping categories as in the other countries. Moreover, harmonized species names from case studies were also corroborated using online databases that continuously update taxonomy of fish, namely FishBase[51] and the World Register of Marine Species.[52]

Additional information was paired to the catch data at the species level, including classifications of functional groups of species (following FAO species nomenclatures and classification schemes,[53] – Table A.5), and ecological and vulnerability traits, as well as IUCN Red List Status. Once the final list of major and detailed functional groups of species was validated, the full list of unique species was finally assigned to its corresponding major and detailed functional group categories (using mainly the species name). The two classifications for functional groups of species remain a key instrument of the IHH project to aggregate or disaggregate catch data at detailed or broad classification groupings. The following functional groups of species were excluded from the final datasets: aquatic plants, miscellaneous aquatic products,[54] aquatic mammals,[55] and some miscellaneous aquatic animals.[56]

Validation process

Final CCS data were checked and corroborated with available global databases and expert consultations via a series of data quality, triangulation, and outlier detection tests (see Table A.6 for examples on indicator-specific checks).

A final validation process was applied to catch estimates (as an average from 2013 to 2017) disaggregated by inland, marine, small- and large-scale fisheries at the national level to ensure the methodology employed by the CCS experts was appropriate and robust to produce reliable national-level estimates, and that differences with other data sources were consistent with the different data sources and methodologies used. The process also aimed at highlighting any specific issues with the data. The process consisted of three steps:

- Scrutiny of IHH methodology and data sources to produce catch estimates
- Triangulation with independent data sources (FAO official statistics and responses to the ad hoc questionnaire on small-scale fisheries)
- Expert review, with experts outside of the IHH team, internal and external to FAO

[51] See http://www.fishbase.org/search.php

[52] See https://www.marinespecies.org/

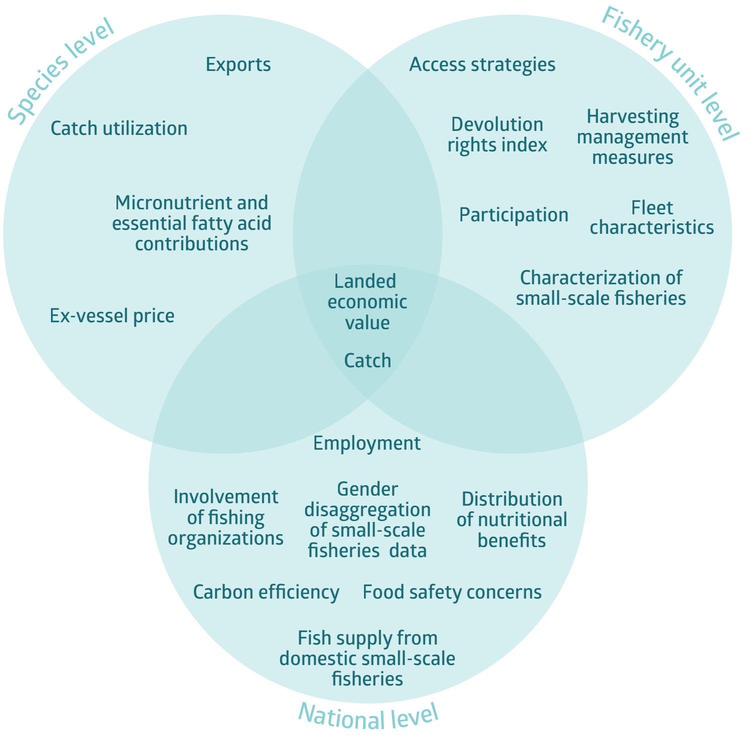
[53] The IHH Functional Classification scheme resulted from a combination of FAO species nomenclatures and species classification schemes: ISSCAAP Division, ISSCAAP Group, FAOSTAT Group of Commodities, and CPC class.

[54] Including coral, pearl, mother-of-pearl, shells and sponges.

[55] Including blue whales, fin whales, eared seals, hair seals, walruses, sperm whales, pilot whales, and other miscellaneous aquatic mammals.

[56] Including crocodiles and alligators, frogs and other amphibians, and turtles.

Figure A.3 Sample IHH indicators organized according to different levels of aggregation for country and territory case study data compilation and synthesis



For marine fisheries, the validation process had to be done by aggregating CCS data from large-scale and small-scale fisheries, as FAO's official statistics are not disaggregated this way. For inland fisheries, FAO official statistics data were assumed to be corresponding to small-scale fisheries, as inland fisheries are most likely to be found in the small-scale subsector.

In some cases, the validation process showed that specific years of data had incomplete catch information, and these years were therefore removed from the dataset for those countries (ten cases in total). In other instances, catch estimates from the CCS were found to include catch from foreign fleets. These were removed, making sure that they were accounted for under the relevant flag state.

The validation process also showed that small-scale fisheries catch estimates were incomplete for two countries (one relative to marine fisheries and the other to inland fisheries). In these cases, country values were substituted by the respective ad hoc questionnaire value in one case, and by the respective FAO value in the other case.

In cases where large-scale fisheries catch estimates from the CCS were found to be not reliable, the ad hoc questionnaire value was used instead (one case). In cases where no ad hoc questionnaire was available (or ad hoc questionnaire data could not be used, as they applied a different definition of small-scale fisheries in the breakdown), large-scale fisheries were estimated using the FAO total country value minus the small-scale fisheries estimate from the CCS (a total of nine cases).

The process resulted in a dataset with information on the volume of catch from small-scale fisheries for more than 70 000 records at species level, 876 records at detailed functional group level and 474 records at major functional group level, disaggregated by marine and inland.

A.2.2 Ad hoc questionnaire

A.2.2.1 Design, response rate, and data use

The ad hoc questionnaire was designed by the IHH Core Team and dispatched as an official FAO ad hoc questionnaire to all FAO Members in December 2018. Its objective was to be able to use the official data received as a triangulation tool to help in the validation of the CCS data. The questionnaire was developed following FAO guidelines and structured to minimize the burden on respondents. It was dispatched in English, Spanish, French and Russian, and at least three reminders for responding were sent over the course of one year.

The questionnaire was organized into different worksheets according to five different key indicators: Production, Catch utilization, Export, Employment, and Fishing fleet. Data were requested at the national level for the years 2013 to 2017 for both small- and large-scale fisheries, and marine and inland fisheries, separately. The response rate for the ad hoc questionnaire was 47.8 percent, with 109 responses out of 228 countries and territories.

Table A.3 Characterization matrix for marine fisheries

Characteristics	Score 0	Score 1	Score 2	Score 3
Indicative gear				
Fishing gear	Labour-intensive gear	Passive gear	Gear with aggregating devices	Highly active gear
Comments: Labour-intensive gear includes mostly small gear types handled manually by the fisher (e.g. hand-held tools/ spears, hand-hauled nets, pole-lines, crab pots). Passive gear includes larger gear sets that are deployed passively (e.g. longlines, trap sets, gillnets/driftnets). Gear with aggregating devices includes larger gear sets which use aggregation and attraction methods, such as attracting lights and fish aggregating devices (FADs). Highly active gear includes gear types that require vessel power to encircle, chase, deploy and retrieve fish.				
Mechanization	No mechanization	Small power winch/ hauler powered off engine	Independently powered gear deployment/hauling	Fully mechanized gear deployment/ hauling
Comments: Indicates what type of mechanization, if any, is used to deploy gear during the fishing operation.				
Vessel				
Size of fishing vessel	No vessel	< 12 m, < 10 GT	12 to ≤ 24 m, < 50 GT	> 24 m, > 50 GT
Comments: Although vessel size isn't necessarily an indicator of operational scale and intensity, it is an important characteristic when paired with variables such as motorization and mechanization. The four scoring options give a range of sizes which cover the majority of vessels (including shore-based activities) that occur globally.				
Motorization	No engine	Outboard/ inboard engine ≤ 100 hp	Inboard engine > 100 hp to ≤ 400 hp	Inboard engine > 400 hp
Comments: Indicates what type of mechanization, if any, is used to deploy gear during the fishing operation.				
Operations				
Fishing trip duration	< 6 hours	Day trip (< 24 hours)	>1 day to < 4 days	> 4 days
Comments: Depending on the type of gear, this characteristic could refer to a detailed unit of measure, i.e. number of hours fished; to "number of days fished", i.e. the number of days on which fishing took place (for those fisheries for which searching is a substantial part of the fishing operation, days on which searching but no fishing took place should be included); or to "number of days on ground" which, in addition to days spent fishing and searching, also includes all other days while the vessel was on ground.				
Fishing location and range	≤ 100 m from shoreline / baseline/ high-water mark	> 100 m, ≤ 10 km from shoreline / baseline / high-water mark	> 10 km, ≤ 20 km from shoreline / baseline / high-water mark	> 20 km from shoreline/baseline
Comments: Indicates at what distance from shoreline, baseline or high-water mark the fishing activity is carried out.				
Storage/preservation				
Refrigeration/ storage	No (cold) storage	Icebox (i.e. on deck)	Ice hold (i.e. below deck)	Refrigerated hold
Comments: An ice box is a free-standing container filled with ice for the purpose of chilling fish (above or below deck); an ice hold is a structure below deck containing ice for the purpose of chilling fish; a refrigerated hold is part of boat structure and is mechanically refrigerated for the purpose of freezing fish.				

Table A.3 Cont

Characteristics	Score			
	0	1	2	3
Employment/labour				
Labour/crew	Individual and/or family members	Cooperative group	≤ 2 paid crew members	> 2 paid crew members
Comments: The term cooperative group refers to any arrangement in which individuals, other than family members or paid crew, work together to carry out the fishing operation. The two paid crew categories refer to fishers paid either in monetary or non-monetary (e.g. part of the catch) terms.				
Ownership	Owner/operator	Leased arrangement	Owner	Corporate business
Comments: Owner/operator refers to a fisher who operates vessel/gear that they own; Leased arrangement refers to fishers who operate from a rented vessel/rent gear; Owner refers to a respondent who owns the vessel/gear but does not carry out the fishing operations first-hand; Corporate business refers to a company or group of people that carry out fishing activities as a single legal entity (usually owning multiple vessels/gear and employ multiple crew).				
Time commitment	Occasional	Full-time, but seasonal	Part-time all year	Full-time
Comments: Occasional fishers receive under 30 percent of their livelihood from fishing or spend under 30 percent of their working time in that occupation. Part-time fishers receive at least 30 percent but less than 90 percent of their livelihood from fishing or spend at least 30 percent but less than 90 percent of their working time in that occupation. Full-time fishers receive at least 90 percent of their livelihood from fishing or spend at least 90 percent of their working time in that occupation. The "Full-time, but seasonal" category refers to fishers who are occupied with other full-time seasonal activities when not fishing (such as farming), or who work during a fishing "season" that may be adapted so it does not coincide with the peak tourist period (during which earnings might well be higher).				
Use of catch				
Disposal of catch	Household consumption / barter (exchange for payment in goods or services)	Local direct sale at landing site (exchange for monetary payment)	Sale to traders	Onboard processing and/or delivery to processors
Comments: Household consumption or barter refers to fisheries catch mainly consumed in the household or informally exchanged for goods or services. Local direct sale refers to sales to individuals, restaurants or small local businesses, often close to landing sites. Sale to traders applies when one or multiple traders operate in the value chain between producer and consumer. Onboard processing and/or delivery to processors applies when catch is processed for value addition or preservation before being traded into the value chain.				
Utilization of catch, value addition / preservation	For direct human consumption	Chilled / locally processed / cured	Frozen	Frozen/chilled for factory processing (for human consumption or fishmeal)
Comments: Direct human consumption refers to fish that is consumed fresh, with minimal to no processing. The other three categories indicate varying degrees of sophistication and durability of preservation and value-adding methods. Chilled / locally processed / cured includes smoking and salting.				
Integration into economy and/ or management system	Informal, non-integrated (no fees required)	Integrated (registered, untaxed)	Formal, integrated (licensed fisher, payment of landing fees)	Formal, integrated (licensed, taxed)
Comments: This characteristic describes the level at which the fishing operation is integrated into formal economic and management systems. Informal, non-integrated fishing operations lack any form of licence or registration and are not subject to licence or landing fees or taxation. Integrated fishing operations are formally registered, however they are not taxed or charged a fee for their activities. Formal, integrated operations are licensed and subject to licence and/or landing fees, however they are not taxed as a commercial concern. Formal, integrated fisheries are licensed and taxed as a commercial concern.				

Table A.4 Characterization matrix for inland fisheries

Characteristics	Score 0	1	2	3
Indicative gears				
Passive gear	Foraging by hand, traps, pots	Gill nets, baited longlines	Pumped trap ponds	Large fence traps, large river traps / bag nets
Active gear	Cast net, hand-held lift net, scoop, spear, baited hook	Seine net, lift net	Large lift net	Actively hauled dredge / trawl net
Mechanization	No mechanization	Battery-powered equipment / lanterns	Generator - or engine-powered attracting lights	Small power winch / hauler powered off engine
Vessel				
Size of fishing vessel	No vessel	<4m	<4m to <8m	>8m
Motorized or not	N.A.	No engine	Outboard engine <25hp	Inboard engine >40hp
Operations				
Fishing trip duration	Occasional foraging	Seasonal fishing, short trips	Regular fishing trips, all-day	Multi-day fishing trips
Fishing area/ waterbody type	Seasonal waterbodies, wetlands and small streams, rice fields	Less than ~5km from shore in permanent rivers, medium waterbodies, wetlands	Large rivers, large water bodies, reservoirs <500km^2	Inland seas, large lakes and waterbodies >500km^2
Storage / Preservation				
Refrigeration/ storage	No (cold) storage	Insulated box / ice box	Ice hold	Refrigerated hold
Employment / Labour				
Labour / crew	Individual and/or family members	Cooperative group	<2 paid crew members	>2 paid crew members
Fishing unit / ownership	Owner / operator	Leased arrangement	Owner	Corporate business
Time commitment	Part-time / occasional	Full-time, but seasonal	Part-time, all year	Full-time
Use of catch				
Disposal of catch	Household consumption / barter	Local direct sale at landing site	Sale to local market traders	Sale for export
Utilization of catch, value addition / preservation	For direct human consumption	Chilled, fermented, smoked, salted, dried	Frozen, filleted	Factory processed
Integration into economy and/ or management system	Informal not integrated (occasional, no fees required)	Integrated (registered / recognized fisher, untaxed)	Formal integrated (licensed fisher, payment of landing fees / personal taxes)	Formal, integrated (registered, licensed, taxed as a commercial concern)

Table A.5 Classification of functional groups of species applied to all species-level data in the species-level datasets for the IHH study

Major groups of species	Detailed groups of species
Demersal marine fish	Cod, hake, haddock
	Flounder, halibus, sole
	Miscellaneous coastal fish
	Miscellaneous demersal fish
	Sharks, rays, chimaeras
Pelagic marine fish[a]	Herring, sardine, anchovy
	Miscellaneous pelagic fish
	Tuna, bonito, billfish
Diadromous and freshwater fish[b]	Diadromous and freshwater fish
Cephalopods	Cuttle fish and squid
	Octopus
Miscellaneous aquatic animals[c]	Miscellaneous aquatic invertebrates
Mollusks excluding Cephalopods	Abalone, winkle, conch
	Bivalve[d]
Shrimp, prawn	Shrimp, prawn
Crustaceans	Crab, king crab
	Lobster, spiny-rock lobster
Marine species nei	Miscellaneous marine species
Freshwater species nei	Freshwater species nei

Note: These groups already reflect aggregations and pooling of more detailed groups of species together to ensure adequate sample sizes for the final prediction of marine small-scale fisheries catch, while keeping groups as detailed as possible. **a** Including scad and mackerel. **b**Including miscellaneous diadromous fish, river eel, salmon, trout, smelt, shad, sturgeon and paddlefish. **c** Including horseshoe crabs and other arachnoids, sea squirts and other tunicates, sea urchins and other echinoderms, freshwater molluscs, cephalopods nei, miscellaneous marine molluscs, krill, planktonic crustaceans, freshwater crustaceans, and miscellaneous marine crustaceans.**d** Including clams, cockles, arkshells, mussels, scallops, pectens and oysters.

Table A.6 Data quality and validation checks for key indicators

Indicator	Quality assessment and validation checks
Catch (core indicator for environmental, social, nutrition and economic dimensions)	• Scrutiny of IHH methodology and data sources to produce catch estimates. • Catch outlier detection protocols. • Triangulation with independent data sources: FAO official statistics (aggregating CCS data from large-scale and small-scale fisheries) and the responses to the ad hoc questionnaire. • Expert review of national- and territory-level estimates, with experts outside of the IHH team, internal and external to FAO.
Ex-vessel price (as input for landed economic value estimations)	• Scrutiny of IHH methodology and data sources to produce catch estimates. • Price outlier detection protocols. • Gap-filling protocols via a four-tiered imputation process according to prices within the same CCS, within the most similar and best available data from neighbouring countries, within countries sharing the same income level, and from data at the global level. • Expert review of national- and territory-level estimates, with experts outside of the IHH team, internal and external to FAO.
Exports in small-scale fisheries	• Scrutiny of IHH methodology and data sources to produce small-scale fisheries export estimates from catch utilization data at the species level. • Exported catch outlier detection protocols. • Triangulation with independent data sources: FAO official statistics, and IHH estimates of small-scale fisheries exports at the country and territory level.

Employment	• Scrutiny of IHH methodology and data sources to produce employment estimates for the harvesting segment at country and territory level, including through International Labour Organization and FAO statistics colleagues, and Technical Advisory Group members.
	• Expert review of national- and territory-level estimates, including gender disaggregation, with internal and external experts to the IHH team.
	• Triangulation with other data sources:
	  ◦ For employment in the primary sector of fisheries disaggregated by scale of operation (small/large): triangulation with CCS and responses to the ad hoc questionnaire;
	  ◦ For employment in the primary sector of total capture fisheries (not disaggregated scale of operation): triangulation with FAO employment data;
	  ◦ For employment in the post-harvest segment of fisheries: triangulation with CCS and responses to the ad hoc questionnaires, where available (~ 30 countries).

Governance arrangements	• ·Scrutiny of IHH methodology to exclude arrangements that i) only pertain to large-scale fisheries or aquaculture, or do not pertain to the harvest of aquatic resources; and ii) only pertain to species not included in the IHH study (e.g. seaweeds). • Data screening for internal coherence.

A.2.3 Thematic studies

A.2.3.1 Study selection

The information provided through the thematic studies illustrated the importance of small-scale fisheries within specific contexts and at local levels, providing valuable insights that can easily be lost when aggregating data to the national, regional or global levels. Indicators addressed via thematic studies were considered relevant for allowing a discussion on the importance of these contributions despite the lack of widespread data to quantify them more broadly and highlighting topics where data collection challenges for small-scale fisheries persist and require improvements. Indicators for which thematic studies were considered suitable were selected during the final prioritization of the IHH indicators in 2018 (Table A.7).

Authors for these studies were selected based on availability and expertise in the topics relevant to the thematic indicators. All thematic authors were in constant communication with the different cluster leaders throughout the building of their respective studies, and multiple iterations of the studies were reviewed by the IHH team prior to completion. Most of these studies conducted literature reviews that covered a diversity of approaches, geographies and case studies to identify common subthemes and narratives.

