E€OFISH

Enhancing equitable economic growth by promoting sustainable fisheries in the EA-SA-IO region

BLUE ECONOMY FISHERIES SATELLITE ACCOUNT (BEFSA)

MANUAL PART II OCEAN ACCOUNTS (Draft)

Dr Anand Sookun (NKE)

Promoted and Funded by EUROPEAN UNION

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Blue Economy Fisheries Satellite Account (BEFSA)

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Prepared by

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1. Introduction

This manual focuses mostly on the fisheries component of the Ocean or Blue Economy (BE). The key concepts elaborated will be the same as in the O**cean Accounts manual** (Part I) and thus the processes and steps, etc. can be easily followed by referring to it. Moreover, the **implementation process** is also the same as the one presented in the Part I.

2. Methodological Approach

The fisheries component will be isolated from others found in the SEEA AFF[1]. This will entail an approach to integrate meaningful information that can be identified and extracted. It will enable also to consider social and environmental issues.

Accounts may be compiled in either physical or monetary units, or a hybrid combination of both. Hybrid accounts are often used for fisheries accounting as the combination of physical and monetary information reflects the range of data collected by both fisheries management agencies and national statistical offices.

The general principle builds on the two parts presented below, i.e. the Statistics and the accounts which are linked. The accounts mostly integrates the 3 components of the statistics (Fig. 1).

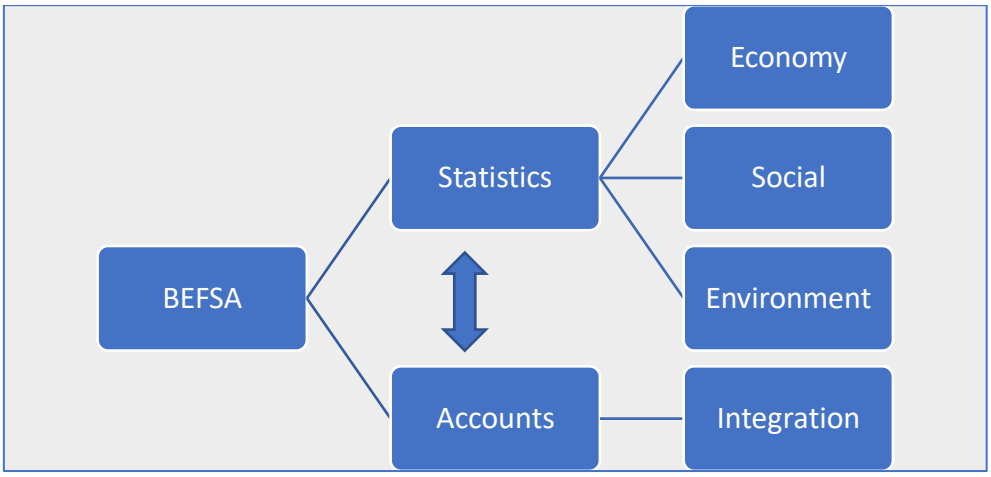

Figure 1: BEFSA Building blocks

[1] FAO and UN. 2020. System of Environmental-Economic Accounting for Agriculture, Forestry and Fisheries (SEEA AFF).
Rome. https://doi.org/10.4060/ca7735en

3. Statistics on Sustainable Fisheries

Statistics and indicators for sustainable fisheries[2] may prove to be very useful for fisheries management. These include those from the economic, social and environmental components that will be covered below. The following list of indicators can also guide the compilation process and is based on the principle of Pressure-State –Response (PSR) framework (Table 1).

