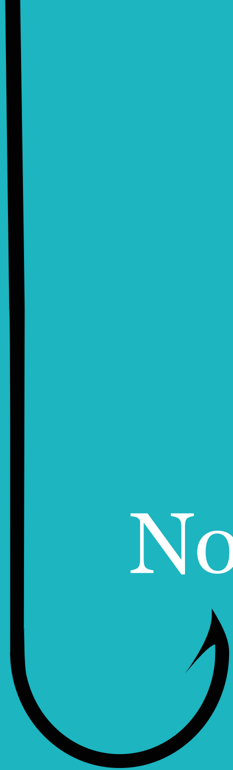


No hidden catch

Mainstreaming values of small-scale fisheries in national accounts

iied

Edited by **Ina Porras** (ina.porras@iied.org)

About the authors

Ina Porras is a senior economist at the International Institute for Environment and Development (IIED). She works on economic valuation and the design of fairer economic instruments and policies.

Essam Mohammed is a principal researcher leading on the work on fisheries at IIED.

Ben Milligan is a lawyer and policy advisor based at the University of New South Wales (Australia), working on the use of environmental information in public policymaking.

Phil James is a fisheries economist at the Fisheries, Aquaculture and Marine Ecosystems (FAME) Division at the Pacific Community.

Sarah Harper is a PhD candidate at the University of British Columbia (Canada) in the Institute for the Oceans and Fisheries. Her work lies at the intersection of gender, fisheries and economics.

German Pochet is a lawyer specialising in environmental governance and legislation at BIOIURIS, Costa Rica.

Renato Vargas is a quantitative economist with wide experience in implementing and using natural capital accounts in Guatemala.

Eugenia Merayo is a researcher in the fisheries programme at IIED, working on fiscal reforms and valuation.

Paul Steele is chief economist at IIED, working on climate finance and macroeconomics.

Produced by IIED's Shaping Sustainable Markets Group.

The Shaping Sustainable Markets group works to make sure that local and global markets are fair and can help poor people and nature to thrive. Our research focuses on the mechanisms, structures and policies that lead to sustainable and inclusive economies. Our strength is in finding locally appropriate solutions to complex global and national problems.

Published by IIED, February 2019
Porras, I (2019) No hidden catch. Mainstreaming values of small-scale fisheries in national accounts. IIED, London.
http://pubs.iied.org/16646IIED
ISBN 978-1-78431-660-0
Printed on recycled paper with vegetable-based inks.

Contents

1. Introduction and format of the guidelines

It is notoriously difficult to obtain data for fisheries, especially for the more elusive small-scale sector, which tends to operate under the radar. These guidelines aim to help national statistics officers and others to improve the way they account for small-scale fisheries (SSF). We do this in two steps. First, we summarise current efforts to collect statistics for SSF. Second, we present how this data can feed into national accounts using the international statistical standard developed by the United Nations[1] to facilitate cross-sectoral macroeconomic analysis.

These guidelines offer a range of strategies to help reveal the sector more clearly. Ultimately, if SSF data are robust, policymakers can design policies that will both improve the lives of people who depend on SSF and secure investments to promote the sustainable management of fishery ecosystems.

1.1 Why is this relevant?

Fisheries are economically important: coastal and marine resources provide a range of ecological functions that directly or indirectly translate to economic services and value to humans. These are often categorised as supporting, regulating, cultural and provisioning services. In 2016, global fisheries provided over 170 million tonnes of fish – of which 46% was marine capture and 30% inland aquaculture – representing US$362 billion and employing almost 60 million people. The average annual increase in the consumption of fish and crustaceans exceeds population growth and that of any type of terrestrial meat.[2]

Not so small: SSF play important social, cultural, environmental and economic roles. They supply a significant proportion of the fish consumed locally, representing a high percentage of the local fishing communities' animal protein intake (FAO 2018).[2] SSF generate jobs for about 12 million men and women, most of them poor and vulnerable, for whom fishing and fish trading are the principal sources of livelihood and income (see **Figure 1**). While lacking access to resources, small-scale fishers often compete against semi-industrial fleets, sports fishing and tourism. Despite their importance to local and national economies, the real impact of SSF is unknown, and often ignored, and there is still some stigma associated with the sector.

Figure 1. Contributions of SSF to wider economy[3]

Fisheries benefits	Large-scale	Small-scale
Annual landings for human consumption	About 60 million tonnes	About 27 million tonnes
Annual catch discarded at sea	10 million tonnes	Almost none
Annual catch for industrial reduction to fishmeal and oil etc	26 million tonnes	Almost none
Fuel used per tonne of fish for human consumption	10–20 tonnes	2–5 tonnes
Number of fishers employed	about 1/2 million	About 12 million
Government subsidies (billions of USD)	25–30 billion USD	5–7 billion USD

Source: From *Global Atlas of Marine Fisheries* edited by Daniel Pauly & Dirk Zeller. Copyright © 2016 by the authors. Reproduced by permission of Island Press, Washington, DC.

Data gaps: data from offshore fisheries are usually in much better shape than data from coastal fisheries, which receive little attention and few resources from fisheries agencies.[4] For example, researchers believe that FAO global fishery statistics may be widely underestimated,[3] because they often do not include illegal or unreported catches or SSF contributions to catch and livelihoods.

Gathering and translating data from local communities is challenging. SSF activities are often informal, for example fishers might land their catch at home rather than at official landing sites and much of the produce is dispersed through scattered informal markets. To truly represent SSF, information should go beyond catch and take a more holistic approach, for example including the often-ignored roles of women and children.

SSF are rarely reflected in national statistics. This means they are not factored in decision-making processes that directly affect the sector. As a result, resources and investments often fail to reach those who need them most.

What we don't know can hurt: despite their importance for food security and coastal fisheries,[4] small-scale fishers face many problems such as lack of infrastructure, low technology and no access to markets and credit.[5] Forced to fish close to the shore, their activities are further threatened by anthropogenic effects, such as over-fishing, harmful fishing practices, coastal erosion, oil pollution, coral reef destruction and competition with industrial fleets. With little access to alternatives and no means to withstand sudden shocks from market fluctuations and climate change, small-scale fishers are under threat.

According to FAO[2] estimates, global fish stocks are declining with around a third considered to be overexploited. Without data on fisheries' catches, it is difficult to develop targeted environmental policies to reverse stock decline and improve coastal ecosystems.

Information is power and measuring is a step towards better management: these guidelines present methodological and policy opportunities and challenges in disaggregating data in SSF. To make progress, it is critical to have both an explicit understanding of the value the host communities place on coastal and marine ecosystems and for this to be mainstreamed in national policies.

1.2 Objectives: data and policy

The ultimate goal of this document is to enhance our understanding of the economic value of SSF, both at macro level and within social groups. The specific objective is to develop guidelines, based on the System for Environmental and Economic Accounts (SEEA) approach[6] to help mainstream SSF values in national accounts. It complements ongoing efforts (eg SSF Guidelines[7,8]) to reveal the SSF sector and provide guidance on fairer and better-informed decisions, and the WAVES project supporting the implementation of SEEA frameworks worldwide.

Good quality data can provide evidence-based information to help answer policy questions about SSF, such as:

- **Value:** what are SSF's economic contribution to the national economy, including employment and food security?
- **Returns to investment:** what level of investment is needed and what are the returns to these investments?
- **Distribution:** where should public investments be directed? Eg towards women and efforts aimed at gender equity, as well as towards other important socio-economic groups such as low-income fishers?
- **Sustainability:** how sustainable are they, for example, how sustainable are their harvest yields, and how would they respond to external changes such as climate change?