A.3 Environmental data analyses

A.3.1 Catch data for small-scale and large-scale fisheries

A.3.1.1 Catch data collection

As described in Section A.2.1, CCS experts compiled existing data on catch for small- and large-scale fisheries for the years 2013 to 2017 (and in some cases authors included data from 2018) and following the IHH methodology and training. CCS were conducted in 58 countries and territories, of which 32 displayed data on catch from both inland and marine fisheries, 6 had data only for inland fisheries, and 20 had data on marine fisheries only.

Data on the volume of catch (expressed in tonnes) for the 58 countries and territories were collected at the species level and disaggregated between marine and inland, and small- and large-scale fisheries. For each collected record, CCS reported on the full taxonomy of each species (i.e. species, genus, subfamily, family, order, class, superclass, phylum and kingdom), as well as its corresponding ASFIS Species for Fishery Statistics Purposes code following the FAO species list (i.e. a three-letter code that uniquely identifies each of the 13 060 potentially available species in the ASFIS classification[57]).

Table A.7 List of thematic studies within each cluster

Dimension	Thematic studies
Environmental	• The environmental interactions of small-scale fisheries • Impacts of climate change on small-scale fisheries
Economic	• Analysis of the value added by small-scale fisheries value chains, and the hidden contribution to GDP (Malawi, Peru, Sierra Leone) • Role of employment at subnational level
Social	• Indigenous small-scale fisheries: rights, resources, and sustainable policy • The value of small-scale fisheries: social and cultural identity
Nutrition	• Small-scale fisheries, poverty and food security: quality data provide new insights in sub-Saharan Africa • Small-scale fisheries and fish consumption during the first 1 000 days

[57] The full list of 13 060 species can be found at http://www.fao.org/fishery/collection/asfis/en

A.3.2 Global extrapolation of marine small-scale fisheries catch

The final constructed dataset of catch formed the basis for the development of a modelling framework aimed at predicting recent average catch of marine small-scale fisheries in approximately 150 countries around the world using models fit to the estimated marine catch (as reported by the CCS) in 52 countries. The framework was largely based on machine-learning algorithms and regression models used to generate predictions, and included a variety of fishery-related, economic and geographic covariates. A wide variety of candidate models were constructed on the basis of simple data-driven rules, and for each fitted model a number of model fit summary statistics and cross-validation summary statistics were compared to choose the best model. Predicted catches were estimated under all candidate models, both at the country level (up to 152 countries; across 68 candidate models) and at the joint country-functional group level (up to 2013 combinations of country and functional group; across 172 candidate models).

A.3.2.1 Response (independent) variables

Marine small-scale fisheries catch data were collected under the IHH study for 52 countries. These were treated as observed values, known without error. One dataset involved marine small-scale fisheries catches aggregated to the country level, and another involved country-level marine small-scale fisheries catches further disaggregated by functional group.

The two response variables considered, one for each level of aggregation, were:

- SSF_Catch_{c}
- $SSF\_Catch_{c,f}$

where *SSF_Catch* capture marine small-scale fisheries catch, c denotes country, and f denotes functional group. The two response variables were log-transformed in natural logarithms. The global extrapolation of small-scale fisheries catch consisted of a snapshot in time, rather than modelling changes over time. Because marine small-scale fisheries catches used as response variables were time-varying – i.e. the volume of catch for a given country and functional group as extracted from case studies was available for more than one year – the mean value over the period 2013 to 2017 was calculated for each of these time-varying catches.

A.3.2.2 Selected explanatory variables for prediction

To extrapolate marine small-scale fisheries catch to global level, three main groups of predictor variables (categorical variables, scaling variables and other variables) were initially selected for inclusion. Thus, for countries that were not part of the CCS, the econometric predictions of marine small-scale fisheries catch were based on the covariate values of the selected predictors. Concerning the first group of variables, two multilevel categorical variables were considered:

- "Region", with all countries grouped into one of five categories (Africa, Americas, Asia, Europe, Oceania);
- "Functional group", which was constructed as an intermediate level of taxonomic classification, with 18 levels (Table A.5, excluding "Freshwater species nei"). This variable was only used for the prediction of the volume of catch for the combination of countries and functional group of species, and it was included in all candidate models.

In addition to multilevel categorical variables, 15 scaling explanatory variables were included in the regression analyses. These variables were expected to scale with the magnitude of marine small-scale fisheries catch. Some were fishery-related variables like marine catch from FAO FishStat data, effort, or employment, others were geographic variables like EEZ area or shelf area, and others were economic variables like country-wide subsidies or country-wide GDP, with the expectation that countries with more subsidies or larger economies may, all else equal, have greater small-scale fisheries catches. Like the response variable, all scaling variables were log-transformed for normality.

Finally, 17 other explanatory variables[58] were considered for possible inclusion in regression analyses that were not expected to share positive strong covariation with marine small-scale fisheries catches but were still expected to explain catch variation. These covered a wide range of geographic, social, economic, and fishery-related variables. Many of these consisted of ratios between available variables. All but one of these other explanatory variables were numeric; the other was a two-level categorical variable. Some were log-transformed, others were not as their distributions were already roughly normal.

[58] The other explanatory variables considered for possible inclusion in the analyses included: chlorophyll-a, coastal population (elevation) / coastline, GDP per capita, capacity-enhancing subsidies / country catch, beneficial subsidies / GDP, beneficial subsidies / country catch, percent of total subsides to rural communities, percent MPA coverage in territorial waters, percent of IUU effort in marine small-scale fisheries (estimated based on the ratio of Rousseau *et al.* (2019)'s reported effort and IUU effort variable sat country level), percent of country effort in marine small-scale fisheries (estimated on the basis of country effort in marine small-scale fisheries and large-scale fisheries), percent of country jobs in marine small-scale fisheries (estimated on the basis of country employment in marine small-scale fisheries and large-scale fisheries).

A.3.2.3 Construction of predictive models

Overall, 172 candidate models for the prediction of marine small-scale fisheries catch for combinations of country and functional groups were constructed. As the number of possible combinations of explanatory variables was very large, a stepwise approach was used, including four data-based rules aimed at constraining the number of predictors to be included in each candidate model. These rules include:

- **Constraints based on correlation among scaling variables**. To further reduce the number of potential combinations of scaling variables, two rules were applied: 1) a maximum of three scaling variables were allowed to be included in the same candidate model; and 2) all pairs of scaling variables had to have correlation coefficients r < 0.4 to be included in the same candidate model.
- **Constraints based on identifiability.** Some explanatory variables were log-transformed ratios of pre-transformed explanatory variables, for example the log-transformed ratio of coastal population to coastline length. Including all these variables in any one candidate model would result in issues of model identifiability because, despite the differing application of log transformations, they are not independent predictors. To avoid issues of model identifiability, when both variables used to construct ratios were contained in the same candidate model, the corresponding ratio variable was omitted.
- **Constraints based on variance inflation factors (VIFs).** VIF was performed to help detect multicollinearity among predictor variables and, in turn, to quantify how much the variance of the regression coefficients could potentially be inflated due to collinear predictors that enter a given model (i.e. VIF measures the extent to which the variance of an explanatory variable is inflated as a result of correlation with the other explanatory variables). VIFs were calculated twice for sets of explanatory variables to remove some of the violating predictors, in case multicollinearity was detected. First, they were calculated for the 12 explanatory variables that had high correlation (greater than 0.7) with others. One variable (i.e. ratio of coastline length to land area) had moderate collinearity and therefore was omitted. Second, the 11 remaining explanatory variables were assembled with each of the 172 combinations of scaling and categorical explanatory variables, and VIFs were then calculated for the combined set of explanatory variables.
- **Constraints based on maximum specified number of parameters.** To potentially limit the number of explanatory variables (and thus estimated parameters) included in candidate models, step-down procedures were considered. The values assumed for regression analyses are: 1) maximum eight parameters for linear regressions; 2) maximum ten parameters for random forest regressions.

A.3.2.4 Model fitting, cross-validation, and selection of the best predictive model

Model fitting

Candidate models were constructed as outlined above for use in random forest regression analyses and linear fixed-effect or mixed-effect regression models.

The random forest regression analyses is a non-parametric method that makes no assumption about the distribution of response variables, but for consistency with linear regression summaries and predictions, log-transformed values of the response variable were used. The method implicitly incorporates interactions among explanatory variables and allows for non-linear relationships between explanatory and response variables.

In linear regression analyses, instead, the response variable is assumed to be normally distributed, and log-transformation of appeared to sufficiently normalize the variable. No interactions between explanatory variables and no higher-order terms of any explanatory variables were included. Parameters are estimated for an overall intercept, variances of random effects, and coefficients associated with each explanatory variable. In half the candidate models, the five-level geographical "region" categorical variable was included, and this was treated as a random intercept. In all of the candidate models, the intermediate 18-level categorical variable for functional group (Table A.5) was included and treated as a random intercept. In models that included both "region" and the intermediate functional group random effects, these were treated as crossed random effects. All other explanatory variables were treated as fixed effects.

Extrapolation of predicted values

After model fitting, the final fitted model (fit to combinations of 52 countries and on average 10.4 "intermediate" functional groups per country with marine small-scale fisheries catch available) was used to predict marine small-scale fisheries catch values for all combinations of country (~152) and "intermediate" functional groups in the dataset. These predictions were based on the covariate values of the ~152 countries. For any given candidate model, values of all explanatory variables used in fitting the model had to be available for a given country in order for a predicted value of marine small-scale fisheries catch to be generated for a combination of country and functional group.

Cross-validations

Following the extrapolation of marine small-scale fisheries catches, cross-validations were carried out for all 172 candidate models to evaluate prediction accuracy. Prediction accuracy represents how well predicted values of marine small-scale fisheries catches for combinations of countries and functional groups adhere to corresponding observed catches extrapolated from the CCS. The best model in terms of fit (low sum of squared residuals, high R-squared, etc.) is not necessarily the best model for predicting values outside of the dataset used for fitting. Cross-validations split the dataset into portions for fitting (training) and testing, so that validation of a candidate model does not involve data that were used for fitting the model. Cross-validations do not affect the predicted values under the final model fit of each candidate model, they only inform which of the candidate model(s) may be most reliable in terms of prediction accuracy. Three metrics were summarized across the cross-validation evaluations, comparing observed and predicted values from the testing dataset:

- mean value of standardized Mean Absolute Error
- mean value of standardized Root Mean Squared Error
- mean value of correlation coefficients

Selection of the best candidate model

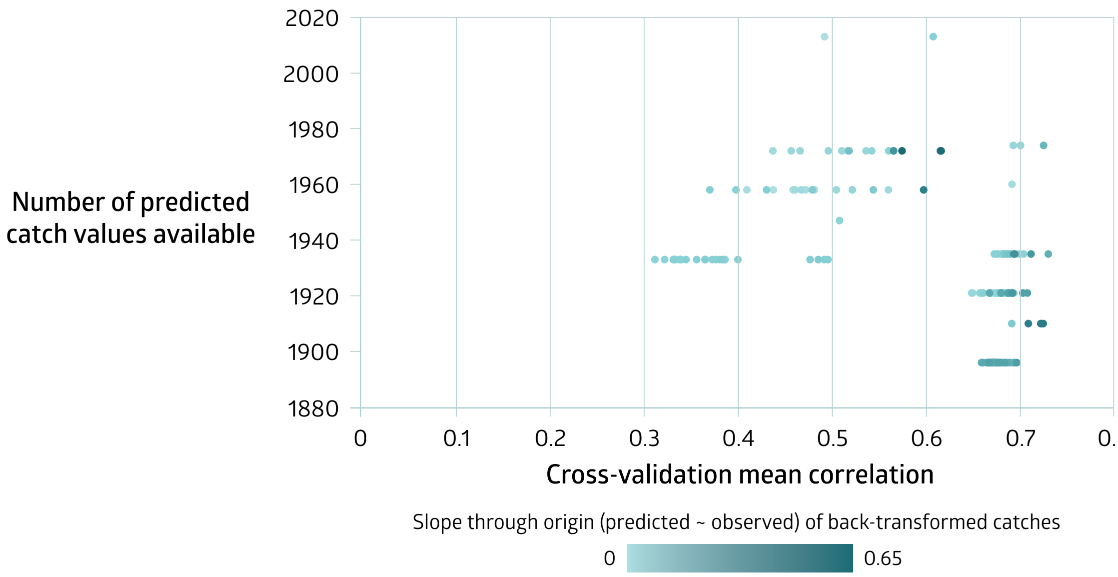
Three main criteria were eventually used to select the best candidate model for presenting estimates of marine small-scale fisheries predicted catch. The three criteria included: 1) high cross-validation mean correlation, 2) large number of predicted catch values available, and 3) slope through the origin of back-transformed catches (predicted versus observed) near 1, as presented in Figure A.4. For each of the 172 candidate models, the number of predicted data points is presented on the horizontal axis; the vertical axis shows the cross-validation mean correlation; finally, the bar on the top of the figure presents the slope through the origin of back-transformed catches, with the transition from darker to lighter violet indicating models with predicted data points having a slope through the origin near 1.

Considering the three selection criteria discussed above, model m14 was selected for presenting the estimates of marine small-scale fisheries catch, for combinations of countries and functional groups with unknown catches. The model was fitted through a linear regression analysis, and it achieved a reasonable number of predicted data points (152), a high cross-validation mean correlation (0.854), and a slope through the origin equal to 0.72. The predictions of marine small-scale fisheries catch were done using the following explanatory variables: 1) log (GDP), 2) log (small-scale fisheries jobs), and 3) region.

A.3.3 Global estimates of inland small-scale fisheries catch

A first attempt to extrapolate inland small-scale fisheries catch data for non-CCS was based on the same extrapolation methodology as implemented for the global extrapolation of marine small-scale fisheries catch. However, following the evaluation process of the predicted data points for inland small-scale fisheries catch, it was decided not to use this approach. The poor prediction accuracy generated from the implemented inland methodology was widely discussed with fishery experts. Both the limited availability of suitable predictors, the added complexity of inland systems, and the limited sample size to extrapolate inland small-scale fisheries catch at functional group level for countries with unknown values resulted in poor prediction accuracy. Gaps in inland small-scale fisheries data for non-CCS were filled using FAO official statistics. This approach was justified given that most of the CCS estimates were largely based on official data, and the general assumption (confirmed by the available CCS data) that close to 100 percent of inland catch would come from small-scale fisheries.

Figure A.4 Diagnostic plot for the 172 models explored



Notes: Y-xis: total number of predicted catch values at functional group level (i.e. number of countries multiplied by number of functional groups); x-axis: cross-validation mean correlation. Colour scale: slope through the origin (predicted vs observed) of back-transformed catches. Models closest to upper-right corner are those considered most suitable.

A.4 Economic data analyses

A.4.1 Landed economic value of small-scale fisheries

A.4.1.1 Price and landed economic value data collection and processing

CCS experts were recruited to compile existing data on catch and ex-vessel prices or landed economic value (among others) for small- and large-scale fisheries in the 58 countries that formed the CCS, for the years 2013 to 2017, according to a standard IHH protocol and training. The indicators estimated for these 58 CCS formed the basis for global extrapolation.

For small-scale fisheries, CCS experts compiled data on nominal catch (in annual tonnes of live weight equivalent) and average annual ex-vessel prices by species within fishery units (e.g. multiple species caught within a fishery unit as defined in each country, and average annual ex-vessel prices per species). The aim was to use average annual ex-vessel prices per species caught within a fishery unit, and the annual catch of the species within that fishery unit, to calculate landed economic value per species, and then aggregate to a total landed economic value for small-scale fisheries. Admittedly, applying an average price for the year to the total catch of a given fishery unit does not capture the heterogeneity of fleets that constitute a fishery unit, nor even the heterogeneity of catch (and value) for a specific vessel. However, the aim was to capture the average across different product qualities and supply chains. Finally, while the catch was reported in nominal weight, the ex-vessel prices were reported for the landed weight of the catch. For calculation of landed economic value, the nominal weight of the catch was assumed to equal the landed weight (i.e. no processing of the catch occurred before landing), unless specified otherwise – in which case nominal weight was converted to landed weight for the calculation of landed economic value. For large-scale fisheries, researchers compiled data on nominal catch and landed economic value.

As a first step, the data were reviewed according to the following protocols:

- **Choice of ex-vessel prices or landed economic value for small-scale fisheries:** Data for small-scale fisheries were provided as landed economic value in some cases and accepted as such, rather than just the average annual ex-vessel price. Both were accepted as long as catch was also included so that it was possible to convert landed economic value to average annual ex-vessel price.
- **Choice of ex-vessel prices for small-scale fisheries catch in nominal or landed weight:** Based on the protocol given to CCS experts, all small-scale fisheries catch volumes recorded were assumed to be in nominal weight unless otherwise specified, and nominal weight was assumed to equal landed weight unless specified otherwise. If ex-vessel prices were specified in landed weight of the catch, and this weight was confirmed to differ from nominal weight, conversion factors were requested to ensure that nominal weight could be converted to landed weight (where nominal weight was assumed always to be greater than or equal to landed weight), before the catch was multiplied by the price to calculate landed economic value. If no conversion factors were given, the nominal weight was assumed to equal landed weight, for purposes of calculating the landed economic value.

During the CCS iterative review process, feedback pertaining to ex-vessel prices and landed economic value most often focused on confirming the units the data were provided in and on ensuring that nominal weight equalled landed weight of catch, or if not, that a conversion factor was provided. Once the CCS data review was completed and any clarifications and amendments completed, the data were processed and harmonized to generate a uniform set of average annual ex-vessel prices for small- and large-scale fisheries catch, associated with the catch in nominal and landed weight (if differing), as a basis for landed economic value calculations. The datasets of average annual ex-vessel prices throughout the CCS were both harmonized to USD and converted to purchasing power parity (PPP[59] – price in local currency * PPP–GDP conversion factor), for purposes of comparison to identify outliers. All currency conversions were conducted with World Bank conversion factors.

A.4.1.2 Outlier detection and analysis

Once the dataset of average annual ex-vessel prices was converted to PPP,[60] an outlier detection protocol was run to identify anomalies for review by subject matter experts, and by CCS experts as well if needed. Outliers were identified for individual prices (i.e. prices considered outliers because of how high or low they were) and for time series of prices (i.e. prices entered for one year that deviated significantly from the mean for the time series). All catch entries for which prices were not available (entered as "NA") were excluded from the review and treated as missing data.

[59] See https://data.worldbank.org/indicator/PA.NUS.PPP

[60] The Cook Islands and Greenland prices were reviewed in USD and not converted to PPP, as rates were not available from the World Bank.

Box A.1

Key terms for the landed economic value of small-scale fisheries

Key terms

Ex-vessel price: The prices that fishers receive for their catch, or the price at which fish are sold when they first enter the seafood supply chain, for commercially exploited fish stocks.

Landed catch weight: The net weight of the quantities landed as recorded at the time of landing.

Landed economic value: The first sale value of the catch. Calculated by multiplying the ex-vessel price by landed catch weight, essentially capturing an average of product quality for the catch, while recognizing that different levels of product quality exist for the same species caught within a given fishery unit.

Nominal catch weight: The live weight equivalent of the landings (e.g. landings on a round, fresh basis; landings on a round, whole basis; landings on an ex-water weight basis, including whole weight with shells for molluscs and gastropods for example). Note: does not include discards.

