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Ocean Ecosystem Accounts in India- A Framework

A Report by the Expert Group

Ministry of Statistics and Programme Implementation
National Statistics Office

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डॉ. सौरभ गर्ग, भा.प्र.से.
सचिव
Dr. Saurabh Garg, I.A.S.
Secretary

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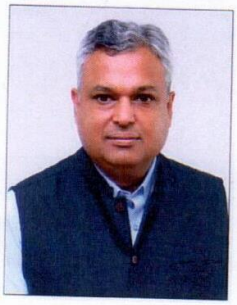
भारत सरकार
सांख्यिकी एवं कार्यक्रम कार्यान्वयन मंत्रालय
Government of India
Ministry of Statistics & Programme Implementation



MESSAGE

The Ministry of Statistics and Programme Implementation regularly compiles accounts on various facets of environment. The 'Strategy for Environmental Economic Accounts in India: 2022-2026' released in 2021 has identified Ocean Accounts as one of the priority areas well realizing the fact that the ocean ecosystems play a pivotal role in sustaining India's economy and livelihoods.

This Expert Group report on the Framework of the Ocean Ecosystem Accounts in India, provides a way forward for integrating ecological and economic data, facilitating informed decision-making that balances development with environmental sustainability for oceans. I extend my heartfelt gratitude to the Secretary, Ministry of Earth Sciences, Dr. M.Ravichandran and the team of officers at NCCR for their constant support. I also commend the members of the Expert Group along with the officers of Social Statistics Division, MoSPI under the overall guidance and supervision of Director General (Central Statistics) Shri N.K. Santoshi for their dedication and hard work in compiling this important document well before time. Their collective expertise is invaluable in shaping the future of ocean ecosystem accounting in India.

I am sure that this report will serve as the base document for the Ocean Ecosystem Accounts in India and will be an essential resource for policymakers, researchers, and all stakeholders engaged in the sustainable management of our ocean resources. I look forward to receiving feedback to further enhance our efforts.

Saurabh Garg

(Dr. Saurabh Garg)

Place : New Delhi

Room No. 204, Khurshid Lal Bhawan, Janpath, New Delhi-110001, Tel.: 011-23742150, 23344689, Fax : 011-23742067
E-mail : secretary@mospi.gov.in

सत्यमेव जयते
डॉ. एम. रविचंद्रन
Dr. M. Ravichandran

सचिव
भारत सरकार
पृथ्वी विज्ञान मंत्रालय
पृथ्वी भवन, लोदी रोड, नई दिल्ली–110003
SECRETARY
GOVERNMENT OF INDIA
MINISTRY OF EARTH SCIENCES
PRITHVI BHAWAN, LODHI ROAD, NEW DELHI-110003

MESSAGE

We live on a blue planet, with oceans and seas covering more than 70 per cent of the Earth's surface. Oceans are vital to the well-being of all people across the globe and the health of our oceans is intricately linked to our own health. Ocean provides oceans of opportunities and seas of challenges. Oceans feed us, regulate our weather and climate, serve as the largest carbon sink on the planet, and generate most of the oxygen we breathe. They provide both living and non-living resources, from fisheries to marine biotechnology, minerals to renewable energy, and even fresh water. Furthermore they offer social and economic goods and services such as tourism and recreation, maritime transport and security and coastal protection. It is imperative to understand our Ocean for better manage it, conserving, protecting, and restoring it for ourselves and future generations. However, the challenges faced by the Ocean and its consequences are huge, in terms of both climatic and non-climatic stresses, which in turn, impacts the health of the ocean ecosystem.

India, with its extensive coastline of over 7500 kilometres and rich marine biodiversity, relies heavily on these resources for economic stability, food security and livelihoods. Recognizing this vital connection, the Ministry of Statistics and Programme Implementation (MoSPI) established an Expert Group on Ocean Ecosystem Accounts to develop a robust framework for understanding and managing the ocean resources.

This report of the Expert Group marks the culmination of extensive collaboration and rigorous analysis, offering an extensive methodology for laying the foundation for the development of Ocean Accounts. The report will provide the backbone for compiling ocean related data which will facilitate the decision-makers with vital insights which in turn will help in balancing developmental aspirations with the parameters of environmental sustainability.

I would like to extend my heartfelt appreciation to the members of the Expert Group whose expertise and leadership have helped giving a concrete structure to the report. I also appreciate the dedicated officers of MoSPI, under the dynamic guidance of Secretary, MoSPI who have contributed enormously in each and every step of the report right from its inception.

This report would serve as a useful start for the development of the Ocean Accounts in India which will ensure having a sustainable future for our oceans. By fostering a better understanding of ocean health and the services, effective policies can be framed that support both economic growth and environmental preservation.

(M. Ravichandran)

Tel. : +91-11-24629771, 24629772 ❑ Fax : +81-11-24629777 ❑ E-mail : secretary@moes.gov.in

नरेन्द्र कुमार संतोषी
महानिदेशक
N.K. Santoshi
Director General

सत्यमेव जयते

भारत सरकार / Government of India
सांख्यिकी एवं कार्यक्रम कार्यान्वयन मंत्रालय
Ministry of Statistics & Programme Implementation
राष्ट्रीय सांख्यिकी कार्यालय / National Statistics Office
चौथा तल, खुर्शीद लाल भवन, जनपथ, नई दिल्ली-110001
4th Floor, Khurshid Lal Bhawan, Janpath, New Delhi-110001
फोन/Tel : +91-11-23455409
ई-मेल/E-mail : dg-es.cso@mospi.gov.in

Preface

The "Ocean Ecosystem Accounts in India- A Framework: A Report by the Expert Group" presents the framework of the Ocean Ecosystem Accounts for India, prepared by the Expert Group formed by the Ministry of Statistics and Programme Implementation. This framework is designed to provide a comprehensive accounting structure considering various dimensions of India's ocean ecosystems, including their extent, condition, services, and assets.

This report provides a framework which is closely aligned with international standards, particularly the United Nations System of Environmental Economic Accounting (SEEA). The framework addresses critical areas such as assessment of ocean health, valuation of ecosystem services, identification of relevant data sources, linkages with the SDGs and the other government efforts thereby enhancing our understanding of the interplay between economic activities and marine ecosystems.

I extend my gratitude to all contributing ministries, departments, research agencies and organizations for their collaboration in providing their valuable inputs which helped in shaping the report. I also wish to acknowledge the tireless efforts of the Expert Group members under the able leadership of Additional Director General, Social Statistics Division, MoSPI Shri S.C. Malik whose expertise and commitment have been instrumental in bringing this report to fruition.

As we move forward, I invite comments and suggestions that will help refine our approach to ocean ecosystem accounting and further our commitment to sustainable ocean management in India.

(N.K. Santoshi)

सुभाष चन्द्र मलिक, भा.सां. से
अपर महानिदेशक
S.C Malik, I.S.S.
Additional Director General

सत्यमेव जयते

भारत सरकार
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सांख्यिकी एवं कार्यक्रम कार्यान्वयन मंत्रालय
Ministry of Statistics & Programme Implementation
कमरा नं. 113, खुर्शीद लाल भवन, जनपथ,
नई दिल्ली-110001
Room No. 113,Khurshid Lal Bhawan, Janpath,
New Delhi-110001
फोन/Tel : +91-11-23455139
ई-मेल/E-mail :adg.ssdiv@mospi.gov.in

FOREWORD

The health and sustainability of our oceans are paramount not only for ecological balance but also for the economic prosperity of nations. With this in mind, the Ministry of Statistics and Programme Implementation (MoSPI) constituted the "Expert Group on Ocean Ecosystem Accounts" on July 11, 2023. This initiative aims to create a robust framework for systematically compiling Ocean Ecosystem Accounts, which will capture changes in ocean extent, condition, services and assets over time. I am happy to announce the release of the report much before the expected time.

The report is an attempt to present a detailed framework encompassing ecosystem extent accounts, condition accounts, identification of ecosystem services and asset accounts, all designed to reflect the complexities of marine ecosystems and their contributions to human well-being.

The development of this report involved the collective expertise of members from wide variety of sectors, especially Ministry of Environment, Forest and Climate Change and the Ministry of Earth Sciences. I extend my sincere gratitude to the members of the Expert Group especially the leads of the two sub-groups of the Expert group- Dr. K.S. Kavi Kumar, Prof, Madras University and Dr. M.V. Ramana Murthy, Director, NCCR (National Centre for Coastal Research) for their constant support and guidance throughout this endeavour. I would also take the opportunity to congratulate the officers of the SSD under the leadership of Ms. Sandhya Singh, Deputy Director General, MoSPI for their painstaking work on the nitty-gritties of the report and giving the report a final shape.

I believe this framework will serve as a critical resource for policymakers, researchers, and stakeholders interested in the sustainable management of our ocean resources. The report may have scopes of further refinement and Ministry is open to any suggestions/feedback for the quality enhancement of the report.

(Subash Chandra Malik)

Table of Contents

Acronyms

	Acronyms and Abbreviations	
B	BEVT	Blue Economy Valuation Toolkit
C	CMLRE	Centre for Marine Living Resources and Ecology
	CMFRI	Central Marine Fisheries Research Institute
	CMPA	Coastal & Marine Protected Areas
	CMSP	Coastal Marine Spatial Planning
	CPCB	Central Pollution Control Board
	CRZ	Coastal Regulatory Zone
	CSIR	Council of Scientific & Industrial Research
D	DO	Dissolved Oxygen
E	EEZ	Exclusive Economic Zone
	ES	Ecosystem Services
	ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
	EUNIS	European Nature Information System
F	FSI	Forest Survey of India
G	GDP	Gross Domestic Product
	GET	Global Ecosystem Typology
	GIF	Global Indicator Framework
	GOAP	Global Ocean Accounts Framework
	GoI	Government of India
	GSI	Geological Survey of India
H	HTL	High Tide Line
I	IAEG-SDGs	Inter-agency and Expert Group on Sustainable Development Goal Indicators
	ICMBA	Important Coastal and Marine Biodiversity Areas
	IOC-UNESCO	Intergovernmental Oceanographic Commission UNESCO
	INCOIS	Indian National Centre for Ocean Information Service
	ISRO	Indian Space Research Organisation
	IUCN	International Union for Conservation of Nature
	IUU	Illegal, unregulated, and unreported
K	km	Kilometre
	km^2	Square kilometre
M	m	Metre
	MDGs	Millennium Development Goals
	MISHTI	Mangrove Initiative for Shoreline Habitats and Tangible Incomes
	MLR	Marine Living Resources
	MLRE	Marine Living Resources and Ecology
	MoEFCC	Ministry of Environment, Forest and Climate Change of India

Acronyms and Abbreviations		
	MoES	Ministry of Earth Sciences
	MoPNG	Ministry of Petroleum and Natural Gas
	MoSPI	Ministry of Statistics and Programme Implementation
	MPA	Marine Protected Area
	MSFD	Marine Strategy Framework Directive
	MSP	Marine Spatial Planning
N	NCAVES	Natural Capital Accounting & Valuation of Ecosystem Services
	NCCR	National Centre for Coastal Research
	NCSCM	National Centre for Sustainable Coastal Management
	NDZ	No Development Zone
	NIF	National Indicator Framework
	NIWE	National Institute of Wind Energy
	NPP	Net Primary Production
	NRA	Natural Resource Accounting
	NRSC	National Remote Sensing Centre
	NSO	National Statistics Office
O	OMAS	Ocean Modelling and Advisory Services
	OON	Ocean Observation Network
P	PA	Protected Area
	PMMSY	Pradhan Mantri Matsya Sampada Yojana
S	SCC	Social Cost of Carbon
	SDG	Sustainable Development Goal
	SEEA	System of Environmental Economic Accounting
	SEEA CF	System of Environmental Economic Accounting Central Framework Central Framework
	SEEA EA	System of Environmental Economic Accounting Ecosystem Accounting Ecosystem Accounting
	SIDS	Small Island Developing State
	SNA	System of National Accounts
	SSD	Social Statistics Division
	SST	Sea Surface Temperature
T	TSS	Total Suspended Solids
U	UN	United Nations
	UNCEEA	United Nations Committee of Experts on Environmental-Economic Accounting
	UNECA	United Nations Economic Commission for Africa
	UNESCO	United Nations Educational, Scientific and Cultural Organization
	UNSC	United Nations Statistical Commission
	UNSD	United Nations Statistics Division
	US	United States

Acronyms and Abbreviations		
W	WACA	West Africa Coastal Areas
	WAVES	Wealth Accounting and the Valuation of Ecosystem Services

Members of the Expert Group

S. No.	Name and Details	Role
1	Additional Director General, Social Statistics Division (SSD), NSO, MoSPI, New Delhi	Chair
2	Director, National Centre for Coastal Research (NCCR), Ministry of Earth Sciences (MoES), Chennai	Member
3	DDG (NAD), NSO, MoSPI, New Delhi	Member
4	Adviser, NITI Aayog, New Delhi	Member
5	Joint Secretary or equivalent officer from M/o Environment, Forest & Climate Change (MoEF&CC), New Delhi	Member
6	Joint Secretary or equivalent officer from Department of Fisheries, Ministry of Fisheries, Animal Husbandry & Dairying, New Delhi	Member
7	Cdr. P K Prashant Srivastava, Scientist-F, M/o Earth Sciences (MoES), New Delhi	Member
8	Member Secretary / Representative from Centre Pollution Control Board (CPCB), New Delhi	Member
9	Director, National Centre for Sustainable Coastal Management (NCSCM), M/o Environment, Forest & Climate Change (MoEF&CC), Chennai	Member
10	Director, Central Marine Fisheries Research Institute (CMFRI), Kochhi	Member
11	Dr. K S Kavi Kumar, Professor, Madras School of Economics (MSE), Chennai	Member (Non-Official)
12	Dr. Pranab Mukhopadhyay, Professor, Goa Business School, Goa University	Member (Non-Official)
13	Dr. V Selvam, Coastal / Mangrove Expert, Former Executive Director, M S Swaminathan Research Foundation, Chennai	Member (Non-Official)
14	DDG(Environment), SSD, NSO, MoSPI	Member Secretary

Members of the Sub-Groups of the Expert Group

Sub-group I	Sub-group II
Lead: Dr. K.S. Kavi Kumar, Professor, Madras School of Economics	**Lead:** Dr. M.V. Ramana Murthy, Director, National Centre for Coastal Research (NCCR)
Members: • Dr. V. Selvam, Former Executive Director, M.S. Swaminathan Research Foundation, Chennai • Dr. Pranab Mukhopadhyay, Professor, Goa University • Representatives from National Centre for Coastal Research (NCCR) • Representatives from National Centre for Sustainable Coastal Management (NCSCM) • Representatives from MoSPI	**Members:** • Dr. Pranab Mukhopadhyay, Professor, Goa University • Representatives from Central Marine Fisheries Research Institute (CMFRI) • Representatives from Ministry of Environment, Forest and Climate Change (MoEFCC) • Representatives from Central Pollution Control Board (CPCB) • Representatives from Indian National Centre for Ocean Info Service (INCOIS) • Representatives from Centre for Marine Living Resources and Ecology • Representatives from National Remote Sensing Centre (NRSC) • Representatives from Geological Survey of India • Representatives from Ministry of Petroleum and Natural Gases • Representatives from National Centre for Polar and Ocean Research • Representatives from MoSPI

Executive Summary

Ocean ecosystem accounts serve as a vital tool for systematically capturing changes in the ocean extent, condition, services and assets over time. By integrating ecological and economic data, these accounts highlight how ocean ecosystems contribute to the economy and society along with the impact of economic activities on these ecosystems. India, which is uniquely positioned, bordered by oceans on three sides with a vast coastline and rich marine biodiversity supporting millions of livelihoods, having a regular ocean accounts becomes particularly important.

On July 11, 2023, MoSPI established the "Expert Group on Ocean Ecosystem Accounts," composed of members from various sectors to review global methodologies, develop a national framework, recommend indicators and data sources, and identify ocean-related ecosystem services and valuation techniques. The framework seeks to enhance decision-making processes and sustainable ocean management in India by standardizing fragmented data into reliable integrated indicators of policy relevance. The framework for ocean ecosystem accounting in India is comprehensive, including ecosystem extent accounts, condition accounts, asset accounts, and services accounts. Each component is designed to capture the complexities of marine ecosystems and their contributions to human well-being. This framework is aligned with international standards set by United Nations System of Environmental Economic Accounting (SEEA), providing a structured approach that encourages collaboration among various stakeholders. Some of the ocean ecosystems that have been identified for ecosystem accounting include mangroves, coral reefs, seagrass, lagoons, sandy coast, coastal ocean water and estuaries.

The framework for the Ocean Extent Accounts provide vital information about the spatial distribution of marine ecosystems, providing vital information about their size, location, changes over time and the impact of human activities. The Ocean Condition Accounts framework focuses on assessing the health of these ecosystems through key indicators, such as salinity, pH, temperature, nutrients etc. The framework promotes a tiered approach to accounting, where Tier 1 parameters represent essential indicators that can be consistently monitored, while Tier 2 parameters are ecosystem-specific which may be compiled depending on the data availability. The framework for the Ocean Ecosystem Services Accounts categorize the various benefits derived from marine ecosystems, such as fish and fuel (provisioning services), climate regulation (regulatory services) and recreation and tourism (cultural services). Quantifying these services, allows the economy and stakeholders to acknowledge the economic and social value of healthy ocean ecosystems. The report suggests initially estimating these services in physical terms, with subsequent efforts aimed at developing monetary valuations with the available data. The valuation

techniques for these services are still at a nascent stage, and future developments in methodologies with stakeholder review and consultations can enhance these efforts. Ocean Asset Accounts framework record the ecosystem assets in physical terms, reflecting changes in the marine resources over an accounting period, enabling stakeholders to understand the economic implications of ecosystem degradation or restoration.

The report also discusses various global practices in ocean ecosystem accounting, presenting a backdrop for understanding India's initiatives. The Global Ocean Accounts Partnership (GOAP) is noted as a key initiative that helps countries build capacities for SEEA and Ocean Accounts, with pilot projects in China, Malaysia, Thailand, Samoa, and Vietnam. Despite these efforts, many countries are still in the early stages of developing comprehensive ocean accounts, underscoring the need for a cohesive international framework for Ocean Accounts that adheres to the SEEA structure. Although many countries are at the initial stages of developing comprehensive ocean accounts, there is a pressing need for cohesive international frameworks.

The report identifies various national and state-level agencies that can serve as potential data sources, including the Ministry of Environment, Forest and Climate Change, the Ministry of Earth Sciences, and the State Fisheries Departments etc. Collaboration among these agencies will enhance data sharing and facilitate comprehensive assessment of ocean ecosystems. Policy integration is also vital for the effective implementation of ocean ecosystem accounts, allowing for informed decision-making in regulatory, operational and strategic contexts. This framework aligns closely with the SDGs, particularly Goal 14, which focuses on the conservation and sustainable use of oceans, seas, and marine resources.

Last but not the least, the report provides actionable recommendations for enhancing ocean ecosystem accounting in India. Key actions include improving data collection through stakeholder collaboration, capacity building, and adopting innovative valuation techniques for ocean services. By implementing this comprehensive framework, India can advance sustainable ocean management, fostering economic growth while preserving its invaluable marine resources for future generations.

Chapter 1: Background and Introduction

Background

1.1 The Ministry of Statistics and Programme Implementation (MoSPI) in accordance with the allocation of Business Rules[1] has the mandate for development of Environment Statistics, development of the methodology, concepts and preparation of National Resource Accounts in India.

1.2 For MoSPI, Environment Accounting is not an unexplored territory. The Ministry constituted a Technical Working Group on Natural Resource Accounting (NRA) in 1997, under the aegis of which several studies were conducted during the period 1999-2000. But despite having vast richness of findings, these research studies could not be concretized into a full-fledged account due to their lack of comparability in the methods and definitions used, which limited their aggregation. Later on, in 2011, in order to help the development of Environmental Economic Accounts, a high-level Expert Group was constituted under the chairmanship of Prof. Sir Partha Dasgupta. The Expert Group submitted its report titled 'Green National Accounts in India–A Framework'[2] in 2013 and recommended compilation of the accounts envisaged in the System of Environmental Economic Accounting (SEEA).