To answer these questions, we need data from a mix of indicators such as employment, catch, added value of the activity (in relation to government expenditures), multiplier effects of SSF in the economy, intervention points to direct investments, as well as stocks and flows of fishery resources.

These guidelines aim to bring ongoing efforts to improve sectoral SSF and fisheries statistics into the SEEA structure. When possible, we suggest practical steps towards implementing the SEEA framework in a way that shows the role of SSF in the national economy and helps mainstream its values into national policies.

1.3 Audiences

The main audience for these guidelines is national statistics officers who are interested in improving the way fisheries statistics are embedded in national formats so they can contribute to macroeconomic and multisector planning.

Another key audience is fisheries departments and agencies that want to improve SSF conditions. SSF organisations and cooperatives will also benefit: better data will help them understand their own social and economic contributions, enabling them to negotiate better and more sustainable policies and working practices.

According to Gillet,[4] "the preparation of fishery statistics requires considerable knowledge of the sector and government fishery officials and agencies must play a strategic role with statistics office staff in determining categories and indicators, formulating survey strategies and scrutinising survey results."

1.4 Format of the guidelines

Although these questions are sector-specific, their responses are of macroeconomic concern. To enable policymakers to make better informed decisions, they require policy language and indicators that are common to other sectors.

These guidelines are thus presented in three parts:

1) How to 'reveal' the SSF: who and how much (section 2)
2) How to use the SEEA format to present national fishery accounts (section 3)
3) Potential data sources (section 4).

2. How to reveal SSF in a data-deficient context

SSF are about people, not just fish. Because data is so scant, gaps are filled with expert opinion, probability assessment and instrumental variables. This leads to an inaccurate portrayal of the sector.

To get accurate data on SSF, this section focuses on how to:

1) Define SSF (in relation to other fisheries sub-sectors)
2) Create indicators to estimate the number of people involved in SSF and disaggregate this data
3) Define catch and harvest.

2.1 Defining SSF

SSF are described by a mix of indicators, which include boat sizes, gross registered tonnage (GRT), engine size, type of gear used, distance to shore where fishing takes place and nature of economic activity (ie subsistence, traditional). SSF can be subsistence (non-commercial) or artisanal (commercial). While there is no single, agreed definition of the subsector, SSF and artisanal fisheries are often used as synonyms:

"Small-scale and artisanal fisheries, encompassing all activities along the value chain – pre-harvest, harvest and post-harvest – undertaken by men and women, play an important role in food security and nutrition, poverty eradication, equitable development and sustainable resource utilization." (FAO voluntary guidelines)

Individual countries have their own definitions of SSF and in the absence of an internationally agreed definition, we recommend that you use (or develop) your own definitions to suit your country context.

Table 1 presents some of the definitions and indicators you can use or adapt to define SSF.

Table 1. Categories and indicators for defining SSF

Method/source/ country	Categories and indicators				
Hidden Harvest project[9] Disaggregation matrix, Score system (0–3, with 0 being smallest).[8]	**Score**	**0**	**1**	**2**	**3**
	Size of fishing vessel (or equivalent range for fixed gears)	No vessel	< 12m < 10 GRT	< 24m < 50 GRT	> 24m > 50 GRT
	Motorisation	No engine	Outboard engine	Inboard engine < 400hp	Inboard engine > 400hp
	Mechanisation	No mechanisation	Small power winch/hauler powered off engine	Independently powered gear deployment/ hauling	Fully mechanised gear deployment and hauling
	Refrigeration/ storage on board	No storage	Ice box	Ice hold	Refrigerated hold
	Labour/crew	Individual and/family members	Cooperative group	< 2 paid crew	> 2 paid crew
	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
	Day trip/ multiday	< 6 hours	Day trip	< 4 days	> 4 days
	Fishing grounds/ zone/distance from shore	< 100m from shoreline	< 3km from shoreline	< 20km	> 20km from shoreline
	Disposal of catch	Household consumption/ barter	Local direct sale	Sale to traders	Onboard processing and/or delivery to processors
	Utilisation of catch, value added/ preservation	For direct human consumption	Chilled	Frozen	Frozen/chilled for factory processing (for human consumption or fishmeal)
	Integration into economy and/or management system	Informal, not integrated (no fees)	Integrated (registered, untaxed)	Formal, integrated (licensed, landing fees)	Formal, integrated (licensed, taxed)

Global estimates of SSF[10]	The following key features and ranges define SSF: • Boat size: 5–7m; less than 10, 12 or 15m (2 to 24m) • Boat GRT: less than 10 GRT (3 to 50 GRT) • Size of engine: less than 6hp; 40–75hp (15 to 400hp) • Boat type: canoe, dinghy, non-motorised boat, wooden boat, boat with no deck, traditional boat • Gear type: coastal gathering, fishing on foot, beach seine, small ring net, handline, dive, traps • Distance from shore: 5–9km; within 13km; up to 22km • Water depth: less than 10, 50 or 100m • Nature of activity: subsistence, ethnic group, traditional, local, artisanal • Number of crew: 2–3; 5–6 • Travel time: 2–3 hours from landing sites
Costa Rica[11]	Costa Rica has four categories for fishing licences: subsistence (<3 miles off the coast, no commercial), small fishery (<3 miles off the coast), medium fisheries (< 40 miles off coast) and advanced fishery (> 40 miles off the coast).[13] Based on FAO guidelines, Pochet and Zango[11] suggest that the artisanal, small-scale fishing sector is constituted by (at least) the following activities: • Fishing to feed oneself or one's family • Low-impact fishing for commercialisation • Fishing anchored on sustaining communities • Other forms of fishing linked to vulnerable groups • Fishing by indigenous peoples and ethnic minorities • All pre- and post- harvest activities associated with the above fishing activities.
Sea Around Us[12] SSF within other fishery categories.	Compares SSF to other fishery sectors: • Industrial sector: relatively large motorised vessels that require large capital investments and operate commerically in domestic, high seas or other countries' waters • Artisanal sector: smaller vessels that require lower capital investments and use small-scale (hand lines, gillnets etc) or fixed gears (weirs, traps, etc). Mostly commercial although some catch may be given to crew. Operate on domestic waters within inshore fishing area • Subsistence sector: mostly harvested/done by women for family's consumption. Could include a fraction of artisanal catch given to crew • Recreational sector: pleasure-led fishing.

2.2 Estimating the number of people in SSF

The lack of official data on the number of small-scale fishers is a major statistical challenge. For example, the number of approved licences or registered fishers is often different from the number of active ones, sometimes varying significantly (see **Table 2** below for Costa Rica). Counting the number of vessels may also be misleading, as in some regions some fishing boats may belong to migrating fishers (eg along Northern African coasts). But it is vital to find ways of estimating numbers of fishers, disaggregated by sex, age and other indicators to understand how this impacts on jobs and quality of life.