Purchasing power parity (PPP) conversion factor: A spatial price deflator and currency converter that controls for price level differences between countries, thereby allowing volume comparisons of gross domestic product (GDP) and its expenditure components.

All individual price outliers (i.e. high- and low-price outliers) were investigated by subject matter experts to clarify discrepancies and decide whether to include or exclude the outliers in the final dataset. After the investigation, less than 0.35 percent of the average annual ex-vessel prices for any given year ultimately was excluded from the final dataset (with the exception of 2017, where 0.85 percent of the data was excluded).

In summary, most data flagged as a potential outlier was the result of a data processing error (e.g. prices were provided for units of catch in kilograms instead of tonnes, or prices were recorded in the wrong currency), or upon investigation was deemed reasonable for the context (e.g. lionfish being a low-value species, or spiny lobster a high-value species). Remaining price anomalies that could not be explained by the context or further investigation were excluded from the final dataset and considered as missing data.

A.4.1.3 Imputation of missing ex-vessel prices

Data coverage after processing and cleaning

Of the 58 CCS (52 with marine ecosystems; 36 with inland ecosystems), experts were able to provide some price data on marine small-scale fisheries for 48 countries and on inland small-scale fisheries for 30 countries. Complete price data for 100 percent of small-scale fisheries catch was available for at least one year in the time series for 36 of the CCS, while another 11 CCS provided price data for at least 85 percent of the catch for at least one year. There were five CCS which yielded no small-scale fisheries price data (Chad, Egypt, Ghana, Seychelles and Sri Lanka) and two which yielded price data for less than 50 percent of the catch (Zambia with 21 percent, and India with 45 percent). The final four CCS yielded price data for 50–75 percent of small-scale fisheries catch.

For large-scale fisheries, 34 of the 58 CCS were able to provide at least partial data for one year of ex-vessel price or landed economic value data. Of these, 31 provided almost complete price data (at least 97 percent of catch) for at least one year in the time series. There were 23 CCS which yielded no large-scale fisheries landed economic value data, and three that yielded landed economic value data for 30–70 percent of the catch (Mauritania with 34 percent, Samoa with 50 percent, and Greenland with 68 percent).

Imputation of missing ex-vessel prices (“gap filling”)

While most countries were able to produce data on either ex-vessel prices or landed economic value and catch volumes for some of their small- and large-scale fisheries, there were a number of data gaps. To fill these, a process to impute missing ex-vessel prices was developed that assigned the mean price value from a set of records with observed prices (i.e. the “donor”) to a record with a missing ex-vessel prices (“the recipient”). Four “imputation classes” were then defined according to four hierarchical levels, with the first level having priority over the others. If it was not possible to use the first level, the next level was considered, and so on, to fill in missing ex-vessel prices. The first level was defined within the same CCS; the second level was defined within the best and most similar available data from neighbouring countries; the third level was defined within countries sharing the same income level; and the fourth level was defined from data at the global level if not available at national or regional levels.

Within each imputation class, missing ex-vessel prices were imputed using the mean price for the same species and year, of for different years if the former was not available. In instances where the mean price for the same species was not available for any year, missing ex-vessel prices were imputed using the mean price for the same detailed functional group of species and year, or if not possible then for different years. If none of the above mean prices could be calculated, the same mean prices were calculated using the second-level imputation class.

This imputation process was conducted separately for the small- and large-scale fisheries data (i.e. data from large-scale fisheries were not used to impute gaps for small-scale fisheries, and vice versa). It is noteworthy that the imputation process only applied to those countries with partial price data that had gaps, e.g. missing prices for some (but not all) functional groups. Following this imputation process, a complete dataset of average annual ex-vessel prices of the catch was generated for the 52 CCS with marine small-scale fisheries and 38 CCS with inland small-scale fisheries.

A.4.1.4 Global extrapolation of the landed economic value of small-scale fisheries

The dataset of average annual ex-vessel prices of the catch formed the basis for the development of an econometric model used to extrapolate the landed economic values of small-scale fisheries, disaggregated by marine and inland. The econometric framework used for the global extrapolation was largely based on machine-learning algorithms, using models fit to small-scale fisheries landed economic values in the 52 countries with data on marine small-scale fisheries and the 38 countries with data on inland small-scale fisheries (Figure A.5) to produce regional and global estimates of landed economic value at functional group level. The final dataset for the global extrapolation of landed economic value was constructed based on the combination of countries and functional groups, leading to an average of 15 detailed functional groups in 152 countries with marine small-scale fisheries, and 4.5 detailed functional groups in 155 countries with inland small-scale fisheries.

Selected predictor variables for the prediction of landed economic value of small-scale fisheries

To extrapolate small-scale fisheries landed economic value at global level, 48 predictor variables were initially selected for inclusion in the econometric framework. For countries that were not part of the CCS, the econometric predictions of landed economic value in small-scale fisheries were based on the covariate values of the combination of countries and functional groups, for a total of 2 315 observations predicted. The selection of predictor variables was guided by the theory of what drives prices and landed economic value of fisheries.

In general, a fishery's short-run yield (or catch), in simplest terms, is expected to reflect the biomass of the targeted stock(s), some measures of their catchability under different fishing technology, and the amount of fishing effort. Assuming the primary goal is profit maximization, the amount of fishing effort that a firm or enterprise decides to engage in reflects a vessel's profit function (i.e. price multiplied by yield, subtracting fixed and operating costs). In short, fish availability is expected to reflect yield, which depends upon stock biomass or resource status, fishing technology used, and the amount of fishing effort, the latter of which reflects vessel/unit profitability where profit maximization is the primary goal of fishing (Anderson and Seijo, 2010).

In addition to the ones listed above, a number of indirect factors – e.g. the compensation of employees, the average inflation rate in the past ten years and the unemployment rate – can help explain the variation in landed economic values of fisheries through their direct impact on the average level of price in the economy and, in turn, their indirect effects on fishery-specific prices.

Although the initial selection of predictor variables was largely guided by their expected impact on small-scale fisheries landed economic value, the final list of predictor variables included in the econometric framework was further constrained by their availability in external data repositories.

Predictors were selected according to two underlying and mutually interdependent principles:

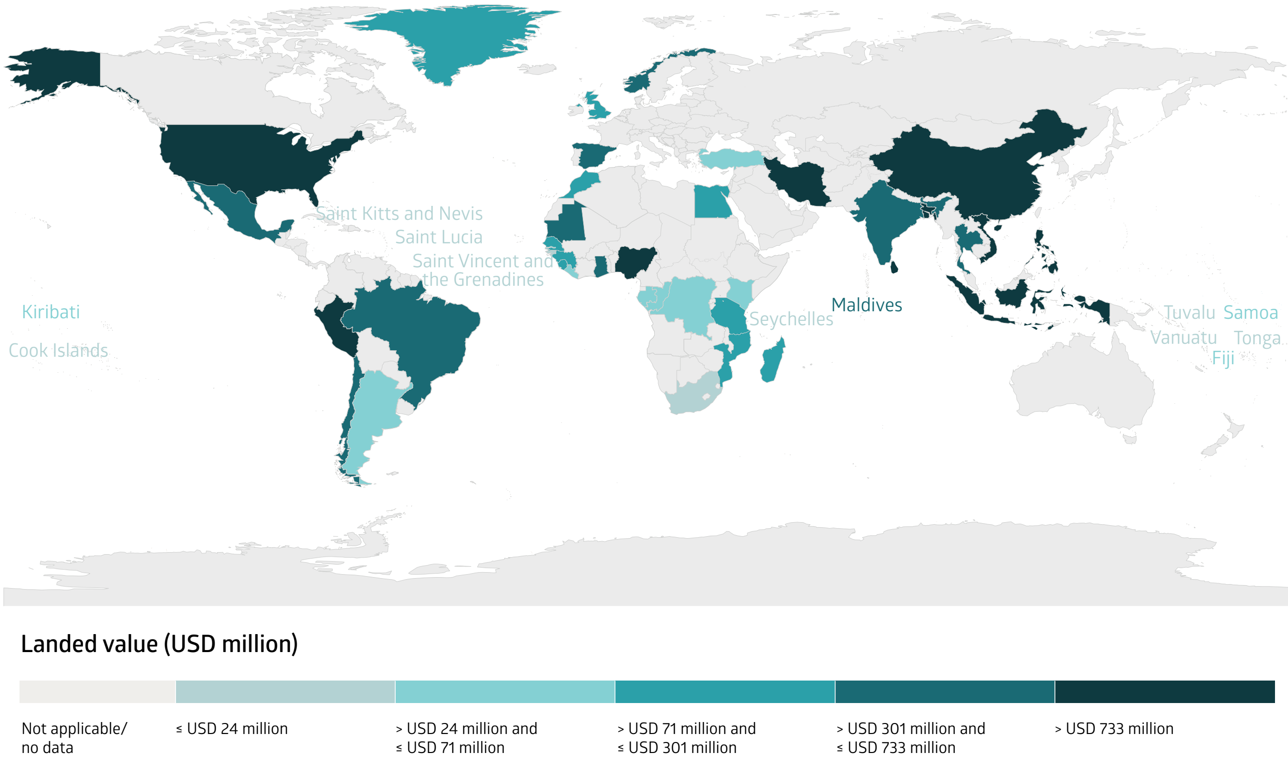
- The "expected" predictive power on the two components of small-scale fisheries landed economic value (i.e. price and catch), as suggested by the theory;
- The availability of covariate values in external data repositories for the largest possible number of countries (and functional groups). This latter principle for the selection of explanatory variables was a key priority, considering the goal of predicting small-scale fisheries landed economic value for the largest possible number of countries and related functional groups.

The 48 selected predictor variables[61] were further arranged in four separate family groups, and all of them were initially considered for model fitting. The first two family groups of explanatory variables, *catch- and price-related predictors*, included variables that were expected to scale with both the magnitude of prices (for a total of 7 explanatory variables) and the magnitude of catch (for a total of 22 explanatory variables). The third family group (*other explanatory variables*) included 16 explanatory variables that were neither catch- nor price-related but may still

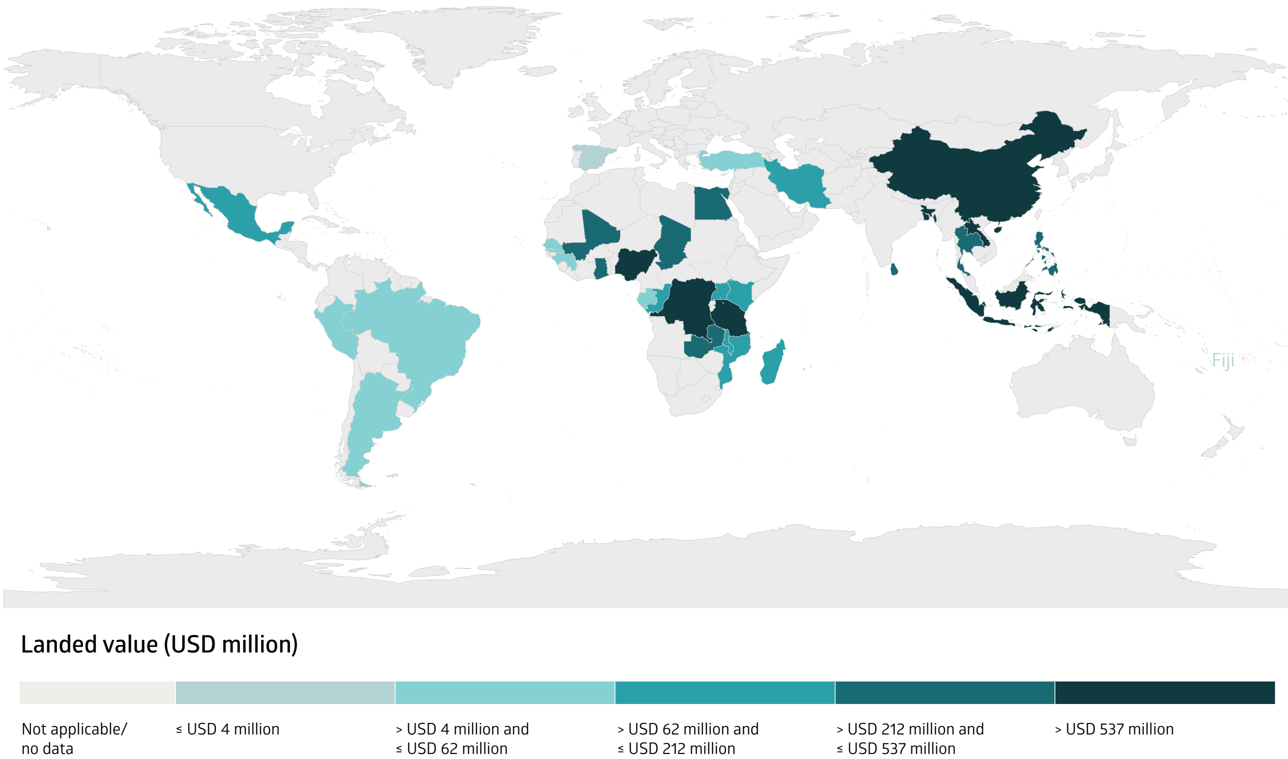
[61] The list of 48 explanatory variables includes: volume of catch from marine and inland fisheries; employment in marine and inland fisheries; EEZ in km^2; continental shelf area in km^2; length of coastline in km^2; area of inland waterbodies with fisheries; perimeter of inland waterbodies with fisheries; coastal population by elevation; gross domestic product in USD; volume of catch from marine and inland fisheries multiplied by the corresponding efforts and level of employment; capacity-enhancing subsides; beneficial subsides; volume of catch exported from marine and inland fisheries; a number of macroeconomic variables capturing variation in general price level in the economy; some bioclimatic variables (e.g. temperature and precipitation); logistic performance index and its subcomponents; and three multilevel categorical variables measuring taxonomic, region and income-group classification, respectively. Whenever possible, variables were further disaggregated by small- and large-scale fisheries.

Figure A.5 Global estimates of landed economic value of marine and inland small-scale fisheries catch by country, extrapolated from 58 IHH country and territory case studies (average annual values, 2013–2017)

Marine small-scale fisheries



Inland small-scale fisheries



Source: United Nations Geospatial. 2020. Map geodata [shapefiles]. New York, USA, United Nations, modified by the authors.

Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. Final boundary between the Sudan and South Sudan has not yet been determined.

explain variation in small- and large-scale fisheries landed economic values. For example, geographic, economic, infrastructure, weather, and social-related explanatory variables may co-vary with landed economic values of fisheries, despite their covariation not expected to be as strong as the one that landed economic values would share with catch- and price-related variables. Finally, a fourth family group of variables included *multilevel categorical variables* (for a total of three variables).

Construction of predictive models

The predictive models were constructed and fitted to estimate the parameters of the relationship between the observed small-scale fisheries landed economic value and the final list of selected explanatory variables (predictors) included in each candidate model. More generally, the final objective of each predictive model was to estimate the unknown effect on the dependent variable of changing one predictor variable. Estimated parameters from each predictive model were finally used to predict small-scale fisheries landed economic values for all combinations of countries and functional groups – only in countries where data were not observed (i.e. countries that were not part of the IHH study) – based on the covariate values of the selected explanatory variables (final extrapolation) and the corresponding estimated coefficients.

The final combination of explanatory variables that was considered for inclusion in the construction of candidate models only included variables that passed the VIF test (Beckett, 1995). Moreover, all pairs of explanatory variables with a correlation higher than 0.4 were not included in the same constructed candidate model, but they were considered separately in one or more candidate models.

In addition, in all candidate models, 21- and 15-level categorical variables were included that define marine and inland functional groups and that were treated as fixed effects,[62] respectively in models used for the prediction of marine and inland small-scale fisheries landed economic value. The inclusion of functional group fixed effects reflected the need to remove omitted variable bias by measuring changes within a functional group across a given country. Fixed effects in a predictive model were operationalized by including n-1 dummy variables for the missing or unknown characteristics.

As results of this process, model fitting was performed on 40 candidate models constructed for the prediction of marine small-scale fisheries landed economic value, and 40 candidate models constructed for the prediction of inland small-scale fisheries landed economic value. The predictive models were constructed for a combination of countries and functional group. An important step concerned the identification of those functional groups for which marine and inland landed economic value was to be predicted, in cases of countries where the landed economic value of small-scale fisheries was unknown. Predicted marine and inland landed economic values by functional group were restricted to the functional groups contained in FAO FishStat data, which provided the only basis for extrapolation of a given functional group. Departing from FAO FishStat classification, an intermediate level of taxonomic classification was then constructed according to the IHH functional classification scheme.

Model fitting, cross-validation and selection of best predictive models

To predict missing data points for the combination of countries and functional groups where landed economic value was not observed, the constructed predictive models were estimated using a random forest regression analysis.

Given the large number of constructed predictive models, cross-validation (or out-of-sample testing) was carried out to select the best candidate model according to its accuracy. The method helped identify the constructed predictive models whose underlying relationship did not contain issues of overfitting and, therefore, could be generalized to the out-of-sample dataset.

The cross-validation technique allowed for assessing how the results of the regression models would generalize to an independent data set (Schaffer, 1993). The performance of each predictive model was summarized using the sample of model evaluation scores (i.e. the mean value of correlation coefficients [Huang and Boutros, 2016]). The predictive model(s) with the highest mean correlation coefficients were selected and used for the global extrapolation of marine and inland small-scale fisheries landed economic value.

The final, best fitted models were used to predict small-scale fisheries marine and inland values for all combinations of countries and functional groups in the dataset. These predictions were based on the covariate values of the combination of countries and functional groups. In addition to functional group fixed effects, statistically significant explanatory variables included in the best model used to predict marine small-scale fisheries landed economic values were: i) volume of catch from marine small-scale fisheries at functional group level, ii) unemployment rate, iii) price level ratio (i.e. the ratio between the average level of domestic prices and the average level of price in the United States of America), and iv) marine protected areas in territorial waters. In a similar fashion, statistically significant explanatory variables included in the best predictive model for inland small-scale fisheries landed economic value

[62] In the models, 20 n-1 dummy variables were included for each functional group related to marine small- or large-scale fisheries and 14 n-1 dummy variables for each functional group related to inland small-scale fisheries.

were: i) volume of catch from inland small-scale fisheries at functional group level, ii) area (km²) of selected inland waterbodies where inland small-scale fisheries are expected to be found, and iii) average inflation rate over the past 10 years.

Outlier detection and imputation

As a last step, the detection of outliers was performed to avoid predicted landed economic values of small-scale fisheries that were extremely high (or low) relative to the volume of catch and, as such, out of range of the plausible values of prices.[63] The outlier detection was performed according to four interdependent steps, as follows.

- First, predicted landed economic values obtained from the regression analysis were converted into international USD (PPP), using the price level ratio from the World Bank WDI database, a measure of the ratio of a PPP conversion factor to an exchange rate.

The conversion of landed economic values into international USD (or PPP) allowed for a better cross-country comparison of values belonging to the same functional group, as the spatial price deflator (i.e. the price level ratio) controls for differences between countries in the general price level. This conversion allowed for standardizing landed economic values, helping to ensure that the potentially detected high or low extreme values were due to high standard errors in the predictive models, rather than due to differences in the general level of prices between countries[64] (World Bank, 2017).

