DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS
STATISTICS DIVISION
UNITED NATIONS

System of Environmental Economic Accounting

System of Environmental-Economic Accounting—Ecosystem Accounting

Section 13.5 on Accounting for the ocean

of the draft document submitted to the Global Consultation on the complete document

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Note: This is just an extract from the complete draft of the SEEA EA that can be accessed at: https://seea.un.org/sites/seea.un.org/files/documents/EEA/Revision/1._seea_ea_complete_draft_for_global_consultation_oct_2020.pdf

Disclaimer:
This draft has been prepared under the guidance of the SEEA Experimental Ecosystem Accounting Technical Committee under the auspices of the UN Committee of Experts on Environmental Accounting (UNCEEA). It is part of the work on the Revision of the System of Environmental-Economic Accounting 2012—Experimental Ecosystem Accounting being coordinated by the United Nations Statistics Division. The views expressed in this document do not necessarily represent the views of the United Nations.

13.3 Accounting for the ocean

13.3.1 The role of accounting in supporting decision making about oceans

13.64 The ocean, earth's coastal and marine areas is large, deep and mostly unknown. Yet, it is an essential source of natural resources and its health is critical to the climate and global ecosystems. Demand for ocean space and resources, and associated anthropogenic pressures on ocean systems, are increasing rapidly. Fish stocks are increasingly over-exploited, while at the same time growing pollutant loads (including plastics, nutrients, CO_2 emissions) are impairing the capacity of these stocks to survive. There is concern, especially in Pacific Small Island Developing States that, not only fish depletion, but the growing impacts of climate change will decimate the livelihoods of coastal populations. The ocean is seen as a source of oil and minerals, yet this exploitation may risk the existence of ocean ecosystems that we have not yet discovered. Only about 20% of the ocean has been mapped in terms of depth (bathymetry), while only about 0.001% has been sampled in terms of seafloor cover and biota. Although concerns about ocean ecosystems may seem first in mind, others including currents, chemical and climatic processes are also being affected by human activities.

13.65 In recent years, a growing number of countries have established ambitious policies and programs designed to accelerate ocean-based development and conservation. Decision-makers are increasingly confronted with complex challenges and pressures to balance the social, environmental and economic interests of present and future generations. Many countries are embarking on ocean strategies, marine spatial planning and designating marine protected areas. In this context, an integrated and standardized set of accounts that record economic activity, social conditions, and environmental conditions empower decision-makers to make and justify balanced decisions for near-term policy and long-term sustainability.

13.66 At the global level, 2021 will mark the beginning of the Decade of Ocean Science,[1] declared by the International Ocean Commission of UNESCO; UN Oceans is in the process of updating the First Global Ocean Assessment;[2] the OCED is continuing to support the assessment of the ocean economy;[3] the High Level Panel for a Sustainable Ocean Economy[4] is developing an action agenda for transitioning to a sustainable ocean economy; and the IPCC recently released an assessment of the "Ocean and Cryosphere in a Changing Climate".[5] All of these initiatives have in common the need to integrate fragmented data and the objective of advising national governments on sustainable use of the ocean.

13.67 Conceptually, the ocean is included in the SNA, SEEA Central Framework and SEEA Ecosystem Accounting, at least to the limit of the exclusive economic zone (EEZ). However, information on the ocean is more fragmented than for terrestrial and freshwater areas. This requires a special focus to strengthen our understanding of the ocean, the governance of our activities that impact it, and the coordination of ocean data within and outside of national territories.

13.3.2 A set of ocean accounts

13.68 A comprehensive set of ocean accounts enables decision-makers to monitor several critical trends: (1) changes in ocean wealth, including produced assets (e.g., ports) and non-produced assets (e.g., mangroves, coral reefs); (2) ocean-related income and welfare for different

[1] https://en.unesco.org/ocean-decade
[2] https://www.unenvironment.org/resources/report/first-global-integrated-marine-assessment-world-ocean-assessment-i
[3] http://www.oecd.org/ocean/topics/ocean-economy/
[4] https://www.oceanpanel.org/about-the-panel
[5] "Cryosphere" refers to areas of water that are frozen for at least part of the year. See: https://report.ipcc.ch/srocc/pdf/SROCC_FinalDraft_FullReport.pdf

groups of people—e.g., income from fisheries for local communities; (3) ocean-based economic production—e.g., GDP from sectors deemed to be ocean-related; (4) changes in how oceans are governed and managed—e.g., ocean zoning, regulatory rules and responsibilities, and social circumstances.