Below are some examples of methods used to estimate the number of people in the sector:

Table 2. Strategies to estimate the number of people in SSF

Method/source	Description
Experts' estimates, Costa Rica	According to German Pochet[13] there are about 1,200 licences registered for SSF in Costa Rica, but surveys suggest that the number of people engaged in the activity — including those without licenses — is around 12,000–15,000. Official fisheries data must be adjusted to better reflect the participation of SSF in the economy and the parts of the value chain they operate on. Suggestions for doing so include counting the number of registered fishing vessels regardless of whether they have a license or not. This may mean cross-referencing data from the Ministry of Transport, satellite images, surveys and checking social protection payments for coastal/ fishing communities.
Benefit transfer approach and Montecarlo simulation to fill in data gaps[14]	A practical approach to filling data gaps is presented by Teh and Sumaila,[14] with a comprehensive estimate of SSF employment by country and using a Montecarlo technique (computer algorithms that generate probabilistic distributions) to estimate uncertainty.
Disaggregating SSF participation by gender and age	Although women and children's participation in fishing activities, especially along shorelines, is common, it is often overlooked or unreported in data collection. It can be difficult to obtain this information as it may not be reported due to fear of stigmatisation or risks involved in reporting child labour. The following information on gender is being compiled by Sarah Harper and Rashid Sumaila from the Institute for the Oceans and Fisheries, University of British Columbia, using a systematic review of the literature on gender and fisheries. This involves going through FAO fishery country profiles, Sea Around Us catch reconstruction reports, and by contacting local fisheries experts to compile (qualitative and quantitative) information on women's participation in fishing and fishing-related activities, number of women/men (% female participation), catch amounts and associated landed value, by fisheries sub-sector. Availability of data varies by country – in some cases, information is available on the species targeted, gears used and habitats fished, but databases are not always regularly updated. In some cases, countries may also have information on participation by age group. A recent special issue of Maritime Studies provides detailed information on gender in SSF around the world.[15]

Using access to fisheries subsidies as indicators[16,17]	Distribution of subsidies and access to social protection can be a good source of data to reveal small-scale fishers. Sources of information include government reports, surveys and interviews with key informants. Fishery subsidies are financial transfers (direct and indirect) from public entities to the fishing sector. They include fuel and non-fuel subsidies. **Non-fuel subsidies** 1) Beneficial subsidies: fisheries management; fisheries research and development and marine protected area; 2) capacity-enhancing subsidies: boat construction, renewal and modernisation; development programmes; port development; infrastructure for market and storage; tax exemptions and fishing access agreements; and 3) ambiguous subsidies: fisher assistance; vessel buyback and rural fisher community development programmes. **Fuel subsidies** are split into small and large-scale, depending on fuel consumption data. This commonly relies on engine type for estimation of fuel requirements. Schuhbauer[17] splits subsidies between SSF and large-scale fisheries (LSF) using existing quantitative or qualitative data, if available, or according to the proportion of catch reported by sector. Results showed that LSF fishers receive four times more subsidies than the SSF fishers and that removing capacity-enhancing subsidies towards more sustainable systems will have minimal negative impact on SSF communities.
Contributions from social protection and rural investments	Contributions and investments directed to areas directly linked to fisheries, such as coastal fishing communities. It can be useful to obtain the value of investments and number of beneficiaries from: • Types and number of rural infrastructure investments linked (directly and indirectly) to SSF (capture and aquaculture) • Number of small-scale (aquatic) farms in an area; percentage of farm households that are active members of SSF programmes, associations or organisations • Number of activities in which farmers work together to improve shared resources in the community (eg water systems, road, reservoirs). Although this kind of information, which can also be used to track Sustainable Development Goal contributions, can provide qualitative indicators it may be difficult to harmonise databases and information in practice.
Networks providing social information	Examples of such networks include Community Conservation Research Network (www.CommunityConservation.Net), which provides information on ethnic minorities, consumption, employment, etc.

2.3 Recreating catch for SSF

Catch is usually estimated as a function of effort — eg number of fishers, boats or trips — for each gear type, multiplied by the mean catch/effort of that gear type. While data from overall catch are uncertain, data on SSF catch are largely missing and often need to be recreated using existing information. This involves a variety of techniques and often includes considerable uncertainty. But fishery experts indicate that it is better to have an imperfect estimator than a 'zero' value. Gillet's study of the Pacific Islands[4] suggests that estimations of annual fisheries harvest "require considerable analysis and, in some cases, speculation (based on as much rigour as possible, including general understanding of the sector)".

Difficulties in obtaining this information include:

- SSF are not always well regulated or monitored, unless species caught are of high commercial value
- Catch data may exclude sales in local markets or catch that is illegally sold locally or across borders
- Official accounts rely on local cooperatives for data collection and will exclude information from non-associates
- Catch or harvest from women or children is often not reported. Although their contribution is often for subsistence,[18] significant amounts go into local markets.

Estimates often begin with officially collected data. Most countries already collect some information on nominal catches, defined as the net weight of the quantities landed as well as fisheries discards. Global datasets can be complemented or replaced with data from other sources such as detailed local sources (target species, gears used, and social statistics, particularly those related to women and children).

The Hidden Harvest project used catch data from FAO FishStat Plus (currently being updated, with focus on SSF — see Barsuto *et al*[8]) and includes reported and unreported catches disaggregated by small- and large-scale sectors, by species, country and year for 1950–2014. These data are likely to be a better source than the FAO fishery catch statistics that do not distinguish between small- and large-scale. Any breakthrough in fisheries accounting requires "making bold assumptions to infer major trends in fisheries".[19]

Table 3 summarises some of the methods you can use to recreate small-scale catch and harvest data.

Table 3. Methods for recreating SSF catch and harvest

Indicator and source	Description
Official data for total landings	Amount of fish in weight landed from all site ports, using FAO and Sea Around Us data complemented with government reports, surveys and monitoring landing sites. Most official fisheries information comes from mandatory inspections, data collection from book logs and ports, so tends to exclude SSF. Collecting data for SSF is difficult because inspections are not always mandatory, and small-scale fishers tend to land outside official ports, although it may be possible to track information by directly engaging with buyers and extracting information from their invoices. It is possible to track some of this information for SSF with licences but extrapolating to fishers without licences requires additional steps for validation. Some small-scale fishers keep their own logbooks, although the reliability and accuracy of this information has been questioned, due to the inability to cross-check and validate it. In the short term, countries could improve inspection and enforcement, licensing systems and community management (ie reporting catch as an agreed approach to managing the stock).
Assigning a fixed proportion SSF–LSF (Hidden Harvest)	Hidden Harvest used a **ratio of small-scale to large-scale fisheries,** to adjust the catch information: 70% SSF in the marine sector and 98% in inland waters.
Sea Around Us project – general fisheries catch[3,19]	**General fisheries catch** is usually estimated as a function of effort (number of fishers, boats or trips) for each gear type, multiplied by the mean catch/effort of that gear type (eg mean annual catch per fisher, or per trip). Annual estimates can be done by size of vessel (ie small or large). **Seasonality** is added by estimating monthly catch, if possible. The analysis develops 'anchor points' in time for missing data items, which are used for expansion and interpolating. It uses **linear interpolations** to fill in information gaps: eg year 1 catch is 1000t, and year 4 catch is 4000t, with years 2 and 3 missing. Rather than using zeros, or 'no data', the study assumes 2000t for year 2 and 3000t for year 3. Catch composition is based on fragmentary information eg combining observed catch composition of a few units with anecdotal information and scattered samples. In the absence of any information, equal contributions can be assigned to the representative groups (eg 25% snapper, 25% grouper, 25% grunt, 25% other). Interpolations through time can be made to reconstruct historical catches and composition series. Estimates should also include calculations of uncertainty.
FAO harvest statistics (www.fao.org/fishery/statistics/en)	FAO harvest statistics provide data in production, export quantity, domestic supply quantity, food supply quantity and other uses. They do not include fish discarded at sea or catches from illegal, unreported or unregulated (IUU) fisheries, suggesting that the amount of removed fish is larger than reported, but they vary on estimated magnitude or temporal trends. While incomplete and uncertain, FAO suggests using 'value reconstructions' to complement primary data.