- Second, predicted landed economic values obtained from the regression framework and converted into international USD were standardized on the same scale. The process of standardization implied dividing the predicted landed economic values expressed in international USD by the corresponding predictions of the volume of catch, to eventually generate the average price at functional group level (price per tonne of catch).
- Finally, following the conversion to international USD and the standardization process, outlier detection was carried out to identify extreme values that raised suspicions by differing significantly from most of the values within a given cluster, the latter defined according to a combination of functional groups and geographic areas (Ben-Gal, 2013; Hodge and Austin, 2004). Extreme high and low prices were identified according to their distance from the median: by default, the outlier is defined as a price value per 1 tonne within a given cluster which is higher or lower than 2 standard deviations[65] from the median of the cluster.

The detection of outliers for a given functional group was performed by dividing the dataset into smaller stratified clusters, with stratification based on functional group and large marine ecosystem (LME) for marine small-scale fisheries landed economic value, and functional group and FAO region for inland small-scale fisheries landed economic value. These stratifications were expected to encompass prices that were more homogeneous within the created clusters, to better capture "real" outliers.

The imputation of outliers represents a viable option to conduct the analysis by using a complete sample at both functional group and country level. The basic form of imputation for outliers was based on deductive methods and it involved using logical relationships to derive a value for the outlier item.

The method adopted for the imputation of outliers in this study was largely based on "donor method" and was implemented by assigning the value from a set of records with an observed item (the donor) to a record with an outlier value on that item (the recipient). Thus, outlier data for a recipient functional group was substituted with the median value from a donor that had similar characteristics. To select the best donor, many "imputation classes" were constructed, with classes defined based on functional group and LME for the imputation of marine small-scale fisheries outliers, and functional group and FAO region for the imputation of inland small-scale fisheries outliers. Within each class, the median value at functional group level was then calculated from non-outlier data.

The choice of replacing outlier data using the median value calculated from non-outlier data, rather than its mean value, largely depended on the distribution of non-outlier data themselves. If the variable was skewed, the mean was biased by the values at the far end of the distribution. In these instances, the median was a better representation of most of the values in the variable related to non-outlier data. Finally, it is worth noting that not only outliers but also missing predictions were imputed using the donor method.

The detection and imputation of price data only applied to those prices that were extrapolated through regression analysis. On the contrary, price

[63] The prices for a given functional group were obtained by dividing landed economic value by the corresponding quantity of catch.

[64] A useful example behind the need to convert landed economic values into PPP before outlier detection is provided by the World Bank: "Suppose that there is a basket of goods and services that costs 50 USD. 50 USD would be equivalent to 363 South African Rand (ZAR) when using a market exchange rate of 7.26. However, due to South Africa's lower price level in relation to the United States of America, the cost of a similar basket is actually 239 ZAR. Therefore, 50 USD would buy a larger basket of goods and services in South Africa than it would in the United States of America; the PPP of South Africa to the United States of America would be 239 ZAR/50 USD, which is equal to 4.77."

[65] By default, 2 standard deviations from the median were used to detect an outlier. It is possible to change the number of standard deviations used to detect an outlier.

data from CCS were treated as being without error and as such not imputed in this phase.[66] The only exception concerned the prices of two functional groups in China, i.e. "crab and king crab" from marine small-scale fisheries and "freshwater crustaceans" from inland small-scale fisheries which, despite being derived from case studies, appeared to be problematic and unlikely to be observed. The extreme high value of the prices of these two functional groups (USD 35 845 per tonne for crab and king crab and USD 11 436 per tonne for freshwater crustaceans), both relative to the volume of catch and to the mean prices of the same functional groups, resulted in an extreme high value of landings. More specifically, the price of crab and king crab from marine small-scale fisheries in China was almost 11.5 times higher than the corresponding global mean price,[67] and the price of freshwater crustaceans from inland small-scale fisheries in China was 7.7 times higher than the global mean price.[68] Given the extremely high prices detected in China, it was decided to apply the imputation procedure also to the observed prices of these two functional group in that country.

Finally, as a check on the results, the weighted average of the estimated mean prices of functional groups of species caught in small-scale fisheries (weighted by the national landed economic value of the catch as a proportion of the total landed economic value from all countries of the functional group) was compared to the global mean prices from FAO of the same groups of species caught in all capture fisheries (both small- and large-scale combined) (Table A.8).

A.4.1.5 Methods for calculating small-scale fisheries value added along the value chain

Data from four CCS – Malawi, Mozambique, Peru and Sierra Leone – formed the basis for estimating the share of valued added from small-scale fisheries in terms of country GDP.

Small-scale fisheries value chains included in the analysis for each country

In the four countries studied, the value added of the largest small-scale fisheries value chains was estimated. Individual value chains were identified according to the "economic agents" in the production sector (see Table A.9), typically distinguished by a unique combination of gear/vessel type, although in some cases by other attributes such as commercial vs subsistence fleets (in the case of Peru), by species (e.g. Peru's small-scale squid fleet), or by jurisdictional district, as was the case for Mozambique. Essentially, the economic agents, and thus the small-scale fisheries value chains associated with them, were identified according to how catch and effort data were disaggregated in available fisheries statistics.

For the value chains included in the study, the value added at each stage was estimated by subtracting the intermediate consumption (i.e. the total monetary value of the goods and services consumed as inputs) from total revenues, and summed to estimate the direct value added of the chain, including both (i) the value added of all economic agents within the value chains (direct value added), and (ii) the value added of the goods and services provided by local productive capacity as inputs to each of these value chains (the indirect value added). The value added comprises four main elements, namely 1) labour remuneration, 2) financial costs, 3) taxes, and 4) gross operating profit.

The indirect value added is often accounted in other sectors and therefore "hidden" from measures of the contribution of small-scale fisheries to GDP, but represents the value added of economic activity induced by small-scale fisheries that would not have otherwise occurred, i.e. a fuller measure of the impact of these small-scale fisheries value chains on the countries' economic growth. This indirect value added is typically not classified in national accounts by sector for which it is an input, but for the sector from which it is an output (unless there are input-output tables showing the value of transactions between sectors). The calculation of the indirect value added from local intermediate consumption was carried out by breaking down local intermediate consumption using technical coefficients, because detailed information concerning the intermediate goods and services of the small-scale fisheries value chains was not available. The technical coefficients represented estimations of the proportion of imports and of value added "incorporated" into the subsector's output.

For each of the four countries, data were collected on the revenues and costs for each segment of the value chains studied, and consolidated into one account for the small-scale fisheries to estimate the aggregate value added. Another often "hidden" value of small-scale fisheries is that of own consumption of fish by various actors along the supply chain, which can also be conceptualized as in-kind wages. Where data are available, the analysis included in-kind wages in the form of fish directed to own or household consumption. Data were collected and compiled by teams of experts for each of the four countries. Where available, government statistics were utilized. When government data did not exist, a combination of expert query and original data collection was employed. The direct and indirect value added of the small-scale fisheries value chain was summed to estimate the total value added in the economy as a result of the value chain, i.e. its impact on GDP (Figure A.6).

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[66] In reality, an outlier detection and imputation process was also applied to CCS with partial price data, and any gaps within countries imputed (see Section A.4.1.3.2).

[67] The mean price of crab and king crab was calculated over 94 countries.

[68] The mean price of freshwater crustaceans was calculated over 26 countries.

Table A.8 Global mean ex-vessel prices of small-scale fisheries (weighted by portion of total national landed economic value of the catch) and global mean capture fisheries prices, at functional group level (2013 to 2017)

Functional groups	Mean price (USD per tonne)	Number of observations	Total capture fisheries Mean price[a] (USD per tonne)
Marine fisheries			
Abalone, winkle, conch[b]	2 382.27	61	6 186.00
Cod, hake, haddock	1 624.62	68	1 610.00
Flounder, halibut, sole	4,051.52	90	2 740.00
Herring, sardine, anchovy	1 134.25	111	668
Lobster, spiny-rock lobster	12,712.47	101	11 620.00
Miscellaneous coastal fish	2 795.08	125	2 870.00
Miscellaneous demersal fish	1 727.66	103	2 660.00
Miscellaneous pelagic fish	1 810.45	129	721
Sharks, rays, chimaeras	1 683.26	121	1 208.00
Shrimp, prawn[c]	13 837.10	108	4 040.00
Tuna, bonito, billfish	2 320.49	129	1 750.00
Inland fisheries[d]			
Carp, barbel and other cyprinids	1 218.92	74	915
Clam, cockle, arkshell	913.18	3	1 244.00
Crab, sea-spider	6 005.25	4	4 060.00
Freshwater crustaceans	3 008.14	34	3 040.00
Freshwater molluscs[e]	3 518.91	7	1 138.00
Herring, sardine, anchovie	704.05	10	668
Miscellaneous coastal fish[f]	5 044.13	28	2 870.00
Miscellaneous demersal fish	646.53	4	2 660.00
Miscellaneous diadromous fish	2 410.54	10	1 029.00
Miscellaneous freshwater fish	2 174.76	138	772
Miscellaneous marine crustaceans	2 730.57	2	3 138.00
Miscellaneous pelagic fish	2 057.03	10	721
River eel	7 091.72	34	10 570.00
Salmon, trout, smelt	2 719.36	42	2 780.00
Shad	5 633.56	20	1 322.00
Sharks, rays, chimaeras	784.24	5	1 208.00
Sturgeon, paddlefish	7 339.40	8	7 640.00
Tilapia and other cichlids	1 644.57	42	979

Notes: **a** FAO mean prices. **b** The relatively low price of this functional group reflects low prices from Senegal (USD 378.4/tonne), which when excluded increases the mean to USD 3 700/tonne. **c** The higher mean price for shrimp and prawn is largely driven by observations from China, which represent an estimated 48.9 percent of the global small-scale fisheries catch for this functional group of species; when excluded the mean price for small-scale fisheries drops to USD 2 800/tonne. **d** Some functional groups by definition include marine species, but were associated to inland fisheries at the country level, e.g. for brackish areas. For this reason, in some instances functional groups labelled "marine" include species also associated to inland fisheries in some country case studies. **e** Price driven largely by China (97.8 percent of total catch). **f** Price driven largely by the Islamic Republic of Iran (USD 21 019/tonne); when excluded the mean price for small-scale fisheries drops to USD 3 270/tonne.

Table A.9 Value chains measured as economic agents in the "hidden GDP" country and territory case studies in Malawi, Mozambique, Peru and Sierra Leone

Country	Economic agents	
Peru	• Small-scale purse seiners • Small-scale squid fleet • Small-scale longliners • Bottom longliners • Compressed air divers • Hook and line • Small-scale gillnets • Small-scale trawlers	• Amazonian inland commercial fishing • Amazonian subsistence fishing with vessels • Amazonian subsistence fishing without vessels • Collection of macroalgae
Malawi	• Small-scale gillnets • Small-scale traps • Small-scale, open water seine nets	• Small-scale hook and line • Small-scale beach seine nets
Sierra Leone	• Gillnets • Hook and line	• Driftnets / ring nets • Beach seines
Mozambique	• Small-scale fishery – Cabo Delgado • Small-scale fishery – Maputo	

Based on the results, the analysis also compared small-scale fisheries gross value added to that of each country's fisheries sector as a whole (i.e. inclusive of both small-scale and large-scale fisheries). For example in the case of Peru, it was possible to find an estimate of total value added (rather than just percent contribution to national GDP) for the fisheries sector (3.2 billion in 2009, which represents 3.5 billion in 2015 currency,[8] the year for which the current study estimated small-scale fisheries value added). The total value added from small-scale fisheries was divided by that figure to arrive at an estimated 50 percent of overall fisheries GDP in Peru originating from the small-scale subsector. In the cases of Malawi, Mozambique and Sierra Leone, to understand the proportion of fisheries GDP from small-scale fisheries, the analysis divided the value added as percent of national GDP from small-scale fisheries and compared that to published figures on percent national GDP from fisheries (inclusive of small-scale and large-scale fisheries):

Value added as percent of fisheries GDP = value added as a percent of national GDP from small-scale fisheries / percent national GDP from all fisheries.

The literature was reviewed to identify existing estimates of fisheries GDP in the four countries, for comparison. The most recent estimates were compared, though in some instances these occurred earlier than those generated by the study for small-scale fisheries. In those instances, the contribution of the subsector to national GDP was assumed to have remained constant.

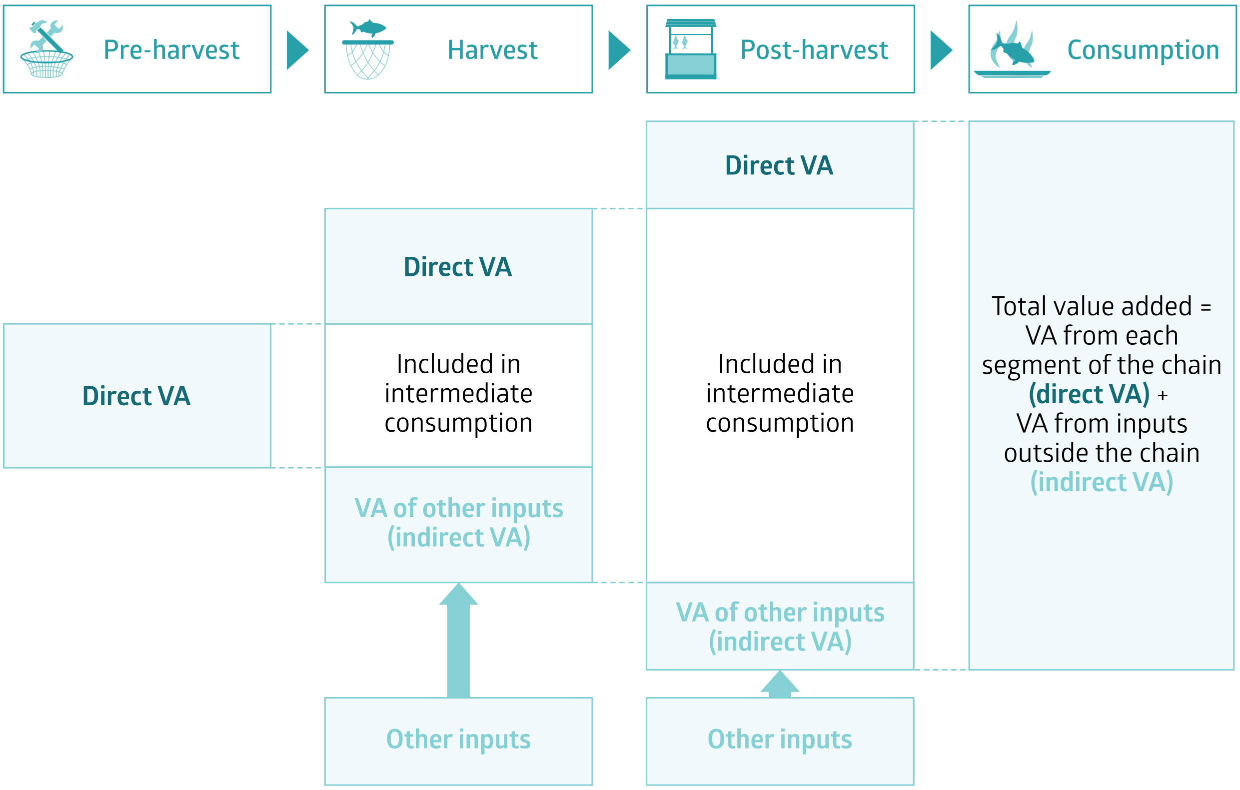
Methods for calculating value added as a percent of fisheries GDP

In each of the four countries studied, data were collected on the revenues and costs for each segment of the largest (by catch volume) small-scale fisheries value chains.

In the cases of Malawi, Mozambique and Sierra Leone, to understand the proportion of fisheries GDP coming from small-scale fisheries, the small-scale fisheries value added was divided as percent of national GDP, and compared to published figures on total capture fisheries value added as percent of national GDP (inclusive of small-scale and large-scale fisheries).

In official statistics, fisheries contributions to GDP are often grouped with aquaculture or the agricultural sector more broadly. Therefore, it was necessary to review the literature to identify figures for proportion of national GDP from fisheries. Where figures for proportion of national GDP contributed by fisheries were from years earlier than those to which the

Figure A.6 Distribution of value added (VA) across a small-scale fisheries value chain



current study's analysis pertains, it was assumed that the proportion of GDP from fisheries has not substantially changed in the intervening time periods.

Malawi: Estimates of the proportion of national GDP contributed by fisheries in Malawi range from 1.2 percent (2018) to 7.2 percent (2017) (Torell *et al.*, 2020; Government of Malawi, 2019). Accordingly, small-scale fisheries value added as percent of fisheries GDP was estimated in the range of 30 percent to 180 percent. A figure greater than 100 percent could be possible if the (hidden) contributions of small-scale fisheries to GDP are not fully accounted for in estimates of percent national GDP from all fisheries.

Sierra Leone: Fisheries were estimated to contribute 9.1 percent of national GDP in 2010 and 10.2 percent in 2013 (FAO, 2010; Neiland *et al.*, 2016). Accordingly, small-scale fisheries value added as percent of fisheries GDP was estimated in the range of 45 percent to 50 percent.

Mozambique: Estimates of the proportion of national GDP contributed by fisheries in Mozambique range from 3 percent to 4 percent (FAO, 2010; Benkenstein, 2013). Accordingly, small-scale fisheries value added as percent of fisheries GDP was estimated in the range of 135 percent to 180 percent.

Peru: In the case of Peru, it was possible to find an estimate of total value added (rather than just percent contribution to national GDP) for the fisheries sector (3.2 billion in 2009, which represents 3.5 billion in 2015 currency, the year for which the current study estimated small-scale fisheries value added) (Christensen *et al.*, 2014). Therefore, total value added from small-scale fisheries was divided by that figure to arrive at an estimated 50 percent of overall fisheries GDP in Peru originating from the small-scale subsector.

Finally, the value added for the small-scale fisheries was estimated, including both (i) the value added of all economic agents within the value chains (direct value added), and (ii) the value added of the goods and services provided as inputs to each of these value chains (the indirect value added). Once the economic agents were identified for each stage of the small-scale fisheries value chain, the value added at each stage was estimated by subtracting the intermediate consumption (i.e. the total monetary value of the goods and services consumed as inputs) from total revenues, and summed to estimate the direct value added of the chain. Additionally, the value added from the inputs at each segment of the value chain was calculated and summed to estimate the indirect value added of the chain, often accounted in other sectors and so "hidden" from measures of the contribution of small-scale fisheries to GDP (but representing the value added of economic activity induced by these fisheries that would not have otherwise occurred). The direct and indirect value added of the small-scale fisheries value chain was added to estimate the total value added in the economy from the value chain, i.e. its impact on GDP.

A.4.2 Employment and livelihood dependency of small-scale fisheries

A.4.2.1 Defining and operationalizing employment in small-scale fisheries

For this study, employment was defined according to the 19th International Conference of Labour Statisticians (ICLS, 2013) as all persons of working age who, during a short reference period, were engaged in any activity to produce goods or provide services for pay or profit. These persons comprise: employed persons "at work", i.e. who worked in a job for at least one hour during the reference period; and employed persons "not at work" due to temporary absence from a job, or to working-time arrangements (such as shifts in work, flextime and compensatory leave for overtime).