1.3 Realizing the need to adopt a common framework for international acceptability, MoSPI initiated the compilation of environmental accounts following the SEEA Framework in 2018. Since then, MoSPI has been regularly releasing accounts on Environment. Till date, seven issues of the publication have been released by the Ministry covering a variety of ecosystems, but the scope ahead is enormous. In the document titled 'Strategy for Environmental Economic Accounts in India: 2022-2026'[3], released in 2021, some of the potential areas identified in line with national priorities are Material Flow Accounts, **Ocean Accounts**, Energy Accounts, and Thematic Accounts for Biodiversity and Urban Areas.

[1] https://cabsec.gov.in/writereaddata/allocationbusinessrule/completeaobrules/english/1_Upload_1187.pdf
[2] https://www.mospi.gov.in/sites/default/files/publication_reports/Green_National_Accouts_in_India_1may13.pdf
[3] https://www.mospi.gov.in/sites/default/files/publication_reports/Environment%20Accounting%20Strategy%202022-261638528460762_0.pdf

Introduction

1.4 The ocean occupies more than 70% of the Earth's surface, holds 97% of its water and supports 80% of its life forms. Oceans are a life source for our planet and are strong drivers of the Earth's climate and ecology. Human well-being and economic prosperity are dependent on a healthy ocean. The benefits in the form of ocean resources (i.e., natural capital) provide ecosystem services such as food, raw materials and also the maintenance of the environment, which caters to both the market as well as non-market needs of humanity.

1.5 The ocean produces[4] half of the Earth's oxygen and absorbs more than 90% of heat from greenhouse gas emissions. It regulates the climate and also facilitates flood control, and protection from natural disasters, natural hazards, and pollution.

1.6 On the edges of the ocean, coastal wetlands–such as mangroves, salt marshes, and seagrass meadows–protect the shores, too. These unique areas also draw in carbon as they grow and store it in their leaves, stems and the rich soils held by their roots. This 'blue carbon'[5] can remain in the soil for thousands of years. In fact, coastal wetlands store far greater amount of carbon per hectare than rainforests, helping mitigate climate change. The ocean is one of the largest carbon reservoirs on Earth, holding about 50 times more carbon than the atmosphere.

1.7 The coastal regions are complex environments characterised by diverse hydrodynamic conditions, bio-geomorphologic features, socio-economic and ecological challenges. These are among the most affected by both natural and anthropogenic activities. The sustainable future for coastal zones depends on systematic mapping, monitoring and modelling for effective management at different spatio-temporal scales. The challenges for the policymakers and coastal resource managers is to figure out ways to reap the economic benefits of coastal resources sustainably.

1.8 The ocean also plays a crucial role in the global economy as it is an important source of food, energy and other ocean resources. These include traditionally exploited marine resources – either living resources (fish) or non-living resources (oil and gas) – as well as the use of ocean for tourism, research and shipping. Ocean is also

[4] OECD- Sustainable Ocean Economy Country Diagnostics of Indonesia

[5] https://www.undp.org/nature/our-work-areas/ocean-governance

critical for the livelihoods of billions of people, as many economic sectors are either directly or indirectly dependent on ocean resources.

Ocean in the context of India

1.9 India has a unique maritime position and a coastline extending 7,517 km across 9 Coastal States and 4 Union Territories including 2 groups of islands. It has over 4 million fishermen and other coastal communities. The coastal belt comprises a wide range of ecosystems extending from beaches and mangroves to coral reefs. These coastal ecosystems play an important role in the economy and contribute significantly to several industries like fishing, mining, tourism, transport and tidal energy. India's Exclusive Economic Zones of over 2 million square kilometres provide significant economic benefits through industries such as fishing, mining and transportation. In coastal states, the fishing industry alone is estimated to directly employ a large chunk of fisherfolk, with many more indirectly employed in allied industries.

1.10 In current scenario, oceans and marine ecosystems are being impacted by climate change in five major ways: ocean warming, ocean acidification, ocean deoxygenation, rising sea levels, and heat stress. Coastal seas face the broadest array of human pressures and uses, as the rate of pollution and land-use change is greatest near the coast. Through agriculture, aquaculture, settlements, port development and tourism, the ability of coastal ecosystems to accumulate carbon is diminished, potentially leading to the release of CO_2 from coastal sediments.

1.11 In order to ensure that the potential of these ecosystems is sustainably harnessed, checks and balances need to be put in place so as to counter the negative side-effects of an increase in these industries. This can be effectively done with the help of the Ocean Accounts.

Ocean Accounts

1.12 Ocean Accounts is a structured compilation of consistent and comparable information: maps, data, statistics and indicators-concerning marine and coastal environment, including related social circumstances and economic activity. Major advantages for compiling Ocean Accounts include:

(i) To inform and enable public policy decision-making about oceans, and related analysis and research;

(ii) To provide coherent structure for standardizing fragmented data to produce reliable integrated indicators of policy interest;

(iii) To achieve the UN Sustainable Development Goals (SDGs) - 14 and SDG Targets 15.9 and 17.19 towards management of a healthy and resilient ocean, integrating biodiversity into the planning process.

India's efforts towards Ocean Accounts

1.13 Recognizing the significant contribution of ocean and coastal resources to India's economic output, the Government of India's Vision of New India by 2030 enunciated in February 2019 highlighted 'Blue Economy' as one of the ten core dimensions for growth. Further, the Draft Policy Framework on India's Blue Economy[6], released in September 2020, identified seven priority areas for strengthening India's Blue Economy, where the development of a robust mechanism for a National Accounting Framework for Blue Economy and Ocean Governance is outlined as its first priority. In the recent past, significant thrust has been given to the development of Coastal and Marine Spatial Plans for various regions in India (such as Puducherry, West Bengal, Lakshadweep, etc.), and to the preparation of framework and action plan for the National Coastal and Marine Spatial Plan. Further, the Ocean Accounts have a synergetic association with the ongoing Environmental - Economic Accounting work in India. The NSO, India joined the Global Ocean Accounts Partnership (GOAP)[7] in 2020 to gear up the compilation of Ocean Accounts. In addition, the NSO, India and the Ministry of Earth Sciences (MoES), GoI have together joined the Working Group on Ocean Accounts constituted by the United Nations Statistics Division (UNSD) for development of Global Ocean Accounts Framework.

1.14 As an important step towards operationalizing the Ocean Accounts in India, the NSO, MoSPI organized a brainstorming session in collaboration with the Ministry of Earth Sciences in November, 2022 at the National Centre for Coastal Research (NCCR), Chennai. The deliberations of the brainstorming session essentially focussed on approaches to the use of existing database to gauge the health of oceans, assess the flow of services provided by them, identify data gaps, and development of the condition accounts for the oceans, challenges for ocean accounting and global best practices in addressing these challenges, among various other issues.

[6] https://incois.gov.in/documents/Blue_Economy_policy.pdf
[7] https://www.oceanaccounts.org/about-the-global-ocean-accounts-partnership/

Expert Group on Ocean Ecosystem Accounts

1.15 As a way forward, MoSPI constituted an "Expert Group on Ocean Ecosystem Accounts in India" on 11th July 2023 involving members from various central Ministries/ Departments, research institutions/ organization and eminent experts with the following Terms of Reference (copy of the Office Memorandum is provided in the Annexure-1.1). The tenure of the Expert Group is 2 years from the date of constitution.

i. To review the Global Methodology & Framework as well as countries practices, if any, on the compilation of Ocean Ecosystem Accounts;
ii. To develop the National Framework as well as periodicity for the compilation of Ocean Ecosystem Accounts in India.
iii. To recommend statistics/indicators/parameters along with data sources to be used for the compilation of various dimensions of Ocean Ecosystem Accounts.
iv. To identify the various ecosystem services related to oceans and to suggest suitable valuation techniques for them.
v. To suggest relevant studies in case of any data gaps.
vi. To ensure consistency in the definitions/concepts in the National Framework developed and the data sources to be used for the compilation of the Ocean Ecosystem Accounts.
vii. To review and refine the National Framework and if required suggest for appropriate revisions in line with the global advancements.

1.16 In November 2023, two sub-groups of the Expert Group were constituted to work specifically on the respective ToRs as outlined below. A copy of the order of the sub-groups of the expert group on Ocean Ecosystem Accounts is placed at Annexure 1.2.

Sub-Group 1: Led by Dr. K. S. Kavi Kumar, Professor, Madras School of Economics to review the global methodology and framework as well as country practices on the ocean ecosystem accounts & to identify the various ecosystem services related to oceans and to suggest suitable valuation techniques for them.

Sub-Group 2: Led by Dr. M. V. Ramana Murthy, Director, NCCR to develop a framework on the Ocean Ecosystem Accounts & to recommend statistics/indicators and parameters along with data sources to be used for the compilation of various dimensions of Ocean Ecosystem Accounts.

Content of the Report

1.17 The report aims to develop a national framework for the ocean ecosystem accounts, adhering to the SEEA Framework to the extent possible. The framework thus, would include ocean extent, ocean condition, ocean assets, and ocean services. Additionally, the report explores the linkages between the ocean accounts and the ongoing efforts of the Government of India, such as Marine Spatial Planning (MSP), the Blue Economy, Coastal Regulatory Zones (CRZ), etc. The report further covers the interlinkages with relevant policies and the Sustainable Development Goals (SDGs). A brief overview of the content of the different chapters is provided below:

- *Chapter 2: Global Practices*: This chapter provides a comprehensive review of the publicly available literature on ocean ecosystem accounts for different countries, including case studies to identify key data sets required, the methodology followed and the challenges therein;
- *Chapter 3: Overview of Ocean Ecosystem Accounts Framework:* This chapter provides the general structure of the Ocean Ecosystem Account framework;
- *Chapter 4: Ocean Ecosystem: Extent and Condition Accounts*: This chapter focusses on the structure and parameters required for extent and condition accounts of ocean ecosystems best suited for the Indian scenario. The parameters for ocean extent and condition accounts are discussed in the chapter.
- *Chapter 5: Ocean Ecosystem: Services Flow and Asset Accounts*: This chapter highlights the Ocean Ecosystem Services and their appropriate valuation techniques suitable for the Indian context and the Ocean Assets.
- *Chapter 6: Linkages of Ocean Ecosystem Accounts with Other Ongoing Efforts of the Government*: This chapter helps to build up linkages between the ocean accounts and several ongoing efforts of the government, such as Marine Spatial Planning and Blue Economy, Coastal Regulatory Zones and Marine Protected Areas, etc.;
- *Chapter 7: Policy Perspective of Ocean Ecosystem Accounts*: This chapter highlights the policy perspective of ocean accounts and the linkages between ocean accounts and the Sustainable Development Goals; and
- *Chapter 8: Recommendations and Way Forward*: This chapter provides the conclusion and possible way forward/recommendations towards the direction of refining ocean accounting.

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Chapter 2: Global Practices

Introduction

2.1 Despite the global relevance of the oceans, there is no internationally agreed standard framework available for ocean accounting to date. However, efforts towards ocean ecosystem accounts around the world are gaining momentum, and nations are taking steps toward sustainability to produce more holistic statistics to inform ocean policy.

2.2 Oceans are in transition; the structure of the global ocean economy is changing, with more industries being developed, while the ocean environment is also changing with a dramatic decline in ecosystems and biodiversity, largely due to anthropogenic impacts. At this juncture, it becomes all the more important to have a continuous assessment of the oceans. Ocean accounts can provide a comprehensive set of information to better inform integrated policy decisions, ensuring the sustainability of our ocean. These accounts will also help policy makers to make better decisions about how to manage marine ecosystems and resources.

2.3 In the present chapter, various global efforts and country practices have been documented. Increasing recognition of challenges related to ocean ecosystem and ocean economy is driving action by both international organizations and national governments.

The Statistical Commission and SEEA Ocean

2.4 The oceans provide significant opportunities for economic growth and prosperity. Concurrently, oceans also face threats such as over-exploitation, pollution and climate change. This has led to the international community having increased commitments towards sustainable ocean development through instruments such as the 2030 Agenda for Sustainable Development[8], the Convention on Biological Diversity[9], the High-Level Panel for a Sustainable Ocean Economy[10], and others. These commitments stress the need for integrated ocean information, which collates and

[8] https://sdgs.un.org/2030agenda
[9] https://www.cbd.int/
[10] https://oceanpanel.org/

standardizes data and knowledge from multiple domains (e.g., environmental, economic and social).

2.5 In March 2020, the United Nations Statistical Commission commended ESCAP for its work on the 'Technical Guidance on Ocean Accounting'[11] and the progress made through country piloting in China, Malaysia, Thailand, Samoa, and Vietnam. It also recognized that this 'Technical Guidance' provides a solid foundation for integrating ocean accounts into the SEEA.

2.6 Some of the global efforts focusing on oceans include the UN Decade of Ocean Science for Sustainable Development[12], the High-Level Panel for a Sustainable Ocean Economy[10] and the World Ocean Assessments[13]. In particular, the High-Level Panel identified a "complete sequence of national ocean accounts that are actively used" as one of its transformational priority actions for a sustainable ocean economy. Pilot ocean accounting activities, responding to this priority, are already underway globally.

2.7 The UNSC has also discussed the approaches towards developing the SEEA-Oceans as the agreed methodology for ocean accounting, based on the progress made in the development of the Technical Guidance on Ocean Accounting for Sustainable Development[14], including its testing and experimentation at the country level. The report to the 52nd UN Statistical Commission (Item 3f on the agenda: Developing a SEEA-Ocean) sets out the approach to develop SEEA-Oceans as adopted by the UN Committee of Experts on Environmental-Economic Accounts (UNCEEA). This approach was supported by the UNSC, which further highlighted the importance of SEEA-Oceans framework being completely aligned with the SEEA Central Framework and SEEA Ecosystem Accounting[15].

2.8 Many of the international organizers and partners are working in the direction of making the value of ocean ecosystem visible and enabling countries and other stakeholders in the sustainable management of ocean resources. The most notable amongst them are Global Ocean Accounts Partnership[16] (GOAP), which is a global multi-institutional partnership established to enable countries and other stakeholders

[11] https://www.oceanaccounts.org/technical-guidance-on-ocean-accounting-2/
[12] https://www.oceandecade.org/
[13] https://www.un.org/regularprocess/woa2launch
[14] https://www.oceanaccounts.org/technical-guidance-on-ocean-accounting-2/
[15] https://unstats.un.org/unsd/statcom/52nd-session/documents/BG-3f-SEEA_Ocean_background_paper_final-E.pdf
[16] https://www.oceanaccounts.org/about-the-global-ocean-accounts-partnership/

to go 'Beyond GDP' and to measure and manage progress toward sustainable ocean development; and Economic and Social Commission for Asia and the Pacific[17] (ESCAP), which is a member of GOAP and works on building the capacity of ESCAP countries to implement SEEA in the region and to expand and adapt the SEEA to produce Ocean Accounts. Pilot studies were conducted in collaboration with UNESCAP in five Asia-Pacific countries: China, Malaysia, Samoa, Thailand and Vietnam[18]. These studies provide insights into the types of accounts these countries considered adopting as well as the challenges faced and way forward.

2.9 As far as broad global efforts are concerned, the predominant focus of the Asia-Pacific region is the assessment of seagrass, mangroves and coral reef ecosystems. The Europe regions' efforts draw largely from European Union datasets or assessments such as the European Nature Information System (EUNIS) and the Marine Strategy Framework Directive (MSFD). In North America, the US Marine Economy Satellite Accounts provides comprehensive estimate of the US Marine and Great Lakes, economy while Canada regularly publishes estimates of the economic contribution of their marine sectors to the national and provincial estimates. In Latin America countries, such as Guatemala (supported by WAVES), Mexico (supported by NCAVES) and Columbia have published accounts targeting marine and coastal ecosystem services.

2.10 In Africa, ocean accounts initiatives are steadily advancing, with a prominent focus on developing SEEA EA concerning the extent of coastal ecosystems, relying on remote sensing. Several accounting pilot activities have been conducted in Ghana, Kenya, Madagascar, South Africa and Mozambique, with planning underway for activities in Namibia, Togo and the autonomous region of Zanzibar. In 2020, the United Nations Economic Commission for Africa (UNECA) developed a Blue Economy Valuation Toolkit (BEVT) based on the information gathered in the Satellite Accounts applied to the Blue Economy. UNECA has applied the BEVT in Seychelles, Tanzania and Zanzibar. At the regional level, the West Africa Coastal Areas Management Program (WACA) is working on the valuation of ecosystem services (particularly, on the role of the mangroves in reducing the risk of coastal flooding). Countries already participating in the program include Benin, Cote d'Ivoire, Ghana, Mauritania, Sao Tome and Principe, Senegal and Togo.

[17] https://www.unescap.org/our-work

[18] https://www.unescap.org/kp/2022/ocean-accounting-briefs-china-malaysia-samoa-thailand-and-viet-nam

2.11 This chapter brings together the methodologies followed across the globe and datasets that are generally being used in various countries for ocean ecosystem accounting. The Table 2.1 below provides a systematic review of ocean ecosystem accounting approaches that have been recommended or endorsed in the countries. The focus is on the types of ecosystems, parameters used in the extent and condition accounts. The physical and monetary ecosystem services compiled by various countries have been taken up in the subsequent paragraphs of the chapter. The review highlights that commitments and strategies have been made by many countries recognizing the vital role of coastal and marine ecosystems, yet very few of them have focused their initial efforts on ocean ecosystem accounting. Most countries are at a nascent stage in developing ocean ecosystem accounts and have either developed or are developing satellite accounts related to the ocean economy and ocean tourism.

2.12 A review of various country practices as well as global efforts are presented in Annexure 2.1. The table below provides country groupings based on the work done by each of the country on Ocean Accounts.

Table 2.1: Countries by their level of work towards Ocean Ecosystem Accounts

Type of Accounts			
Ecosystem Accounts (I)	**Satellite Accounts/ Sector-wise Accounts (II)**	**Preliminary Stage (III)**	**MSP/Blue/Marine Economy (IV)**
Australia Canada China (Pilot) Fiji Islands France Indonesia Malaysia (Pilot) South Africa Maldives Netherlands United Kingdom Columbia Grenada	Norway Portugal Republic of Korea United States of America Japan	Costa Rica Japan Mexico Samoa Thailand Philippines Viet Nam Chile Myanmar Guatemala Madagascar	Republic of Korea Samoa Thailand China Maldives Philippines Canada Costa Rica United States of America Seychelles
Remarks: *I: These countries have developed some of the ecosystem accounts for selected ocean ecosystem. Extent and condition parameters have been provided by many of the countries,*			

however, estimation of ocean ecosystem services is at a preliminary stage. The monetary valuation of some services which have market price have been attempted.
II: These countries have compiled ocean economy or ocean tourism satellite accounts. Separate Ocean Ecosystem Accounts have not been compiled.
III: These countries have identified certain roadmap and are yet to develop frameworks. Some of the countries have begun the pilot work and have constituted technical committees. Some of the countries may not have defined Ocean ecosystem related roadmap, but a few components are covered as part of some other environment accounting policy or sustainable development plans.
IV: These countries have identified MSP and Blue Economy as a priority policy area and are either working towards it or planning to initiate work in this direction.