Using inshore fishing areas and fisher density to estimate SSF[10]	Estimating inshore fishing area (IFA): this is the area of its shelf (and within its exclusive economic zone) ranging from the shoreline to 50km offshore or 200m depth, whichever comes first, based on a bathymetric map of the world ocean (or the 'submerged' topography of the seabed). Limits are selected on the assumption that small-scale fishers usually (a) perform day trips (a few hours, sailing, a few hours, fishing and a few hours, sailing back), and hence the limit in terms of distance from shore that they can travel to in a day; and (b) do not fish in very deep waters, except in areas where the shelf is very narrow (eg around oceanic islands) and so are restricted to on-shelf (neritic) waters and resources. The study uses the Human Development Index for SSF estimates instead of GDP.
Fleet size as indicator of effort[2]	The state of the fishing fleet is a common indicator for harvest. The FAO[2] estimated there are about 4.6 million fishing vessels in the world (as of 2016). The data include some indicators for disaggregation: for example, by type of engine (eg 61% are engine-powered), size (around 86% less than 12m). However, the FAO[2] highlights that vessels used in SSF are often not subject to registration requirements, making them more difficult to track.

2.4 Prices and values

Prices and values need to be collected for each country. Estimating the value of subsistence fisheries may require additional work, to assign monetary values to subsistence production. See for example Gillet,[4] and Cisneros-Montemayor et al[20] for shadow price strategies. **Table 4** below shows examples of techniques for collecting information on prices and values.

Table 4. Methods and indicators for estimating prices in SSF

Source	Description
SEEA-AFF	Proposes simply using the market price equivalent.
Pacific Islands[4]	Gillet[4] provides several methods for valuing subsistence fisheries, for example: • Farm gate pricing, using the market price of the product minus the cost of getting it to market. Used as a measure of the opportunity cost of self-consumption, this method is commonly used to estimate household non-market production. • The number of calories produced. Caloric values are commonly used in situations with absent markets in other sectors – for example to estimate the monetary value of unpiped water consumption in East Africa.[21]. This method requires more thinking, especially in relation to supply tables in the SEEA framework, although additional efforts would be useful to assess the value of SSF towards nutritional security (see Section 3.2 for using calories or nutritional content to aggregate consumption of fish products). • The opportunity cost of labour (or the reservation price of labour).
Mexico[17]	Ex-vessel price (US$): price received by fishers at the dock per unit weight of fish sold. This study complemented information from the Fisheries Economic Research Unit and the Sea Around Us Project database with data from a literature review, government reports, surveys, log books and buyer records.

Ex-vessel fish price data	A useful first stop is Sumaila et al,[22] which provides a database of average annual ex-vessel prices for commercially fished species by country. This was subsequently expanded by Swatz et al[23] and fed into the Sea Around Us Project (SAUP) database.
Cost of fishing	Schuhbauer[17] presents total cost as the value of inputs at the next alternative best use. Cost is split up into fixed cost, which does not change with production (eg capital investment, sunk cost) and variable cost, which can vary based on the output (eg fuel, crew, maintenance). The total cost includes opportunity cost, which makes total cost different from accounting cost, which is represented as labour costs. Schuhbauer[17] presents a methodology to estimate SSF and LSF fuel consumption by multiplying the fishing effort (number of boats x hours fished) by specific fuel consumption rate and by the fuel coefficient. It used a specific fuel consumption rate (FCR) of 0.35kg/kWh for SSF and 0.2kg/kWh for the industrial sector and assumed the number of hours fished as 12h/day for SSF and 24h/day for LSF. The data for Mexico was obtained from the Fisheries Economic Research Unit (FERU), the Commission of Aquaculture and Fishing's (CONAPESCA) annual fisheries reports and the SAUP database.

3. Using the SEEA framework to account at national level

The SEEA, developed by the UN's statistical office, provides a useful framework for fishery accounts linked to broader in-country national statistical systems that already provide some level of data on fisheries.[24] The same national statistical office should ideally also prepare the accounts, as they already have structures in place to collect, align and harmonise data from different sectors. Sources of data include traditional surveys and censuses, data from administrative sources (eg local government offices) and geospatial information systems (GIS) where available. Preparing the accounts will require a multidisciplinary approach that brings together statisticians, resource economists, ecologists and other fields.

The types of indicators required to build the accounts include:

- Physical variables of fisheries: (eg metric tonnes of fish, number of fishers) and variables for aggregation, such as monetary (eg US$ million) or nutritional values (calories, protein content)

- Variables for the stocks (and changes to them) of individual environmental assets (eg fish resources, ecosystem health)

- Economic transactions related to the fisheries sector: environmental taxes, subsidies, and other transfers, environmental protection expenditures, payments for fisheries quotas, etc.

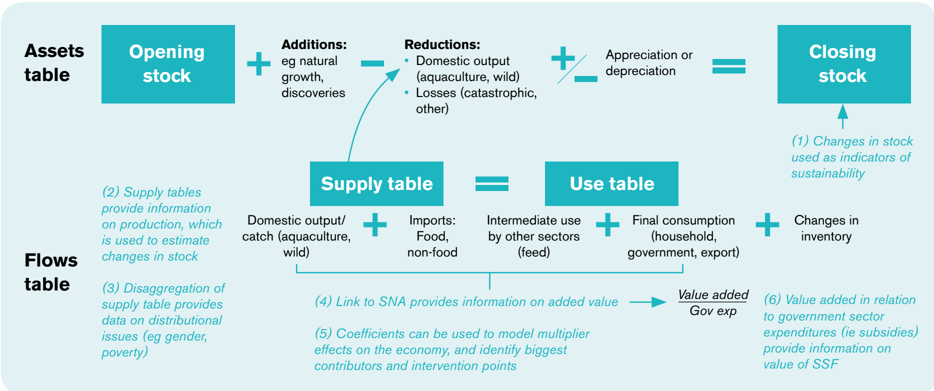
Practical steps you can take include: reviewing available data to compile satellite accounts, revising local technical capacities in your country's statistical units and working with government and technical partners to progressively update and improve accounts.

3.1 What is the SEEA framework?

The SEEA is the first international statistical standard for organising data to reflect interactions between the environment and the economy.[1,25] The data format is coherent and complementary to other international standards – such as the System of National Accounts (SNA) and the Balance of Payments and International Investment Position – potentially enabling modelling and policy analysis at the macroeconomic level.[26]

SEEA provides detailed modular guidance on how to improve accounting of physical and monetary flows from the environment into the economy. The physical supply and use tables are an expansion of the SNA's monetary supply and use tables. Provided by the UN[27], the SEEA-AFF is the conceptual framework for the agriculture, forest and fisheries sectors and focuses on improving the measurement systems for these primary renewable sectors. A growing number of countries are implementing it. The framework provides a system for organising data into *assets* and *flows* tables (see **Figure 2**). You can then use the information from these tables to answer specific questions on production and the sector's sustainability, such as those presented in Section 1.2.

Figure 2. Relations between SEEA statistic framework and policy questions



To apply the framework at sub-national level, you will need to determine the sub-national boundaries – which could be drawn administratively (eg by province) or by ecosystem (eg by river basin) – and find a suitable range of data for the unit of analysis. You will probably have to accept a degree of compromise between data available and scaling up or down. For cross-boundary units, you will need to coordinate with other countries, so using a coherent statistical framework to collect the data is an advantage. You can prepare SEEA accounts for different sectors and include different forms of resource (water, minerals, forests) and ecosystem indicators (eg environmental accounts, emissions).