Employment was also classified according to common standards that allow for cross-country comparison, according to the type of activity undertaken as defined by the International Standard Industrial Classification of all Economic Activities (ISIC) and the International Standard Classification of Occupations (ISCO) standards, as well as the relation of the employee to the job (either paid or self-employed, with the latter subdivided into "employers", "own-account workers" and "contributing family workers"). Persons employed in activities related to fisheries that are classified as "own-account workers" and "contributing family workers" were assumed to participate in small-scale fisheries, and of the remainder, all of those persons employed in enterprises whose total number of workers is less than two-thirds of the 90th percentile number of workers engaged in all fisheries-related enterprises within a given country were assumed to participate in small-scale fisheries. Categories within the ISIC and ISCO classification standards were cross-checked to identify employment categories of pre- and post-harvest activities related specifically to fisheries.

This study also considered how many people throughout low-income countries participate in small-scale fisheries for subsistence (World Bank, 2012), where individuals of any sex and age carry out an activity in order to produce fish for their own final use, with no transaction occurring in the marketplace (ICLS, 2013).

A.4.2.2 Beyond employment to more fully understand livelihoods

In order to consider the number of livelihoods supported by small-scale fisheries, the total population dependent upon this activity was estimated in terms of the number of household members per person employed. However, as many households will have some members employed in small-scale fisheries and other members employed in different sectors, a distinction was made between persons whose livelihoods are "partially dependent" (defined as all members of a household where at least one member is employed in small-scale fisheries) and those whose livelihoods are "fully dependent" (defined here as the total number of household members who are solely dependent upon employment in small-scale fisheries, calculated as the proportion of employed household members who are participating in small-scale fisheries multiplied by the total number of household members).

Finally, using the calculation for the total number of partial livelihoods dependent upon small-scale fisheries, the total number of livelihoods dependent upon subsistence activities in small-scale fisheries was also calculated as the sum of all household members belonging to those households where at least one member was engaged in small-scale fisheries, mainly for final consumption within the household (and hence considered as engaged in subsistence fishing, as opposed to employment as defined by the ICLS).

A.4.2.3 Data collected on employment

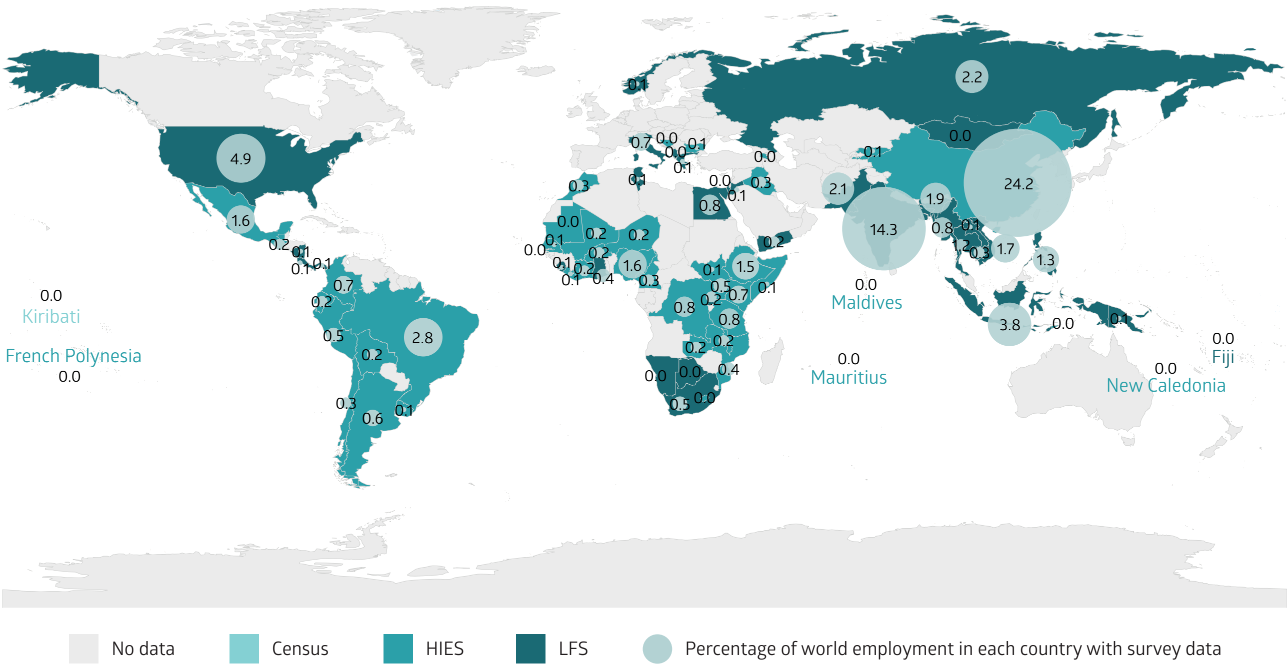
For this study, three different types of household survey instruments were used for data on employment at the national level: population censuses, labour force surveys (LFS) and household income and expenditure surveys (HIES). In total, the national datasets used to estimate employment and dependency in small-scale fisheries (population censuses, LFS and HIES) were available for 78 countries over the period 2008–2018: LFS for 33 countries, HIES employment modules for 44 countries, and a population census for one country (Figure A.7). These surveys represent almost 79 percent of the total world population in 2016 and cover an estimated 78.8 percent of world employed population in 2016. The available surveys were spread over the period 2008 to 2018, although most survey data had been collected starting in 2014 (54 out of 78 surveys). Unsurprisingly, China and India absorb more than one-third (38.5 percent) of the world employment population, followed by the United States of America, Indonesia and Brazil. For all these countries, either a LFS or a HIES was found.

A.4.2.4 Global extrapolation of employment in small-scale fisheries

Global and regional estimates of employment, subsistence and livelihood dependency in small-scale fisheries were generated through three steps: (i) collection and processing of microdata from household-based surveys (LFS and HIES) from 78 national datasets conducted between 2008 and 2018, including imputation of any variables of interest missing in specific national datasets; (ii) extrapolation from these 78 countries to the regional and then global level, using weighted regression analysis; and (iii) comparison with other global datasets to evaluate the results.

Figure A.7 Number of national datasets available for analysis during the study period (2008 to 2018), by type of household survey instrument and geographic region

Countries covered



Source: United Nations Geospatial. 2020. Map geodata [shapefiles]. New York, USA, United Nations, modified by the authors.

Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. Final boundary between the Sudan and South Sudan has not yet been determined.

For the first step, the employment and livelihood dependency-related variables were extracted from these 78 national datasets, providing information for 971 variables at a coverage rate of 72.6 percent (i.e. the coverage of all variables extracted from the surveys over all potential variables to extract). Where data for variables were missing in the 78 national datasets (e.g. distinction between marine and inland small-scale fisheries, pre- and post-harvest employment, subsistence data), they were imputed, by calculating and applying ratios from the mean of available data from other countries within a geographic archetype, according to the regional grouping provided by the ILO.[69]

For the second step, the results were extrapolated to the regional level (according to the geographic archetypes used by the ILO) and subsequently to the global level. To correct for non-response bias in countries not included in the 78 national datasets (given that these datasets were selected based on the availability of information, and not randomly as a representative sample of nations worldwide, and assuming that countries with higher representation in small-scale fisheries may have a different likelihood of conducting LFS), a weighted regression analysis based on independent variables considered as predictors was used, following recommendations by the ILO (ILO, 2017).

Weights of the different predictor variables were calculated as the inverse probability of selection (or inverse propensity score), to account for differences between the 78 countries for which data were collected, and the world's remaining countries to which the results were extrapolated. Using these weights to correct for non-response bias, the weighted regression analysis was conducted, essentially generating estimates based on assumed relationships between employment and livelihood dependency variables and a set of predictor variables.

The choice of the predictor variables for estimation purposes was guided by two considerations: first, the predictor variables must be strongly correlated with the outcome variables to be estimated to ensure a high explanatory power. Second, the selected predictor variables must be available for the largest number of countries in the global dataset. For both marine and inland small-scale fisheries, the **main** predictor variables included: i) employment in agriculture, forestry and fishery; ii) employment in industry and employment in services; iii) total population; iv) GDP per capita (PPP); v) GDP growth; and vi) value added in agriculture, forestry and fisheries. For marine small-scale fisheries, the additional predictor "length of coastline (km)" was included, whereas for inland small-scale fisheries it was "area of inland waterbodies".

[69] See https://ilostat.ilo.org/resources/concepts-and-definitions/classification-country-groupings/

For the third and final step, the regional and global estimates resulting from the weighted regression analysis were compared to the compiled available data on employment in small- and large-scale fisheries from the 58 CCS, as well as government responses to the ad hoc questionnaire issued by FAO to Members between 2018 and 2019. In addition, two publicly available global datasets were reviewed for comparison, although they do not contain employment data disaggregated between small- and large-scale fisheries: (i) ILOSTAT data on employment in either fishing or aquaculture (aggregated), and (ii) FAO data on employment in fisheries (aggregated between small- and large-scale fisheries). For countries where significant differences emerged, experts were consulted to help provide further explanations and eventually adjust estimates from the weighted regression analysis.

Finally, the employment distribution between marine small-scale fisheries and marine large-scale fisheries was further revised based on data on efforts of the global marine fishing fleet, in both the artisanal and industrial sectors, as provided by Rousseau *et al.* (2019). The Rousseau dataset contains a reconstruction of marine fishing efforts disaggregated by the artisanal and industrial sector and, as such, it provides useful information to identify countries where marine fisheries are found in the artisanal sector, the industrial sector, or both. The revision process was applied to a handful of countries where fishing efforts in large-scale fisheries (or small-scale fisheries) in the Rousseau dataset were found to be zero, but estimates from surveys suggested that employment in large-scale fisheries was different from zero (and vice versa). For those countries, the inconsistency between the two sources of data was due to the criteria used from the surveys to estimate employment in small-scale fisheries *vis-à-vis* employment in large-scale fisheries. In those countries where no fishing efforts in large-scale fisheries, for example, were found in estimates from the surveys, marine employment was shifted from large-scale fisheries to small-scale fisheries, and employment in large-scale fisheries was recoded as zero. Although the Rousseau dataset was not considered authoritative relatively to the assumed distribution of marine small- and large-scale fisheries in the IHH study, the dataset provided useful information on the distribution between small- and large-scale fisheries, especially in those countries where the distinction of employment in the two subsectors was placed along a continuum. In this regard, the recoding process was aimed at ensuring coherence between the two sources of data concerning the distribution by small-scale fisheries and large-scale fisheries.

Global extrapolation of gender-disaggregated variables

The national datasets used for the global extrapolation of employment in small-scale fisheries and large-scale fisheries contain information on the gender of the individual who participated in any fisheries-related activity (large- or small-scale), namely pre-harvest, harvesting or post-harvest. In order to capture the share of women who participate in each small- or large-scale fisheries activity, the employment variables extracted from the 78 national datasets were gender disaggregated. Regional and global estimates of the gender distribution in each fishery activity based on partial coverage of all countries was achieved by imputing values for the non-reporting countries using the information from countries with available national datasets and, finally, aggregating the results to regional and global totals.

The imputation method was based on three interrelated steps: 1) computation of gender ratios from the available 78 national datasets; 2) extrapolation of the average gender ratio from the sample of national datasets at the lowest possible regional grouping; 3) finally, imputation of missing gender-disaggregated data in countries for which datasets were not available by applying the average gender ratio to the corresponding employment variable derived from the econometric specification.

A.4.3 Estimates of the portion of small-scale fisheries harvests exported in the country and territory case studies

A.4.3.1 Data collection and processing for small-scale fisheries exports

CCS experts compiled existing data on small-scale fisheries catch and its utilization (including use for commercial export) for the years 2013–2017 according to the IHH methodology. For small-scale fisheries catch volumes reported in each CCS, authors provided information on "catch use" at the finest resolution available (e.g. by species or fishery unit), including a category of catch use for "commercially exported", assuming compliance with relevant laws and regulations (e.g. not including smuggled fish, high seas trans-shipments, etc.). These catch use data were submitted either as a percentage or volume of a total catch volume for a given species, for each catch use category. Data were extracted from empirical studies or drawn from expert knowledge, and as a result, proportions may have been calculated from secondary sources of data or estimated to calculate the percentage of small-scale fisheries catch exported at the species level. CCS experts were instructed to utilize expert elicitations and ancillary information (e.g. population size of the area where the fishery is found, estimated average catch per fisher, economic activity, indications of how much seafood is eaten, accessible household survey data, grey or primary literature available) to triangulate expert knowledge and to document the process in their methodology report.

The complete 58-country dataset was then harmonized to a standardized percentage-based format for catch utilization (with catch labels standardized to the IHH functional group classifications), and inconsistent data were clarified with the authors or flagged for removal. The percentages of small-scale fisheries catch that were "commercially exported" in the resultant dataset were aggregated to the species level (using weighted proportions of the total catch recorded in the catch use data sheet for that species), and percentages were joined with the complete small-scale fisheries species and catch volume dataset for each country. The resulting export percentage dataset with full species list was aggregated by functional groups for comparison, and missing species were identified for imputation.

A.4.3.2 Assessing reliability of export data

Data coverage after processing and cleaning

Of the 58 CCS, 31 provided catch use data for all small-scale fisheries catch, 7 provided data for some but not all species, 17 provided no catch use data, and 3 stated that they did not have any small-scale fisheries exports. The resulting dataset of the percentages of small-scale fisheries catch that was commercially exported occurred mainly at the species level, but occasionally as a larger group of species or at the national level.

Data reliability and final selection of countries

On the basis of expert judgment and the evaluation of data capturing the portion of small-scale fisheries catch exported, a dataset of the percentage of the small-scale fisheries catch exported was generated. At the end of the evaluation process, reliable data on the share of catch exported at functional group level and disaggregated by marine and inland small-scale fisheries were included in the dataset for a total of 26 countries, distributed as follows: 22 countries[70] with reliable data on the share of catch exported from marine small-scale fisheries, and 9 countries[71] with data on the share of catch exported from inland small-scale fisheries only. Of the total countries with data on export, five countries had reliable data on the share of catch exported from both marine and inland small-scale fisheries.[72]

A.5 Food security and nutrition

A.5.1 The importance of nutrient contributions from small-scale fisheries to diets

The concentration of calcium, iron, selenium, zinc, vitamin A, and omega-3 fatty acids were estimated for all 879 species in the IHH catch database. Species predictions were generated using a trait-based model fitted to nutrient analysis of 539 marine and freshwater species (Hicks *et al.*, 2019; MacNeil *et al.*, forthcoming). Nutrient data were obtained from 183 published studies, primarily reporting analysis of wet samples of muscle tissue and whole fish (dried fish samples were converted to wet weight equivalents), and traits such as life histories, body morphology, habitat and feeding strategies were obtained from FishBase. To understand the nutritional value of fish across multiple nutrients, the nutrient density (Drewnowski *et al.*, 2015) was estimated for each species. Using reference values for adult women (18 to 65 years of age), nutrient density was the sum of RNI (in percent) for calcium, iron, selenium, zinc, vitamin A and omega-3 fatty acids (FAO and WHO, 2010; WHO, 2004), available from a 100 g portion of raw muscle tissue. For each of the IHH functional groups of species, a list of landed species was extracted and the mean nutrient density was estimated, weighted by each species' total catch landed in least developed countries or other developing countries or areas (mean annual catch in million tonnes). Nutrient predictions were made at the species level, and catches resolved at higher taxonomic levels (e.g. family, genus, order, or nei) were excluded (35 percent of total catch). Because nutrient predictions for raw muscle tissue (e.g. fish flesh or fillet) were used, the data do not account for the effects of food preparation (e.g. cooking or drying fish) or fish consumed whole, for which higher nutrient concentrations would be expected (Hicks *et al.*, 2019; Bogard *et al.*, 2015b). The relative affordability of fish species in African Great Lakes countries was also investigated, using CCS data on the ex-vessel landed economic value of each catch record. For each species in each country, the mean USD per kg of landed catch was estimated, and these values were then visualized against species' nutrient density and mean annual catch.

A.5.2 Small-scale fisheries, poverty and food security: quality data provide new insights in sub-Saharan Africa

The World Bank's Living Standards Measurement Survey and its Integrated Surveys on Agriculture (LSMS-ISA) from Uganda, United Republic of Tanzania, and Malawi were analysed to investigate the association between small-scale fisheries, poverty and food security (Table A.10). Unique

[70] Bangladesh, Barbados, Brazil, Chile, China, Greenland, Indonesia, Kenya, Liberia, Madagascar, Maldives, Morocco, Norway, Peru, Philippines, Senegal, South Africa, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, United Kingdom of Great Britain and Northern Ireland, and Viet Nam.

[71] Argentina, China, Ghana, Madagascar, Peru, Senegal, South Africa, Thailand and Uganda.

[72] China, Madagascar, Peru, Senegal and South Africa.

geospatial data were combined with the LSMS-ISA indicators on small-scale fisheries: proximity to inland and coastal waterbodies where small-scale fisheries are known to be found, and households engaged in small-scale fisheries livelihoods activities (see Table A.11 for full list of variables). Geospatial data on waterbodies were obtained from the Global Lakes and Wetlands Database (GLWD) for inland waterbodies (layers 1 and 2) (WWF, 2004), and the European Space Agency GlobCover databases for coastlines (ESA and UCLouvain, 2010). Statistical analyses were performed using Stata Version 14. A multicountry dataset for the three countries was created with nationally representative observations for 18 715 households. A probit regression model was used to investigate correlates of poverty (households living below the national poverty line) and food insecurity (households with poor food consumption levels), and to examine the association with fisheries in terms of proximity to waterbodies (km) and engagement in small-scale fisheries as a livelihood activity. A number of control variables capturing household-related characteristics were included. For each model (poverty and food insecurity), associations at the cross-country, national and rural levels were examined, accounting for fixed effects at the district level (Simmance *et al.*, 2022b).

A.5.3 Small-scale fisheries and fish consumption during the first 1 000 days

In this cross-sectional analysis, secondary data (Table A.12) were used to investigate the association between proximity to fisheries, proximity to formal markets and dietary quality for rural children aged 6 to 23 months (Table A.13). Demographic and dietary data were accessed from demographic and health surveys – a data source available for over 90 countries in readily accessible online formats. Spatial and geographic data come from a range of open access databases. SPSS were used for data cleaning and Stata 14 for statistical analysis. Variables which were not normally distributed were log-transformed. Linear regression modelling was used to investigate associations demonstrated in Figure 13 of the chapter on nutrition (Chapter 7, Section 7.5.2), which were considered significant at the 0.05 level.

A.5.4 Improving data quality to illuminate the magnitude and distribution of nutrition benefits from small-scale fisheries

As outlined above in the IHH methodology section, data on fish consumption were collected across the 58 countries. Only 8 of 58 CCS teams were able to provide nationally representative consumption data for fish, with 2 teams providing data by women or pregnant/lactating women, obtained from national or subnational consumption surveys administered through governments or international organizations. Consumption data from these countries were analysed and combined with data on fish consumption from six countries (Argentina, Bangladesh, Burkina Faso, Italy, Lao People's Democratic Republic and Zambia) obtained from the FAO Global Individual Food consumption data Tool (GIFT). The quantity of fish consumption was reported as kg/capita/year for countries. Comparisons were made with FAO finfish supply data (FAOSTAT) for the same year of data collection, or the closest year available.