2.13 Among the countries who have initiated the work on the Ocean Accounts, the types of ecosystems and types of accounts covered are given in the Table below:

Table 2.2: Types of Ecosystems and Ocean Ecosystem Accounts covered by different Countries

Countries	Year	Ecosystem Types	Extent	Condition	Asset
Australia	2021	Mangrove Forests Seagrass Meadow Saltmarsh Kelp	Area in Ha of Mangrove, seagrass and saltmarsh, Location of the mangroves and seagrass, Intertidal seagrass meadow location, the number of people living near mangroves who are benefiting from storm surge protection	Mangrove Canopy Cover, Seagrass & Meadow Density, Condition of the Mangroves and Seagrass	Carbon Stock in mangrove, seagrass & saltmarsh
Canada	2014-2022	Coastline, Seagrass Meadows, Salt marshes, Surface Epipelagic, Lower Epipelagic,	Coastline Length, Coastline Population Area of the various Coastal Ecosystems	Tidal Hydrology, Marsh Surface elevation change, Salinity, Pollution, Dominant & Invasive	

Countries	Year	Ecosystem Types	Extent	Condition	Asset
		Mesopelagic, Bathypelagic, Abyssal pelagic, Coastal and Ocean Floor Ecosystems, Salt Marsh Seagrass ecotone, Kelp Forest, Soft Substrate, Mixed substrate, Hard Substance, Unassigned Marine Area, Coral and Sponge		Species, Vegetation Structure Surrounding Land use Tidal barriers & restrictions Landscape contiguiation	
China (Pilot Accounts)	2021 under NCAVES project for Guangxi	Mangrove Coral Reef Seagrass	Area	Marine Ecosystem Condition Accounts	Mangrove Coastal Beaches
Fiji Islands	2008, 2010 and 2016	Mangrove	Area (Mangroves)	Mangrove: Maximum canopy tree height, Basal-weighted tree height, Above ground biomass, Net primary production (NPP), Measures of Biomass, Chemical Composition, Biodiversity, Growth Rate	
France	2020	Marine	EEZ, Marine Sub-regions	Biodiversity Protected Area Waste on the seabed	Fish Stock

Countries	Year	Ecosystem Types	Extent	Condition	Asset
				Number of species groups / Abundance Eutrophication (Nitrate, Phosphate / Turbidity/ Dioxygen / Chlorophyll-A) Floating Waste	
Indonesia	2015 and 2021 for Gili Matra	Coral reefs Seagrass Mangrove	Coral reef, Seagrass and Mangrove extent	Water Quality (sea surface temperature (SST), chlorophyll-a, total suspended solids (TSS), acidity (pH) and dissolved oxygen (DO) Diversity	Coral reefs, seagrass, mangrove, Fish, Other Substrate (Opening, Addition/ Deletion, Closing)
Malaysia (Pilot)	2019 for Straits of Malacca	Study on factors affecting fish landing	Mangrove Cover	Land use change, sea surface temperature, chlorophyll concentration water quality, CO_2, land-based pollution	
South Africa	2021-2024 for Table Bay, South Africa	Coastal Area Kelp Forest	Area- Kelp Forest, Estuaries, Harbour, Water, Rocky Shore, Upper Beach, Lower Beach, Subtidal, Built Surface		Beach Shore Nearshore Surf Zone Subtidal Region Offshore Current Cells Estuaries Rocky Shore Kelp Forests

Countries	Year	Ecosystem Types	Extent	Condition	Asset
					Harbours
Maldives	2023 for Laamu Atoll	Seagrass Mangroves	Seagrass Cover Seagrass Cover per species of seagrass Canopy cover of mangrove	Species Diversity, Basal area, Canopy cover of mangrove	
Netherlands	2019 for Dutch North Sea		Transitional waters Shoreline systems Marine shelf: shallow, medium and deep waters	Biodiversity Inorganic nitrogen concentrations Dissolved oxygen concentration Phosphate concentration Chlorophyll Phytoplankton Fishing Intensity Water depth, Salinity Sea Surface Temperature Contaminants	
United Kingdom	2021 for Marine and Coastal Region of UK		EEZ Boundary	Marine protected areas Water Quality (percentage of estuary and coastal surface water bodies in the UK by their condition classification) Percentage of bath water sites at coastal locations	
Grenada	2017	Seagrasses, Mangroves and Coral Reef	Extent of beaches, littoral forest, shelfs and deep-sea habitat	Characteristics of Seagrass	

Countries	Year	Ecosystem Types	Extent	Condition	Asset
Columbia	2017-2019 Pilot for Cienega Grande de Santa Marta Ramsar Site	Mangroves and Coastal Lagoons	Spatial Extent	Conditions of Mangroves and Coastal Lagoons.	Monetary valuation of coastal mangroves and lagoons

2.14 These reviews help in understanding that for some countries, the extent and condition accounts for oceans are utilizing spatial and satellite data along with some ground validation surveys. Spatial/satellite data may be a good source for measuring extent, however, for condition parameters, the data should also reflect volume in addition to the area. Marine ecosystems spread below the ocean surface and parameters related to depth are also vital for condition accounts.

2.15 As regards the ecosystem services assessments, the work done by the countries are shown in the following Table 2.3.

Table 2.3: Countries by their level of work towards Ocean Ecosystem Services

S. No.	Countries	Ecosystem Types	Ecosystem Services (physical)	Ecosystem Services (monetary)
1	China	Mangroves	Carbon Sequestration Water Filtration	Carbon Sequestration Coastal Protection
		Coastal/Marine Beaches		Underwater Tourism
2	Australia	Mangroves	Carbon Storage	Coastal Protection
		Salt Marshes/Estuaries	Carbon Storage	Coastal Protection
3	Indonesia	Mangroves		Shoreline Protection
				Cultural and supporting

		Seagrass		Carbon Sequestration Nutrient Cycling Nursery Ground
		Coral Reef		Fish Provisioning Erosion Control Recreation
4	Canada	Salt Marshes/Estuaries	Wild Harvest and Raw Material Proposed	
5	USA	Coral Reef		Raw Material Provisioning Services Recreation
6	Netherlands	Coastal/Marine Beaches	Marine Fishing Extraction of sand/gravel/oil/gas Generation of Electricity from wind power	Fish Provisioning Mineral Provisioning Electricity Provisioning
7	UK	Coastal/Marine Beaches	Fish Capture Minerals	Offshore wind energy generation, Fossil Fuels
8	Columbia	Mangroves Coastal and Lagoons	Carbon sequestration, Carbon Storage	Fish Provisioning, Carbon sequestration, Carbon Storage
9	Granada	Seagrasses, Mangroves and Coral Reef	Fish and Shellfish provisioning services, coral reef extent, carbon stored, outdoor recreation	Fish and Shellfish provisioning services, reef coastal protection benefit, carbon retention, outdoor recreation

Conclusion

2.16 The above assessment helps in understanding that there is an increased acknowledgment of the ocean's pivotal contribution to sustainable economic growth and societal well-being. It also underscores how countries are moving towards incorporating ocean information into decision-making frameworks and policy

directives. Although very few countries currently have regular estimates of ocean accounts in place, the various stages of development and initiatives taken by different countries towards concretizing ocean accounts are significant. This calls for an internationally agreed-upon framework on Ocean Accounts adhering to the SEEA structure.

***

Chapter 3: Overview of the Ocean Ecosystem Accounts Framework

Introduction

3.1 It is well established that healthy ecosystems such as ocean ecosystems are essential for maintaining and advancing our economies, communities, and well-being. The management of the oceans requires achieving a balance between protecting the marine environment and developing opportunities for their sustainable use and enjoyment promoting social wellbeing and equitable prosperity. Ocean Accounts are integrated records of regularly compiled and comparable data concerning ocean environment conditions (e.g., extent/ condition of mangroves), economic activity (e.g., sale of fish) and social conditions (e.g., coastal employment). Using the accounting principles and structures described in the System of National Accounts (SNA) and System of Environment Ecosystem Accounts (SEEA), Ocean Accounts describe:

- The interactions between the economy and the environment;
- Stocks and changes in the stocks of environmental assets (natural capital) that provide benefits to people;
- Flows of services and benefits to society (including businesses and people) and the distribution of those benefits; and
- Social and governance factors affecting the status and condition of environmental assets and associated benefits.

3.2 Over the recent years, ocean accounting has become prominent through several initiatives worldwide. Given the high policy demand for ocean accounting and the global importance of the ocean economy, several methodological documents such as the draft Ocean Accounting Frameworks and Technical Guidelines have been developed. Some of the relevant frameworks are described below:

System of National Accounts (SNA)

3.3 **System of National Accounts (SNA)**[19] is the international statistical standard that countries use to measure the economy within the production boundary. It produces a well-understood set of macro-economic indicators, including Gross

[19] https://unstats.un.org/unsd/nationalaccount/sna.asp

Domestic Product (GDP). Many of the concepts such as exchange value, residence principle, etc. that are used in SEEA have been borrowed from SNA.

System of Environmental Economic Accounting (SEEA)

3.4 SEEA is the globally recognised statistical standard for organising environmental information in accounting framework for decision-making. The SEEA provides a framework for the measurement of the environment as an asset that produces material stocks, flows and services. It comprises two main documents: the SEEA Central Framework (SEEA CF) and the SEEA Ecosystem Accounting (SEEA EA). Additionally, there are a number of other supporting documents for specific sectors or environmental themes that support measurement in specific contexts. The SEEA Central Framework (CF) is designed to integrate information on natural resources (stocks), environmental flows and transactions with economic information. The focus of the Central Framework is the use of the environment as an economic input. Ecosystem accounting complements the approach of the SEEA Central Framework by providing an approach to accounting that considers the environment as a system of connected ecosystems. It is designed to integrate information on ecosystems, biodiversity, ecosystem services and economy.

3.5 The SEEA Ecosystem Accounting (EA) has a dedicated section on Ocean accounting. The section highlights that building on the SEEA ecosystem extent, condition and service flow accounts, the Ocean Accounts Framework adds accounts for natural resources and pressures on oceans from the SEEA Central Framework and accounts concerning the ocean economy, concerning governance, management and technology. The SEEA suggests compiling accounts for coastal and marine ecosystems as well as pressures on the ocean in line with SEEA EA and SEEA CF respectively.

Global Ocean Accounts Partnership (GOAP)

3.6 The technical document developed by GOAP[20] describes a statistical framework for measuring the ocean. The document defines Ocean Accounts as a structured compilation—of consistent and comparable information: maps, data, statistics and indicators—concerning marine and coastal environments, including related social circumstances and economic activity. The general purpose of such

[20] https://oceanaccounts.atlassian.net/wiki/spaces/DTGOOA/overview?homepageId=20512905

accounts is to inform and enable public policy decision-making about oceans, and related analysis and research.

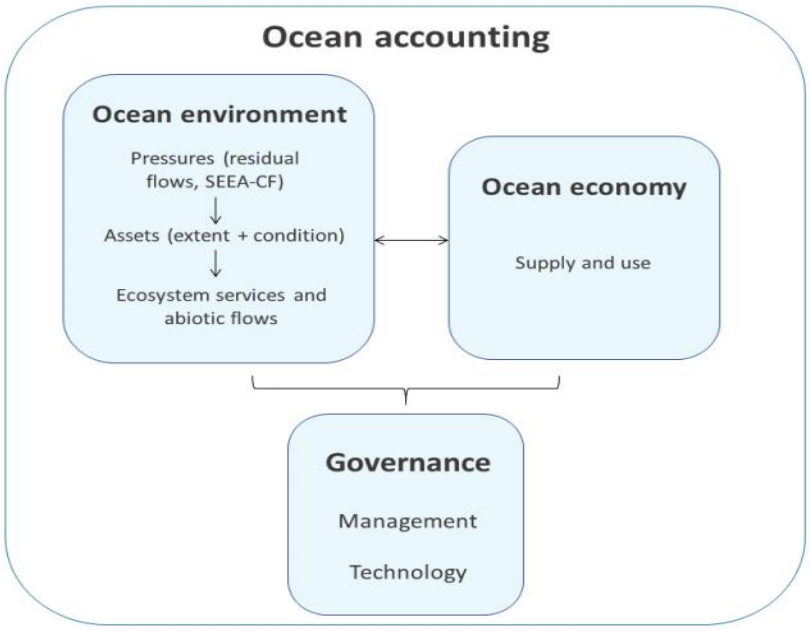
UNCEEA Working Group on Ocean Accounts:

3.7 In the meeting of the 52nd session of the United Nations Statistical Commission, the Commission supported the proposal to establish a working group to draft a methodological document for ocean accounting, SEEA Ocean, in support of the SEEA Central Framework and SEEA Ecosystem Accounting. The framework suggested in this report broadly focuses on the different aspects of SEEA EA Ocean Accounts Framework. SEEA EA suggests following accounts to be included for ocean ecosystem accounts.

1. **Ecosystem Extent Accounts:** To track the size of ecosystem assets in terms of spatial area;
2. **Ecosystem Condition Accounts**: To measure the quality of an ecosystem by tracking indicators of ecosystem health through the ecosystem's abiotic and biotic components;
3. **Physical Ecosystem Service Flow Accounts**: To record the supply of ecosystem services by ecosystem assets and the use of those services by economic units such as households;
4. **Monetary Ecosystem Service Flow Accounts**: To record the value of ecosystem services in monetary terms based on prices for individual ecosystem services; and
5. **Monetary Ecosystem Asset Accounts**: To record the value of stocks of assets given the expected flow of ecosystem services over a specified time horizon, and changes in asset degradation and enhancement projected over that time horizon.

3.8 According to the SEEA-EA guidelines, the Ocean Accounts Framework can be described as shown in the following figure:

Figure 3.1. Coverage of Ocean Accounts Framework



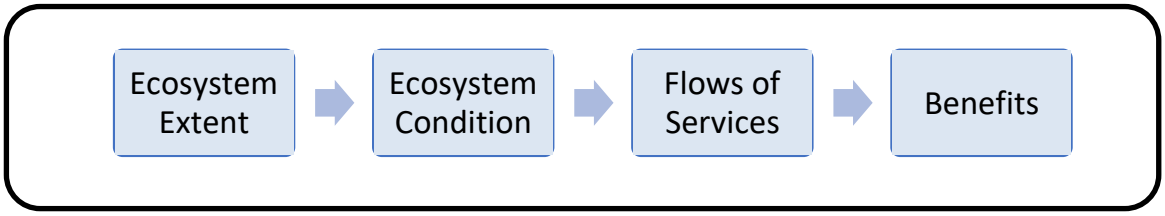
Source: System of Environmental-Economic Accounting—Ecosystem Accounting, 2021

Ocean Accounts integrate the following four key components:

i. Macro-economic accounts from which economic measures such as GDP are derived and from which legal, illegal, unreported, and unregulated activities can be accounted for;
ii. Environmental-economic accounts that explain assets and flows, wastes, expenditure, taxes, and subsidies and the distribution of those flows across economic units;
iii. Ecosystem accounts which agree on a spatial framework or the extent, condition, biodiversity, services, and value of ecosystems; and
iv. Structured data on ocean beneficiaries (in particular concerning identification of the characteristics of different beneficiaries), technology, governance, and management.

3.9 Figure 3.2 shows the core ecosystem accounting framework, and the framework revolves around this core structure.

Figure 3.2: Core Accounting Structure of the Framework



With this core accounting structure, ocean ecosystems can be described as a set of assets, with a size and type (for example, extent or area of seagrass meadows) and condition (for example, characteristics such as seagrass density assessed against a reference condition) that produce a set of services (such as fish for food or a pleasant location for tourism). These assets and services have cultural and intrinsic value, and the user of services, whether government, household, or community, also experiences some benefit.

India's Ocean Accounts Framework

3.10 The SEEA framework acts as the foundation for ecosystem accounting on a global scale. Nevertheless, there is no universally accepted paradigm for assessing the ocean and its associated ecosystems. Given the growing concern of policy makers for assessing the contribution of oceans in the economy as well as human wellbeing, the NSO, India has initiated the process of developing a framework for ocean ecosystem accounting.

3.11 This Expert Group has been entrusted with the task of compiling the Ocean Accounts Framework for India. In the absence of any international standard for Ocean Accounts, the SEEA structure has been adhered to. Therefore, the following accounts have been considered by the Expert Group:

i. Ocean Extent
ii. Ocean Condition
iii. Ocean Services
iv. Ocean Assets

3.12 The framework has the following objectives:

i. To provide structure at the national level to measure ocean-related ecosystems and their contributions to the economy and society; and
ii. To improve understanding of how ocean ecosystem accounts can assist in the sustainable management of marine resources and aid in decision-making.

3.13 This report, compiled by the Expert Group, is an assessment of parameters and methodologies required to initiate the compilation of Ocean Ecosystem Accounts for India. The framework on Ocean Accounts in India is an integrated statistical framework for organizing information on ocean-related ecosystem extent and its

condition, tracking the changes therein, and its services that contribute to the benefits of the economy and society, as well as valuing such services and assets. The framework provides a structured approach to capturing the information relevant to ocean accounting.

Salient Features of the Framework

3.14 Among the myriad guidelines available for the counting oceans' contribution, the framework developed on Ocean Ecosystem Accounts by the NSO, India, stands out as a pivotal tool, designed to highlight the contributions of ocean ecosystems. It further lays down the foundation for the decision-makers concerned with sustainable national development and delivering better outcomes for the environment and society. The following table broadly describes the information captured by the framework.

Table 3.1: Information captured by the Framework

Element	Description
Ecosystems/ Assets	• The stock and changes of different Ocean/Marine resources, both biotic and abiotic • The stock and changes of different ocean ecosystems • Levels and changes in the condition of ocean ecosystems and/or assets
Material Flows and Services	• Physical quantities of flows from the environment to the economy and vice versa. • Physical quantities of biotic ecosystem service flows to different human users • Physical quantities of biotic ecosystem service flows from and to different ecosystem units
Monetary Valuation	• Market and non-market values of material flows and services
Ocean Governance	• Various policies and programmes aimed at conservations of oceanic and marine resources, and promoting their sustainable management
Linkages of Ocean Ecosystem Accounts with	• Other ongoing efforts of the government such as Marine Spatial Planning, Blue Economy etc.

Element	Description
other ongoing efforts	
Policy Linkages of Ocean Ecosystem Accounts	• Various Central and State level policies related to the Oceans

3.15 The framework provides suggestions on what elements are necessary for developing ocean ecosystem accounts in the Indian context. This chapter dwells on the following aspects in this regard:

(i) Relevant ocean ecosystems;
(ii) Relevant parameters representative of the selected ocean ecosystems;
(iii) Applicable spatial units;
(iv) Units of measurement; and
(v) Periodicity of Accounts.

The subsequent chapters delve into a specific set of parameters and potential data sources concerning various ocean ecosystem accounts (viz. extent, condition, etc.).

Table 3.2: Structure of a Generalized Ecosystem Extent and Condition Accounts

S. No.	Account	Indicator(s)	Units	Levels of Reporting*	Periodicity
1	Extent				
	E1	Area	Ha	Entire Ecosystem; EEZ; State; District, etc.	P1
	E2…	Area	Ha	Entire Ecosystem; EEZ; State; District, etc.	P2
2	Condition				
	E1	Biodiversity, Salinity, pH, etc.		Entire Ecosystem; EEZ; State; District, etc.	P1
	E2…	Biodiversity, Salinity, pH, etc.		Entire Ecosystem; EEZ; State; District, etc.	P2

**Levels of reporting may be one of the listed levels*

3.16 In the case of each ecosystem, it is proposed that the accounts be prepared with different levels of detail – depending on data availability. For example, in the case of Extent Accounts, Tier 1 accounts would contain aggregate area information for the entire ecosystem, whereas Tier 2 accounts could provide area information pertaining to sanctuaries, reserve forests, CRZs, etc. The Ocean Accounts can be expanded gradually as more granular data is made available in the future. Similarly, for Condition Accounts, Tier 1 accounts could provide information on some of the commonly available ocean condition parameters. Tier 2 accounts could provide information on some more additional parameters. Subsequently, information on these parameters can be aggregated to various indices viz. Water Quality Index, Plankton Diversity Index, Fish Diversity Index. For spatial datasets the standard resolution may be taken as 10*10 Km. for processing and dissemination of these spatial datasets. However, the resolution may vary depending on the ecosystem, the data compiling agency and the purpose for which the data is captured.

3.17 Table 3.3 and 3.4 provide the broad framework for recording Extent Accounts under Tier 1 and Tier 2 for Ocean Ecosystem Accounts.