Table 1: Suggested Indicators for sustainable fisheries

Dimension	Pressure	State	Response
Ecosystem (Resources and Environment)	- Total catch - Total Area fished - Catch vs Sustainable Yield - Total effluent discharged	• Biomass vs Total Biomass • Fm Mortality vs Target Fm • E rate vs Target E rate • Biodiversity index • Community structure - Trophic structure • Area of critical habitat	• TAC/Sustainable yield • % depleted stocks rebuilding • Reduction of land based pollution • User rights established • User fees established
Social	• Fishing effort • Number of vessels • Growth rate of fishers • Unemployment rate • Fish Consumption • Immigration rate • Social conflict /unrest	- Number of fishers - Demography - Number of associations - % Below Poverty Line - Income & asset distribution	- Unemployment assistance - Support to associations - Gender Development - Food Security Measures • Resource allocation decision
Economic	• Sector unemployment • Subsidies • Excess fishing capacity • Resource Rent potential	• Profitability • Wages and salaries • Sector Employment	• Economic incentives & Disincentives (e.g., subsidies, taxes, buy-back etc.) • Command & control measures
Institution/Governance	• Employment policies • Absence of use of property rights	• % resources assessed • % with management plans • % Mgmt cost recovery • Rate of compliance • % resources co-managed	• % resources assessed • Job conversion programmes • Retraining programmes • Number of compliance operations

Note: B: Biomass Fm: Fishing Mortality E: Exploitation Rate TR: Target Resource NTR: Non-Target Resources

[2] Source: S. Sweenarain, Ecofish Programme: Elaborating a Sustainable Development Reference System (SDRS) For The Marine Fisheries Of Eastern Africa, Southern Africa, And The Indian Ocean Region

3.1 Economic Component

3.1.1 Compilation steps

Step 1: **Select the appropriate economic statistics/indicators**

- Refer to the regional manual and the international guidelines/standards such as the SNA, and the SEEA AFF.
- List the indicators, such as the Value Added (VA)/Gross Value Added (GVA), investment (Gross Capital Formation GCF), employment and others as appropriate.

Step 2: Disaggregate the Fisheries components

- Identify the components to be included and those that are relevant for the country;
- Disaggregate the data to cover the **whole value chain** of the fisheries sector, and not just the fishing sector, as is common in national accounts;
- A detailed split of the activities is required: refer to **fisheries sector components and the sustainomics of fisheries in the regional framework**
- Also see standards such as FAOs[3]
  - *International Standard Statistical Classification of Fishery Commodities* (ISSCFC),
  - *Harmonized Commodity Description and Coding System* (abbreviated to HS), and
  - *Classification and illustrated definition of fishing gears*[4] elaborates the revised International Standard Statistical Classification of Fishing Gear (ISSCFG). The classification applies to commercial, subsistence and recreational fisheries in marine and freshwater fisheries.
  - United Nations *Standard International Trade Classification* (SITC).
- Match the sectors/activities of the **fisheries value chain,** to **the International Standard Industrial Classification (ISIC) of economic activities;**
  - Consider the **backward (upstream) and forward (downstream) linkages** of fishing activities and fisheries that can show direct and indirect Gross Value Added (GVA);

[3] FAO, Fishery commodities classification
[4] FAO 2021: Classification and illustrated definition of fishing gears

- This will comprise activities linked to fishing, such as boat repairs and maintenance, sales of fishing gears and other equipment, transport, seafood processing, fishing support activities such as insurance and finance, and sales and consumptions. Table 1 below provides a simple way of presenting the data

- The sustainable fisheries and SDGs can also be linked to these value chains, e.g. through Natural Capital Accounting (NCA).

Step 3: Compile the data

- Obtain disaggregated data for tabulations, graphs and other illustrations.
- e.g. GVA or employment by sectors in the value chain, trade of fish and fish products by species, etc.
- Estimate missing data
  - For some sectors in the value chain, assumptions can be used, e.g. 10% of the VA in Manufacturing of food is for fisheries related products;
  - E.g. coastal fisheries GVA = Gross output (coastal catch x average prices) – Intermediate Consumption (IC): fuel, water, fishing gears, etc.
- Present the data

These types of data can be used for as an end product by users/policy makers and also for the next steps in the BE fisheries accounting.