13.69 These are important inputs to a range of ocean governance processes including marine spatial planning, integrated coastal zone management, development planning for ocean sectors, and collaborative resource management.

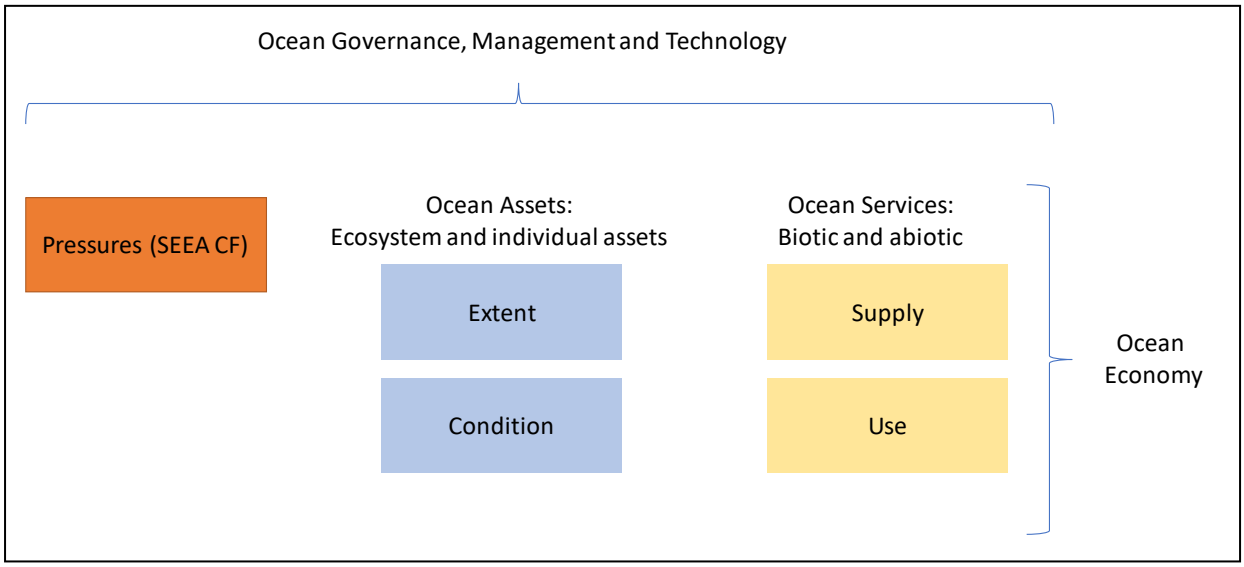
13.70 The Ocean Accounts Framework (Figure 13.2) builds on the components of the SEEA. Ocean accounts add the perspective of the ocean economy, governance, management and technology to the SNA and SEEA core accounts.

13.71 The SEEA Central Framework provides guidance on measuring **Pressures on the ocean**, particularly air emissions, water emissions and solid wastes. For ocean accounts, these are spatially detailed by catchment area to estimate the quantities flowing to the ocean.

13.72 **Ocean Assets** are a combination of accounts for individual environmental assets (minerals, energy and aquatic resources) from the SEEA Central Framework and ecosystem assets from the SEEA EA. Individual environmental assets are distinguished between terrestrial and marine and located spatially. This provides input to a separate calculation of Ocean Assets and changes in them.

13.73 Marine ecosystems are treated according to the SEEA EA. Extent and condition accounts describe the coastal and marine ecosystems. For transitional ecosystems, such as estuaries and tidal flats, applying the IUCN Global Ecosystem Typology (GET) provides a link to terrestrial and freshwater ecosystem accounts.