Box 1. Examples of SEEA accounts that include fisheries

Guatemala created accounts between 2001–2005 for aquaculture and open capture.[28]

The Philippines created fisheries accounts in Laguna Lake, which depict the tension between cultivated and open water capture. These accounts have been linked to other environmental accounts, such as mangroves and water pollution, generating vital information for the local authority in terms of lake and coastal ecosystem management. The accounts in Laguna Lake are helping design policies to manage open capture and aquaculture activities.[29]

Colombia's detailed water and emissions accounts of Lake Tota are helping design a strategy for water allocations and pollution.[30]

Madagascar is working towards accounts of the Malagasy Fishery Sector.[31]

3.2 Preparing supply tables

Supply tables show how much of a resource (in this case, fish) is captured in a year. A physical flow account for fish and other aquatic products records the total supply and use of all fish and aquatic products (volume in tonnes or numbers), including production from capture fisheries and aquaculture. You can further disaggregate fisheries into production categories to reveal SSF. Total supply includes domestic production and imports; total use covers intermediate use of fish products, final consumption by households, changes in inventories and exports (see Section 3.3).

$$\sum \; \textit{Supply} = \textit{domestic production} + \textit{imports}$$

The physical flow account for fish and aquatic products is shown in **Table 5**.

Table 5. Supply table: physical flow account for supply of fish and aquatic products (tonnes)

		Domestic Output												Imports			
		Small-scale fisheries						Large-scale fisheries									
		Capture fisheries			Aqua-culture			Capture fisheries			Aqua-culture						
Fish and other aquatic products		Gross catch	Discarded catch	Nominal catch	Gross catch	Discarded catch	Nominal catch	Gross catch	Discarded catch	Nominal catch	Gross catch	Discarded catch	Nominal catch	Food use	Non-food use	Total imports	Total supply
Fish	freshwater fish																
	diadromous fish																
	demersal fish																
	tuna, bonito, billfish																
	other pelagic fish																
	other marine fish																
Crustaceans	crustaceans																
Molluscs	cephalopods																
	other molluscs																
Aquatic animals, others	other aquatic animals																
	pearls, sponges, corals																
Aquatic plants, algae	algae																
	macro plants																

Categories: there are various major groups of fish products, described in **Table 5**.[32]

Production process: these groupings of fish products may also be categorised by production process, splitting it into capture fisheries (ISIC – 031) and aquaculture (ISIC – 032). You can also separate SSF as an extra column in the supply table that differentiates SSF from LSF. The level of disaggregation will depend on the data available.

- *Capture fisheries* can be defined as an activity leading to the harvesting of fish in a defined area. This broad concept covers all aspects of human fisheries activity including economic, managerial, biological, environmental and technological viewpoints.

- *Aquaculture*[33] is the farming of aquatic organisms, including fish, molluscs, crustaceans and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production – such as regular stocking, feeding or protection from predators as well as individual or corporate ownership of the stock being cultivated. For statistical purposes, aquatic organisms harvested by an individual or corporate body that has owned them throughout their rearing period contribute to aquaculture, whereas aquatic organisms that are exploitable by the public as common property resources, with or without appropriate licenses, are the harvest of fisheries.

Domestic output (catch or harvest): we discussed issues and strategies for obtaining catch indicators in section 2.3. Determination of weight equivalents will vary by country. The table has four main categories of catch:

- *Gross:* total live weight of fish caught (including subsistence, commercial, illegal, unreported, and unregulated).

- *Nominal:* live weight equivalent retained and landed by fishers after at-sea discards, equal to the gross catch less the discarded catch.

- *Discarded:* catch discarded at sea in live weight equivalent. UN-STAT suggests this to be the difference between gross and nominal catch.

- *Other catch:* (including household catch) entry includes other fish production except for capture fisheries and aquaculture – subsistence catch or recreational fishing, for example.

Imports: in this column, you should list the total imports of fisheries commodities in live weight equivalent. A distinction is made between: food, which includes whole-meat, filleted and processed fish in live weight equivalent, and non-food, which includes fodder, industrial use and other uses.

Reporting units:

Tonnes of biomass are an acceptable aggregate, though you may choose to measure large marine mammals in numbers rather than by weight. SEEA-AFF suggests not aggregating physically in terms of tonnage, because of the diversity of products. An alternative method of aggregation is in terms of nutritional values – for example, in calories or protein content – or later in terms of monetary values.

The use table template in the next section (**Table 6**) can help you extend your analysis of the use or consumption of fish products in the physical flow table to measure calorie and nutritional intake from household fish consumption. Linking this information, which is also available in food balance sheets, with economic and environmental variables could help to improve assessments of food security and sustainability issues.

3.3 Preparing use tables

Use tables show how a resource (in this case, fish and aquatic products) is consumed in a year, recording the use of all the products accounted in the supply table. **Table 6** is a template you can use to assess the use of fish and aquatic products. These can include:

$\sum$ *Use = Intermediate use of fish products + final consumption* *(households, goverments)* *+ exports + change in inventories*

- Used by other industries ('intermediate consumption')
- Consumed by households ('household final consumption expenditure')
- Consumed by governments ('government final consumption')
- Sold to the rest of the world ('exports')
- Held as inventories ('change in inventories', which is used to balance both equations. See Section '2.4.8 Treatment of changes in inventories, losses and waste' of SEEA-AFF for details.[1]
- Used as assets over a longer period (eg vessels or machines) to produce other products ('gross fixed capital formation'). This use applies more to forestry and agriculture than to fisheries.

Table 6. Use table: physical flow account for use of fish and aquatic products (tonnes)

		Inter-mediate		Final consumption			Changes in inventory		Exports			
Fish and other aquatic products		Feed	Other uses	Food cons	(of which)	Other uses	Post-harvest/catch losses	Other changes	Food use	Non-food use	Total exports	Total use
Fish	freshwater fish											
	diadromous fish											
	demersal fish											
	tuna, bonito, billfish											
	other pelagic fish											
	other marine fish											
Crustaceans	crustaceans											
Molluscs	cephalopods											
	other molluscs											
Aquatic animals, others	other aquatic animals											
	pearls, sponges, corals											
Aquatic plants, algae	algae											
	macro plants											

Intermediate consumption:

- *Feed:* use of fish products as input to manufactured feeds, an important element of modern commercial aquaculture (in granule or pellet form, fish meal and fish oil).
- '*Other uses*'*:* this includes all other industrial uses except export, household final consumption and changes in inventories.

Household final consumption:

- *Food:* total amount of fish and aquatic products consumed by households as food, both purchased and otherwise obtained.
- '*Other uses*'*:* refers to the total amount of fish and aquatic products consumed by households for purposes other than food.

Changes in inventory:

- '*Post-harvest losses*' includes fish and fish products lost between the point of capture or harvest and the point of use, when such information exists or is obtained through surveys. Record any other positive or negative changes in inventory in the other column. This section basically absorbs all positive and negative differences in relation to the supply tables.

Exports

- *Food,* including whole-meat, filleted and processed fish
- *Non-food,* which includes fodder, industrial use and other uses.

3.4 Accounting for fisheries stocks (assets)

The current System of National Accounts (SNA) provides fisheries statistics that show monetary flows, but they do not show what happens to the stocks. This can lead to a false sense of wealth, as a country with over-extraction can indicate apparent increases in national income while depleting its fishery stocks in the long term.

SEEA-AFF looks at processes to improve practical indicators for fish stock inventories, using biophysical-economic models to estimate these inventories, eg global datasets and other indicators to estimate gross catch. According to the SEEA methodology, this should include the weight of fish caught in illegal, unreported and unregulated (IUU) fishing activity, but in practice this will be difficult.

This physical asset account shows the total biomass of all species harvested or cultivated within a national boundary. As we described in the previous section, harvesting includes commercial sea and freshwater operations, aquaculture, subsistence and recreational catch.

The physical asset account (**Table 7**) shows opening and closing stocks over a given period, as well as additions and reductions in stock resulting from natural growth, catches and other factors.