Table A.10 Overview of household surveys used in the study in sub-Saharan Africa

Country	Survey name	Survey year	Total sample households[a]	Number of fishing households	Number of agriculture households	Number of non-agriculture/ fishing households
Malawi	Fourth Integrated Household Survey	2016-17	12 447	414	9 937	2 096
United Republic of Tanzania	National Panel Survey, Wave 4	2014-15	3 352	136	2 101	1 115
Uganda	National Panel Survey	2010-11	2 916	76	2 246	594
Total			18 715	626	14 284	3 805

Note: a Sample size corresponds to the total number of households sampled in the survey. Due to missing data or outliers, the final numbers of households are slightly less in the analysed data (18 610 households in the probit regression).

Table A.11 Description of variables used in the study in sub-Saharan Africa

Variable	Description
	Water body
Distance to nearest water body (km)	Distance to waterbodies included in GLWD layers 1 and 2 (and coastlines)
Distance to nearest agriculture market (km)	Distance to agriculture markets
Households unable to reach food market	Households who self-reported to be unable to reach the food market
Rural households	Household living in rural areas (as defined by the survey)
Households with cultivated and/or owned land	Household with land
Wealth index	Total number of assets owned by the household (durable goods – radio, bicycle, TV; utilities and infrastructure – access to protected water source and electricity) with an index developed using principal component analysis
Per capita monthly expenditure (local currency unit)	Monthly total expenditure by the household (divided by the total household members)
Poverty line (local currency unit)	Per capita (monthly) national poverty line based on cost of basic needs (calculated by national authority)
Per capita daily expenditure (international USD)	Daily total expenditure by the household divided by the total household members
Small-scale fishing households	Household with at least one member who engages in small-scale fisheries activities (fishing, harvesting, processing and/or trading)
Agriculture households	Household with at least one member who engages in agriculture (non-fishing)
Non-agriculture, non-fishing household	Household with no members who engage in agriculture or fishing
Poverty headcount rate	Household with per capita expenditure below the national poverty line
Food consumption score (FCS)	Composite score based on household dietary diversity (number of food groups consumed), frequency of household food group consumption, and relative nutritional importance of different food groups[a]
Food consumption profile: poor	Household with a poor food consumption profile (FCS < 28)
Food consumption profile: borderline	Household with a borderline food consumption profile (FCS ≥ 28 and < 41)
Food consumption profile: acceptable	Household with an acceptable food consumption profile (FCS ≥ 41)
Quantity of food item (fish, poultry, goat, pork, beef, eggs) consumed over the past 7 days (kg/week/household) from purchased, own consumption, gifts	Quantity of food item consumed by the household
Household which consumed food item (fish, poultry, goat, pork, beef, eggs) over the past 7 days	Household that self-reported to consume at least some food item
Number of days food item (fish, poultry, goat, pork, beef, eggs) was consumed over the past 7 days	Frequency of food item consumed
Household size	Total number of household members
Employment	Share of household members in employment over total household members
Age	Age of the head of household
Male-headed household	Count of households headed by a man
Education of the head of the household: no education, primary, secondary, tertiary	Education attained by the head of household

Note: **a** WFP. 2008. *Food consumption analysis: calculation and use of the food consumption score in food security analysis.* Vulnerability Analysis and Mapping Branch. Rome.

Table A.12 Description and source of variables used in analysis of dietary quality in rural children

Variable name	Definition	Source
Environmental		
Proximity to inland fisheries	Continuous – measured as distance (meters) between demographic and health survey (DHS) cluster centre and the edge of permanent open inland waterbodies (lakes, reservoirs and rivers) with a surface area of ≥ 0.1 km^2	Global Lakes and Wetlands Database (https://www.worldwildlife.org/pages/global-lakes-and-wetlands-database)
Proximity to urban (formal) markets	Continuous – measured as average walking travel time (minutes) between DHS cluster centre and urban centre for 2015	Accessibility to Cities Database (https://malariaatlas.org/research-project/accessibility-to-cities/)
Agricultural land ownership	Dichotomous – self reported yes/no at the household level	DHS (https://www.dhsprogram.com/)
Livestock ownership	Dichotomous – self reported yes/no at the household level	DHS
Population density	Continuous – United Nations adjusted mean number of people per km^2 at the cluster level for 2015; control variable only	Center for International Earth Science Information Network (http://ciesin.org/)
Child and household		
Child gender	Dichotomous - female, male	DHS
Child age	Continuous – measured as month.	DHS
Wealth index	Categorical – measured as the following quintiles: poorest, poorer, middle, wealthier, wealthiest	DHS
Nutrition and health		
Child consumed fish in past 24 hours	Dichotomous – self reported yes/no at the child level	DHS
Child consumed terrestrial ASF in past 24 hours	Dichotomous – self reported yes/no at the child level	DHS
Child diet diversity	Continuous – score in 0–8 range, calculated from self-reported 24-hour food recall data and WHO-defined food groups	DHS

Table A.13 Characteristics of rural children aged 6 to 23 months

	Malawi 2015/16 n = 3 995	Zambia 2013/14 n = 2 333	Cambodia 2014 n = 1 034
Environmental characteristics			
Proximity to waterbody mean (km)	34.0 ± 24.9 km	49.84 ± 36.63 km	22.1 ± 21.56 km
<5	14.4%	11.5%	25.2%
5-50	58.0%	43.5%	63.6%
>50	27.6%	45.0%	11.1%
Missing (n)		15%	

Table A.13 Cont

	Malawi 2015/16 n = 3 995	Zambia 2013/14 n = 2 333	Cambodia 2014 n = 1 034
Market access (average minutes)			
<60	33.0%	28.8%	29.2%
60-120	50.1%	33.3%	41.6%
>120	16.9%	37.9%	29.2%
Agricultural land ownership			
Yes	81.5%	88.5%	72.5%
Livestock ownership			
Yes	52.6%	72.9%	76.4%
Child and household characteristics			
Child is female	48.8%	50.1%	48.3%
Child age mean (months)	14.4 ± 5.2 months	14.4 ± 5.1 months	14.4 ± 5.2 months
6-8	16.2%	16.9%	17.5%
9-17	52.4%	50.9%	49.0%
18-23	31.3%	32.2%	33.5%
Household has			
No electricity	95.4%	94.4%	59.0%
Earth / sand floor	84.6%	80.1%	8.0%
Improved drinking water	83.4%	43.7%	79.4%
Improved toilet	80.5%	23.2%	41.2%
Bicycle	41.4%	58.3%	50.3%
Motorcycle/scooter	2.2%	1.8%	66.5%
Wealth index			
Poorest	27.3%	38.0%	31.7%
Poorer	25.4%	32.7%	24.8%
Middle	21.5%	21.0%	18.2%
Richer	17.6%	6.6%	17.0%
Richest	8.1%	1.8%	8.3%
Mother's age mean (years)	27.0 ± 6.8 years	28.0 ± 7.2 years	27.4 ± 6.0 years
Mother's highest level of education			
No education	12.1%	13.8%	15.3%
Primary	71.2%	64.0%	57.6%
Secondary or higher	16.8%	22.1%	27.1%

Table A.13 Cont

	Malawi 2015/16 n=3,995	Zambia 2013/14 n=2,333	Cambodia 2014 n=1,034
Mother's highest level of education			
No education	12.1%	13.8%	15.3%
Primary	71.2%	64.0%	57.6%
Secondary or higher	16.8%	22.1%	27.1%
Mother's body mass index (BMI)			
Underweight	7.0%	11.7%	17.9%
Healthy weight	80.2%	76.9%	68.2%
Overweight/obese	12.8%	11.5%	13.8%
Problem accessing healthcare			
Yes	25.5%	31.2%	18.7%
Nutrition and health characteristics			
Child consumed fish in past 24 hours	22.7%	25.9%	59.6%
Child consumed non-fish, animal source food in past 24 hours	25.3%	29.1%	70.0%
Dietary diversity mean (score)	3.5 ± 1.5	3.2 ± 1.4	4.0 ± 1.5
Adequate dietary diversity (5+ food groups)	24.6%	16.6%	38.5%
6-8-months old	1.9%	1.3%	4.2%
9-17-months old	13.5%	9.2%	20.3%
18-23-months old	9.2%	6.1%	14.0%
Dietary diversity by food group			
Breastmilk	87.0%	85.3%	74.9%
Grains	69.0%	77.0%	91.4%
Legumes	24.3%	17.3%	8.0%
Dairy	8.2%	5.4%	23.9%
Meat (ie. beef, chicken, fish)	32.1%	37.8%	77.9%
Eggs	11.6%	14.4%	37.5%
Vitamin A-rich fruits and vegetables	48.9%	24.9%	30.6%
Other fruits and vegetables	67.4%	58.9%	58.3%
Diarrhoea incidence in the last 2 weeks	37.4%	26.9%	19.5%
Stunting			
Severely stunted	9.1%	19.8%	8.3%
Moderately stunted	24.9%	24.4%	22.2%
Not stunted	66.0%	55.8%	69.5%

A.6 Governance

A.6.1 Analysis of governance arrangements

A.6.1.1 Definition of governance arrangements

Governance arrangements were defined as a formal or informal prescription of rules or norms assigning rights of access, withdrawal, management, exclusion or transferability as defined by Schlager and Ostrom (1992). Prescriptions could take the form of laws, acts, regulations, etc., affecting the said fishing rights in their country. The property rights classification system of Schlager and Ostrom (1992) provided a basis to synthesize and summarize the large diversity of tenure rights found in small-scale fisheries around the world (in this study, property rights and tenure rights are used as equivalents). By paying attention to five different broad types of property rights (i.e. access, withdrawal, management, exclusion and transferability) granted by governments through legislation or national, subnational or local policy, it became possible to measure the devolution of rights across the thousands of fisheries included in this report. Access is defined as the right to enter a defined physical property – in this case a body of water where fishing will take place. Withdrawal or harvest is defined as the right to obtain the "products" of a resource (e.g. catch fish). Management is defined as the right to regulate internal use patterns and transform the resource by making improvements. Exclusion refers to the right to determine who will have an access right, and how that right may be transferred. Transferability (i.e. alienation) consists of the right to sell or lease either or both of the above collective choice rights (management and/or exclusion).

A.6.1.2 Data sources and coverage

The analyses of governance arrangements were based on two independent sources of data. The first source was data collected through in-country experts with the directive to list the most important formal and informal governance arrangements influencing each fishery units listed for their country. This effort yielded 976 formal policies corresponding to 52 countries which were paired to their associated catch (in tonnes) and other metadata related to these policies. All of these policies influence the management of the 2 169 fishery units around the world. Altogether the policies analysed formally govern about 83 percent of the reported small-scale fisheries catch, representing 55 percent of estimated global catch. The second data source was the FAOLEX fisheries legislation database, a fisheries policy database maintained by FAO for all Members. It is the most comprehensive depository of fisheries legislation known, yet it was assumed not to contain 100 percent of all relevant policies for each country. All fisheries policies in FAOLEX were coded for the 19 top producing countries (in terms of catch), and these data were then used to verify and complement the policy information obtained from in-country experts through this data collection effort. FAOLEX was also relied upon when in-country experts indicated they could not provide sufficient information for their countries. Altogether, data were complemented with FAOLEX for 38 of the countries.

A.6.1.3 Data collection and cleaning process

Data compilation for the analysis of governance arrangements was requested in a separate spreadsheet requesting a list of governance arrangements (Table A.14). These arrangements were meant to pertain only to small-scale fisheries harvesting and did not consider the governance of pre-harvest or post-harvest activities, nor arrangements that pertained only to large-scale fisheries.

Each governance arrangement was specific to the set of fishery units that it governed, and these fishery units linked the governance data to other variables of interest (e.g. catch, functional group classifications, characterization matrix scores and other associated metadata). For definition of fishery units, see Section A.2.1.3.3.

Arrangements were removed from the governance dataset when they fell outside of the scope of the IHH study (i.e. pertained only to large-scale fisheries, or aquaculture; described only enforcement, monitoring, or research; did not pertain to the *harvest* of aquatic resources; only pertained to species not included, such as seaweed). Data were screened for internal coherence, and modifications were done when a response clearly conflicted with the description of the arrangement (i.e. a protected area indicated no spatial restrictions). Arrangements were consolidated if they had identical characteristics in the spreadsheet, and if they also pertained to the same fishery units. In addition, they were disaggregated if it became clear that the arrangement applied differently to different fishery units, and if these differences affected the answers within the arrangements' spreadsheet. Finally, answers were organized to facilitate machine reading. All changes were approved by multiple members of the IHH Core Team, and all changes were documented in a log noting the original entry, the changes made, and the reason for these changes.

Table A.14 Tenure rights characteristics listed in the governance sheet for IHH country and territory case study experts to complete

Variable	Choices each respondent was given for each variable[a]
Types of access strategies	
Licence	Based on formal application
Historical	Based on historical access or use
Registration	Based on vessel registration
Residence	Based on place of residence
Other	Based on kinship
Harvesting management measures	
Vessel restriction	Yes – there is a limit on the number of fishing vessels, but only for specific areas Yes – there is a limit on the number of fishing vessels for the entire fishing area No – there is no limit on the number of fishing vessels
Total allowable catch (TAC) restriction	Yes – there is a TAC that is divided into quotas Yes – there is a TAC that is divided into transferable quotas Yes – there is an overall TAC No – there is no TAC
Size restriction	Yes – there is a restriction on both minimum and maximum size Yes – there is a restriction on minimum size No – there is no restriction on size
Sex restriction	Yes – there are restrictions on the catch of both females and males Yes – there are restrictions on the catch of females No – there are no restrictions on sex
Gear restriction	Yes – there are restrictions on fishing gear permissible in the fishery No – there are no restrictions on fishing gear permissible in the fishery
Spatial restriction	Spatial restrictions in place Spatial restrictions not in place
Temporal restriction	Temporal restrictions in place Temporal restrictions not in place
Management rights	
Management with high engagement	Yes – fishers are allowed, and the majority engage in management
Management with medium engagement	Yes – fishers are allowed, but only some engage in management
Management with low engagement	Yes – fishers are allowed, but none engage in management
No Management	No – fishers are not allowed to engage in management
Exclusion rights	
Exclusion	Yes – fishers have the right to decide who is allowed to harvest the resource(s) No – fishers do not have the right to decide who is allowed to harvest the resource(s)
Transferability rights	
Transferability	Yes – fishers have the right to transfer their fishing rights to others No – fishers do not have the right to transfer their fishing rights to others

Note: **a** Respondents could choose more than one option.

Sources: Expert knowledge consultations; Schlager, E. & Ostrom, E. 1992. Property-rights regimes and natural resources: a conceptual analysis. *Land Economics*, 68(3): 249–262; Cochrane, K.L. & Garcia, S.M., eds. 2009. *A Fishery Manager's Guidebook*. Second edition. Rome, FAO & Hoboken, USA, Wiley-Blackwell. www.fao.org/3/i0053e/i0053e.pdf

New indicators were created at this stage to facilitate specific analyses. For instance:

- **Policy focus** indicates what type of fishery the arrangement applies to: small-scale fisheries (SSF-specific policies), large-scale fisheries, and both (general fisheries policies). General fisheries policies were defined as those that referred to fisheries without explicitly distinguishing between small-scale and large-scale fisheries, or between marine and inland. SSF-specific policies explicitly made reference to small-scale fisheries in the description of the policy provided by the CCS experts or coded from the FAOLEX database. When policies explicitly referred to both (i.e. marine and inland, or small-scale and large-scale) they were categorized as general fisheries policies.
- **Policy level** indicates the political jurisdiction level at which the arrangement applies when implemented: local, subnational and national.
- **Policy integration** refers to whether policies focus only on production, or incorporated other considerations affecting fishers' livelihoods in line with the aims of the SSF Guidelines (Part 2 and Part 3). Examples of keywords coded as representative of Part 2 and Part 3 of the SSF Guidelines include: "participation" and "co-management", coded as examples of Theme 5a (Responsible governance of tenure); "sustainable use of resources" and "conservation", coded as examples of Theme 5b (Sustainable resource management); and "human rights", "livelihood sustainability" and "equality", coded as examples of Theme 6 (Social development, employment and decent work). "Food security" was also coded as a cross-cutting theme for the SSF Guidelines and not particularly associated to one particular section in the document.

Some arrangements were excluded from the dataset because they did not define specific governance harvesting actions, but instead set the parameters by which fisheries *may* be governed: for instance, the conditions by which the director of fisheries could be appointed. Including these would lead to an overestimation of the catch governed. These arrangements were therefore left in the overall dataset to retain evidence of their existence, but removed from analyses related to catch.

A.6.1.4 Main assumptions and caveats

It was assumed that the entirety of a fishery unit was governed by an arrangement. As such, an arrangement applied to the full quantity of particular attributes of the fishery unit it governed (e.g. its catch, the species included). Given that countries defined fishery units in different ways, it was likely that some governance arrangements did not apply to entire fishery units, for example:

- when the arrangement covered an area smaller than the fishery unit;
- when the arrangement restricted only some species caught in a fishery unit;
- when the arrangement restricted only some gear types used in a fishery unit.

In these cases, the analyses possibly led to the overestimation of the catch governed by certain arrangements.

It is also important to note that not all fishery units had available catch data. Therefore, all results that took catch into consideration should be understood in terms of "reported catch". In addition, catch amounting to 18 percent of the global reported catch did not have information on governance arrangements. However, this catch was included as the denominator of calculations for "% of total catch". For this reason, there might be an underestimation of the amount of governed catch. Given the sources of overestimation and underestimation, no artificial weights were implemented in the estimations of governed catch to correct for these issues.

Finally, governance data could only provide information on the presence of arrangements, not their absence. As it was not possible to determine whether the governance dataset contained all existing small-scale fisheries arrangements, it was considered that the absence of an arrangement may have signalled lack of information rather than inexistence.

A.6.1.5 Types of analyses for governance arrangement data

Tenure rights analysis

The tenure rights analyses were performed at three different levels: globally, by small-scale fisheries operational scale, and by income level according to the World Bank's income level classification. Fishery units were assigned to a small-scale fisheries operational scale employing their characterization matrix scores (see Section A.2.1.3.3). Not all fishery units had a characterization matrix score and not all catch was assigned to a fishery unit. Therefore, 16 percent of the total estimated catch was not included in the tenure rights analysis by small-scale fisheries operational scale. Table A.15 summarizes the number of countries and catch volumes within each small-scale fisheries operational scale, and Table A.16 the different types of tenure rights examined and variables included in each analysis.