Figure 13.2: Simplified Ocean Accounts Framework



13.74 **Ocean services** include biotic ecosystem services, but also the abiotic (environmental) services obtained from, for example, mineral extraction and energy capture.

13.75 The ocean economy is the contribution of characteristic ocean-related activities (marine transportation, coastal tourism, marine fishing, offshore minerals and gas, etc.) to the national economy. At the core of **Ocean Economy Satellite Accounts** are the contribution to GDP and Gross Value Added (GVA) of the sectors already in the SNA. More detail is added from estimates of the proportions of sectors (shipping, boatbuilding, etc.) partially related to

the ocean. Potentially, the economic value of ecosystem services not counted in these sectors (e.g., charitable contributions to ocean conservation organizations) could be added.

13.76 The objective of the **Ocean Governance Accounts** is to provide spatially-explicit (that is, by ecosystem type) summary information so that decision makers and planners can make the most effective decisions in ensuring the sustainable use of the ocean. It includes combined presentations of the elements mentioned above, but also explicit consideration of the institutional and legal frameworks such as zoning, rules and decision-making institutions, social circumstances of affected populations, and measures of ocean-related risk and resilience to them.

13.77 Much of the information required to compile ocean accounts is common to other communities of practice including marine spatial planning, disaster risk and climate change. One objective of the ocean accounting community[6] is to ensure that these common data are standardized and shared.

13.78 Terrestrial and freshwater ecosystems are largely within national jurisdictions. However, the ocean is mostly beyond national jurisdictions (ABNJ or Areas Beyond National Jurisdiction). This raises the opportunity to compile global ocean accounts, where much of the data are already collected by international agencies. A Global Ocean Data Inventory[7] was compiled by ESCAP and is organized using the components of the Ocean Accounts Framework. It shows that substantial data are available on ABNJ to compile ecosystem extent and condition accounts, but data on pressures, services, and beneficiaries are under-represented.

13.79 Adjacent coastal countries could also compile comparable Ocean Accounts to better understand transboundary impacts, including flows to and from ABNJ.

13.3.3 Indicators derived from ocean accounts

13.80 In terms of ecosystems, the ocean maybe viewed as a set of marine, coastal, and transitional ecosystem types and any indictors derivable from the SEEA EA can be derived for the ocean. By focusing on one biome, ocean accounts can provide specific indicators for ocean conditions such as acidification and concentrations of marine debris. As well, ocean accounts can provide indicators for ocean-related beneficiaries, such as income of small-scale fishers.

13.81 Linking to the SEEA Central Framework adds the capacity to include indicators of sub-national sources of pressures (such as solid waste supply and use by catchment area), separate accounts for individual environmental assets for the ocean (such as marine fish and offshore oil and gas), and for environmental protection and other expenditures on the ocean.

13.82 The ocean economy satellite accounting component provides means to calculate the contribution of ocean-related sectors to national economies. As well, the focus on governance adds indicators on actors/institutions, norms and behavioural relationships. For example, knowing the location of ocean assets, the degree to which they are used and the designated use of that area provides useful information for the management of that area. A listing of indicators derived from ocean accounts is presented in Annex 13.2.

13.83 The Global Ocean Accounts Partnership has been working with several ocean-related communities of practice, including oceanographers and ocean ecologists to produce a draft set of “Core Ocean Statistics”.

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[6] https://www.oceanaccounts.org/ and https://communities.unescap.org/environment-statistics/tools/regional-ocean-accounts-platform

[7] http://communities.unescap.org/system/files/global_ocean_data_inventory_v1.0_text_20191213_compressed.pdf

13.84 What may be of most interest to ecosystem accounting, are the scientifically supported statistics of ocean ecosystem condition, which are categorized by biodiversity, ecosystem fitness, biogeochemical cycling, physiochemical quality and GHG retention. These characteristics are represented by different metrics in different ecosystems (Table 13.4).