Closing stock

= opening stock + additions (natural growth, other)
− reductions (gross catch, natural and catastrophic losses, other reductions)

Table 7. Physical asset account for fish and aquatic resources (1,000 tonnes)

	Opening stock	Additions to stock			Reductions to stock					Net change in stock	Closing stock
		Natural growth	Other additions	Total additions	Gross catch/ harvest	Natural losses	Catastrophic losses	Other reductions	Total reductions		
Type of fish/ aquatic resource											
Cultivated aquatic resource	Breeding stock inventories										
Natural (wild) aquatic resources											

Source: Table 4.9 of SEEA-AFF

While it is a challenge, measuring stocks is a key step towards understanding sustainability. According to the SEEA Central Framework,[26] an asset account of a country's fish and other aquatic resources should cover:

- Stocks of aquaculture facilities
- All resources in coastal and inland fisheries in its exclusive economic zone throughout their life cycles
- Migrating fish and those that straddle the border of its exclusive economic zone, which are considered to belong to that country while inhabiting the zone
- Fish stocks on the high seas and those subject to international agreements on exploitation, in accordance with the portion of access rights to the resources that belong to it. These estimates must be in line with legal frameworks for international fisheries management established under the UN Convention on the Law of the Sea.

Measuring of cultivated stocks should be relatively straightforward, given that such stocks are managed and controlled. Therefore, this section focuses on natural (wild) aquatic resources. Informal aquaculture ponds linked to SSF may be more difficult to identify and might require additional efforts to include.

Direct measuring of opening and closing stocks and elements of change in stocks cannot usually be observed or measured directly, except for the harvest or gross catch. Therefore you will need to use biological models and assumptions to make estimates, understanding that they may not be fully robust (see section 5.9 of the SEEA Central Framework). Many countries conduct occasional assessments of resources and use these to calibrate their models.[34]

These guidelines do not give detailed practical steps for estimating fisheries stocks, as this requires special expertise. But the following techniques can help you develop methods to do this:

- Providing a **more qualitative assessment** of fish stocks by considering various biological and bio-economic models and catch statistics to show whether species and fisheries are being under-fished, fully fished or over-fished.

- **Estimating stocks based on effort:** a common approach is to consider changes in the gross catch relative to fishing 'effort' – for example: labour, days at sea, size of vessel and fishing gear. The catch per unit effort (CPUE) may be an indicator of the change in stock size, assuming that population density and population size are correlated and that the catch per unit effort increases as population densities increase. Although this may be valid for larger industrial fisheries, it may not hold for SSF. Size (length) distribution of landed catch by species can be a more accurate measure of the fishery ecosystem. Having better indicators for SSF, as we discussed in the previous section, will improve your catch estimation.

- Using **indicators of the condition of marine and inland water ecosystems** to understand the state of fish and other aquatic resources. These include:
  - Land-cover accounts, which are part of the SEEA Central Framework, for useful information about the surface area of lakes and wetlands – for example, to assess the changing seasonal patterns of an area of rivers and wetlands, such as mangroves, that can provide important habitats for the breeding cycle of certain fish stocks.
  - Indicators such as the Mean trophic index[35] and the ocean health index[36]. These may be used for marine environments. You will need more information on how to apply this indicator at country level, and how to link it to the accounts.
  - Indicators of the condition and quality of water resources, such as changes in river flow, which are probably only available on an ad hoc basis for specific locations.

- **Reclassifications:** recording the reclassification of cultivated and natural fish stocks can be a challenge. For example: when wild fish are introduced as breeding stock, when cultured seeds are released into the wild or there are escapes from aquaculture facilities in river and marine environments.

- **Catastrophic losses:** unexpectedly large losses from disease or natural disasters should be recorded as 'catastrophic losses'.

3.5 Wider applications of the SEEA-AFF

Currently, national fisheries do not provide much disaggregated data that can be linked back to contributions to GDP. In this section, we consider how you can extend the analysis of fisheries data to rural incomes and poverty, access to water and energy in rural areas, age and gender. Although there are no clear, practical steps for doing this at this stage, we offer some suggestions on how you can start this process.

The SEEA-AFF framework examines and reports on activities at national level, based on aggregate measures of production, supply and demand. There is space to expand this to spatial relationships and disaggregate data at sub-national level. The existing SEEA-AFF framework provides information on the main channels using fish: households, manufacture and exports. It is possible to use this information to understand the sector's added value to the economy and feed into discussion on policy changes — for example, around what happens after fiscal reform of the sector.

Making micro-level data from sectors (for example, on SSF and gender) compatible with SEEA is not straightforward. These guidelines are one of the first efforts to determine how to scale them up.

Fisheries accounts need to improve the way they reflect context and stakeholders. The UN's Economic and Social Commission on Asia and the Pacific's work on ocean accounts will contribute to this by defining coastal and marine ecosystems, accounting for their condition, services (the aquatic products) and beneficiaries.

Analysing waste discards from marine fishing can help us understand the sector's level of losses and inefficiencies and we can use time series to monitor the impact of policies tackling efficiencies in the sector. Sea Around Us project data has time series data on discards, disaggregated by sector (artisanal, subsistence, industrial, etc), year and fishing country, for 1950–2014. Waste accounts can be extended to include toxic discharges and plastics, linked to the SEEA experimental ecosystem accounts.

Figure 3. How to use extensions of the SEEA-AAF framework in fisheries

Disaggregate between industrial and SSF. A better understanding of the suppliers can also be reflected in gender statistics.

Disaggregate between inland and marine fisheries.

Focus on individual fishery rather than species, which allows for connections between species and health individual fisheries.

It is possible to organise fisheries data to help integrate it with standard economic data and compare it with other activities such as agriculture and forestry.
The supply-and-use structure facilitates comparisons of data on the production, trade and consumption of fish products.

The framework will allow us to use the data collected to generate indicators that show trends in relationships, including:

- Macroeconomic indicators, such as GDP
- Environmental ratios that show the intensity of use of environmental assets and flows — eg stocks and depletions — relative to production
- Sectoral contributions to production, exports, food supply; share of employment in fisheries; added value of fisheries
- The changing intensity of a commodity in terms of greenhouse gas (GHG) emissions, which will be important for monitoring a country's Intended Nationally Determined Contributions under the UN Framework Convention on Climate Change
- Indicators that focus on residual flows or flows considered potentially unsustainable, such as GHG emissions/GDP growth. It is possible to use polluter-pay indicators that link estimates of physical flows of residuals (eg GHG emissions) to the activity to revamp taxes
- Fisheries supply accounts, which facilitate comparisons of data on production, trade and consumption of fish products along value chains. It is possible to extend the analysis of consumption to calorie and nutritional intake or households and use this to assess food security and sustainability issues. There is also potential to expand the analysis to understand the quality of fish consumed locally versus quality and price of exports.

By linking SEEA-AFF data to SNA, you could develop environmentally extended input-output tables, to support modelling studies, for example input-output analysis, and general or partial equilibrium analysis. You could derive multipliers to measure direct and indirect impacts per unit of the industry's output such as:

- Direct and indirect dependence on a natural input (eg fish), and depletion- and degradation-adjusted net savings (eg are expectations of constant flows of inputs realistic?)

- Impacts on the economy from changes in resources. By linking chains of inputs and outputs the multipliers can be *backward* (series of inputs and outputs leading to production x) or *forward* (series of inputs and outputs that begin with those outputs)

- Footprints to help producers or consumers visualise the responsibility for environmental flows.