Table 2: Gross Value Added of Fisheries (LCU monetary value) and employment

	Gross Value Added		Employment	
Industry	Year xxx	Year yyyy	Year xxx	Year yyyy
Direct				
Aquaculture				
Fishing				
Indirect*				
Aquaculture				
Fishing				
Aquafeed				
Fishing boat				
Fish processing				

Fish marketing	
Rest of the economy	
Total	

*Including backward and forward linkages

3.2 Social Component

3.2.1 Compilation steps

Step 1: **Identify and select the appropriate social variables**

- E.g. Employment: categorise by ISIC and if possible by ISCO occupations:
  - e.g. ISCO-88 International Standard Classification of Occupations, e.g. Major Group 6. Minor Group 615 - Fishery Workers, Hunters and Trappers[5]. These include:
- Aquatic life cultivation workers
- Inland and coastal waters fishery workers
  - Deep-sea fishery worker
  - Hunters and trappers
- Wages, e.g. for fishers, and others
- Gender, e.g. by specific occupations, etc.
- Fish food: includes the fisheries commodities consumed as presented in national food balance sheets[6].

Step 2: **Compile data**

- Obtain the data for the variables identified and selected in step 1
- Estimate or impute the missing data – consult sectoral experts/units

Step 3: **Prepare the data presentation format**

- Select from tabular, graphic or other ways to present the data – see example hereafter

[5] FAO 2004: Handbook of Fishery Statistical Standards
[6] See e.g. FAO: https://www.fao.org/fishery/statistics/global-consumption/en

Table 3: Sectoral employment/occupation by gender

Sector/sub sector	Occupation	Male	Female	Total
Coastal fishing	Fisher			
Deep sea fishing	Skipper Fisher Etc.			
Aquaculture				
Etc.				

Other details may include employment by gender, wages, etc., for pre-harvest, harvest, and post-harvest activities

1. Employment

Process: Employment Statistics

Step 1: Obtain Employment Data from by Industry and by Gender. Employment data includes both number of persons employed by Gender and by Industry, and respective wages paid.

Step 2: Restructure the published Employment data estimates according to this Manual Layout of activities, e.g. by ISIC related to the BE.

Step 3: Multiply employment data by industry with any Ocean or BE related rations to obtain BE employment statistics covering both number of persons employed by Industry, Gender and Wages paid.

3.3 Environmental Component

For the environment, since the statistics are varied, the FDES and the CBD QSP can be consulted for details. In those documents, further references are provided. Below is an example on ocean acidification.

- SDGs Indicator Description 14.3.1: Average marine acidity (pH) measured at agreed suite of representative sampling stations.
- This is a Tier III - No internationally established methodology or standards are yet available for the indicator, but methodology/standards are being (or will be) developed or tested.
- Common practices include the following approaches:
  - Collection of seawater samples for laboratory analyses of total dissolved inorganic carbon (CT) and total alkalinity (AT) is a standard practice if ship or fixed platform access to the water allows. Parameters of interest, such as pH and aragonite saturation, can be derived via commonly available software (e.g., CO2SYS). Some calculations require nutrients and other variables.

- As of 2018, sensors are only commercially available for measurements of pH and pCO2 in the ocean. Currently, sensors capable of measuring either of these parameters with the high precision required to detect the ocean acidification signal are costly and require high maintenance. New developments are underway to produce less expensive and high accuracy sensors.
- Use of empirical proxies, such as more easily and accurately measured variables (salinity, temperature, oxygen), to estimate pH and aragonite saturation has been tested for use in oceanic waters, but has yet to be established for estuarine waters where other factors may interfere.
- The Global Ocean Observing System (GOOS) considers these parameters Essential Ocean Variables (EOVs) and provides detailed specifications here.

Ecosystems

According to UN ESCAP, to build ocean accounts, some tools and principles need to be applied as presented in the following figures.

National Spatial Data Infrastructure (NSDI)

- SEEA Ecosystem extent
  - Terrestrial and Freshwater ecosystem types (Land Accounts)
  - Coastal communities
  - Coastal infrastructure
  - Pollution sources
- Ocean spatial units
  - Ocean ecosystem types
  - Marine protected areas
  - Fishery, tourism, mining areas
  - Water quality / temperature
- National statistics
  - Emissions, effluents, wastes
  - Assets: fish stock
  - Supply/use: catch, beneficiaries

3.3.1 Compilation steps

Step 1: Identify and select the appropriate environmental variables

- Fish Stock
- Catch per unit effort (CPUE)
- Ecosystems (marine and others)