Table 13.4: Example Core Ocean Statistics for Category: Asset Condition: Biogeochemical Cycling (most common variables measured) (in progress)

Ecosystem type					
Coral reef (M1.3)	**Mangrove (MFT1.2)**	**Kelp forest (M1.2)**	**Salt marshes and estuaries (FM1 Transitional freshwater-marine)**	**Sediment (M1 marine shelf and M3 deep sea)**	**Open Ocean (M2 pelagic ocean)**
Nitrate concentration	Soil Nitrogen	Nitrate Concentration	Sediment Redox Potential	Nitrate Concentration	Thermocline
Total Alkalinity	Turbidity	Ammonium Concentration	Hypersalinity	Sulphate Concentration	Pycnocline
Offshore: Inshore DIC ratio	Sediment Accumulation: Sea Level Rise	Kelp Growth Rate	Inundation Depth	Sediment Redox Potential	Vertical Profile: Oxygen
Aragonite Saturation State	Particulate/Dissolved Organic C:N	Dissolved Oxygen Concentration	C:N Sediment ratios	Particulate/Dissolved Organic C:N	Vertical Profile: Nitrate
Dissolved Oxygen	Dissolved Oxygen	C13 Stable Isotopes	Submerged Plant Growth Form	Dissolved Oxygen	Vertical Profile: pH
pH (total scale)	Soil and Water pH	N15 Stable Isotopes		pH (total scale)	Vertical Profile: DIC

13.85 While seemingly complex, the broad palate of the Ocean Accounts Framework has proven effective in supporting several pilot studies, each of which has aimed to answer policy-relevant questions. The pilot studies in Samoa, Thailand and Viet Nam centred around sustainable tourism by linking tourism income, natural resources use, land-based pollution, and ecosystem impacts. China's pilot focused on developing harmonised mangrove maps as well as improving the understanding of environmental assets of the mangrove ecosystems in Beihai Bay, one of China's important marine ecological sites. Malaysia examined food security risk (i.e., fish) along the Straits of Malacca under expected future climate variability. All pilots depended on available and, often limited data. One important aspect of the Ocean Accounts Framework was to guide the search for and integration of the data.

Annex 13.2: Indicators derived from Ocean accounts

	Ocean-related biomes [Note h]										
	SM1 Subterranean tidal biome	FM1 Transitional waters biome (Freshwater Marine)	M1 Marine shelf biome	M2 Pelagic ocean waters biome	M3 Deep sea floors biome	M4 Anthropogenic marine biome	MT1 Shorelines biome	MT2 Supralittoral coastal biome	MT3 Anthropogenic shorelines biome	MFT1 Brackish tidal biome	Total
Physical ocean assets											
Ecosystem assets											
Area (ha)											
Change in area from previous accounting period (%)											
Individual environmental assets											
Minerals (tonnes)											
Energy (PJ)											
Fish (tonnes)											
Timber (e.g., mangrove) (m^3)											
Other flora available for harvesting (e.g., seaweed) (tonnes dry weight)											
Monetary ocean assets (NPV of expected flow of services) (currency units)											
Ecosystem assets											
Value (currency units)											
Change in value from previous accounting period (%)											
Individual environmental assets											
Minerals											
Energy											
Fish											
Timber (e.g., mangrove)											
Other flora available for harvesting (e.g., seaweed)											
Condition of ocean assets [Note a]											
For ocean ecosystems											
Acidification (pH)											
Eutrophication (BOD, COD, Chlorophyll-A concentrations)											
Temperature (°C)											
Plastics density (g/m^3)											
Biodiversity (Shannon index)											
Health (index)											
For individual environmental assets											
Minerals (quality, accessibility)											
Energy (quality, accessibility)											
Fish (quality in terms of size, age, health)											
Timber (e.g., mangrove) (quality, accessibility)											
Other flora available for harvesting (e.g., seaweed) (quality, health)											
Physical ocean services											
Ocean ecosystem services											
As in SEEA-EA services list (specific units)											
Other ocean services (examples)											
Seawater for cooling (m^3)											
Sand (tonnes)											
Petroleum (megalitres, PJ)											
Monetary ocean services											
Ocean ecosystem services											
As in SEEA-EA services list (appropriate valuation techniques)											