Table 3.3: Framework for Ecosystem Extent Accounts – Tier 1

S. No.		Ecosystem(s)		
		E1	E2	E3
1	**Opening Stock (at time T1)**			
2	**Addition to Stock (2a+2b+2c)** *(During the period T1 to T2)*			
2a	Managed Expansion			
2b	Natural Expansion			
2c	Upward Reappraisals			
3	**Reduction of Stock (3a+3b+3c)** *(During the period T1 to T2)*			
3a	Managed Reduction			
3b	Natural Reduction			
3c	Downward Reappraisals			
4	**Closing Stock (at time T2) (1+2-3)**			

Table 3.4: Framework for Ocean Ecosystem Extent Account – Tier 2

S. No.	Ecosystem Extent Parameter	Opening Stock (at time T1)	Additions to Stock	Reductions in Stock	Closing Extent (at time T2)	Percentage Change over time (T2-T1)
(1)	(2)	(3)	(4)	(5)	(6) = (3) + (4) - (5)	[(6) - (3)] * 100 ÷ (3)
Ecosystem 1						
1	E1_EP1					
2	E1_EP2					
3	E1_EP3					
	…					
Ecosystem 2						
4	E2_EP1					
5	E2_EP2					
6	E2_EP3…					
	…					

Where, E1_EP1 refers to 'Extent' Parameter 1 for Ecosystem 1

3.18 For ocean ecosystem condition account also, as mentioned above, a tiered approach is prescribed. The tiered approach will enable initiating the accounts with the data available at hand and with the scope of gradually refining the existing accounts with newer data availability. The SEEA suggests to adapt the proposed materials and processes to national circumstances for strategic planning of implementation of SEEA[21]. The tiered approach suggested align broadly with SEEA. Since, the ocean accounts framework is at nascent stage, prioritized parameters would help in focussed efforts and better outcomes. Tier 1 parameters are those which are comparatively estimable in the light of data availability as compared to Tier-2 parameters where further granular level data along with further research is required. Depending on data availability, more parameters may be included at a later stage. Details of the parameters can be found in Chapter 4 of the report. Reference value for

[21] https://seea.un.org/content/seea-implementation-guide-strategic-planning#2.3

any condition indicator helps in monitoring the health of the ecosystem. For any chemical, physical parameters, reporting of reference values is suggested for better monitoring of the ecosystem condition.

Table 3.5: Framework for Ocean Ecosystem Condition Accounts – Tier 1

S. No.	Ecosystem Condition Parameters	Condition at time (T1)	Condition at time (T2)	Reference Value (quantitative/ qualitative)	Changes w.r.t Reference (quantitative/ qualitative)
Ecosystem 1					
1	CP1				
2	CP2				
	…				
	CPn				
Ecosystem 2					
1	CP1				
2	CP2				
	…				
	CPn				
….					
…	…				

where, CP1 - Condition Parameter 1

Table 3.6: Framework for Ocean Ecosystem Condition Accounts – Tier 2

S. No.	Ecosystem Condition Parameters	Condition at time (T1)	Condition at time (T2)	Reference Value (quantitative/ qualitative)	Changes w.r.t Reference (quantitative/ qualitative)
Ecosystem 1					
1	E1_CP1				
2	E1_CP2				
	….				
	E1_CPn				
Ecosystem 2					
1	E2_CP1				
2	E2_CP2				
	…				
	E2_CPn				

S. No.	Ecosystem Condition Parameters	Condition at time (T1)	Condition at time (T2)	Reference Value (quantitative/ qualitative)	Changes w.r.t Reference (quantitative/ qualitative)
….					
…	…				

where, CP1 - Condition Parameter 1

Ocean Ecosystem Services

3.19 The broad objective of quantifying ecosystem services is to describe the relationship between environment and the economy. In many respects, flows of ecosystem services, which describe the contributions that ecosystems make to benefits used in economic and other human activities, are a central part of describing this relationship. Ocean Ecosystem services broadly include ecosystem services and abiotic flows (e.g., mineral extraction and energy capture). Also, there are many ocean ecosystem services including the provision of biomass (through wild fish and aquaculture), coastal protection and tidal surge mitigation, water purification, nursery population, habitat maintenance, recreation-related services and visual amenity services. Ocean ecosystems also play a pivotal role in regulating climate by absorbing and storing carbon dioxide (CO_2) from the atmosphere and influencing global climate patterns. Recording of these services supplied by coastal and marine ecosystems in physical and monetary terms are essential for proper ocean governance and management.

3.20 Understanding and valuing ocean ecosystem services is essential for the sustainable management and conservation of oceans. Ocean ecosystems provide tangible and intangible benefits to society, and they are increasingly being recognized in policy-making and economic assessments to ensure their preservation for future generations.

3.21 In the present framework, various ecosystem services have been identified under different categories. In addition to provisioning, regulating and cultural services, there are some supporting services of ocean such as shipping where oceans play a crucial role. Such services have also been considered in the present framework.

3.22 For the monetary valuations of ecosystem services, the directly observed values, which may be taken as basic price, are preferred. However, in the absence of

requisite data on such values, methods prescribed by SEEA may be explored. The detailed description of services and their valuation techniques has been provided in Chapter 5 of the report.

Ocean Asset Accounts

3.23 SEEA EA defines ecosystem assets as contiguous spaces of a specific ecosystem type characterized by a distinct set of biotic and abiotic components and their interactions. Ocean ecosystem asset accounts record stocks and flows of biotic and abiotic natural assets related to oceans. Ocean ecosystem assets are recorded in a combination of accounts for individual environmental assets (minerals, energy and aquatic resources, e.g. fish stocks) from the SEEA CF and for ecosystem assets (such as wetlands, coral reefs) from the SEEA EA. The ocean ecosystem assets, such as mangrove, corals, etc. may be characterized by their extent and condition. For the individual natural assets, such as sand and minerals, quantity and quality may be specified based on their characteristics. Ecosystem accounting incorporates recording entries for ecosystem assets based on their exchange values, together with associated changes in the value of ecosystem assets over an accounting period. The broad framework for Ocean Asset Accounts in physical terms is given as follows:

Table 3.7: Framework for Ocean Asset Accounts

Unit: Physical

Ocean Asset	Opening Stock at time (T1)	Addition to Stock	Reduction in Stock	Closing Stock at time (T2)
Environmental Assets				
Asset 1				
Asset 2				
Asset 3				
…				
Ecosystem Asset				
Asset 1				
Asset 2				
Asset 3				
…				

Table 3.8: Framework for Ocean Asset Accounts (Quality)

Unit: Physical

Ocean Asset	Condition of Stock at time (T1)	Condition of Stock at time (T2)	Reference Value (quantitative/ qualitative)	Changes w.r.t Reference (quantitative/ qualitative)
Environmental Assets				
Asset 1				
Asset 2				
…				
Asset n				

***

Chapter 4: Ocean Ecosystem: Extent and Condition Accounts

Introduction

4.1 A common starting point for any ecosystem accounting is the compilation of extent account which provides information on the spatial distribution and the extent of different ecosystem types within the accounting area and how it changes over the years. SEEA EA defines 'Ecosystem Extent' as the size of an ecosystem asset.

4.2 Ecosystem extent accounts are intended to support decision-making by providing useful information regarding the location, size, and temporal variations of ecosystems to planners, policymakers, and other stakeholders.

4.3 Having the information on the extent of an ecosystem, the next priority becomes to get an idea of the condition of that ecosystem – whether the ecosystem is in a healthy state or is deteriorating over the years. Ecosystem condition accounts provide a structured approach to record and aggregate data describing the characteristics of ecosystem assets and how they have changed over a period. According to the SEEA EA, ecosystem condition is the quality of an ecosystem measured in terms of its abiotic and biotic characteristics. The measurement of ecosystem condition is pivotal in order to support environmental policy and decision-making particularly related to protecting, maintaining and restoring the condition of ecosystems.

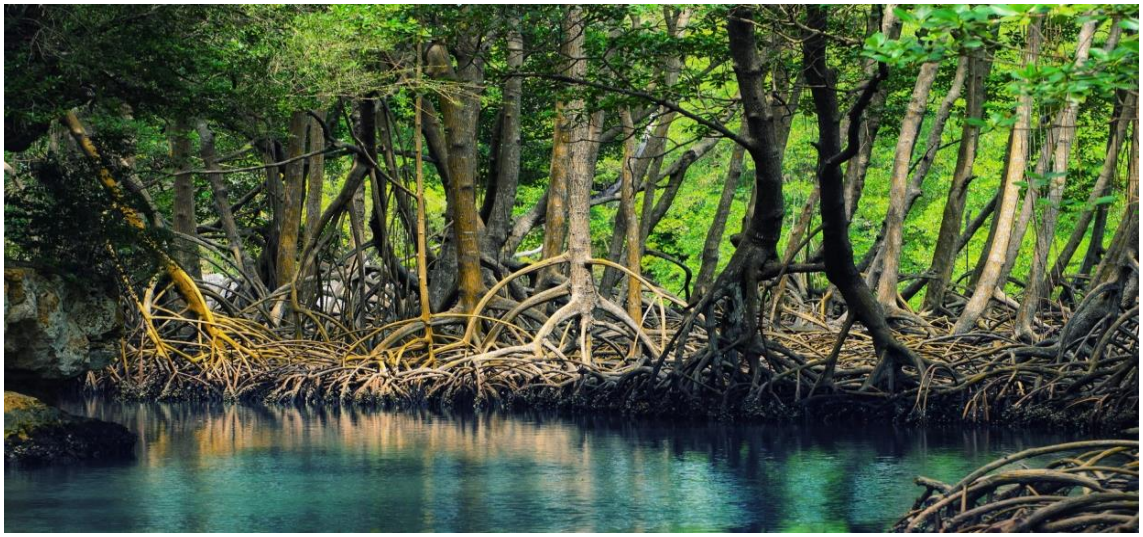
4.4 This chapter discusses about the framework for Ocean Ecosystem Extent and Condition Accounts. As described in Chapter 3, the selected Ocean Ecosystems for India are as follows and the corresponding International Union for Conservation of Nature (IUCN) Global Ecosystem Typology (GET) Functional Groups are given in the table alongside.

Table 4.1: Selected Ocean Ecosystems for India and corresponding IUCN GET Functional Groups

S. No.	Ecosystems	IUCN GET Functional Group
1	Mangroves	MFT1.2 Intertidal forests and shrublands
2	Coral reefs	M1.3 Photic coral reefs
3	Seagrass	M1.1 Seagrass meadows
4	Estuaries	FM1.2 Permanently open riverine estuaries and bays
5	Lagoons	FM1.3 Intermittently closed and open lakes and lagoons
6	Sandy coast	MT1.3 Sandy Shorelines
7	Coastal Ocean Water	M2.1 Epipelagic ocean waters
8	Mudflats	MT1.2 Muddy Shorelines

4.5 The description of these ecosystems and their properties are given as follows[22]. It is pertinent to mention here that the description is based on IUCN Global Ecosystem Typology. Existing national definitions/regulations may be followed while implementing the framework or while undertaking studies for these ecosystems.

S. No.	Ecosystems	IUCN GET Functional Group
1	Mangroves	MFT1.2 Intertidal forests and shrublands



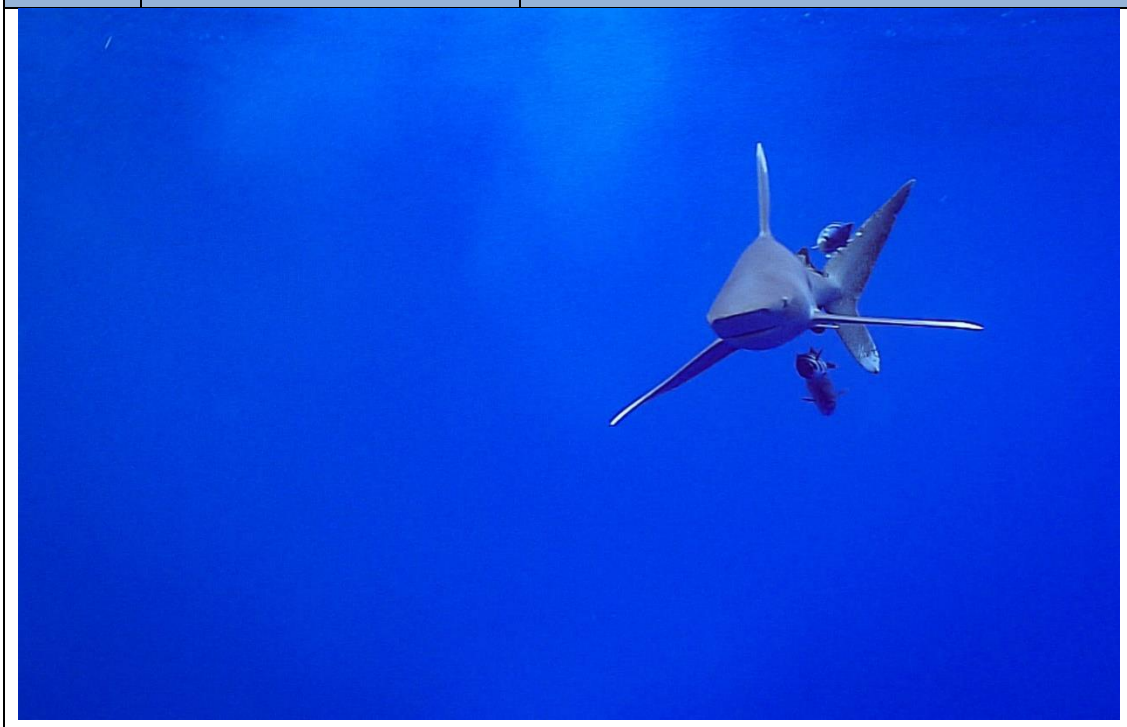
[22] https://global-ecosystems.org/

S. No.	Ecosystems	IUCN GET Functional Group
Mangroves create structurally complex and productive ecosystems in the intertidal zone of depositional coasts, around tropical and warm temperate regions. The iota includes aquatic and terrestrial species, and intertidal specialists. Large volumes of mangrove leaves and twigs are decomposed by fungi and bacteria, mobilizing carbon and nutrients for invertebrates such as crabs, worms and snails. Shellfish and juvenile fish are protected from desiccation and predators amongst mangrove roots. Mangrove canopies support many terrestrial species, particularly birds. These forests are important carbon sinks, retaining organic matter in sediments and living biomass.		
2	Coral reefs	M1.3 Photic coral reefs
		
These slow growing biogenic structures are formed by the calcium carbonate skeletons of certain coral species that depend on symbiotic relationships with algae. They occur in warm, shallow, low-nutrient waters and provide complex three-dimensional habitat for a highly diverse community across all trophic levels, from algae to sharks, along with other characteristic sessile organisms like coralline algae and sponges. Niche habitats produce specialist behaviours and diets, like the symbiotic relationship between clown fish and anemones. Storms and marine heat waves drive cycles of reef destruction and renewal.		
3	Seagrass	M1.1 Seagrass meadows

S. No.	Ecosystems	IUCN GET Functional Group
		
These shallow, subtidal systems are the only marine ecosystems with an abundance of flowering plants. They are typically found mostly on soft, sandy or muddy substrates around relatively sheltered coastlines. Extent is limited in the shallows by wave action and tidal exposure, and at depth by light availability. Productive ecosystems, their three-dimensional structure provides shelter for juvenile fish, invertebrates and epiphytic algae. Diverse organisms live in and around seagrass beds including many grazers, from tiny invertebrates to megafauna such as dugongs.		
4	Estuaries	FM1.2 Permanently open riverine estuaries and bays
		

S. No.	Ecosystems	IUCN GET Functional Group
These coastal ecosystems are shifting mosaics of different habitats, depending on the shape of the local coast, and proportional inflow of freshwater and seawater. Combined nutrients from marine, freshwater and land-based sources support very high productivity. Transient large animals like dugongs, dolphins, turtles and shorebirds feed on abundant fish, invertebrates and plant life, and they commonly serve as sheltered nursery areas for fish. Many organisms are adapted to large variations in salinity.		
5	Lagoons	FM1.3 Intermittently closed and open lakes and lagoons
		
These coastal water bodies have high spatial and temporal variability in structure and function, which depends largely on the status of the lagoonal entrance (open or closed). Communities have low species richness compared to those of permanently open estuaries. Lagoonal entrance closure prevents the entry of marine organisms and resident biota must tolerate significant variation in salinity, inundation, dissolved oxygen, and nutrient concentrations. Resident communities are dominated by opportunists with short lifecycles.		
6	Sandy coast	MT1.3 Sandy Shorelines

S. No.	Ecosystems	IUCN GET Functional Group
		
Sandy shorelines include beaches, sand bars, and spits. They all are exposed to waves and tides on moderate-high energy coasts, and they rely on drift seaweed and surf-zone phytoplankton for nutrients. Polychaete worms, bivalve shellfish and a range of smaller invertebrates burrow in the shifting sediments, while larger vertebrate animals like seabirds, egg-laying turtles and scavenging foxes can also be found at various times. Storm tides and waves periodically restructure the sediments and profoundly influence the traits of the organisms living in these highly dynamic systems.		
7	Coastal Ocean Water	M2.1 Epipelagic ocean waters

S. No.	Ecosystems	IUCN GET Functional Group
		
The epipelagic or euphotic zone of the open ocean is the uppermost layer that is penetrated by enough light to support photosynthesis. This uppermost ocean layer (0-200m depth) is the most influenced by the atmosphere, and is defined and structured by light availability. Photosynthesis in these ecosystems account for half of all global carbon fixation. That productivity supports diverse marine life, including many visual predators, like tuna, that rely on the high light environment. Migration is a common life history trait across all groups: either vertical – rising from the depths to feed at the surface at night to evade daytime predators; or horizontal – between breeding and feeding grounds. Detritus from this zone is an important nutrient source for lower oceanic layers.		
8	Mudflats	MT1.2 Muddy Shorelines

S. No.	Ecosystems	IUCN GET Functional Group
		
Mudflats occur on low-energy coastlines. Mud and silt, often from nearby rivers, protect the burrowing organisms living in these ecosystems from common shoreline stressors (e.g. high temperatures and desiccation) and predatory shorebirds, crabs and fish. These shorelines are critical stopovers and foraging grounds for migratory shorebirds. Primary productivity is mostly from diatoms (single-celled algae) that rely on tides. Oxygen can be low where sediments are very fine or burrowing or other disturbance is limited.		

Images Source: ***https://global-ecosystems.org/***

4.6 The above list of ecosystems is the initially proposed list which is not exhaustive. Keeping the data availability in view, the initial list is restricted to above ecosystems, however, other ecosystems may also be added at later stage. There are many more coastal and marine ecosystems which are contributing to the benefits derived by societies and economies to a great extent. One such ecosystem is Atoll Ecosystem. India hosts a unique atoll ecosystem in the Lakshadweep archipelago, which has been maintained in its pristine condition to date. The uniqueness of atoll ecosystems lies in their formation, biodiversity, adaptations to isolation, complex ecological interactions, sensitivity to environmental changes, and cultural significance. Protecting these ecosystems is crucial for maintaining their biodiversity and the benefits they provide to human societies.

Framework for the Extent Accounts

4.7 The following table provides a framework for recording statistics on ocean ecosystem extent accounts. A fundamental objective of compilation of ecosystem extent accounting is to record differences between the current composition of ecosystem types and a reference or baseline composition. Here, the selection of baseline/ reference year is crucial and also depends on data availability. Having information on extent accounts over a long time-period helps in understanding how the different economic activities and policy measures are impacting the ocean ecosystems.

4.8 The parameters of the Extent Accounts have been categorized into tiered approach. The Tier 1 parameters are the essential parameters for extent accounts for each selected ecosystem. Tier 2 parameters are ecosystem specific parameters and may be compiled subsequently based on the data availability.

Table 4.2: Framework for Extent Accounts for Ocean Ecosystems (Tier 1)

S. No.	Ecosystem Extent Parameters	Opening Extent at time (t1)	Additions	Reductions	Closing Extent at time (t2)	Changes over time (t2-t1)
1	**Mangroves**					
	Coverage					
2	**Coral reefs**					
	Coverage					
3	**Seagrass**					
	Coverage					
4	**Estuaries**					
	Coverage					
5	**Lagoons**					
	Coverage					
6	**Sandy coast**					
	Coverage					
7	**Coastal Ocean Water**					
	Coverage					
8	**Mudflats**					
	Coverage					

4.9 The above table provides Extent in terms of Tier 1 parameters for each of the 8 ecosystems. Tier 2 parameters for extent accounts are ecosystem specific and are provided in the Annexure 4.1.