- MPA: designated Marine Protected Areas
- Marine spatial panning: includes well demarcated areas that can be on maps and Geographical Information System (GIS) databases.
- Consider Fisheries, as elaborated by the FAO[7],
  - Capture fisheries statistics
  - Catch and landings
  - Nationality of catch and landings
  - Fishery fleet
  - Fishers
  - Fishing gear classification
  - Fishing effort
- Further socio economic variables, as outlined by the FAO, comprise:
  - Fisheries production
  - Aquaculture production
  - Food balance sheets on apparent consumption
  - Fishery commodities classification
- Refer to Table 1 above to select other environmental variables

Step 2: Set up an appropriate database

- Consider the diverse types of environmental variables, e.g. their units, etc.
- Keep appropriate formats, e.g. tables/spreadsheets, GIS data, etc.

Step 3: Populate the database

- Obtain appropriate data for the diverse thematic topics
  - e.g. fish catch, area of mangroves, Sea level rise, etc.
- Some estimates might be needed
  - E.g. areas of fishing reserves using GIS
  - Nominal catch based on landings, etc.

Step 4: Prepare the data presentation

- Use tables, graphs, maps and others
- Consider trends etc.

[7] FAO: Coordinating Working Party on Fishery Statistics (CWP)

4. Blue Economy Fisheries Satellite Accounts

4.1 Scope

The structure of the BEFSA includes physical and monetary accounts (See Regional Framework). The monetary part can be enhanced by the inclusion of all the value chains, including the backward and forward linkages. This can interpreted as **the pre-harvest, harvest and post-harvest** activities.

In the BEFSA accounting module, fisheries statistics are primordial and include the base or underlying data. The accounting process involve the data (re) organisation by using some special tools such as the SUT, IOT or SAM.

4.2 Compilation steps

Step 1: Identify the components to be included and those that are relevant for the country

- Examine the interactions among the different components/value chains of fisheries in the SUT or IOT, etc. See table xxx etc. below

Step 2: Identify the parameters to be included in the matrices

- E.g. catch quantities, price of fisheries by species, value added and other economic variables, import and export quantities and values (monetary), and other data on administrative and financial services.
- Sometimes, grouping or aggregation can be useful. In the SEEA AFF, the groups for fisheries are done according to the ISSCFC as follows:
  - Freshwater fish
  - Diadromous fish
  - Demersal fish
  - Tuna, bonito, billfish
  - Other pelagic fish
  - Other marine fish
  - Crustaceans
  - Cephalopods
  - Other molluscs
  - Aquatic mammals
  - Other aquatic animals
  - Aquatic plants, algae

Step 3: Organise the data for tabulations, graphs and other illustrations.

- These can be used for as an end product by users/policy makers and also for the next steps in the BE fisheries accounting.
- Further details can be found in the SEEAA AFF and the FAOs ISSCFC.
- Once the matrices are developed and populated, useful simplified tabular presentations and graphics can be crafted.
- These may show specific issues such as pollution by residuals or wastes generated by industries or consumers/end-users, the reuse of residuals, or the economic outputs from natural ecosystem inputs, and other issues.

Examples of accounting results

Some examples have been already presented in the Regional Framework and here some others are added to help compilers. Users and compilers of the accounts will have a choice from several of the formats and concepts provided in the regional framework. The international standards like the SEEA AFF should always be consulted for further details.

Monetary Accounts

- Can be derived from standard national input-output or supply-and-use tables
- The monetary accounts basically presents the economic or national accounts aggregates like the **value added** and its underlying data such as the **intermediate consumptions**.
- The SUT (Table 3) has one example for capture fisheries .
- It follows the general structure of the SNA monetary supply and use account, with fisheries products in the rows and standard components of total supply and total use in the columns.
- For each row, **total supply (output plus imports), must equal total use** in terms of intermediate consumption, final consumption, gross fixed capital formation, changes in inventories and exports.
- Note that a column for government final consumption is not included, as the purchase of fisheries products by general government units will form part of their intermediate consumption as inputs to the production of government services.