General approach for tenure rights analysis : Formal and informal governance arrangements or policies were analysed separately and then compared. The number of countries with the presence of each right and the amount of catch regulated by that right was calculated separately for each rights analysis. If at least one fishery unit within a country was governed by a right, then that right type was considered "present" for that country. For example, if country A had three category-2 fishery units, and one of those

Table A.15 Number of countries and catch sample size for each small-scale fisheries operational scale for marine and inland small-scale fisheries

Operational scale (matrix score)	Marine		Inland	
	Number of Countries	Catch (tonnes)	Number of Countries	Catch (tonnes)
Category 1 (0-8)	18	590 873	16	1 639 456
Category 2 (9-17)	35	10 046 858	31	3 428 553
Category 3 (18-26)	39	5 901 220	18	1 825 911
Category 4 (27-33)	7	792 564	5	95 145
Total	52	20 966 259	43	7 866 476

Note: Catch represents total catch recorded for all fishery units (with associated catch) in each category.

fishery units had management rights, then it was considered that country A had management rights for all their category-2 fishery units. However, the total amount of catch under each type of right was calculated by only summing the catch of all the fishery units governed by each type of right.

General approach for combined tenure rights analysis: Tenure rights' analyses were combined in order to answer more complex questions about the devolution of management, transferability and exclusion rights and their interaction with withdrawal and access rights (Table A.17).

Policy scale (i.e. jurisdiction analysis)

Fishery units were subdivided into those fishery units governed under local, subnational or national arrangements, and their total catch was calculated. Double-counting of catch across the groups was possible given that some fishery units were regulated by two or more of those types of arrangements (i.e. the sum of a country's catch under local, subnational and national arrangements could add up to more than 100 percent of the catch for that country). In addition, the management rights analysis described in Table A.14 was conducted separately for the local, subnational and national arrangements (i.e. how much catch had management rights from each of these arrangement types was calculated). Similarly, double-counting of catch volume was also possible.

Policy focus (i.e. general fisheries vs SSF-specific) analysis

Fishery units were subdivided into those governed under SSF-specific arrangements and those governed under general fisheries arrangements, and their total catch under each arrangement was then calculated. An SSF-specific arrangement was defined as such when there was explicit evidence in the text of the arrangement that it pertained to small-scale fisheries, otherwise it was defined as a general fisheries arrangement. Double-counting of catch across the groups was possible given that some fishery units were regulated by both types of arrangements. In addition, the management rights analysis described in Table A.14 was conducted separately for the SSF-specific and general fisheries arrangements. Similarly, double-counting of catch was possible.

Fishery units were also subdivided into those units that were under only SSF-specific arrangements, fishery units that were under only general fisheries arrangements, and fishery units that were under both types of arrangements, and the total catch for each one was then calculated. Double-counting of catch under these conditions was not possible. The management rights analysis described in Table A.14 was conducted separately for SSF-specific arrangements, general fisheries arrangements, and both (i.e. how much catch had managements rights from each of these arrangement types/combinations was calculated).

A.6.2 Fishing organizations analysis

A.6.2.1 Data collection and cleaning process

Information from CSOs (i.e. small-scale fisher and fish harvester organizations) was collected in three main ways:

- National-level case studies: In the governance spreadsheet, CCS experts were asked to provide the name and characteristics of the three main small-scale fisheries organizations in their country, in addition to any women-only small-scale fisheries organizations.

Table A.16 Types of tenure rights and the main variables for each one used in the analysis

Types of tenure rights	Variables in analysis	Notes
Withdrawal	• Vessel restrictions • TAC restrictions • Size restrictions • Sex restrictions • Gear restrictions • Spatial restrictions • Temporal restrictions	• If a fishery unit was governed by more than one type of restriction through one or multiple arrangements, then its catch was included in the total of each of the restrictions.
Access	• Based on place of residence • Based on formal permit application • Based on kinship • Based on historical access or use • Based on vessel registration	• If a fishery unit was governed by more than one access type through one or multiple arrangements, then its catch was included in the total of each of the access types.
Management	• Management • Level of Engagement	• Catch with management rights was further analysed to determine each country's level of engagement in management rights. • The different levels of engagement were defined as "high", "medium" or "low", depending on the original answer given by the CCS experts. • Each fishery unit with management rights was assigned to a level of engagement depending on the CCS author's answer when characterizing each arrangement. • If a fishery unit appeared in more than one arrangement and it had different levels of engagement depending on the arrangement, then its catch was included in the total of each of the levels of engagement. • The total amount of catch under each level of engagement was calculated by summing the catch of all the fishery units with each level of engagement.
Exclusion	• Exclusion	• CCS experts were contacted to ensure correct interpretation of exclusion and transferability rights, and ensure these were being accurately portrayed in the spreadsheet.
Transferability	• Alienation	• CCS experts were contacted to ensure correct interpretation of exclusion and transferability (i.e. alienation) rights, and ensure these were being accurately portrayed in the spreadsheet.

Table A.17 Combined property rights and the main variables for each one used in the analysis

Combined tenure right	Variables in analysis	Comments
Devolution of Rights Index	• Some devolved • Mostly devolved • Fully devolved	• The management, exclusion and transferability analyses were combined to define the amount of catch with different levels of devolution rights. • Catch with some devolved rights was defined as catch with at least one of these rights; catch with mostly devolved rights was defined as catch with at least two rights; catch with fully devolved rights was defined as catch with three rights.
Devolution of Rights + Withdrawal	• Some devolved • Mostly devolved • Fully devolved • By withdrawal restriction	• The devolution of rights and withdrawal analyses were combined to calculate the amount of catch under each withdrawal restriction type with devolution rights.
Devolution of Rights + Access	• Some devolved • Mostly devolved • Fully devolved • By access type	• The devolution of rights and access analyses were combined to calculate the amount of catch under each access type with devolution rights.
Devolution of Rights + SDG contribution	• Policies for SDGs	• The withdrawal and devolution of rights analyses were combined to calculate a range of the amount of catch under policies with the highest likelihood to make contributions towards SDGs. The upper boundary of the range was calculated as follows: If a fishery unit was governed by a policy that mentioned historical or residence access and had any one of management, exclusion or transferability rights, then its catch counted towards the final upper boundary figure. The lower boundary of the range was calculated as follows: If a fishery unit was governed by a policy that mentioned historical or residence access and had all of management, exclusion and transferability, then its catch counted towards the lower boundary figure.

- Google survey: A Google survey asking for information about small-scale fisheries organizations was sent to key contacts who then forwarded it to other participants they considered would be able to complete the form (snowball sampling). Main respondents included:
    - Members from the International Collective in Support of Fishworkers (ICSF)
    - Members from the African Confederation of Artisanal Fisheries Professional Organizations (CAOPA in French)
    - Oak Foundation grantees
    - Members from the World Forum of Fish Harvesters and Fishworkers
    - Members from the African Union – Interafrican Bureau for Animal Resources (AU-IBAR)
    - FAO key contacts
- Web searches: More organizations were added to the database by browsing the websites of the organizations collected through the first two methods, as oftentimes these included the names of more partner or member organizations.

The information from these three sources was then consolidated into a single database. Duplicates were deleted and missing information was filled out through web searches when possible.

A.6.2.2 Main assumptions and caveats

Overall, the presence/absence and number of organizations in each country identified here is not representative of the total number of organizations in each country. This number is treated as unknown. African countries were oversampled in comparison to countries in other world regions, as almost 40 percent of the countries with organizations in the IHH database are in Africa. This may be the result of key contacts belonging to African regional organizations. In addition, pre-harvest organizations were undersampled, probably due in part to these types of organizations being more often informal organizations.

A.6.2.3 Content analysis

To explore the role CSOs could play in the governance of small-scale fisheries and the implementation of the SSF Guidelines, the stated objectives of producer organizations were identified when available (of the 424 producer organizations surveyed only 151 provided information about their stated objectives) and mapped against important SSF Guidelines themes. Themes were taken from Part 2 and Part 3 from the Guidelines and used as a basis to define each theme category and code (see Table A.18). A team of three coders got together to discuss and familiarize themselves with the themes and codes and then coded the stated objectives of a small sample of organizations (n = 30) as a test. They subsequently met again to discuss coding differences among them and coded the remaining organizations with an intercoder reliability goal of at least 85 percent. Results presented in the report reflect the average obtained for all three coders.

A.6.3 Preferential access analysis

Two sources of data were used to determine whether countries had preferential access areas for small-scale fisheries:

- Empirical data produced by the national-level case studies, where authors were asked whether the country had an exclusive small-scale fishing zone (yes/no), and if yes, what was (or where to find) the associated legal and geographic information about these areas;
- Analysis of the FAOLEX database.

For the FAOLEX database review, fisheries laws were first reviewed by title, keywords and abstract to determine relevance. Relevant cases were read in full to determine the geographic information on the artisanal/small-scale preferential access zone. Non-English documents were translated using Google translate. An additional literature review was conducted for countries that did not provide sufficient geographic information in their legislation. The search used country name and "small-scale fishery" as keywords. Any resulting academic papers or scientific reports were carefully examined for relevance. China, Gabon, Senegal and Sri Lanka were examined through this additional literature review process. CCS experts were contacted and consulted to request additional information when all literature reviews failed to yield any useful information. A total of 52 countries were included in this analysis.

Table A.18 Small-scale fisheries themes, and the definitions used to code them, found in stated objectives of producer organizations

Theme Category	Code	Definition
Responsible governance of tenure, including access and participation rights	TENURE	This theme involves working towards achieving or protecting tenure rights. Tenure rights include the rights fishers have to access and use of fishing resources – but not how the resources are used (that goes in the FISHMAN code). This can also involve respecting tenure rights, taking into account customary and equitable tenure practices. Issues related to accessing fishing resources are coded here, including designations of preferential access for small-scale fisheries and maintaining their status in coastal waters. This also involves securing the rights for fisher participation in all aspects of fisheries governance (e.g. co-management). When fishers already have rights to participate in fisheries governance and are exercising those rights, then the GOVERN code should be used.
Sustainable resource management (and use	FISHMAN	This theme refers to managerial issues related to production or harvesting. These include all aspects related to the management of harvesting restrictions on gear, space, species, total allowable catch, vessels, etc. It might entail adopting measures for the long-term conservation and sustainable use of fisheries resources, compliance with and development of harvesting management measures, banning fish gear that is particularly damaging, and improving fisheries exploitation..
Social development, employment and decent work	WELLBEING	This theme speaks to all different dimensions of livelihood issues and community needs outside of fisheries management or governance, such as (but not limited to) investment in health, education, literacy, water, sanitation, hygiene – i.e. activities related to sustainable development. It also includes human rights; safety at sea; appropriate working conditions; and freedom from piracy, crime and slavery.

Table A.18 Cont

Theme Category	Code	Definition
Value chains, post-harvest and trade	VALUE	This theme concerns commercialization, markets and value chains. It includes issues related to investment in post-harvest infrastructure (quality, safety); addressing power relationships in value chains; access to local, regional and international markets; equitable value chains; and information about pricing and trends.
Gender equality	WOMEN	This theme covers all issues related to women in fisheries, including acknowledging, asserting and valuing the role of women in small-scale fisheries, and increasing their empowerment, representation and well-being where necessary.
Disaster risks and climate change	CLIMATE	This theme includes any explicit references to issues attributed to climate change. This can include combating or adapting to climate change and preparing for disasters.
Policy coherence, institutional coordination and collaboration	GOVERN	This theme covers fishers exercising their rights to be involved in management or governance. For instance, those working towards improving small-scale fisheries policies and integrating them into larger policies; and those promoting institutional linkages and collaboration among institutions, improved local governance, and enhanced international cooperation. Federations by definition play a cross-scale coordination role and will be coded in this theme.
Information, research and communication	INFO	This theme covers communication and information dissemination. This can include, for example, systems for collecting fisheries data or best practices, and information sharing among fishers or fisher groups or with other stakeholders. The theme also encompasses any form of knowledge generation and sharing, including traditional or non-western forms.
Capacity development	ORGCAP	This theme refers to enhancing capacity to participate in decision-making processes: adaptive capacity, skills-building, training – i.e. changing the abilities of members. If it is only about information sharing, then it is coded as INFO.
Implementation support and monitoring	IMPLESUPP	This theme refers to activities and projects related to implementing the SSF Guidelines and support to their advancement.
Food sovereignty and nutrition security	FOOD	This theme refers to eliminating hunger or achieving food sovereignty or nutrition security, or focusing efforts on nutrition and food, rather than on the resource itself. Mentions need to make direct reference to food sovereignty, food or nutrition security, or be very specific about issues related to food (protein security, micronutrients, etc.). This is a cross-cutting theme in the SSF Guidelines.
Cultural heritage	CULTURE	This theme refers to supporting, protecting and strengthening the small-scale fisheries subsector for the value of traditional and cultural heritage; it is distinct from INDIGENOUS. This is a cross-cutting theme in the SSF Guidelines.
Conservation of ecosystems	CONECO	This theme covers specific mentions of conservation, preservation and restoration of the ecosystem and coastal resources. This is a cross-cutting theme in the SSF Guidelines.
Indigenous rights and empowerment	INDIGENOUS	This theme refers to advocating for indigenous issues including but not limited to tenure rights, roles in management, and general empowerment. TENURE should be coded separately if mentioned independently. If a valued interest group is mentioned, code for INDIGENOUS. This is a cross-cutting theme in the SSF Guidelines.

A.7 Gender

Input data for the gender analysis (Table A.19) were sourced from CCS data for all 58 countries, as well as data on fisheries employment and participation, disaggregated by gender, extracted from 76 LFS and HIES conducted by National Statistical Offices (as described in Section A.4.2.3).

A.7.1 Input from IHH gender advisors

To integrate gender across the IHH study, a team of gender experts (n=29; 92 percent women, 8 percent men) with national or regional expertise from around the world was assembled (Table A.20). Wherever possible, these gender advisors connected with CCS leads to further identify gender-inclusive and gender-disaggregated data as well as any gaps.

The gender advisors also completed a set of open-ended questions focusing on gender and small-scale fisheries, developed by the lead authors. The information from this survey was used to compliment, support and fill gaps in the information derived from the CCS. Responses by gender advisors included citing the source of knowledge or data, which ranged from peer-review publications, reports and media to personal observations. Qualitative analysis of responses to the questions involved inductive and deductive approaches. Themes were grouped by the four dimensions outlined in Chapter 6, while insights within each of these were categorized based on emergent themes. Cited knowledge sources were dominated by information on environmental and economic dimensions of small-scale fisheries, with fewer on nutrition and governance dimensions (Figure A.8).

Table A.19 Data and methods used for gender analysis of different thematic areas

Thematic area	Data sources used	Methods
Economics	Country and territory case studies (CCS); labour force surveys; household income and expenditure surveys; censuses; input from gender advisors	Feminist approach to data science: investigating multiple data sources and uncovering bias[a]
Environment	CCS; input from gender advisors	"Foot fisheries" (i.e. fishing without a vessel) used as an imperfect proxy for fishing activities in which women tend to participate[b]
Nutrition	Input from gender advisors	Intersectionality[c]
Governance	Input from gender advisors; CCS; Duke University database of civil society organizations	Gender-inclusive governance, gender mainstreaming[d]

Notes: **a** D'Ignazio, C. & Klein, L.F. 2020. *Data feminism*. Cambridge, USA, MIT Press. **b** Kleiber, D., Harris, L.M. & Vincent, A.C.J. 2015. Gender and small-scale fisheries: a case for counting women and beyond. *Fish and Fisheries*, 16(4): 547–562. **c** Cooper, B. 2016. Intersectionality. In: L. Disch & M. Hawkesworth, eds. *The Oxford handbook of feminist theory*, pp. 385–406. Oxford, UK, Oxford University Press. **d** FAO. 2015. *Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication*. Rome.

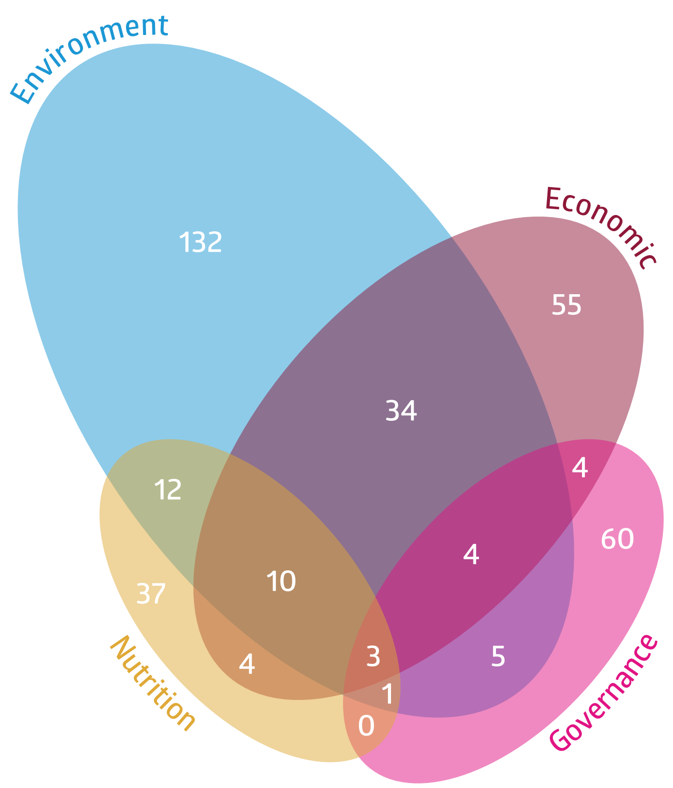
Table A.20 Team of 29 gender advisors, representing 21 countries

Country	Gender Advisor
Bangladesh	Afrina Choudhury
Brazil	Luceni Hellebrandt
Cambodia	Kyoko Kusakabe
Fiji	Sangeeta Mangubhai
Gambia	Ashley Fent
Ghana	Sarah Appiah

Table A.20 Cont

Country	Gender Advisor
Greenland	Hunter Snyder
India	Nikita Gopal, Holly Hapke
Japan	Kumi Soejima
Madagascar	Laura Robson, Charlie Gough, Rindra Rasoloniriana, Tahiry Randrianjafimanana
Malawi	Chikondi Manyungwa
Mexico	Carmen Pedroza
Nigeria	Kafayat Fakoya, Ayodele Oloko
Peru	Santiago de la Puente
Philippines	Alice Joan Ferrer
Saint Vincent and the Grenadines	Clonesha Romeo
Senegal	Amelia Duffy-Tumasz
Spain	Diego Salgueiro Otero, Elena Ojea, Gonzalo Macho
United Republic of Tanzania	Sara Frocklin, Maricela De la Torre Castro
Uganda	J. Lee Johnson
United Kingdom of Great Britain and Northern Ireland	Madeline Gustavsson

Figure A.8 Knowledge sources provided by gender advisors in their responses to open-ended survey questions on gender



Note: Number of knowledge sources (e.g. peer-review journal articles, grey literature, media, and personal observations) are divided according to the information that they contained across four key dimensions of small-scale fisheries: economic, environment, nutrition and governance.

ANNEX B.

Comparison of IHH employment and subsistence estimates

with information available from FAO and other datasets

B.1 Comparison of IHH employment data with data available from other sources

The estimates of employment data (excluding subsistence activities) generated in this IHH study from the labour force surveys, household income and expenditure surveys and population censuses in 78 countries, and further extrapolated at the global level, were compared to other data sources available for small-scale fisheries: i) country and territory case study (CCS) data, ii) FAO Member responses to a 2019 ad hoc questionnaire, iii) previous estimates for small-scale fisheries (World Bank, 2012), as well as iv) FAO data that are not disaggregated between large- and small-scale fisheries.