4.10 Periodicity of Extent Accounts: Adopting a regular reporting approach will enable a clear recording structure that ensures consideration of changes on a regular basis and allows changes to be recorded at appropriate points in time. A 5-year periodicity is suggested for extent accounts keeping in view the fact that extent of such coastal ecosystem may show minute change in shorter time-period. However, recording will also depend upon the data availability with the concerned data providing agencies. Availability of remote sensing and other spatial data sets might help in regular compilation of extent accounts for the ocean ecosystems.

4.11 Relevant accounting entries are defined below:

Opening Extent at time (t1): It represents the total area of ocean ecosystem at the beginning of an accounting period (t1).

Additions: Additions to extent represent increases in the area of an ecosystem type. This could be of two types; managed and unmanaged. Managed expansion represents an increase in the area of an ecosystem type due to direct human activity in the ecosystem, including the unplanned effects of such activity. Unmanaged expansion represents an increase in the area of an ecosystem type resulting from natural processes.

Reductions: Reductions in extent represent decreases in the area of an ecosystem type. As in the case of additions, here also, managed reduction represents a decrease in the area of an ecosystem type due to direct human activity in the ecosystem whereas unmanaged reduction represents a decrease in area of an ecosystem type associated with natural processes.

Closing Extent at time (t2): It represents the total area of ocean ecosystem at the end of an accounting period (t2).

Changes over time (t2-t1): It represents the changes in the area of an ecosystem between two accounting period.

Framework for Conditions of Ocean Ecosystems

4.12 The coastal regions are unique because of their position at the interface of atmosphere, lithosphere and hydrosphere. This interaction creates a wide variety of complex habitats, which host a rich biodiversity, energy and mineral resources. Ocean Ecosystems provide important ecological and economical services in the form of coastal protection, fisheries and other living and non-living resources. This has made the coastal areas centre of human activity for millennia. However, the services provided by the ocean are much dependent on the health of the oceans. The condition

accounts help to make an assessment about the health of the ocean over a period of time.

4.13 Ecosystem condition accounts provide a structured approach to record and aggregate data describing the characteristics of ecosystem assets and how they have changed.

4.14 The following table provides a structure for organizing data on various condition parameters for different ocean ecosystems. As the Ocean Ecosystems comprise of different sub ecosystems having separate set of condition parameters representing their condition, in the following structure, the ecosystem-wise condition parameters have been listed. Regarding the variable to be considered for condition parameters, SEEA EA has extensive recommendations on choice of indices and variables for several condition parameters.

4.15 In the current chapter, a tiered approach is recommended for compilation of condition accounts of ocean ecosystems, similar to that suggested in extent accounting. Here also, Tier 1 parameters are some commonly available crucial parameters, and Tier 2 parameters are more detailed and ecosystem-specific, and have been identified in Annexure 4.2. When data availability of Tier 1 and Tier 2 condition parameters for each ecosystem is achieved, certain indices such as water quality index, fish diversity index, plankton diversity index etc. may be developed at later stage.

Table 4.3: Framework for the Condition Accounts for Different Ocean Ecosystem Types (Tier 1)

S. No	Ecosystem Condition Parameters	Condition at time (t1)	Condition at time (t2)	Changes over time (t2-t1)
1	**Mangroves**			
1	Concentration of Nutrients (Nitrate, Phosphate…)			
2	pH			
3	Salinity			
4	Biodiversity			
5	Soil Nutrients			
2	**Coral Reefs**			

S. No	Ecosystem Condition Parameters	Condition at time (t1)	Condition at time (t2)	Changes over time (t2-t1)
1	pH			
2	Salinity			
3	Biodiversity			
4	Surface Temperature			
5	Coral Diversity			
6	Turbidity			
3	**Seagrass**			
1	Concentration of Nutrients (Nitrate, Phosphate…)			
2	pH			
3	Salinity			
4	Biodiversity			
5	Turbidity			
6	Seagrass Diversity			
4	**Estuaries**			
1	Sediments			
2	Concentration of Nutrients (Nitrate, Phosphate…)			
3	Dissolved Oxygen			
4	pH			
5	Salinity			
6	Biodiversity			
5	**Lagoon**			
1	Concentration of Nutrients (Nitrate, Phosphate…)			
2	Dissolved Oxygen			
3	pH			
4	Salinity			
5	Biodiversity			
6	Sediment Carbon			
6	**Sandy Coast**			
1	Soil Texture			
2	Chemical Deposition			
3	Biodiversity			
4	Soil Temperature			
7	**Coastal Ocean Water**			

S. No	Ecosystem Condition Parameters	Condition at time (t1)	Condition at time (t2)	Changes over time (t2-t1)
1	Biological Oxygen Demand			
2	Concentration of Nutrients (Nitrate, Phosphate…)			
3	Dissolved Oxygen			
4	Salinity			
5	Biodiversity			
6	Temperature			
7	Turbidity			
8	**Mudflats**			
1	Soil Texture			
2	Concentration of Nutrients (Nitrate, Phosphate…)			
3	Biodiversity			

The Framework for the Condition Accounts for different Ocean Ecosystem Types (Tier 2) is provided in Annexure 4.2.

4.16 Periodicity of Condition Accounts: Adopting a regular reporting approach for condition accounts will establish a clear recording structure in place, ensuring consideration of changes on a regular basis and allowing changes to be recorded at appropriate points in time. A five-year periodicity for ocean condition accounts may be taken. However, recording will also depend upon data availability with the concerned data provider agencies.

4.17 Regular reporting on condition accounts enables comparability over years and reflects the changing condition of the ecosystem. Having a reference level of such condition variables, will enhance the utility of condition accounts. The reference level is the value of a variable at the reference condition, against which it is meaningful to compare past, present or future measured values of the variable. The difference between the value of a variable and its reference level represents the distance from the reference condition. The reference level for the same variable for different ecosystem may vary considerably. Choosing a reference level for each condition variable requires proficient knowledge about the ecosystem. A reference value suitable for the Indian context may be decided in due consultation with the subject-matter experts and the concerned agencies.

Potential Data sources

4.18 Ecosystem Accounts are compiled using diverse data sources. There is a wide array of potential data sources at the national and state level that might be used for the compilation of Ocean Ecosystem Extent and Condition Accounts. Some of the potential data source agencies are the Ministry of Environment, Forest and Climate Change, Ministry of Earth Sciences, Department of Fisheries, Geological Survey of India, Forest Survey of India, National Centre for Sustainable Coastal Management, Zoological Survey of India, Botanical Survey of India, Central Marine Fisheries Research Institute, Central Pollution Control Board, National Centre for Coastal Research, Indian Council of Agricultural Research, National Institute of Oceanography, Space Application Centre, National Remote Sensing Agency, etc.

4.19 In addition, since many of the data required for extent and condition accounts, may fall under the purview of state administration, the state departments of the coastal states/UTs may also serve as potential data source. Some of the notable state agencies would be the State Forest Departments and State Fisheries Departments.

4.20 The following table describes the potential data sources for Tier 1 parameters of extent accounts.

Table 4.4: Table: Potential Data Source Agencies

S. No.	Ecosystems	Data Source
1	Mangroves	Forest Survey of India[23]
2	Coral reefs	Indian National Centre for Ocean Information Services[24] National Centre for Sustainable Coastal Management, Ministry of Environment Forest and Climate Change
3	Seagrass	National Centre for Sustainable Coastal Management, Ministry of Environment Forest and Climate Change[25]
4	Estuaries	Indian Council of Agricultural Research[26]

[23] https://fsi.nic.in/isfr-2021/chapter-3.pdf
[24] https://incois.gov.in/portal/CoralReef.jsp
[25] https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1810578
[26] https://agritech.tnau.ac.in/fishery/fish_estuarian.html#:~:text=Major%20estuarine%20systems%20of%20India&text=The%20states%20of%20Orissa%2C%20Gujarat,to%20be%202%2C340%20km%C2%B2.

S. No.	Ecosystems	Data Source
5	Lagoons	Space Application Centre, ISRO[27]
6	Sandy coast	National Centre for Coastal Research
7	Coastal Ocean Water	National Centre for Coastal Research
8	Mudflats	National Centre for Coastal Research

4.21 However, the fact cannot be denied that the data requirement for ecosystem accounting is very explicit and often are not typically captured in data sources of statistical offices such as surveys, administrative data and censuses. Additionally, reporting environmental data in a way that can be integrated into accounting frameworks without oversimplifying complex ecological and socioeconomic processes underpinning ecosystem services is challenging.

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[27] https://vedas.sac.gov.in/static/downloads/atlas/Wetlands/wetland_L4_atlas_12March2024.pdf

Chapter 5: Ocean Ecosystem: Services Flow and Asset Accounts

Background

5.1 Ecosystem services are the benefits derived from the ecosystem for society and the economy. These ecosystem services serve as a connecting point between the production and consumption activities in the economy and the ecosystem/natural asset. Thus, their measurement lies at the core of ecosystem accounting and it can reveal the quantity of ecosystem services being provided by different spatial units of ecosystems. Their supply and use measured over time can further provide a trend in the relationship between the ecosystems and their use dynamics which may reveal the impact of management and conservation activities adopted in the economy. Accounting for ecosystem services is also crucial as many economic production processes use inputs directly from the ecosystem; however, those inputs and their associated degradation are not explicitly recorded in the national accounting framework.

5.2 The measurement of ocean ecosystem services is of particular interest in explaining the variety of contributions that ocean ecosystems provide to society and the economy. These contributions extend well beyond those of marketed goods, such as fish, and include services such as global climate regulation and recreation-related services, etc.

5.3 SEEA EA defines ecosystem services as ***the contributions of ecosystems to the benefits that are used in economic and other human activity***[28]**.** Ecosystem Services can be broadly categorized into three categories[28]:

a. Provisioning Services are those ecosystem services representing the contributions to benefits that are extracted or harvested from ecosystems. These are related to the supply of food, fibre, fuel and water;

b. Regulating Services are those ecosystem services resulting from the ability of ecosystems to regulate biological processes and to influence

[28] System of Environmental-Economic Accounting— Ecosystem Accounting, 2021

climate, hydrological and biochemical cycles and thereby, maintain environmental conditions beneficial to individuals and society. These services are related to activities of filtration, purification, regulation and maintenance of air, water, soil, habitat and climate, etc.; and

c. Cultural Services are the experiential and intangible services related to the perceived or actual qualities of ecosystems whose existence and functioning contributes to a range of cultural benefits. Cultural[29] ecosystem services and benefits can include health, learning and social connections, sensory experiences, cultural and symbolic importance and identity.

Ocean Ecosystem Services

5.4 Collectively, the benefits provided by ocean ecosystems are referred to as ocean ecosystem services. Ocean ecosystems have been providing many benefits to human kind since ages. Some of these are listed below:

a. Provision of seafood, habitats, fuelwood, energy sources, wetland protection and genetic resources.
b. Regulation of weather and climate, protection of coasts and sediment deposition, and mitigation of storm damage.
c. Provision of cultural services, including recreational, educational, aesthetic and spiritual experiences.
d. Support for economic activities, including jobs, fisheries, food, marine transportation, trade, fuel, and energy.

A detailed list of various services provided by the oceans is provided in **Annexure 5.1.**

Framework for Ocean Ecosystem Services

5.5 In the framework of Ocean Ecosystem Accounting for Ocean Ecosystem Services, all three categories of services have been considered. A few ecosystem services relevant to the Indian context, as shown in Table 5.1, are suggested for compilation. Some of these suggested services are applicable to all eight ecosystems, while others are relevant to only a few selected ecosystems.

[29] https://www.forestresearch.gov.uk/research/cultural-ecosystem-services-values-and-benefits/#:~:text=Cultural%20ecosystem%20services%20and%20benefits,and%20symbolic%20importance%20and%20identity

Table 5.1: List of Selected Ecosystem Services against each ecosystem type (Tier 1)

Category	Ecosystem Services	Ecosystem Type							
		Mangrove	Lagoon	Coral reef	Seagrass	Estuary	Sandy Coast	Coastal Ocean	Mudflats
Provisioning	Fish/ Other Aquaculture Provisioning Services	✓	✓	✓	✓	✓	✓	✓	✓
	Food other than fishery Provisioning Services (Salt/Seaweed/…)	✓	✓	✓	✓	✓	✓	✓	✓
	Fuel/Firewood Provisioning Services	✓						✓	
Regulating	Carbon sequestration	✓	✓		✓	✓	✓	✓	✓
	Carbon storage	✓	✓	✓	✓	✓	✓	✓	✓
	Water purification	✓	✓	✓	✓	✓	✓	✓	✓
Cultural	Tourism & recreation	✓	✓	✓	✓	✓	✓	✓	✓
Other	Minerals		✓	✓	✓	✓	✓	✓	✓
	Energy (Solar energy, Wind, Tidal)	✓	✓	✓		✓	✓	✓	✓
	Shipping							✓	

**Tick denotes relevant ecosystem type for an ecosystem service*

5.6 A brief description of each of the services is given in Table 5.2. As an initial step, it is suggested to estimate these services in physical terms, and subsequently, based on the data availability, monetary estimates should be provided. The list of services is not exhaustive; however, these services are found to be most relevant and estimable in light of data availability.

Table 5.2: Brief description of selected Ecosystem Services

Type of Services	Ecosystem Service	Description
Provisioning Service	Fish Provisioning	Fish provisioning services are the ocean ecosystem contributions to the growth of fish that are captured in uncultivated production contexts by economic units for various uses, primarily food production.
	Food (other than fish) Provisioning (Seaweed, salt)	These are the contributions of ocean ecosystems in production of biomass primarily used for food such as seaweed and salt.
	Fuel/Firewood	Fuel and Firewood provisioning services are the ocean ecosystem contributions to the growth of trees and other woody biomass in both cultivated (plantation) and uncultivated production contexts that are harvested by economic units for fuel and energy.
Regulating Services	Carbon sequestration	The carbon sequestration component of the service reflects the ability of ecosystems to remove carbon from the atmosphere. This may involve storage within an ecosystem asset, e.g., a mangrove or wetland. Here, carbon storage in Biomass is considered.
	Carbon storage	This service indicates the carbon sequestration in soil relating to ocean ecosystems. Carbon sequestration in soil is the long-term storage of carbon in soils of ocean-related ecosystems.
	Water purification	Water purification is one of the regulating services that provide benefits through ecosystem processes that moderate natural phenomena. Water purification services refer to the ecosystem's contributions to the restoration and maintenance of water's chemical condition by breaking down or removing nutrients and other pollutants by ecosystem components that mitigate the harmful effects of pollutants on human use or health.
Cultural Services	Tourism & recreation	Recreation-related services are the ecosystem contributions, particularly through the biophysical characteristics and qualities of ecosystems, that enable people to use and enjoy the environment through direct, in-situ, physical and experiential interactions with the environment.

Type of Services	Ecosystem Service	Description
Other Flows/Supporting Services	Minerals Provisioning	These services are the contributions of ecosystems in production of minerals.
	Energy (Solar energy, Wind, Tidal)	These services include energy outputs of ocean ecosystems. The ecosystem services are contribution of ecosystems to the benefits derived in form of energy outputs.
	Shipping	The ocean water and coastal ecosystems are vital for shipping industry. They provide a transportation medium for shipping.

5.7 For the monetary estimation, the various valuation techniques suitable for these services are provided in the subsequent paragraphs. The preferred approaches are listed in the order, however, preferred methodology may also require availability of granular data sets, in absence of which other methods may be attempted. The approach to accounting for ocean ecosystem services presented in the chapter are majorly based on concepts from the SEEA Ecosystem Accounting Framework.

Table 5.3: Brief description of Valuation Techniques for various ecosystem services

Ecosystem Service	Valuation Technique
Fish Provisioning Services	Directly observed prices
Food (other than fish) Provisioning Services (Seaweed, salt)	Directly observed prices Similar markets Residual Value
Fuel/ Firewood Provisioning Services	Directly observed prices (stumpage values) Land rental values
Minerals Provisioning	Directly Observed Prices Residual Value Lease/Rental Price
Energy (Solar energy, Wind, Tidal)	Directly observed prices Similar markets Replacement costs
Shipping	Directly observed prices
Carbon sequestration	Social Cost of Carbon
Carbon storage	Social Cost of Carbon
Water purification	Directly observed prices Replacement costs Avoided damages
Tourism & recreation	SEV+ Random utility mode

	Consumer expenditure

5.8 A brief description of some of the valuation techniques that may be adopted for estimating the aforementioned services is provided in Table 5.4. These methodologies are based on the SEEA Technical Report on Monetary Valuation for ecosystem accounting[30].

Table 5.4: Description of Valuation Methods of Ecosystem Services

Method	Description
Directly observed prices	Directly observed values or market prices are the most direct method for measuring prices and estimating values for the accounts. While the use of directly observed values is the preferred method, the resulting prices may provide accounting entries for the value of ecosystem services that might be considered low (i.e. where the monetary value of the contribution of the ecosystem is negligible).
Similar markets	When market prices for a specific ecosystem service are not observable, valuation according to market price equivalents, or proxy markets may provide an approximation to market prices. Implicitly, it is assumed that the flows of (non-marketed) ES are not significant enough that they would alter the observed price of, and demand for, the good or services from the similar market, i.e. the prices reflect a partial equilibrium.

[30] https://seea.un.org/sites/seea.un.org/files/techreportvaluationv15_final_21072022.pdf

Residual Value	The residual value and resource rent methods estimate the value for an ES by first taking the gross output value of the final marketed good to which the ES provides an input, and then deducting the cost of all other inputs, including labour, produced assets and intermediate inputs. In practice, there can be a number of difficulties in applying these methods. First, the residual may reflect a combination of other non-paid and indirect inputs that could potentially make it difficult to identify the ES contribution. Second, the estimate is subject to uncertainty in calculating the value of all the ´paid´ inputs. The calculation is subject to variations in prices of outputs and inputs that can be considerable under market conditions, resulting in high annual volatility of estimates.
Land rental values	One of the directly observed prices are land rental values when markets exist to rent land for crop production or grazing. These rental prices may be used to derive prices for accounting purposes for the relevant biomass provisioning services. While the use of directly observed values is the preferred method, the resulting prices may provide accounting entries for the value of ecosystem services that might be considered low. For example, it is well documented that the resource rents for natural resources that are extracted in open-access contexts will tend to zero[31].
Social cost of carbon	The social cost of carbon (SCC) represents the economic cost associated with climate damage (or benefit) resulting from the emission of an additional ton of CO_2. The SCC values are based on the qualifiable impacts of climate change. However, some climate impacts can have socioeconomic impacts that are challenging to translate into a dollar cost. Due to this, they might underestimate the risks.
Replacement costs	The replacement cost method estimates the expected cost of replacing a single ES using a process that provides the same benefits but for which there are established costs or prices. It is sometimes called the substitute cost method or alternative cost

[31] https://seea.un.org/sites/seea.un.org/files/techreportvaluationv15_final_21072022.pdf

	approach. In some instances, it may be difficult to relate the observed costs of the substitute with the target ES. For instance, mangroves may be planted or restored as a "green infrastructure" alternative to "hard" engineered flood defences. For water purification, the replacement cost method estimates the cost of putting in place structures and equipments to purify water to the same level of quality. The replacement cost method requires information on the degree of substitution between the market good and the natural resource. Few environmental resources have such direct or indirect substitutes. Substitute goods are unlikely to provide the same types of benefits as the natural resource.
Avoided damages	The avoided damage cost method estimates the value of ecosystem services based on the costs of the damages that would occur due to the loss of these services. Two conditions are relevant: (i) that the damages avoided can be related to a specific service; and (ii) that people would be willing to pay an amount to actually avoid the damage (i.e. if they are willing to accept the damage then this method is inappropriate).
Simulated Exchange Value	The simulated exchange value (SEV) method estimates the price and quantity that would prevail if the ES were to be traded in a hypothetical market. The SEV method is applied by using results from demand functions for the relevant ES. These are used to calculate the value of the ES that would occur if it was actually being marketed. However, the challenge is to design the most realistic alternative that would actually imply a payment for the ecosystem service, and would therefore provide an estimation of the income generated if it would be traded in a market.
Consumer Expenditure	The consumer expenditures method uses estimated costs directly as a proxy for the value of the service. The method involves using estimates of the travel expenditures to visit recreational sites in the form of entrance fees, transport costs and /or accommodation costs to value ecosystem services directly. The rationale for the use of this method is that these expenditures represent the minimum willingness to pay (WTP) for the ecosystem service.