Table 4: Monetary supply and use table (SUT) for fisheries products (currency units)

	Monetary **supply** table for agricultural, forestry and fisheries products (**Fisheries**)							Monetary **use** table for agricultural, forestry and fisheries products (**Fisheries**)					
	Output		Imports	Margins/transport margins	Taxes on products	Less subsidies on products	**Total supply** at Purchaser prices	Intermediate Consumption	Household FC	Gross fixed capital formation	Changes. Inventories	Exports	**Total use** at purchasers prices
	AFF Units	Non AFF Units											
Fisheries products													
Aquaculture													
Can be detailed													
Capture Fisheries, e.g.	100	0	20	5	5	10	110	50	30	20	5	5	110
Can be detailed													
e.g. artisanal													
Commercial/industrial, etc.													
Total Fisheries							110						110

Note: Margins=Trade and transport margins; Taxes Inc. Taxes on products; Subsidies is on products; Supply is at purchasers prices; Household FC=HH Final consumption; GFCF: Gross fixed Capital formation; Changes; changes in inventories. Total use at purchaser's prices. Total Supply = Total Use

Physical Accounts

With the Physical SUT (PSUT)[8], fish products can be grouped according to any available categories. For **each product, total supply must equal total use** (Tables 4 and 5). Fish and aquatic products are measured in tonnes. Estimates of nominal catch – the core measure of production – should be in terms of live weight equivalent. For the purposes of balancing supply and use, all categories of use

[8] FAO and UN. 2020. System of Environmental-Economic Accounting for Agriculture, Forestry and Fisheries (SEEA AFF). Rome. https://doi.org/10.4060/ca7735en, Table 3.8.

should also be recorded in live weight equivalent. It is important when deriving relevant conversion factors that the complete range of uses is accounted for. In particular, conversions should take into account the existence of post-harvest and post-catch losses. In some cases, losses and other waste may be converted into other products, such as dry fish meal. These are considered derivative products and are not included in the supply and use table.

Table 5: Physical Supply Table for fish and aquatic products (t)

		Output/Supply							
		Capture fisheries			Aquaculture			Other catch (including household production)	Total output - Supply
		Gross catch	Discarded catch	Nominal catch	Harvest	Harvest loss	Nominal harvest		
Fish and other aquatic products									
Fish	Freshwater fish	3 062	43	3019	4036	57	3979		6998
	Diadromous fish								
	Demersal fish	1152	16	1135	71	1	70		1205
	Pelagic fish, including Tunas, bonitos, billfishes	1590	22	1568	9		9		1577
	Other pelagic fish	164	2	162					162
	Marine fish, other				599	8	591		591
Crustaceans		401		401	921	1	920		1321
Molluscs	Cephalopods	188		188					188
	Other molluscs excl. cephalopods								
Aquatic animals, other	Marine mammals								

		Output/Supply							
		Capture fisheries			Aquaculture			Other catch (including household production)	Total output - Supply
		Gross catch	Discarded catch	Nominal catch	Harvest	Harvest loss	Nominal harvest		
	Reptiles								
	Other aquatic animals								
	Pearls, sponges and corals								
Aquatic plants, algae	Algae				10748	200	0548		1048
	Macro plants								

Table 6: Physical Use Table for fish and aquatic products (t)

		Intermediate consumption		Household final consumption			Changes in inventories		Exports			Total Use
		Feed	Other uses	Food	Of which food waste	Other uses	Post-harvest catch losses	Other changes	Food use	Non food use	Total Exports	
Fish and other aquatic products												
Fish	Freshwater fish	29	1431	3591	50	405	20	115			1407	6999
	Diadromous fish											
	Demersal fish	4	434	676		63		17			11	1205
	Pelagic fish, including Tunas, bonitos, billfishes	5	428	668		62		4			411	1577

	Other pelagic fish	1	58	90		11					2	162
	Marine fish, other	2	188	293		27		8			73	591
Crustaceans			267	687		45					322	1321
Molluscs	Cephalopods			188								188
	Other molluscs excl. cephalopods											
Aquac animals, other	Marine mammals											
	Reptiles											
	Other aquatic animals											
	Pearls, sponges and corals											
Aquatic plants, algae	Algae		8086	139				105			2218	10548
	Macro plants											

NOTE: Supply = Use, for all products

ASSET Accounts

The Asset Accounts presented here is based on the FAO SEEA AFF. A **physical asset account** for fish and other aquatic resources shows the **total biomass** of all species subject to harvesting or cultivation activity within a national boundary. The scope of harvesting includes **commercial sea and freshwater operations and aquaculture, and subsistence and recreational harvesting** of aquatic resources.