The framework allows for national strategic planning across the economy – for example, by analysing trade-offs and dependencies between natural resource sectors and other sectors of the economy – often ignored at planning stages. Better information can lead to better understanding of the drivers of macro-level trends and from there feed into more effectively designed policy responses such as fiscal reform.

The second stage of these guidelines will focus on expanding data analysis at country level and sharing the methodology with other stakeholders.

4. Data sources

Experience suggests that the biggest challenge is often simply starting the first set of accounts. One way to tackle this is to start with available global data (eg FAO statistics), which should provide a sound base for future and ongoing work. It's important to assess different sources of data that disaggregate for SSF early in the process.

Data sources come in many forms — from global data to national level surveys. **Table 8** presents potential sources of data for fisheries, and SSF in particular. You can find data for SSF in many sectors of the economy. SSF data varies in coverage and quality and you will need to use various techniques to fill the gaps. We discussed useful strategies for identifying indicators such as number of SSF and catch in Sections 2.2 and 2.3. With a coherent reference framework to assess local-level collection, it should be feasible to develop a more rigorous system for reporting fisheries and SSF.

Table 8. Potential sources of SSF indicators

Source	Description
National level	
National Fisheries Database/ Department of Fisheries	Information on number of official licences, number of people employed and catch
System of National Accounts	First step on fisheries as part of a country's primary sector and an indicator of proportionality to other sectors
Government budget/expenditures report	Information on inland revenue expenditure, taxes collected
Transport Department, Maritime Department	Vessel registries to estimate effort for supply (catch) and changes to stock. Can provide information on proportion of licenced/illegal vessels and may provide data on ownership (gender, etc)
Ministries of environment/institutes in charge of marine protected areas	Information on environmental and ecosystem indicators, and on people living in or in proximity to protected areas
Social benefits/social protection institutes (eg IMAS in Costa Rica)	Extracting the number of people accessing benefits who are linked to fisheries/live along coastline and so on can be an indicator for number of people involved in fisheries. Can also be useful as an indicator for government spending
Women's institutes (eg INAMU in Costa Rica)	Can provide indicators for women's participation in fisheries in terms of jobs, organisations, associations, etc

Source	Description
Sectoral level	
Flood and disaster mitigation information (eg Flood Action Plan in Bangladesh)	May have data on river ecology, rural infrastructure, embarkment zonings, boats/transport, fisheries production
Records from harbour masters and other maritime authorities	Information on number of fishing crafts (small boats by type; large boats by length class and/or engine power)
Records from cooperatives or private sectors	Information on fisheries product exports, processing plants, importers of fishing gear and value chain information – such as use of diesel, fuel subsidies, ice etc – for supply/use and multipliers
Household income and expenditure surveys (eg Federated States of Micronesia's new 'fisheries-friendly' survey[4])	Information at household level and/or district/community
Remote sensing and old aerial photos from geographic or other surveys	Used to estimate vessel supply, number of boats on beaches and along piers as indicator of effort
Ecosystem assessment	If they exist, studies on quality of the marine ecosystems can be used to estimate stock
International research/action programmes — eg Mekong River Commission, marine research institutes Academic studies, including peer-reviewed literature, theses, scientific and travel reports, accessible in departmental or local libraries or branches of universities, or through regional databases Interviews with elderly fishers	Data available in published reports often provide detailed information for disaggregation on jobs, gender, catch, sub-sectors and ecosystem indicators that can facilitate multipliers from other studies

Source	Description
Global level	
Sea Around Us project (www.seaaroundus.org) from British Columbia University	Significant historical data on fisheries in general and SSF
Too Big to Ignore (http://toobigtoignore.net) network	Information System on Small-Scale Fisheries (ISSF) database. Recently hosted the 3rd World Small-Scale Fisheries Congress to share information and capacities related to SSF[37]
Hidden Harvest project	Compiling data on the contributions of SSF using information from household surveys, censuses, nutritional information on fish species, consumption among coastal indigenous people and location-based catch estimates. It will provide a framework for ongoing monitoring of socioeconomic contributions from SSF[8]
FAOSTATS (www.fao.org/faostat), FishStatJ (www.fao.org/fishery/topic/16054/en) FAO Yearbook of Fishery and Aquaculture statistics	Source of global aggregated data. But the data will need adjustments as they often do not cover SSF, discarded fish, or illegal and unreported catches, and have been deemed 'profoundly biased'[19]
International Council for the Exploration of the Sea (ICES) marine data[38] (Northeast Atlantic region)	20 ICES member countries officially submit annual nominal catches of more than 200 species of fish and shellfish in the Northeast Atlantic region. ICES has been gathering and publishing fisheries statistics since 1904. The current data are collected and coordinated in collaboration with Statistical Office of the European Communities (EUROSTAT)
Global fisheries landings (1950-2014)[39] (https://researchdata.ands.org.au/global-fisheries-landings-v30/1307266)	Gross-level data from various public sources (but not national datasets) are harmonised and mapped to 30-min spatial cells based on the distribution of the reported taxa and fishing fleets involved. These data were extended to include the associated fishing gear used, as well as estimates of illegal, unregulated and unreported catch (IUU) and discards at sea. Two adjustments to reflect SSF: 1) SSF occurs only in spatial cells both within 200km of shore and with a depth of 50m or less 2) unreported SSF is linked to high levels of corruption – ie authorities are unlikely to forward full and complete records

'Disruptive technologies'[40] – such as mobile internet, robotics and electronic fish tags – can also be useful in the context of SSF to provide data and combine scattered data sources. Although they may be expensive at the outset, these technologies quickly become affordable. For example:

- **Integrating and rationalising scattered data,** which are often not integrated in national systems and remain isolated in different offices and departments. Technological advances (smartphones, tablets, etc) can improve data collection from beaches and on vessels. FAO is developing a global software framework built on cloud technology to integrate web-based inventories of stocks.[2] Environmental economic accounting can then provide the backbone of concepts and classifications needed for the aggregation.

- **Two-way information exchange,** to provide up-to-date information to fishers – for example, on historical and current catches, fishing costs, weather forecasting and satellite positioning – while also allowing for gathering and storing information to improve compliance with regulations and traceability.

- **Tracing along value chains,** allowing fishers to offer 'on demand' products from selective and safe fisheries. This includes blockchains, sensors and automatic identification systems.

The Pacific Community 'Coastal Fisheries Programme' is testing a range of tools to improve data collection and use in the Pacific Islands region. Other countries and regions should follow this example and invest in testing these technologies and helping fishers access, understand and take advantage of them.

5. References

1 UN Statistics Division (2018) SEEA Agriculture, Forestry and Fisheries (SEEA-AFF). Department of Economic and Social Affairs, Statistics Division, New York.

2 FAO (2018) The state of world fisheries and aquaculture: meeting the Sustainable Development Goals. Rome, Italy.

3 Pauly, D and Zeller, D (2016) *Global Atlas of Marine Fisheries: A Critical Appraisal of Catches and Ecosystem Impacts.* Island Press, Washington DC.

4 Gillet, R (2016) Fisheries in the economies of Pacific Island countries and territories. Noumea, New Caledonia: Pacific Community, FFA, Australian Aid.

5 Jacquet, J and Pauly, D (2008) Funding Priorities: Big Barriers to Small-Scale Fisheries. *Conservation Biology 22*(4):832-835.

6 The System for Environmental and Economic Accounts (SEEA) provides a framework to analyse changes in stocks and flows of natural resources in a country (eg land, forests, water, agriculture, mining) in a way that is compatible with existing national reporting. See Section 3.

7 FAO (2015) Voluntary guidelines for securing sustainable small-scale fisheries in the context of food security and poverty eradication at a glance. Rome, Italy.