Ocean Asset Accounts

5.9 Assets are things of value to the society. Ocean itself is an asset and within the ocean lies several other important assets. Most often, oceans and their assets are not appropriately valued in decision-making and plans. It is important to understand the assets because the type of asset and its condition influence its capacity to provide services. Therefore, the asset accounts would help in understanding the stocks of assets available and their changes over time. The following table shows the structure of the Ocean Assets[32].

Table 5.5: Framework for the Ocean Asset Accounts

Unit: Physical

Ocean Asset	Opening Stock at time (t)	Addition to Stock	Reduction in Stock	Closing Stock
Minerals (Fuel Minerals) Petroleum Hydrocarbon				
Minerals (Non-fuel Minerals)				
Fish Stock (Different Fish Species)				
Natural aquatic resources (Different Species)				
Cultivated aquatic resources (Different Species)				
Abiotic Resources				
Timber				
Sediments				
Water Resources				

Remarks: (i) 'Minerals' includes all the minerals available in the oceans

(ii) 'Fish' includes all the different species of fish in marine areas

Potential Data Sources

5.10 Estimating ecosystem services is often a challenge due to the lack of data required in adequate format. It is, therefore, of paramount importance to first identify required data for each of the ecosystem services estimation and their corresponding data source agency. With respect to the services listed above, several agencies are

[32] https://oceanaccounts.atlassian.net/wiki/spaces/DTGOOA/pages/47743101/2.+Structure+of+Ocean+Accounts#General-classification-of-ocean-assets

identified as data provider. Few of them are Ministry of Environment, Forest and Climate Change, Forest Survey of India, Department of Fisheries, National Accounts Division, Ministry of Tourism, NSS Surveys, Ministry of Ports Shipping and Waterways, National Remote Sensing Centre, etc. The data that may be required for the above-mentioned services are listed below along with the potential data source agencies.

Table 5.6: Potential data requirement along with the data source

Service	Data Requirement	Source Agency
Fish/ Other Aquaculture Provisioning Services	• Stock of Fish/ Other Aquaculture (Marine) • Catch (tonnage and value) of Fish EEZ, Production of fish/aquaculture from maricultural/ Ecosystem-wise • Rental Value	CMFRI D/o Fisheries NCSCM
Food other than fishery Provisioning Services (Salt/Seaweed/…)	• Resource rent	CMFRI
Fuel/Firewood Provisioning Services	• Amount of Fuel/ Firewood extracted from Mangrove Forests	FSI
Minerals Provisioning	• Amount of Minerals extracted in Coastal areas	GSI/MoPNG
Energy (Solar energy, Wind, Tidal)	• Amount of Energy generated in Coastal Area • Value/Rent of Land	CEA M/o Power MNRE NIWE State Governments
Shipping		M/o of Shipping and Waterways
Carbon sequestration	• Social Cost of Carbon • Stock of Carbon in Mangrove • Stock of Carbon in Seagrass	FSI CSIR NCSCM
Carbon storage	• Organic Carbon of Soil • Social Cost of Carbon	FSI CSIR NCSCM
Water purification	• Amount of water purified and supplied	Municipal Boards State Water Boards

	• Payment made towards providing purified drinking water	
Tourism & recreation	• Number of Persons visiting coastal area for tourism • Travel related expenditure • Expenditure on Fees/Tickets for visiting Marine/Coastal Parks/Reserves etc.	M/o Tourism State Tourism Departments Consumer Expenditure Survey, MoSPI

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Chapter 6: Linkages of Ocean Ecosystem Accounts with other ongoing efforts of the Government

Background

6.1 The Ocean Ecosystem Account is relevant while addressing the several dimensions of ocean policy challenges like measuring the blue economy, sustainability of ocean economic activities, synergy with area-based planning/management, designing policy/institutional reforms to manage the transition to a Blue Economy, etc.

6.2 The linkages between Ocean Ecosystem Accounts and other government efforts are crucial for integrated and sustainable ocean management. Government of India has taken several initiatives to harness the potential of ocean resources in a sustainable manner. A few of such initiatives are Ocean—Services, Modelling, Application, Resources and Technology (O-SMART), Deep Ocean Mission (DOM), Marine Spatial Planning, Blue Economy, Coastal Regulation Zone Management, Marine Protected Area, Beach Cleaning Drive, Marine Litter Studies etc. The details of these efforts have been provided in the subsequent paragraphs of the report. A list of ocean-related policies of Central and State governments has been provided in Chapter 7 of the report.

Oceanic Pressures

6.3 The ocean, vital for global biodiversity and climate regulation, is not unaffected from the detrimental impacts of anthropogenic activities. The ocean ecosystems are disrupted and marine life is threatened due to practices such as drilling, dredging, destructive anchoring, removal of corals and land reclamation, unsustainable tourism etc. Carbon emissions from industrial activities have led to ocean acidification and warming, compromising the health of coral reefs and marine species. Chemical pollution, exemplified by oil spills and industrial runoff, inflicts immediate harm on marine life via ingestion or disruption in reproductive cycles and other biological processes. Plastic wastes going into marine environments are also posing long-term

risks to ecosystems. Collectively, these pressures illustrate the urgent need for sustainable practices to protect our oceans for future generations.

Efforts to Mitigate Residual Flows to Ocean

6.4 An important aspect of environment accounts is flows to the environment from the economy. To effectively manage and protect our oceans, it is essential to account for residual flows into these vital ecosystems. The SEEA-CF defines residuals as "flows of solid, liquid and gaseous materials, and energy, that are discarded, discharged or emitted by establishments and households through processes of production, consumption or accumulation". It is vital to identify the sources of residual flows to ocean, their monitoring, prevention and elimination. Residual Accounts (Effluent Accounts) may be useful to understand the pressures on the ocean.

6.5 NCCR has initiated monitoring of temporal and spatial distribution of marine litter along the Indian coasts and adjacent seas. It has undertaken several beach clean-up activities, awareness programs at regular intervals, and beach litter quantification studies[33]. Further, the Government of India has initiated several programmes such as 'Swachh Bharat Abhiyan', 'National Mission for Clean Ganga and Smart Cities Mission' in order to develop clean and sustainable environment which contribute towards mitigating the marine litter flows to ocean.

6.6 In 2023, under India's G20 Presidency, the Ministry of Environment, Forest and Climate Change launched the Janbhagidari movement to enhance community participation and raise awareness about the sensitivity of ocean and coastal pollution. This initiative focuses on beach cleaning efforts across all coastal states and union territories.

Marine Spatial Planning

6.7 Ocean is an essential regulator of life on earth, providing invaluable ecosystem services required for human well-being. It also contributes to economic prosperity. Our ocean spaces are becoming increasingly busy although the potential for synergies and coexistence among users has not been fully realized. To ensure sustainability, ocean management has transitioned from sectoral to integrated management, endeavouring towards to overcoming governance silos and make progress towards strategic objectives.

[33] https://pib.gov.in/PressReleasePage.aspx?PRID=1797248

6.8 The Marine Spatial Planning (MSP) is an ecosystem-based spatial planning process for analysing current and anticipated ocean and coastal uses in addition to identifying areas most suitable for ocean-related activities. It provides a public policy process for society to better determine how the ocean and coasts can be sustainably used and protected. It is a public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives. MSP has been used to allocate human activities spatially, usually through participatory processes, to reconcile differing values and priorities between diverse stakeholders.

6.9 Ocean Ecosystem Accounts organise ocean data into a common framework using the structure consistent with SEEA whose underlying principles are in alignment with the System of National Accounts (SNA). It provides countries with the means to go beyond Gross Domestic Product (GDP) to measure progress towards growth and sustainability of the ocean economy. Ocean Ecosystem Accounts also provide a common information infrastructure for ocean policy, strategic planning and reporting.

6.10 The OEA could assist MSP by providing data needed by MSP to analyse and allocate spatial activities according to multiple criteria. It can also provide a standardised data foundation for plan formulation and scenario analyses, including cost-benefit and trade-off analyses. This will reduce duplication in data-gathering exercises and support maintaining time-series of policy and planning relevant data, and providing a framework to monitor and evaluate plans towards pre-defined objectives.

Linkages of Ocean Ecosystem Accounts with MSP

6.11 The two frameworks, OEA and MSP, possess several synergies. Essentially, OEA can provide a structured and integrated data ecosystem that shapes policy through providing a range of comparable statistics and indicators. These policies, in addition to legislation and other layers of governance, define the objectives of MSP, where OEA may provide data to facilitate in the formation of plans, and further evaluate progress towards policy targets.

6.12 Aside from policy motivators, there are clear conceptual links between OEA and MSP, where marine spatial plans are increasingly required to advance an 'integrated' or 'ecosystem-based' approach. The organisation of ecosystem 'stocks'

and 'flows' lends naturally to an accounting framework, and OEA provides guidance to organise and structure the ocean system in a manner compatible with existing international accounting standards. This facilitates comparability in the statistics and indicators produced within and between countries.

6.13 MSP is a data-intensive exercise, where integrated plans require an understanding of relationships between environment, economy, and relevant stakeholders within society.

6.14 Over the last decade, MSP has been increasingly recognised as an important framework for integrated ocean governance. It is generally used as an approach to deal with complex, emerging and strategic issues in the marine realm, and can function as an overarching coordination mechanism for marine and coastal policies established in a country. The MSPs support country-specific environmental and socio-economic objectives to be implemented by various sector-authorities through regulatory and non-regulatory frameworks. Through MSP, the ecosystem approach can be operationalised in a tangible manner, focusing on its spatial and temporal aspects[34]. This is more easily accomplished where MSP informs the operational outcomes and related management measures within each maritime sector[35]. MSP is being developed and used around the world[36], and appropriate governance frameworks and institutional arrangements are crucial for its success. Currently, the actual system designs implemented worldwide vary greatly in terms of legal basis, the role of politics, the degree of regulation and how planning across levels is undertaken. MSP is often legally grounded in planning, economic or environmental legislation, but it can also be based on political agreements. Some systems regulate in detail what the MSP process and outputs are to look like, while others are less prescriptive, leaving room for the development of practice. Some system designs link the land and sea by using similar legislation and management authorities, while others have different planning systems and link across levels and boundaries through overlaps and special coordination bodies and procedures.

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[34] Douvere, F. (2008). The importance of marine spatial planning in advancing ecosystem-based sea use management. *Marine policy*, *32*(5), 762-771. https://msp.naturalcapitalproject.org/msp_concierge_master/docs/Douvere_etal_2008_MP.pdf

[35] Cormier, R., Kelble, C.R., Anderson, M.R., Allen, J.I., Grehan, A. and Gregersen, O. 2017. Moving from ecosystem-based policy objectives to operational implementation of ecosystem-based management measures. ICES Journal of Marine Science, Vol. 74, Issue (1), pp. 406–413. DOI: 10.1093/icesjms/fsw181

[36] Convention on Biological Diversity Secretariat and the Scientific and Technical Advisory Panel —GEF. 2012. Marine Spatial Planning in the Context of the Convention on Biological Diversity: A study carried out in response to CBD COP 10 decision X/29. Montreal. Technical Series No. 68, 44 pages.

6.15 The growing implementation of both frameworks, OEA and MSP, prompts the need to explore the experiences and lessons learnt within their early intersection, to better inform opportunities and barriers to co-implementation. There are clear synergies between both frameworks, explored conceptually in Gacutan et al.[37] Operationally, however, there is a limited understanding of where both MSP and OEA frameworks have been applied, and the alignment of their policy use-cases (e.g., towards informing ocean economy, ecological conservation). Further, there is a limited understanding of the operational and institutional opportunities and barriers that may influence co-development of the frameworks.

6.16 The Ministry of Earth Sciences (MoES) through National Centre for Coastal Research (NCCR), India and Norway have agreed to jointly work in the area of marine spatial planning in the oceanic space for the next five years. India and Norway are conducting marine spatial planning in Lakshadweep and Puducherry. These sites have been chosen for the pilot project in view of their setups with unique opportunities for multiple sectors (such as industries, fisheries, and tourism) to flourish. In the future, marine spatial planning framework of these two environmentally critical areas can be replicated to other coastal regions of the country. The MSP initiative will be implemented by MoES and the Norwegian Environment Agency through the Ministry of Foreign Affairs, Norway. Earlier, NCCR had developed coastal management plans for Chennai, Goa, and Gulf of Kachchh which proved to be very successful. Now, the MSP initiative will aid development of multiple economic sectors and stakeholders in greater number of coastal areas of the country.

Blue Economy

6.17 Blue economy refers to the sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of ocean ecosystems. It encompasses various sectors such as fisheries, aquaculture, tourism, maritime transport, renewable energy, biotechnology, marine conservation etc. The concept recognizes the immense economic potential of oceans and aims to harness it in a way that ensures long-term environmental sustainability and social equity. This approach emphasizes the importance of responsible management, innovation, and

[37] Jordan Gacutan, Kemal Pınarbaşı, Messan Agbaglah, Crystal Bradley, Ibon Galparsoro, Arantza Murillas, Ibukun Adewumi, Teerapong Praphotjanaporn, Michael Bordt, Kenneth Findlay, Coulson Lantz, Ben M. Milligan, The emerging intersection between marine spatial planning and ocean accounting: A global review and case studies, Marine Policy, Volume 140, 2022, https://doi.org/10.1016/j.marpol.2022.105055

collaboration among stakeholders to achieve both economic prosperity and environmental stewardship.

6.18 The blue economy recognizes the economic potential of the oceans' vast resources and seeks to utilize them in a way that balances economic growth with environmental conservation. This includes activities such as sustainable fisheries management, responsible tourism, offshore renewable energy production, marine biotechnology, and conservation efforts to protect marine ecosystems and biodiversity.

6.19 However, it's crucial to ensure that the blue economy operates within the limits of ecological sustainability, considering the finite nature of ocean resources and the importance of maintaining the health and resilience of marine ecosystems. Therefore, sustainable management practices, innovative technologies, and international cooperation are essential to maximize the benefits of the blue economy while minimizing its negative impacts on the ocean environment.

6.20 In India, the blue economy encompasses a wide range of sectors, including shipping, tourism, fisheries, and offshore oil and gas exploration etc. This is also reflected in SDG 14 which focuses on Life Below Water. It advocates the greening of ocean development strategies for higher productivity and conservation of the ocean's health.

6.21 In 2021, the Government of India put out the draft "National Policy for India's Blue Economy"[38], prepared by the Economic Advisory Council to the Prime Minister after deliberations with relevant ministries, think tanks, and experts. While the policy is still in its draft stage, it does highlight the need to "adopt the Coastal Marine Spatial Planning (CMSP) approach of the Intergovernmental Oceanographic Commission (IOC) – UNESCO (2009) guidelines" and calls for establishing a national-level authority to define the scope and nature of CMSP. The draft policy has also proposed the creation of a National Blue Economy Council to bring together all relevant stakeholders from ministries, think tanks, non-governmental organisations, etc. Indeed, if implemented, these measures would greatly accelerate the transition of India towards becoming a sustainable, resilient, and inclusive Blue Economy.

Deep Ocean Mission

[38] https://incois.gov.in/documents/Blue_Economy_policy.pdf

6.22 Deep Ocean Mission[39] has the main objective of addressing issues arising from long-term changes in the ocean due to climate change and to develop technologies for deep-sea mission of living and non-living resources. Other objectives include developing underwater vehicles and underwater robotics, providing ocean climate change advisory services, identification of technological innovations and conservation methods for sustainable utilization of marine bio-resources, developing offshore based desalination and renewable energy generation techniques and to provide clean drinking water and exploring the avenues of desalination of water as well as extracting minerals from the ocean belt. The Deep Ocean Mission of Ministry of Earth Sciences (MoES) is intended to support the Blue Economy Initiatives of the Government of India.

Ocean-Services, Modelling, Application, Resources and Technology (O-SMART)

6.23 The O-SMART[40] scheme of M/o Earth Sciences encompasses seven sub-schemes namely Ocean Technology, Ocean Modelling and Advisory Services (OMAS), Ocean Observation Network (OON), Ocean Non-Living Resources, Marine Living Resources and Ecology (MLRE), Coastal Research and Operation and Maintenance of Research Vessels. The aim of the scheme is to primarily generate and regularly update information on Marine Living Resources and their relationship with the physical environment in the Indian Exclusive Economic Zone (EEZ) and to periodically monitor levels of sea water pollutants for health assessment of coastal waters of India, and to develop shoreline change maps for assessment of coastal erosion due to natural and anthropogenic activities.

6.24 Integrating Ocean Ecosystem Accounts with the other ongoing government efforts will enable policymakers to make more informed decisions that promote sustainable management and conservation of ocean resources for the benefit of present and future generations.

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[39] https://static.pib.gov.in/WriteReadData/specificdocs/documents/2022/apr/doc202242649701.pdf
[40] https://moes.gov.in/schemes/O-SMART?language_content_entity=en

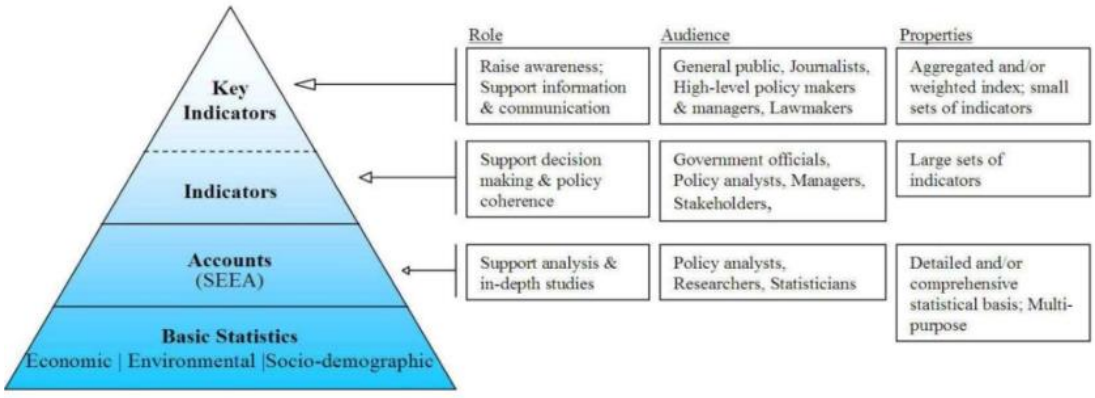
Chapter 7: Policy Perspective of Ocean Ecosystem Accounts

Background

7.1 The SEEA Accounts are well-positioned to help uncover trade-offs and synergies across different policy domains. SEEA reveals[41] society's complex relationship with nature and also helps to identify which policies can be implemented to lower environmental pressures, while at the same time continuing to manage the economy effectively. It is generally assumed that Ocean Ecosystem Accounts can be used to tackle only environmental issues such as climate change, biodiversity loss, air pollution etc., but several other policy domains such as economic development, transportation, agriculture and even health are linked to the environmental issues.

7.2 This chapter focuses on how Ocean Ecosystem Accounting (OEA) can provide useful support to the policy makers and government decision-making related to the oceans. Figure 7.1 below provides the relationship between the ocean accounts and other information products. Ocean Ecosystem Accounts[42] provide an intermediate structure that connect higher-level information (indicators) with lower-level information (basic data and statistics) in a coherent framework.