	Ocean-related biomes [Note h]										
	SM1 Subterranean tidal biome	FM1 Transitional waters biome (Freshwater Marine)	M1 Marine shelf biome	M2 Pelagic ocean waters biome	M3 Deep sea floors biome	M4 Anthropogenic marine biome	MT1 Shorelines biome	MT2 Supralittoral coastal biome	MT3 Anthropogenic shorelines biome	MFT1 Brackish tidal biome	Total
Other ocean services (examples)											
Seawater for cooling (market or equivalent value)											
Sand (market or equivalent value)											
Petroleum (market or equivalent value)											
Pressures (Flows to the environment) [Note b]											
Water emissions flows to the ocean											
BOD/COD (tonnes)											
Suspended solids (tonnes)											
Bilge (m^3)											
Heavy metals (tonnes)											
Solid waste flows to the ocean											
Chemical and health care waste (tonnes)											
Metallic waste (tonnes)											
Mineral waste and soil (tonnes)											
Mixed residential and commercial waste (tonnes)											
Plastics (tonnes)											
Radioactive waste (tonnes)											
Other waste (tonnes)											
Wastewater flows to the ocean (m^3)											
Air emissions flows to the ocean (examples) [Note c]											
CO_2 (tonnes)											
Methane (tonnes)											
Ocean economy											
Contribution of ocean sectors to the national economy (GVA, %GDP) [Note d]											
By sector (fishing/aquaculture, offshore oil and gas, boat and ship building, etc.)											
Contribution of ocean sectors to the national employment (FTE, %)											
By sector (fishing/aquaculture, offshore oil and gas, boat and ship building, etc.)											
Ocean governance											
Zoning											
Jurisdictional zone: internal waters, territorial sea, EEZ (area)											
Management or planning zone: protected area, private property, use designation (area) [Note e]											
Rules and decision-making institutions											
By activity: fishing, wind farm development, marine spatial planning (institution)											
Social circumstances of resident populations (examples) [Note f]											
Health (index), economic equity (GINI), poverty (% below low income)											
Risk and resilience (examples)											
Flood/storm surge, sea level rise, coastal storm risk (vulnerability, occurrence)											
Resilience: disaster plan in place, adequate supplies and facilities (yes/no)											
Environmental protection expenditures ($)											

	Ocean-related biomes [Note h]										
	SM1 Subterranean tidal biome	FM1 Transitional waters biome (Freshwater Marine)	M1 Marine shelf biome	M2 Pelagic ocean waters biome	M3 Deep sea floors biome	M4 Anthropogenic marine biome	MT1 Shorelines biome	MT2 Supralittoral coastal biome	MT3 Anthropogenic shorelines biome	MFT1 Brackish tidal biome	Total
Value of environmental goods and services sector ($, see Ocean Economy) [Note g]											
Environmental taxes less subsidies ($)											

Notes:

a: The Technical Guidance for Ocean Accounting provides specific condition indicators for each ecosystem type.

b: should account generation by terrestrial catchment area, marine sources, inflows from other territories, outflows to other territories (including international waters)

c: air emissions should be estimates of quantities deposited in the ocean, distinguished by national and international territory

d: OAF provides a comprehensive list of ocean-related sectors. Economic activities could be located by ecosystem type.

e: Other examples of "use designation" is aquaculture, energy development, submarine cable corridor, locally managed marine area, etc.)

f: Resident population includes those dependent on the ocean economy and those living near the ocean.

g: the environmental goods and services sector may be embedded in the Ocean Economy as ocean dependent sectors. It may also be distinct if disaggregated from national EG&S surveys.

h: Indicators may be presented for larger groupings or in more detail by ocean-related Ecosystem Functional Units. Note there may be vertical overlap of some of the biomes (e.g., subterranean tidal biomes with shoreline biomes). In this case, ideally, the indicators would be presented separately for the intersection of those biomes (e.g., subterranean below shoreline).