- Obtain (Measuring) fish stocks and changes in stocks.
- Asset accounts for fish and other aquatic resources can be compiled in **monetary terms as well**.

— Fish and other aquatic resources that are considered cultivated resources may be either fixed assets if they are considered breeding stock or as work in progress if they are being raised for harvest.

— A basic physical asset account for fish and other aquatic resources shows the **opening and closing stock of aquatic resources**, and **additions and reductions in stock** resulting from natural growth, catches and other factors. The Physical asset account for fish and aquatic resources (000 tonnes), with small pelagic as example is presented in Table 6.

Table 7: Basic Physical Asset Account for fish and other aquatic resources

	Opening stock (1)	Additions to stock			Reductions in stock						Closing stock (11)
		Natural Growth (2)	Other Additions (3)	Total Additions (4)	Gross catch/harvest (5)	Natural losses (6)	Catastrophic Losses (7)	Other Reductions (8)	Total Reductions (9)	Net changes in stock (10)	
Type of fish and aquatic resource 1. **Cultivated aquatic resources** Breeding stock Inventories											
Small pelagics	3523	1359		1359 =(2)+(3)	1000				1000 =sum(5:9)	359 =(4)−(9)	3881 =(1)+(10)
Big pelagics											
Demersal fish											
Reef fish											
Penaeif shrimp											
Lobster											
Blue swimming crab											
3-spot swimming crab											

	Opening stock (1)	Additions to stock			Reductions in stock						Closing stock (11)
		Natural Growth (2)	Other Additions (3)	Total Additions (4)	Gross catch/harvest (5)	Natural losses (6)	Catastrophic Losses (7)	Other Reductions (8)	Total Reductions (9)	Net changes in stock (10)	
Squid											

1. **Natural (wild) aquatic resources -** *For natural fish and other aquatic resources, direct measurement of opening and closing stocks and elements of change in stocks usually cannot be observed or measured directly; an exception to this is the measurement of the harvest or gross catch. Accordingly, biological models and assumptions must be used to make estimates, but such estimates may not be fully robust.*

Others examples can be found in the SEEA AFF

Input-Output model

- As an integral tool in national accounts for policy analysis and advice, input-output tables (including supply tables and use tables) provide systematic **information on the cost structure and value added of industries and the flow of goods and services in the economy**.
- The input-output table, an example taken from FAO[9] (Table 7), includes six key industries on the fish value chain (**SEE OTHER EXAMPLES IN THE FRAMEWORK**):
    1) Aquaculture;
    2) Fishing;
    3) Manufacture of aquafeed (aquafeed in short);
    4) Building of fishing boats (fishing boat building or fishing boat in short);
    5) Fish processing; and
    6) Fish marketing (transporters, storage services, wholesalers, retailers, etc.).
    7) For simplicity, other industries in the economy, including some important ones on the fish value chain such as the restaurant and food catering industry, for example, are aggregated into the "rest of the economy" (ROE), i.e. the ROE sector.

[9] Cai, J.N., Huang, H. & Leung, P.S. 2019. Understanding and measuring the contribution of aquaculture and fisheries to gross domestic product (GDP). FAO Fisheries and Aquaculture Technical Paper No. 606. Rome, FAO. 80 pp. Licence: CC BY-NC-SA 3.0 IGO.

Table 8: A condensed input-output table for the economy, million (LCU or USD)

Row no.	Column no.	1	2	3	4	5	6	7	8	9	10
		Aquaculture	Fishing	Manufacture of aqua feed	Manufacture of fishing	Fish processing	Fish marketing	Rest of the economy	Import	Gross value added	Total input (Sum of rows 1 to 9)
1	Aquaculture										a
2	Fishing										b
3	Manufacture of aqua feed										c
4	Manufacture of fishing boats										d
5	Fish processing										e
6	Fish marketing										f
7	Rest of the economy (ROE)										g
8	Import										h
9	Gross value added										
10	Total input (Sum of rows 1 to 9)	a	b	c	d	e	f	g	h		i

Note: Row and column totals are equal

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