Figure 7.1: Relationship between Ocean Ecosystem Accounts and other Information Products



[41] https://seea.un.org/sites/seea.un.org/files/seea_-_overview_-_web_ready.pdf

[42] https://unstats.un.org/unsd/statcom/51st-session/documents/BG-item-3h-TG_Ocean%20accounting_ESCAP-E.pdf

Source: Technical Guidance on Ocean Accounting for Sustainable Development

Policy Linkages of Ocean Ecosystem Accounts

7.3 Ocean Ecosystem Accounts is extremely useful in the following cases:

(i) **Strategic and planning decisions**: including marine and coastal spatial planning and the formulation of strategic development plans for ocean economy;

(ii) **Regulatory decisions**: including granting of permits and licences for marine activities, in accordance with relevant spatial and development plans or other policy objectives;

(iii) **Operational decisions**: including management of marine protected areas, integrated coastal zone management and disaster risk response;

(iv) **Finance and investment decisions**: including fiscal policies and programmatic investment related to oceans, including funding for administrative capacity concerning oceans; and

(v) **Technical advice**: including cost-benefit assessment, environmental impact assessments and supporting the delivery of decision-making.

7.4 Any accounts developed become worthwhile only when they are integrated into policies. By virtue of their holistic and integrated structure, Ocean Ecosystem Accounts can be used as a basis for analysing the economic relevance of the ocean's assets, the environmental implications of ocean-based economic activity, and a wide range of other relationships that impact the ability of countries to achieve sustainable development. This analysis can support the identification and evaluation of policy response options regarding their impacts on the assets/ecosystems that underpin development, as well as on the flows of services and benefits from these assets/ecosystems.

7.5 Marine Protected Areas (MPA), which are a part of Ocean Ecosystem Accounting, help in assessing the monetary as well as ecological values associated with the MPAs.

Policies related to the Oceans

7.6 In India, there exist several Central and State level policies related to oceans, marine and coastal areas. State policies are primarily related to Fisheries Act of the Marine Fishing Regulation Act. On the other hand, Government of India has taken several initiatives focusing on the conservation of coastal and marine resources

especially, wetlands, mangroves and coral reefs and their management through implementation of law and continuous monitoring. Some of the policies related to Oceans framed by the Central and State governments of India are as follows:

i. The Wild Life Protection Act of India (1972)[43] provides legal protection to many marine animals. There are total of 31 major Marine Protected Areas in India covering coastal areas that have been notified under Wildlife Protection Act, 1972[44];
ii. The National Committee on mangroves, wetlands and coral reefs constituted in 1993 advise the government on relevant policies and programmes regarding marine species;
iii. The Coastal Regulation Zone (CRZ) notification[45] (1991 and later versions) prohibit developmental activities and disposal of wastes in the fragile coastal ecosystems;
iv. The Biological Diversity Act of India, 2002[46] and the Biological Diversity Rules 2004[47], and the guidelines thereof advise the government on matters related to the protection and conservation of biodiversity, the sustainable use and equitable sharing of its components, intellectual property rights, etc.;
v. The Department of Fisheries, Government of India is implementing a flagship scheme namely the Pradhan Mantri Matsya Sampada Yojana (PMMSY)[48] for the sustainable and responsible development of fisheries sector in India. Two of the key objectives of the scheme are (a) harnessing of fisheries potential in a sustainable, responsible, inclusive and equitable manner and (b) Robust fisheries management and regulatory framework;
vi. Mangrove Initiative for Shoreline Habitats and Tangible Incomes (MISHTI)[49] envisages restoration/reforestation of Mangroves covering approximately 540km^2, spreading across 9 states and 3 UTs for a period of 5 years commencing from 2023-24 onwards,
vii. The Centre for Marine Living Resources and Ecology (CMLRE), an attached office of Ministry of Earth Sciences (MoES) is mandated with the management strategies development for marine living resources through ecosystem

[43] https://www.indiacode.nic.in/bitstream/123456789/1726/1/a1972-53.pdf
[44] https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1796916
[45] https://moef.gov.in/moef/rules-and-regulations/environment-protection/crz-notifications/index.html
[46] https://www.indiacode.nic.in/bitstream/123456789/2046/4/a2003-18.pdf
[47] http://nbaindia.org/uploaded/Biodiversityindia/Legal/33.%20Biological%20Diversity%20Rules,%202004.pdf
[48] https://pmmsy.dof.gov.in/
[49] https://www.pib.gov.in/PressReleasePage.aspx?PRID=2002625#:~:text=MISHTI%20envisages%20restoration%2Freforestation%20of,with%20the%20existing%20schemes%2Fprograms

monitoring and modelling activities. Based on 24 years of survey studies, it has generated an extensive knowledgebase on the biodiversity aspects within India's Exclusive Economic Zone including hotspots for conservation,

viii. The Gujarat Fisheries Act 2003[50] has been formed to provide for protection, conservation and development of fisheries in inland and territorial waters in the state of Gujarat and for regulation of fishing in the inland and territorial waters along the coastline of the state and for matters connected therewith or incidental thereto.

7.7 Involvement of local communities is often seen as an integral part of preserving the marine resources. CMLRE is implementing a national R&D programme on Marine Living Resources (MLR) with an inbuilt component on Societal Services to support the fisher folks of Lakshadweep Islands. The societal services initiative intends to enhance the ornamental and baitfish stocks in the wild. Under the program, CMLRE has organised a series of hands-on training sessions on "Marine Ornamental Fish Breeding and Rearing at Lakshadweep Islands". In addition, under the Pradhan Mantri Matsya Sampada Yojana (PMMSY) scheme of the Department of Fisheries, there are provisions for encouraging sustainable marine fisheries activities, development of fisheries management plans and Integrated Modern Coastal Fishing Villages, promotion of Sagar Mitra, installation of bio-toilets in fishing vessels, communication and tracking devices, livelihood support during fish ban period to fisher families, among other initiatives for the conservation of fisheries resources. During the period 2017-20, an allocation of Rs. 84 Cr was made by Ministry of Earth Sciences for the implementation of the MLR programme[51].

7.8 These policies can be regularly better monitored and assessed, with the help of the regular ocean ecosystem accounts.

Coastal Regulation Zone

7.9 The Coastal Regulation Zone (CRZ) refers to the coastal areas in India that are regulated under the Coastal Regulation Zone (CRZ) Notification issued by MoEFCC These regulations aim to ensure the sustainable development of coastal regions while protecting and conserving the environment. The objectives of CRZ is protecting

[50] https://smallscalefishworkers.org/wp-content/uploads/2019/01/THE-GUJARAT-FISHERIES-ACT-2003.pdf

[51] https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1796916#:~:text=84.00%20Cr%20was%20made%20by,reply%20in%20Lok%20Sabha%20today.

coastal ecosystems, including marine life and habitats like mangroves, coral reefs, and sand dunes, promoting sustainable development in coastal areas while balancing environmental conservation and economic growth, mitigating the impacts of natural disasters like cyclones, tsunamis, and coastal erosion etc.

7.10 Under Section 3 of the Environment Protection Act, 1986 of India, Coastal Regulation Zone notification was issued in February 1991 for the first time, for regulation of activities in the coastal area by the MoEFCC.

- **CRZ-I:** These are ecologically sensitive areas essential for maintaining the ecosystem of the coast. They lie between low and high tide lines. Exploration of natural gas and extraction of salt are permitted;
- **CRZ-II:** These areas are urban areas located in the coastal areas. Under Coastal Regulation Zone (CRZ) Notification 2018, the floor space index norms have been unfrozen;
- **CRZ-III:** Rural and urban localities which fall outside CRZ 1 and 2. Only certain activities related to agriculture and even some public facilities are allowed in this zone; and
- **CRZ-IV:** Lies in the aquatic area up to territorial limits. Fishing and allied activities are permitted in this zone. No Solid waste should be let off in this zone. This zone has been changed from 1991 notification, which covered coastal stretches in islands of Andaman & Nicobar and Lakshadweep.

7.11 As per the notification, the coastal land up to 500m from the High Tide Line (HTL) and a stage of 100m along banks of creeks, lagoons, estuaries, backwater and rivers subject to tidal fluctuations, is called the Coastal Regulation Zone (CRZ). The above notification includes only the inter-tidal zone and land part of the coastal area and does not include the ocean part. The notification-imposed restriction on the setting up and expansion of industries or processing plants, etc. in the said CRZ. CRZ was notified by the Government of India in 1991 for the first time. Under this, coastal areas have been classified as CRZ-I, CRZ-II, CRZ-III, CRZ-IV and the same were retained for CRZ in 2003 notifications as well.

7.12 The **CRZ Notification 2019** was issued to replace the 2011 Notification and develop the coastal region of the country in a sustainable manner based on scientific principles, keeping in view current global problem of climate change and rising sea levels. One of the important developments was the division of CRZ-III areas (rural areas) into two categories, namely CRZ-IIIA and CRZ-IIIB of which the former

denotes an area with population density more than 2161 persons per square km while the later denotes rural areas with population density less than 2,161 persons per square km. As per the latest notification the CRZ-IIIA areas will have No Development Zone (NDZ) of 50 meters from the High Tide Line (HTL) as compared to the 200 meters as stipulated in the notification of 2011. The CRZ-IIIB areas however will have a No Development Zone of 200 meters from the HTL. The population density of respective areas will be measured on the basis of Census 2011.

7.13 The notification of 2019 also promotes the development of tourism infrastructure in the coastal areas. One of the important features of 2019 Notification is the streamlining of the CRZ clearing procedure. MoEFCC will oversee the matter of CRZ clearance only for CRZ-I; i.e. the ecologically vulnerable areas and CRZ-IV (area between low tide line and 12 nautical miles seaward) areas while for the other two categories namely CRZ-III and CRZ-II (urban areas), the power of clearance has been designated at state level. The notification also proposes a No Development Zone of 20 meters for all islands. The ecologically vulnerable areas identified on the basis of Environment Protection Act, 1986 are to be managed in partnership with coastal communities and fisherfolks. For the purpose of pollution abatement in coastal areas, the development of treatment facilities is proposed under the regulation in CRZ-IB areas.

Marine Protected Areas

7.14 The Marine Protected Areas (MPA) are geographically defined zones within marine environments where human activities are restricted or managed to achieve long-term conservation goals. They encompass various marine and coastal ecosystems. MPAs in India are the area defined under IUCN guidelines. They limit anthropogenic activities and exploitation of resources in these areas.

7.15 An MPA is an area within or adjacent to the marine environment, including its overlying waters and associated flora, fauna, and historical and cultural features, that has been reserved by legislation or other effective means, including custom, such that its marine and/or coastal biodiversity enjoys a higher level of protection than its surroundings.

Importance of MPA

7.16 The MPA protects vulnerable ecosystems and endangered species by creating zones. It facilitates the recovery of degraded habitats like coral reefs, mangroves, and seagrass beds improving the overall health of marine environments, acting as breeding grounds and nurseries. They can replenish fish populations both inside and outside the protected area boundaries. Besides, healthy marine ecosystems protected within MPAs are better equipped to withstand climate change impacts like ocean acidification, warming temperatures, and extreme weather events and these offer opportunities for non-destructive marine tourism and recreation, generating income for local communities.

7.17 Numerous direct and indirect pressures arising from different types of economic development and associated activities are a challenge to the coastal and marine biodiversity across the country. Direct impacts of human activities have been the major cause of the changes seen in the coastal zones in the world[52], also leading to the observed changes in the climatic regime. These shifts include a likely increase in the frequency of extreme weather events, a rise in the sea level, increased sea surface temperatures and ocean acidification (IPCC 2014)[53]. A rise in the sea level is likely to have significant implications for the coastal populations and productivity. For example, some of the islands in the Sundarbans, Gulf of Mannar and Nicobar Islands have already witnessed these changes. The largest mass nesting ground of the olive ridley turtle (*Lepidochelys olivacea*) in Odisha is undergoing dynamic changes probably due to climate change. Apart from this, climate change is also rapidly affecting the socioeconomic condition of the coastal communities, which in turn is intensifying pressure on the marine bio-resources. Coastal communities are also witnessing demographic changes due to a constant inflow of people due to droughts in adjoining coastal habitats. These are probably due to climate change. Therefore, it has become imperative to investigate, quantify and monitor the impacts of climate change on the marine biodiversity in coastal areas of India.

7.18 Marine protected areas are regarded as one of the most potent conservation tools for protection of marine habitats and their resources[54]. Studies have shown that designation of areas as MPAs has resulted in a significant increase in the biomass and

[52] Lotze, H. K., Lenihan, H. S., Bourque, B. J., Bradbury, R. H., Cooke, R. G., Kay, M. C., ... & Jackson, J. B. (2006). Depletion, degradation, and recovery potential of estuaries and coastal seas. *Science*, *312*(5781), 1806-1809.

[53] https://www.ipcc.ch/sr15/chapter/chapter-3/

54 Agardy, T., Di Sciara, G. N., & Christie, P. (2011). Mind the gap: addressing the shortcomings of marine protected areas through large scale marine spatial planning. Marine Policy, 35(2), 226-232.

densities of several species[55],[56] over a short period of time[57]. The Environment (Protection) Act, 1986, Coastal Regulation Zone Notification, 1991 and National Biodiversity Act, 2002 have been enacted in India for conservation of coastal and marine environment, along with the Wildlife (Protection) Act 1972, which also provides for establishment of protected areas (PAs) by state governments[58]. The Gulf of Kachchh Marine National Park, Gulf of Mannar National Park, Sundarbans National Park and Wandoor Marine National Park are some of the important MPAs of India.

Coastal and Marine Protected Areas in India

7.19 The MPA network in India has been used as a tool to manage natural marine resources for biodiversity conservation and for the well-being of the people dependent on it. Scientific monitoring and traditional observations confirm that depleted natural marine resources are getting restored and/or pristine ecological conditions have been sustained in well-managed MPAs[55]. India has designated 4 legal categories of protected areas: National Park, Wildlife Sanctuary, Conservation Reserve and Community Reserve. India has created a network of PAs representing all its 10 biogeographic regions[59]. As on July 2023, a total of 1,022 protected areas have been established in India, including 106 national parks, 573 wildlife sanctuaries, 123 conservation reserves and 220 community reserves[60]. Besides, 85 wetlands have been designated as Ramsar sites[61].

7.20 In India, PAs that fall entirely or partially within the swathe of 500 m from the high tide line and the marine environment are considered to be in the MPA network. There are 26 MPAs in peninsular India having approximate area of 7,300 kms and more than 100 MPAs in the country's two islands[62] (as on July 2024). These MPAs cover about 60% of the terrestrial area of the islands and protect more than 40% of the

[55] Halpern, B. S. (2003). The impact of marine reserves: do reserves work and does reserve size matter? *Ecological applications*, *13*(sp1), 117-137.
[56] Selig, E. R., & Bruno, J. F. (2010). A global analysis of the effectiveness of marine protected areas in preventing coral loss. *PLos one*, *5*(2), e9278.
[57] Halpern, B. S., & Warner, R. R. (2002). Marine reserves have rapid and lasting effects. *Ecology letters*, *5*(3), 361-366.
[58] Sivakumar, K., Mathur, V. B., Pande, A., & Chandrabani, D. (2013). Coastal and marine protected areas in India: challenges and way forward. *ENVIS bulletin: Wildlife & protected areas*, *15*, 292-298.
[59] Rodger, W. A., Panwar, H. S., & Mathur, V. B. (2002). Wildlife protected area network in India: a review. Wildlife Institute of India, 1-51.
[60] https://wiienvis.nic.in/Database/Protected_Area_854.aspx
[61] https://www.ramsar.org/country-profile/india
[62] https://wiienvis.nic.in/Database/MPA_8098.aspx

coastal habitat. India has also identified 12 protected areas as trans-boundary protected areas under the framework of the IUCN Transboundary Protected Area programme. India has also designated 6 United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Natural sites, and Sundarbans National Park is one among them.

7.21 India has taken several steps towards achieving the Aichi Biodiversity Targets, especially Target No. 11 (at least 10% of coastal and marine areas are conserved in networks of protected areas) and Target No.14 (ecosystems that provide water, health, livelihoods and well-being are restored and safeguarded). Towards achieving these two targets, 106 coastal and marine sites have been identified and prioritized as Important Coastal and Marine Areas (ICMBAs) by the Wildlife Institute of India. 62 ICMBAs have been identified along the west coast of India, and 4 have been identified along the east coast. These sites have also been proposed as conservation or communities reserves to increase participation of the local communities in governance. In India all PAs of islands are included in the Coastal and Marine Protected Area Network (CMPA). So far, there is no Protected Area notified outside the Territorial Water of India.

Sustainable Development Goals (SDG)

7.22 The SDGs are a set of global goals established by the United Nations and are the blueprint for achieving a better and sustainable future for all. The SDGs are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by the year 2030. The United Nations General Assembly during its 70th Session, on 25th September 2015, with the aim of taking forward the success of Millennium Development Goals, adopted the document titled "Transforming our World: The 2030 Agenda for Sustainable Development" consisting of 17 Sustainable Development Goals and 169 associated targets. The SDGs came into force with effect from 1st January, 2016. The United Nations Statistical Commission (UNSC) in March 2015, created the Inter-Agency and Expert Group on SDG Indicators (IAEG-SDGs), composed of member states including regional and international agencies as observers, with the task of developing and implementing the Global Indicator Framework (GIF) for monitoring the Goals and targets of the 2030 Agenda. The GIF was developed by the IAEG-SDGs and agreed upon, by

United Nations Statistical Commission in March 2017 which was subsequently adopted by the UN General Assembly in July 2017.

SDG Implementation in India

7.23 India is committed to implementing the SDGs based on the nationally defined indicators, responding to national priorities and needs. Monitoring plays a crucial role in the implementation and progress tracking of the SDGs. For monitoring purposes, the Ministry of Statistics and Programme Implementation (MoSPI) developed a National Indicator Framework (NIF) in 2018 along with identifying data sources and periodicity after due consultation with concerned stakeholders. The NIF includes indicators that align with the SDG global indicators and also includes indicators which are tailored to suit India-specific requirements. At present, there are 290 indicators in the NIF, 2024[63].

Linkages of Ocean Ecosystem Accounts with SDGs

7.24 Ocean Accounting Framework is also helpful in deriving some of the Sustainable Development Goals (SDGs) indicators. SDGs encompasses all three dimensions of development i.e. social, environmental and economic. The Ocean Ecosystem accounts would provide a useful tool to overcome the fragmentation of ocean data and would offer a structure to collate data in a coherent and transparent manner so as to arrive at a meaningful conclusions.

7.25 The Earth Summit, 1992 emphasised sustainable use of marine living resources and conserving them and also highlighted ocean as the target for environmental protection. The Earth Summit, 2002 described a detailed action plan for implementation of ocean and coastal sector development. Thereafter, Millennium Development Goals (MDGs) focused on environmental sustainability and also had specific focused targets namely, Target 7.A: Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources and Target 7.B: Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss related to oceans.

7.26 The SDGs regime has an independent goal relating to Oceans i.e. SDG-14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development. A dedicated SDG on ocean emphasizes the growing importance of

[63] https://www.mospi.gov.in/sites/default/files/publication_reports/SDG-NIF-ProgressReport-FullFile-v4N.pdf

ocean development. However, it leans more towards environmental aspects of ocean development. The ten targets of SDG-14 aim to sustainably manage and protect marine and coastal ecosystems. Ocean Ecosystem Accounts will facilitate the structuring of information relevant to SDG-14 and its ten associated targets, which call on all countries and stakeholders to conserve and sustainably use the oceans, seas and marine resources for sustainable development.

7.27 The compilation of Ocean Ecosystem Accounts directly implements a range of international commitments, including but not limited to SDG-14 viz

- SDG 15.9: Calling on countries and stakeholders by 2020 to integrate ecosystems and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts.
- SDG 17.19: Calling on all countries and stakeholders, by 2030 to build on exiting initiatives to develop measurements of progress on sustainable development that compliment GDP, and support statistical capacity building in developing countries.

SDG 14: Life Below Water

7.28 Life below water addresses various issues affecting marine environments, including pollution, overfishing, habitat destruction, ocean acidification, and the impacts of climate change. Rivers, lakes, seas and oceans cover more than 70 per cent of the surface of earth and play a key role in supporting life. Oceans and seas support the most diverse ecosystems, contribute to and regulate the climate, provide natural resources including food, materials, substances, and energy and also act as carbon sinks. SDG-14 seeks to address some of the challenges faced by the life under water – threats of marine and nutrient pollution, resource depletion and climate change, degradation and loss of biodiversity, ocean acidification, all of which are caused primarily by human actions. The Goal advocates corrective human measures including effectively regulating harvesting and overfishing, protecting marine and coastal ecosystems, increasing scientific knowledge to improve ocean health and providing access for small-scale artisanal fishers to marine resources and markets. A list of global and national indicators under SDG-14 is provided in Annexure 7.1.