Overall, the results are typically similar or comparable with these other data sources, for example with the data compiled in the CCS (see Section B.1.2) and the FAO data on aggregated employment (see Section B.1.1), and correlate highly (0.73) with FAO data on total capture fisheries production (Figure B.1). The IHH study found substantial differences in the number of post-harvest workers in small-scale fisheries compared to World Bank (2012) estimates (Section B.1.3).

B.1.1 Comparison of IHH employment data with FAO employment data

Employment data. The estimates for employment generated from national household-based surveys in this study are not fully comparable with the published global estimates of fisheries employment from FAO because of differences in methods.

The FAO dataset represents the largest international data repository and provides comprehensive estimates of the total number of persons employed in capture fisheries and aquaculture. The dataset is a country-level longitudinal dataset (from 1950 to 2020) containing more than 93 million observations disaggregated by the key qualifiers: year, sex, detailed occupation category and time-use categories. Table B.1 shows the structure of the dataset according to their qualifiers.

FAO published estimates are generally available for all countries for the harvesting segment of the capture fisheries and aquaculture value chain, while employment data on processing activities of fisheries are only available for a handful of countries. By contrast, the IHH study provides employment estimates along the value chain, disaggregated by small- and large-scale fisheries.

For the harvesting segment, FAO reports 38.7 million people employed worldwide in all capture fisheries (small- and large-scale) value chains in 2016 (Table B.2). This estimate includes occasional and “undefined” fishers in addition to part- and full-time fishers, while the 29.9 million people estimated in this study to be employed in the harvesting segment of capture fisheries value chains (Table B.3) only includes part- and full-time fishers. In the data sources used for this study, occasional workers are likely to have been counted as subsistence fishers, engaging in fisheries to produce fish for their own consumption.

When FAO data are disaggregated to just part- and full-time fishers, the total is approximately 31.1 million fishers, or 1.2 million more than estimated in this study (29.9 million). That difference is probably due to differences in estimates for China, taking into account that “not all data reported by China [to FAO] is separated between fish farmers and fishers and so some of the fish farmers may be aggregated with fishers.” (FAO, 2018c)

Figure B.1 shows the correlation between FAO and IHH employment numbers (panel a), as well as country-specific absolute differences between IHH and FAO employment numbers (panel b). More specifically, the vertical axis in panel b measures the absolute difference between IHH employment data for the harvesting segment of capture fisheries value chains and the corresponding FAO numbers, while the horizontal axis presents the individual countries for which employment data are available from both sources.

The two sources of data for marine fisheries were highly correlated (correlation = 0.90) (Figure B.1, panel a, upper graph), with only a handful of countries that show significant differences between the two sources, e.g. China, Brazil and the Philippines (Figure B.1, panel b, upper graph). Similarly, estimates of employment in the harvesting segment of inland fisheries generated in this study were also highly correlated with FAO employment data for that segment (correlation = 0.92), with only a handful of countries showing large differences between the two sources (Figure B.1, panel b, lower graph), for example Cambodia, Myanmar and Nigeria.

Livelihood dependents. In addition to these estimates and datasets on global employment in the harvesting segment of the capture fisheries value chain, in 2012 FAO estimated that fishers, fish-farmers and those supplying services and goods to them supported the livelihoods of approximately 660 to 820 million people, or 10 to 12 percent of the global population at the time (FAO, 2012b). The order of magnitude of those estimates is broadly consistent with the

Table B.1 Key qualifiers of the FAO employment dataset

Year	Sex	Detailed occupation category	Time-use category
1950-2019	• Females • Males • Unspecified	• Aquaculture • Inland waters fishing • Marine coastal fishing • Marine deep-sea fishing • Marine fishing, nei • Processing • Subsistence • Unspecified	• Full time • Occasional • Part time • Status Unspecified

Source: FAO. 2021. *FAO Yearbook. Fishery and Aquaculture Statistics 2019.* Rome. https://doi.org/10.4060/cb7874t

Table B.2 Global employment in fisheries and aquaculture reported by FAO Members

Occupational categories	Employment (2016)
Aquaculture	21 667 031
Total fishers in capture fisheries	38 714 436
Others, of which	1 338 733
Processing	669 366
Unspecified	669 367
Total	61 720 200

Source: FAO. 2021. *FAO Yearbook. Fishery and Aquaculture Statistics 2019.* Rome. https://doi.org/10.4060/cb7874t

Table B.3 Total number of part-time and full-time fishers in 2016 according to FAO and IHH study estimates (extrapolated from household-based surveys for 78 countries), by region

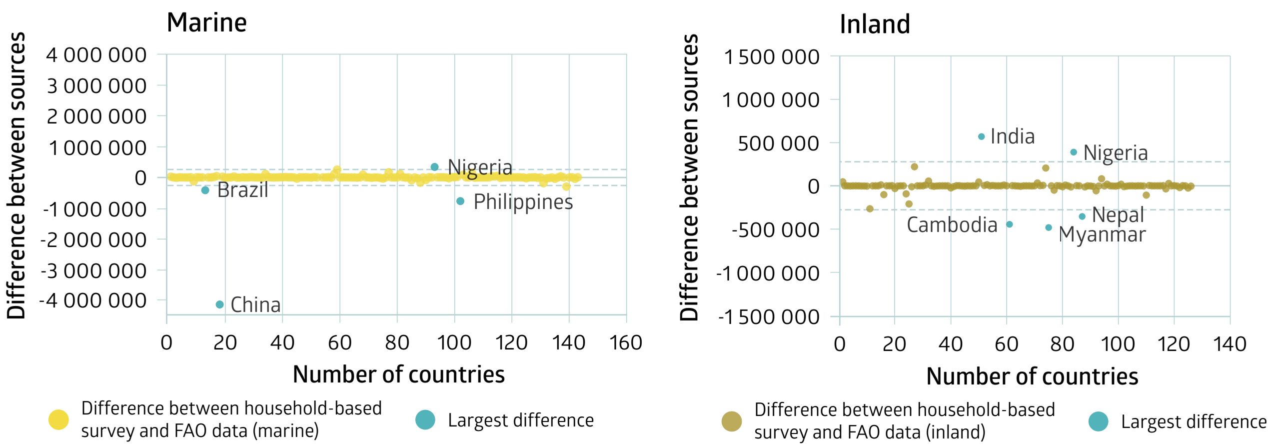
Region	FAO[a]	IHH	Difference
Africa	3,875,352	4,219,606	-344,254
Americas	2,106,193	2,083,321	22,872
Asia	24,780,119	22,882,876	1,897,243
Europe	208,547	426,653	-218,106
Oceania	169,940	302,142	-132,202
Total	31,140,151	29,914,598	1,225,553

Notes: FAO data include part-time fishers, full-time fishers, and those with unspecified status. The latter category is assumed to be either part-time or full-time. **a** FAO. 2021. *FAO Yearbook. Fishery and Aquaculture Statistics 2019*. Rome. https://doi.org/10.4060/cb7874t

Figure B.1 Comparison of IHH estimates of employment in the harvesting segment of the fisheries value chain (marine and inland), extrapolated from household-based surveys for 78 countries, with FAO employment data in the harvesting segment of marine and inland fisheries

a) Correlation

b) Difference between IHH and FAO data[a]



Notes: Panel a: correlation; panel b: difference between FAO and IHH sources. **a** FAO. 2021. *FAO Yearbook. Fishery and Aquaculture Statistics 2019*. Rome. https://doi.org/10.4060/cb7874t

estimates here that in 2016, 491.7 million people were either employed in small-scale fisheries or engaged in small-scale fisheries for subsistence, or at least partially dependent upon those who were, equal to 6.6 percent of the global population at the time. The difference likely reflects the inclusion by FAO in 2012 of fish-farmers and those supplying services and goods to them, as compared to this study's estimate of those employed or at least partially dependent only upon small-scale fisheries.

B.1.2 Comparison of IHH employment data with CCS data

The estimates of employment in the harvesting segment of small-scale fisheries value chains generated from national household-based surveys were further compared to the harvesting employment figures of 48 out of 58 CCS with reported data on employment in small-scale fisheries. The two sources, i.e. household-based surveys and the CCS, show similar results. Estimates of employment in the harvesting segment of the marine small-scale fisheries value chain from household survey data points to 5.7 million employed while, for the same countries and category, CCS data estimates point to 5.8 million people employed. In absolute terms, the largest difference was the case of Viet Nam, where employment estimates generated from survey data were larger by a factor of 281 thousand people compared to employment data collected through the CCS (Figure B.2, panel b, upper graph). Comparison of employment estimates for inland small-scale fisheries harvesting with the data from 24 CCS where employment data were available showed similar results: an estimated 3.7 million people employed compared to 4.6 million in the case studies, with this difference largely imputable to the cases of Nigeria and Indonesia (Figure B.2, panel b, lower graph).

B.1.3 Comparison of IHH employment data with the 2012 Hidden Harvest study

The 2012 Hidden Harvest study estimated 108 million people were employed globally along the small-scale fisheries value chain, compared to the IHH study estimate of 113 million employed in small-scale fisheries and engaged in the subsector for subsistence. While this difference may not be statistically significant and could simply be a result of error bounds on both estimates, it has to be noted that significant changes have taken place since the period covered by the 2012 study that have had an impact on small-scale fisheries employment. For example, in some regions a greater share of small-scale fisheries catch is going into fishmeal production (Corten, Braham and Sadegh, 2017; Kolding *et al.*, 2019), among other changes to fish marketing and processing channels. These changes have likely contributed to the post-harvest segment of the value chain being less employment-intensive than it had been in the past. Employment opportunities for women in small-scale fisheries may also be reduced, for example in India, where female headload fish distribution has been replaced by bulk distribution using minivans and lorries operated by male merchants (Aswathy and Kalpana, 2018).

Table B.4 shows the comparison between estimates generated in this study and estimates generated in the initial 2012 Hidden Harvest study for both small- and large-scale fisheries, noting that the two studies used different employment and subsistence categories, and the only strictly comparable categories are those capturing employment in the harvesting and total post-harvest segments of small- and large-scale fisheries value chains.

The comparison of employment data generated in these two studies shows that the total number of post-harvest workers employed in small-scale fisheries (marine and inland combined) estimated

Figure B.2 Comparison of IHH estimates of employment in the harvesting segment of the small-scale fisheries value chain, extrapolated from household-based surveys for 78 countries, with data from the IHH country and territory case studies (CCS)

a) Correlation

b) Difference between IHH estimates and CCS data

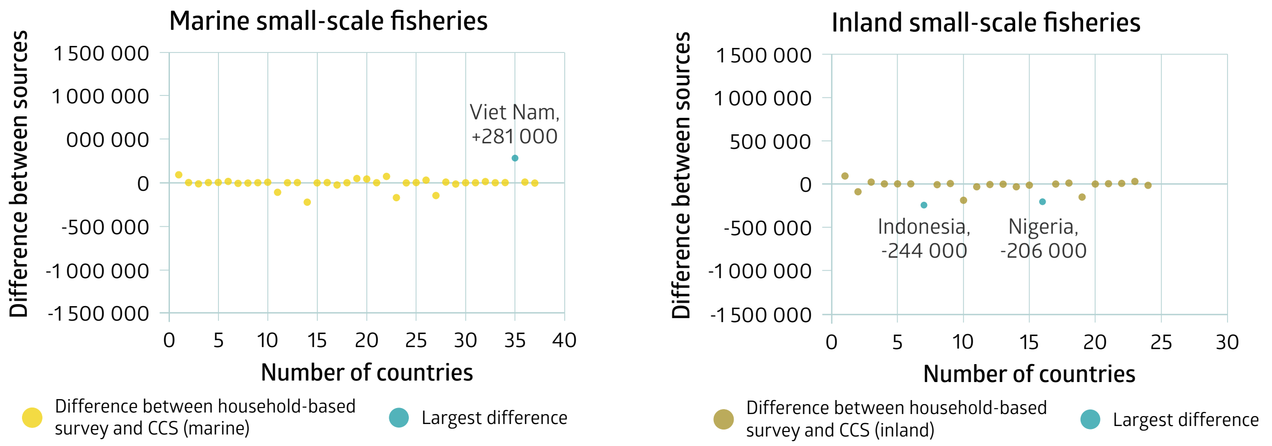


Table B.4 Total participation in small- and large-scale fisheries according to Hidden Harvest 2012 and IHH estimates (extrapolated from household-based surveys for 78 countries), by segment of the value chain

Segment	Small-scale fisheries			Large-scale fisheries		
	Marine	Inland	Total	Marine	Inland	Total
Hidden Harvest 2012[a]						
Pre-harvesting	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Harvesting	14 000 000	18 000 000	32 000 000	2 000 000	1 000 000	3 000 000
Post-harvesting	38 000 000	38 000 000	76 000 000	7 000 000	500 000	7 500 000
Subsistence	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Total	52 000 000	56 000 000	108 000 000	9 000 000	1 500 000	10 500 000
IHH study						
Pre-harvesting	N.A.	N.A.	1 726 030	N.A.	N.A.	465 791
Harvesting	12 863 038	14 598 317	27 461 355	1 737 603	715 640	2 453 243
Post-harvesting	N.A.	N.A.	31 013 344	N.A.	N.A.	4 393 120
Subsistence	16 839 732	35 997 415	52 837 147	N.A.	N.A.	N.A.
Total	N.A.	N.A.	113 037 876	N.A.	N.A.	6 846 363

Note: **a** World Bank. 2012. *Hidden Harvest: the global contribution of capture fisheries*. Report No. 66469-GLB. Washington, DC.

Table A25. Post-harvest multipliers calculated for Hidden Harvest 2012 and IHH study (extrapolated from household-based surveys for 78 countries)

Subsector	Post-harvest multipliers	
	Hidden Harvest 2012[a]	IHH study
Marine	2.8 (9 countries)	N.A.
Inland	2.1 (10 countries)	N.A.
Marine and inland		1.6 (78 countries)

Notes: The post-harvest multiplier measures the total number of post-harvest workers for each fisher. **a** World Bank. 2012. *Hidden Harvest: the global contribution of capture fisheries*. Report No. 66469-GLB. Washington, DC.

in this study is approximately half the number estimated in the Hidden Harvest study (31 million compared to 76 million, respectively). The large difference in the numbers from the two studies is mostly explained by the method and number of countries used to calculate the post-harvest multipliers.

In the initial Hidden Harvest study, the post-harvest multipliers (i.e. the number of post-harvest workers for each worker in the harvesting segment) for marine and inland small-scale fisheries were calculated to be 2.8 and 2.1 respectively (Table A.25). They were applied to the global number of fishers in marine and inland small-scale fisheries (14 and 18 million fishers, respectively) to generate a global estimate of 76 million workers in the post-harvest segment. Those multipliers, however, were only based on nine countries with reported data on marine employment in both the harvesting and post-harvest segments, and ten countries with reported data on inland employment in both the harvesting and post-harvest segments (Table A.25). Moreover, the post-harvest multipliers for marine and inland small-scale fisheries were calculated by first summing all post-harvest workers and fishers from these nine and ten countries, and dividing the totals by the total number of fishers in the same countries. Using this method, the multipliers were driven by "large" countries (in particular China, Nigeria and India) where the number of post-harvest workers exceeded the number of fishers. However, the data used in the initial Hidden Harvest study show that in more than half of the countries used for calculating the multipliers (five countries for marine and six countries for inland), the number of fishers is larger than that of post-harvest workers.

By contrast, in this study, this ratio was adjusted using a much more robust base with a larger number of countries (78 countries with reported data on employment in both the harvesting and post-harvest segments that were collected through household-based surveys). Moreover, country-specific multipliers were calculated for each of the 78 countries, i.e. for each country the total number of processors and traders in small-scale fisheries was divided by the total number of fishers engaged in inland and marine small-scale fisheries, respectively. Finally, the country-specific multipliers were averaged, resulting in a global post-harvest multiplier for small-scale fisheries of 1.6.

B.1.4 Comparison of IHH gender employment data with other available sources

In terms of the gender profile of fisheries employment and subsistence activities, there are very few global estimates that distinguish between pre-harvest, harvesting and post-harvest activities. For the harvesting segment of small-scale fisheries, the estimate of employment presented here for marine and inland combined that women represent 18.7 percent of the people employed is higher than several previous global estimates, including the estimate in Harper *et al.* (2020) that women represented 11 percent of the harvesting segment of marine small-scale fisheries value chains, and that of Gee and Bacher (2017) where the analysis of fisheries employment data from 52 of 194 FAO Member Nations indicated that approximately 15 percent of the harvesting segment of all fisheries value chains (marine and inland, small- and large-scale) were women. A more recent FAO estimate indicates approximately 12 percent of all fish harvesters worldwide are women (FAO, 2020b).

In contrast, looking at the total number of fishworkers employed, including pre-harvest, harvesting and post-harvest activities, the IHH study estimate is lower than the 2012 Hidden Harvest estimate that 46 percent of the small-scale fisheries workforce were women, including inland and marine capture fisheries and the harvesting and post-harvest segments of the value chain. However, the global estimate from the IHH study provided here was extrapolated from 78 countries, compared to the 24 CCS used as the basis for extrapolation in the initial Hidden Harvest study. Rather than reflecting a decrease in women's participation in small-scale fisheries between the two study periods, this revised estimate likely reflects the updated methods and data sources available, and the reality that women's participation in small-scale fisheries remains difficult to capture in statistics for a range of reasons related to gender norms, biases in data collection, and informality of the work, among others.

The above estimate of 18.7 percent does not include subsistence activities; yet another key contribution of this study is the estimated number of people engaged in small-scale fisheries harvesting or processing for subsistence, where women appear to play a much larger role than in commercial small-scale fisheries. This is especially pronounced in Africa, where 56.7 percent of those engaged in subsistence activities are women. Activities reported in this context as subsistence may include both harvesting and post-harvest activities such as smoking and drying fish for own consumption.

Illuminating Hidden Harvests: the contributions of small-scale fisheries to sustainable development (hereinafter IHH) is a global study uncovering the contributions and impacts of small-scale fisheries through a multidisciplinary approach to data collection and analysis. The study provides information that quantifies and improves understanding of the crucial role of small-scale fisheries in the areas of food security and nutrition, sustainable livelihoods, poverty eradication and healthy ecosystems. It also examines gender equality as well as the nature and scope of governance in small-scale fisheries.

The IHH study was carried out in support of the implementation of the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines), themselves developed in recognition of the plight of small-scale fishers, fishworkers and associated communities and released as a contribution to the International Year of Artisanal Fisheries and Aquaculture 2022.

The purpose of this report is to contribute to a more holistic understanding of what small-scale fisheries are, their importance, and why they are essential to efforts to achieve the Sustainable Development Goals (SDGs). By using this knowledge wisely within a human rights-based approach in line with the SSF Guidelines, and by empowering small-scale fishers and fishworkers, a more inclusive, equitable, sustainable and resilient small-scale scale fisheries subsector can be achieved. Realizing this goal would benefit hundreds of thousands in fishing communities and society at large.

With this in mind, the IHH report is aimed at all those with a stake or an interest in the small-scale fisheries subsector, in particular decision-makers who are concerned with fisheries, poverty eradication, food security and nutrition, and sustainable development more generally. It is also addressed to small-scale fisheries actors themselves and those who support them.

Contact: SSF-Guidelines@fao.org; https://www.fao.org/voluntary-guidelines-small-scale-fisheries/ihh/en/

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