8 Barsuto, X, Franz, N, Mills, D, Virdin, J and Westlund, L (2017) Workshop proceedings. Paper presented at Improving Our Knowledge on Small-Scale Fisheries: Data Needs and Methodologies. Rome, Italy, 27-29th June 2017.

9 www.worldfishcenter.org/hidden-harvests

10 Chuenpagdee, R, Liguori, L, Palomares, M and Pauly, D (2006) Bottom-Up: Global Estimates of Small-Scale Marine Fisheries Catches. In *Fisheries Centre Research Reports:* Fisheries Centre, University of British Columbia, Vancouver.

11 Pochet-Ballester, G and Zango-Bulgarelli, D (2018) Legal criteria: the extent of the concept 'artisanal small scale fishing'.

12 www.seaaroundus.org/

13 Mainstreaming values of small-scale fisheries in national accounts: experts' methodological meeting. 19–20 June 2018, at the Centre for Carbon Innovation, Edinburgh, UK.

14 Teh, L and Sumaila, R (2013) Contribution of marine fisheries to worldwide employment. *Fish and Fisheries* 14(1):77-88.

15 Frangoudes, K and Siri, G (2018) Special Issue: (En) Gendering Change in Small-Scale Fisheries and Fishing Communities in a Globalized World. *Maritime Studies 17*.

16 Schuhbauer, A, Chuenpagdee, R, Cheung, W, Greer, K and Sumaila, R (2017) How subsidies affect the economic viability of small-scale fisheries. *Marine Policy* 82:114-121.

17 Schuhbauer, AC (2017) The economic viability of small-scale fisheries, University of British Columbia, Vancouver.

18 Although not in the formal economy, the shadow value of subsistence catch is very important. For example, if not available, households would need to buy food. In many contexts deck-hands and crew are paid with catch, introducing a commercial component in terms of cost of fishing but where no monetary transaction takes place. The line between commercial and subsistence is not always clear and including both would provide a more comprehensive estimate of the real contribution of fisheries to the economy.

19 Pauly, D and Zeller, D (2015) So long, and thanks for all the fish: The Sea Around Us, 1999-2014 A fifteen-year retrospective. Fisheries Centre, University of British Columbia, Vancouver.

20 Cisneros-Montemayor, AM, Harper, S and Tai, C (2018) The market and shadow value of informal fish catch: a framework and application to Panama. *Natural Resources Forum* 42(2):83-92.

21 Thompson, J, Porras, I, Tumwine, J, Mujwahuzi, M, Katui Katua, M, Johnstone, N and Wood, E (2001) Drawers of water II: 30 years of change in domestic water use and environmental health in East Africa. IIED, DFID, SIDA.

22 Sumaila, UR, Marsden, AD, Watson, R and Pauly, D (2007) A Global Ex-vessel Fish Price Database: Construction and Applications. *Journal of Bioeconomics* 9(1):39–51.

23 Sumaila, R, Lam, V, Le Manach, F, Swartz, W and Pauly, D (2013) Global Fisheries Subsidies. European Parliament. Directorate-General for Internal Policies.

24 A common issue for fishery statistics is that they tend to be aggregated to livestock, forestry or agriculture as part of the primary sector statistics. This contributes to masking the real contribution of the sector to national economies.

25 The latest SEEA-AFF document was published earlier in 2018 and is available at https://seea.un.org/content/agriculture-forestry-and-fisheries

26 UN (2015) System of Environmental-Economic Accounting 2012. Central Framework. UN, European Union, FAO, International Monetary Fund, Organisation for Economic Co-operation and Development, The World Bank, New York.

27 Final draft after consultation available at https://seea.un.org/content/agriculture-forestry-and-fisheries

28 Vargas, R (2017) Fisheries and aquaculture: Environmental and economic accounting for fisheries. WAVES, Washington DC.

29 Vinculado, CP (2015) The Philippine experience of ecosystem accounting, Philippines Statistics Authority. In *Regional Training Workshops on the System of Environmental-Economic Accounting (SEEA) Experimental Ecosystem Accounting in Asia Pacific*. Jakarta, Indonesia: UN, UNEP, CBD, Norwegian Ministry of Foreign Affairs.

30 Porras, I and Goodrich, R (2017) *Natural Capital Accounting and Policy.* https://bit.ly/2y8oZt2. World Bank Group, Washington DC.

31 WAVES (2012) Natural capital accounting and management of the Malagasy fisheries sector. WAVES, Washington DC.

32 Production and trade of fisheries commodities are collected through the International Standard Statistical Classification of Fishery Commodities (ISSCFC). In this classification, fisheries commodities are classified according to the species and to the degree of processing. ISSCFC is based on the structure of SITC, with additional codes to include links to ISSCAAP, and breakdown by additional species and product forms. https://seea.un.org/content/agriculture-forestry-and-fisheries

33 A somewhat grey area in aquaculture is shrimp farming, where shrimp larvae is harvested from the marine environment and used to seed shrimp aquaculture operations. Disaggregating these contributions can be significant economically in countries such as India and in other parts of Asia, where large numbers of women and children are involved in larvae harvesting.

34 See for example the ongoing work by UNESCAP in the Pacific: www.unescap.org/events/asia-and-pacific-regional-expert-workshop-ocean-accounts

35 Pauly, D and Watson, R (2005) Background and interpretation of the 'Marine Trophic Index' as a measure of biodiversity. *Philosophical Transactions of the Royal Society: Biological Sciences* 360, 415–423.

36 www.oceanhealthindex.org/

37 WSFC (2018) 3rd World Small-Scale Fisheries Congress: Transdisciplinarity and Transformation for the Future of Small-Scale Fisheries in Chiang Mai, Thailand, 22-26 October 2018.

38 www.ices.dk/marine-data/dataset-collections/Pages/Fish-catch-and-stock-assessment.aspx

39 Watson, RA (2017) A database of global marine commercial, small-scale, illegal and unreported fisheries catch 1950–2014. *Scientific Data* 4:170039.

40 Disruptive technologies are new technologies, often unrefined, that have a potential for drastic alteration in society, often providing new ways to meet objectives. Some everyday technologies (eg personal computers and smartphones) were 'disruptive' when first implemented.

It is notoriously difficult to obtain data for fisheries, especially for the more elusive small-scale sector, which tends to operate under the radar. These guidelines aim to assist national statistics officers and others improve the way they account for small-scale fisheries (SSF). We do this in two steps: 1) summarising current efforts to collect statistics for SSF and 2) presenting how this data can feed into national accounts using the international statistical standard developed by the United Nations to facilitate cross-sectoral macroeconomic analysis.

These guidelines offer a range of strategies to help reveal the sector more clearly. Ultimately, if SSF data are robust, policymakers can design policies that will both improve the lives of people who depend on SSF, and secure investments to promote the sustainable management of fishery ecosystems.

Sida

This toolkit has been financed by the Swedish International Development Cooperation Agency, Sida. Responsibility for the content rests entirely with the creator. Sida does not necessarily share the expressed views and interpretations.

The International Institute for Environment and Development (IIED) promotes sustainable development, linking local priorities to global challenges. We support some of the world's most vulnerable people to strengthen their voice in decision making.

International Institute for Environment and Development
80-86 Gray's Inn Road, London WC1X 8NH, UK
Tel: +44 (0)20 3463 7399
Fax: +44 (0)20 3514 9055
www.iied.org

@iied
www.facebook.com/theIIED
Download more publications at http://pubs.iied.org/

iied

Knowledge Products

Toolkit

February 2019

Fisheries

Keywords:
Sustainable fisheries, ecosystems, environmental economics, ecosystem services