7.29 There are 10 targets in Goal 14 to measure the health and services of water related ecosystems. A total of 11 indicators have been identified at the national level to measure and monitor the progress of these targets and data is available for 9 indicators **(Annexure 7.2)**.

Linkages with other SDGs

7.30 SDG-14 is linked to a multitude of other SDG targets. The figure below uses a systems analysis approach to uncover links between resilience of oceans, seas and marine resources with other SDGs and their corresponding targets.

Figure 7.2: Links between Resilience of Oceans, Seas and Marine Resources with other SDGs and their corresponding Targets

Source: Technical Guidance on Ocean Accounting for Sustainable Development

7.31 Ocean Ecosystem Accounting also has close linkages with the disaster risk management, especially for ensuring stability and sustainability of a disaster-prone area such as a coastal community or small islands. Data concerning coastal communities, infrastructure, ecosystems and ocean conditions such as sea surface temperature, variability, weather patterns and phytoplankton level, etc. are required to build understanding of oceans, disaster risk and climate change.

Ocean Accounts as a tool for Assessing Goal 14 and Blue Economy

7.32 MoES's Draft Blue Economy Policy Framework envisages the optimal utilization of all sectors of the maritime domain (living, non-living resources, tourism, ocean energy, etc.) for sustainable development of coastal areas. This policy document

contains key recommendations on National Accounting Framework for Blue Economy and Ocean Governance, Coastal Marine Spatial Planning and Tourism Priority, Marine Fisheries, Aquaculture and Fish Processing along with Manufacturing, Emerging Industries, Trade, Technology, Services and Skill Development, Logistics, Infrastructure and Shipping, Coastal and Deep-Sea Mining and Offshore Energy and Security, Strategic Dimensions and International Engagements.

7.33 These aspects can be appropriately addressed if a full- fledged Ocean Accounts is developed for the country which will also help to organise social, economic and environmental information to enable coherent measurement of progress towards the sustainable development of the ocean, in line with SDGs and other relevant national, regional and global commitments. Thus, ocean account is a broader ambit which meets the needs of various facets of oceans.

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Chapter 8: Recommendations and Way Forwards

8.1 Both natural and anthropogenic processes are altering ocean systems. The usage of ocean resources is evolving as coastal countries are focusing on leveraging ocean ecosystems to foster economic growth, food, energy and job security, facilitated by new technologies[64].

8.2 The expanding and diversified marine activities increase pressures on the ocean. Prioritizing the sustainable development of ocean activities is essential to ensuring both present and future opportunities resulting from the use of ocean resources. This involves striking a balance between ocean health, wealth, and the fair distribution of opportunities.

8.3 An effective ocean governance for a dynamic ocean ecosystem requires a robust framework that integrate information across and between ocean resources, its uses in the economy, social conditions, scales and times, balancing ocean health with sustainable resources use and supporting informed trade off analysis and decision-making. Advancing and prioritising ocean accounting framework is important for providing such metrics.

8.4 This chapter sets out the recommendations and way forwards from the Expert Group based on the work of the sub-groups and the deliberations in the meetings of the Expert Group.

Recommendations

8.5 Adopting an Ocean Ecosystem Accounts framework can provide important indicators to measure and manage progress towards sustainable management of coastal ecosystem, ocean resources and specific SDGs and their associated targets, as well as to support adaptative governance, which is critical in a changing ocean.

8.6 Various recommendations are listed in this section.

a. Identification of priority ecosystems: A list of coastal ecosystems may be identified for the development of Ocean Accounts following the

[64] https://doi.org/10.1016/j.marpol.2023.105668

suggested framework. The priority may be decided based on the significance of the ecosystems and the data availability.

b. Identification of data requirements and the data source agencies.
c. Gradual Approach to develop accounts: A gradual approach that includes spatial data, survey data and administrative data may be followed to develop ocean accounts in a phased manner. Accounts for which data are already generated may initially be brought out by NSO. Subsequently, data for other accounts also may be explored and cooperation from data stakeholders may be sought.
d. Extension of the Group: The tenure of the group may be extended for a period of 2 years to take the ocean accounts work forward and suggest on the changes, refinements and modification required in the framework from time to time as the need arises.
e. Stakeholder Participation: To enhance stakeholder participation, including local communities and industries, an appropriate strategy may be devised. This approach will ensure the practical relevance of the accounts and improve data accuracy and comprehensiveness.
f. Training and Capacity Building: Consider elaborating on initiatives for training and capacity building among the agencies involved. This effort will ensure effective implementation of the framework and accurate data collection, fostering a knowledgeable and capable workforce.
g. Studies relevant for the development of the Ocean Accounts may be taken up; a pilot study may be initiated for a particular region.

Way Forward

8.7 The Ocean Ecosystem Accounts is a data intensive subject and requires the technical as well as data support from the stakeholder Ministries/Departments and coastal states of India. Also, there is an emerging need for involving the Coastal States/UTs in the development of the Ocean Accounts Framework as estimates compiled using a 'bottom-up' approach presents the true picture rather than 'top-down' approach.

8.8 Capacity Building and awareness building workshops for the coastal States/UTs may be conducted so that they can initiate development of Ocean Accounts at the sub-national level.

8.9 The expert group recommends that the NSO work with data stakeholders and line ministries to establish a gradual approach to implement the framework for the accounting perspective. Areas of priorities may be identified. At the outset, extent

accounts (Tier 1) may be developed for the ecosystems. Gradually, extent (Tier 2) condition and services accounts may be attempted.

8.10 Studies may be conducted in certain regions; and extent, condition and services accounts may be developed for the ecosystems in that selected region on a pilot basis which can be replicated to other regions as well. Studies may also be conducted to assess the monetary valuation associated with several services under consideration. Expert Group will finalize the topics for the study and will oversee the monitoring of the studies. NSO, India will deal with the administrative matters related to conduct of these studies.

8.11 NSO, India may explore the possibility of funding the studies through existing schemes of the Ministry.

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Glossary

Term	Definition
A	
Abiotic	Physical rather than biological; not derived from living organisms
Above-Ground Biomass (AGB)	Component of the carbon pool consisting of all living vegetation above the soil, inclusive of stems, stumps, branches, bark, seeds and foliage.
Abyssal Pelagic	The deep ocean zone located at depths of 2,000 to 6,000 meters, characterized by cold temperatures and high pressures.
Acidification (Ocean Acidification)	A large proportion of the carbon dioxide that enters the atmosphere through combustion processes is taken up by the ocean, causing the seawater to acidify. Strictly speaking the seawater remains basic. But when the acidity, or pH value, of the water decreases in the direction of less basic, it is referred to as acidification of the water.
Alga/ Algae	The simple photosynthetic plants (uni or multi-cellular, not having specialised organs such as leaves, stems, and roots), found in seas and freshwater.
Anemones	Marine animals in the Phylum Cnidaria that resemble flowers and are often found attached to substrates in shallow waters.
Anthropogenic	Changes in nature caused by humans are referred to as anthropogenic.
Aquaculture	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, protection from predators, etc.
Aquaculture-Marine	Marine aquaculture is farming of aquatic organisms which almost always happens in the open sea (Salmon, Oyster, Mussel, Scallops). These organisms prefer clean water.
Atoll	A ring-shaped carbonate (or coral) reef or series of islands/ a ring-shaped island formed of coral that surrounds a lagoon.
B	
Basal Area	A measure of the cross-sectional area of tree stems at breast height, often used in forestry and ecology.
Basal-weighted Tree Height	A measurement that accounts for the height of trees while weighting them by their basal area to provide an average height representation.

Term	Definition
Bath Water Site	A bath water site, or bathing water, is a designated area of surface water where people bathe and where water quality is tested
Bathymetry	Bathymetry pertains to measuring the depths of the ocean
Bathypelagic Zone	The moderately deep parts of the open ocean, between 1000 and 4000 m
Benthic	Organisms living on the bottom of a water body are called benthic.
Biodiversity	Variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part, including diversity within species, between species and of ecosystems. It is a measure of ecosystem health. Variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part, including diversity within species, between species and of ecosystems. It is a measure of ecosystem health.
Biogenic	Substances produced by living organisms such as plants, animals, fungi or bacteria are referred to as biogenic.
Biogeographic Region	A distinct area characterized by unique flora and fauna, shaped by historical, environmental, and ecological factors.
Bio-geomorphologic Features	The physical characteristics of coastal and marine landscapes shaped by biological processes and organisms.
Biomass	The total weight of all the animals and plants living in a given area. It may relate to only one species.
Biota	The total collection of organisms living in a specific area, encompassing plants, animals, fungi, and microorganisms.
Biotic	All animal and plant life of a particular region or time. Biotic (living) factors function with the abiotic (non–living) factors to form a complex unit such as an ecosystem.
Breeding Ground	A place where marine organisms gather to breed.
Built Surface	Human-made structures on coastal and marine environments, which can affect local ecosystems and habitats.
C	
Carbon Sequestration	The process of capturing and storing atmospheric carbon dioxide to mitigate climate change, particularly in marine ecosystems like mangroves and seagrasses.

Term	Definition
Carbon Sinks	Natural systems, such as oceans and forests, that absorb more carbon dioxide than they release, helping to reduce greenhouse gases in the atmosphere.
Carbon Storage	The capacity of ecosystems to retain carbon over time, providing climate regulation benefits.
Cell	The smallest structural and functional unit of a living organisms, consisting of cytoplasm and a nucleus, enclosed in a membrane.
Coastal and Ocean Floor Ecosystems	Ecosystems located at the interface of land and sea, including estuaries, coral reefs, and seabeds, which support diverse marine life.
Coastal Waters	The waters outside the low-water line or the outer limit of an estuary.
Coastal Wetlands	Areas where the land meets the ocean, characterized by marshes, mangroves, and estuaries that provide critical habitat for wildlife. Include estuaries, lagoons, creek, backwater, bay, tidal flat /mudflat, sand /beach, rocky coast, mangrove, salt marsh /marsh vegetation and other hydrophytic vegetation and saltpans.
Coastline	The line that separates land from the ocean or a lake. The coastline is a proxy for the shoreline's position, and is used to assess erosion and accretion trends.
Commercial Fishing	The practice of catching fish or other marine life for profit, with the intention of selling the catch on the market.
Community / Biological Community	All the creatures living in a specific locality. This notion is now used to denote the creatures living in a specific type of locality or habitat. The word community is often used synonymous to 'habitat'.
Conservation	Judicious use and management of nature and natural resources for the benefit of human society and for other reasons (ethical, historical, cultural, etc).
Contiguous Space	A term referring to areas that are connected or adjacent to one another, often used in habitat and ecosystem discussions.
Continental Shelf	The part of the sea floor that adjoins a landmass; over the continental shelf, the water is less than 200m deep. The outer margin of the continental shelf is marked by the continental slope which runs down to the abyssal region.
Coral	A hard limestone structure (fan, ball, brain, whip, antler, table, tupe, cup -shaped) built by many flowerlike organisms that have very thin skins but are often beautifully coloured.

Term	Definition
Coralline Algae	Red algae of the order Corallinales with calcium deposits in their shell walls. Calcareous, stony or coral like algae, typically appearing pink. The encrusting forms are called pink paint and the turfing forms pink turf. Coralline algae are important reef builders in temperate to tropical seas.
Crustacean	A member of a large subphylum Crustacea, most of which have a hard external skeleton, segmented body, jointed limbs, two pairs of antennas and compound eyes. Crayfish, lobster, shrimp, crab, barnacle, isopod, amphipod, copepod.
Cultural Aquatic Resources	Resources in aquatic environments that hold cultural significance for communities, such as fisheries and sacred sites.
D	
Deepwater	Water that is deeper than midwater, but not ultra-deep. Deepwater can be up to 7,000 feet (2,133 meters) deep
Delta	A triangular alluvial plain at the mouth of a river where the river divides into a series of channels before entering the sea or lake.
Density	Mass per unit volume of a substance (e.g., g/cubic cm)
Dessication	The process of drying out, which can significantly impact marine and coastal ecosystems.
Detritus	Debris of any kind, produced by erosion, decay, rubbish, waste. Organic debris from decomposing plants and animals. In the ocean, dead (and alive) plankton organisms rain down to the sea bottom to make up the detritus found there.
Diatoms	Single-celled, hard-shelled algae with a carapace of silica. Most diatoms in the ocean are a component of the plankton, and they are among the most important producers of oxygen in the ocean. They are also an important nutrient base for higher organisms. Diatoms also occur in freshwater and on the sea floor.
Diversity	Variety, number of species, functions, habitats, etc.
Dominant Species	Species that are most abundant or influential in a particular ecosystem, shaping community structure and function.
Duogongs	Large marine herbivores related to manatees, primarily feeding on seagrasses and found in warm coastal waters.
E	
Ecology	The branch of science dealing with the relationships of organisms to one another and to their physical surroundings. The study of the relationships of animals and plants to their animate and inanimate surroundings. 2) the study of the interaction of people with the environment.

Term	Definition
Economic Activity	Activity for profit or for a living. Economic activity relating to the sea has very many aspects: freight, transport, ferrying, charter boating, boat repair, fishing, marine farming, living, building, sightseeing, ecotourism, diving and so on.
Economy	An economy is an area of the production, distribution and trade, as well as consumption of goods and services.
Ecosystem	A dynamic complex of plant, animal and micro-organism communities and their nonliving environment interacting as a functional unit.
Ecosystem Accounting	Ecosystem accounting is a coherent framework for integrating measures of ecosystems and the flows of services from them with measures of economic and other human activity. Ecosystem accounting complements, and builds on, the accounting for environmental assets as described in the System of Environmental-Economic Accounting (SEEA) Central Framework (e.g. water resources, soil resources). In ecosystem accounting as described in the SEEA Ecosystem Accounting (SEEA EA), the accounting approach recognises that these individual resources function in combination within a broader system and within a given spatial area.
Ecosystem Assets	Spatial areas comprising a combination of biotic and abiotic components and other elements which function together. Some examples are forests and wetlands.
Ecosystem Condition	Overall quality of an ecosystem asset in terms of its characteristics. Measures of ecosystem condition are generally combined with measures of ecosystem extent to provide an overall measure of the state of an ecosystem asset
Ecosystem Services	Benefits supplied by the functions of ecosystems and received by humanity.
Endangered Species	Species in danger of extinction and whose survival is unlikely if the causal factors continue operating. Included are species whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction
Epipelagic	Living very close to the surface in the open ocean, to about 100m.
Erosion	The wearing away and lowering of the land surface by wind, water, sand and ice.
Estuary	An estuary is a partially enclosed, coastal water body where freshwater from rivers and streams mixes with salt water from the ocean.

Term	Definition
Euphotic Zone	The area in the sea closest to the surface, receiving enough light for photosynthesis (0-80m, depending on water clarity).
Eutrophication	Eutrophication is characterized by excessive plant and algal growth due to the increased availability of one or more limiting growth factors needed for photosynthesis (Schindler 2006), such as sunlight, carbon dioxide, and nutrient fertilizers. Eutrophication occurs naturally over centuries as lakes age and are filled in with sediments.
F	
Fauna	The animal life of a particular region or time
Feeding Grounds	The places where an animal feeds. Usually an animal lives on its feeding ground, thus saving energy while feeding. Some reef fishes may live and sleep on or about the reef, only to forage far afield.
Fjord	A deep, U-shaped estuary that was carved out by advancing glaciers
Flora	The plants of a particular region or period.
Food Chain/ Food Web	The chain of organisms in any natural community, through which energy is transferred. Each link in the food chain feeds on and thus obtains energy from the one preceding it, and is then itself eaten, providing energy for the next organism in the chain. The beginning of the chain is plant matter . Most food chains are more complicated than this simple model and now the term food web is prefered. The food webs in the sea have many tiers because the plants in the phytoplankton are so small.
Foraging Grounds	Areas where marine animals search for food, crucial for their survival and reproduction.
Fossil	The remains of an organism, or the direct evidence of its presences, preserved in rocks. Usually only the hard parts are preserved. Fossilisation is the process by which fossils are formed. See time table.
Fragmentation	The process by which habitats are increasingly subdivided into smaller units, resulting in their increased insularity as well as in losses of total habitat area. See also edge effect, allee effect.
G	
Genetic Resources	Genetic material of plants, animals or microorganisms containing functional units of heredity that are of actual or potential value as a resource for future generations of humanity.
Grazer	A herbivore that eats whole plants and mainly one or a few species. See also browser.

Term	Definition
Greenhouse Gas (GHG)	Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include, carbon dioxide, methane, nitrous oxide, ozone, chlorofluorocarbons, hydro−chlorofluorocarbons, hydro−fluorocarbons, perfluorocarbons, sulphur hexafluoride
H	
Habitat	Site or environment where a plant or animal lives, such as forest.
Halophyte	A plant able to grow in a salty environment or salty soil.
Harbour	A sheltered body of water where ships and boats can anchor safely, often playing a key role in trade and transport.
Heat Stress	The physiological strain experienced by marine organisms due to elevated water temperatures, affecting their health and behavior.
Hotspot (Environmental)	Those lands and waters that are experiencing the most evident and dramatic change.
Hydrodynamic Conditions	The water movement dynamics within marine environments, including currents, waves, and tides, which influence marine ecosystems.
Hydrological Cycle	The cycling of water through the ocean, atmosphere, lakes, organisms, and other reservoirs
Hydrology	The study of all water on or in Earth.
I	
Intertidal Zone	the region of a coast between the high and low tide lines. Also called the littoral zone
Inundation	Submergence of land by water, particularly in a coastal setting.
Invasive Species	Non-native species that spread rapidly in a new environment, often causing harm to local ecosystems and economies.
Invertebrates	Animals without a backbone, such as jellyfish, octopuses, and crabs, that play critical roles in marine ecosystems.
J	
Jetty	A long structure built to protect a harbor from filling with sand due to longshore transport
K	
Kelp Forest	Underwater ecosystems formed by large brown algae, providing habitat for diverse marine species and supporting coastal food webs.
L	
Lagoons (Coastal)	Shallow bodies of water separated from the ocean by barrier islands or reefs, often rich in biodiversity.

Term	Definition
Landscape Contiguation	The arrangement of landscapes in a connected manner, which is important for biodiversity and ecosystem functioning.
Lifecycle	The cyclical sequence of different stages through which organisms pass during their lives. Stages usually include egg, larva, juvenile and adult. Adults reproduce to create the next generation of eggs, thus completing the cycle.
Lithosphere	The crust of Earth, inside which is the mantle and the core.
Littoral	Pertaining to the shore of a lake, sea or ocean. The intertidal zone. The environment between the highest and the lowest tide levels. Littoral faunas and floras have special characteristics enabling them to survive their continuously changing conditions. supralittoral= above the intertidal zone.
Low Tide Line	The low tide line (LTL) refers to the shoreline boundary that is exposed during low tide. It marks the point where the land meets the sea at the lowest level of the tidal cycle. The low tide line is important for various ecological and legal reasons, including habitat availability for intertidal species, coastal erosion studies, and marine resource management. Understanding this boundary helps in the conservation of coastal ecosystems and planning for sustainable development
Lower Epipelagic	The zone of the ocean from 200 to 1,000 meters deep, where light still penetrates, supporting a variety of marine life.
M	
Marine	Relating to the sea or ocean. This term encompasses all aspects of oceanic environments, including the organisms that inhabit them, the ecosystems they form, and the physical and chemical processes occurring within marine waters.
Marine Ecosystem	A complex network of living organisms (plants, animals, and microorganisms) and their physical environment in the ocean, including habitats like coral reefs, estuaries, and the open sea.
Marine Biodiversity	The variety of life forms found in marine environments, including species diversity, genetic diversity, and ecosystem diversity, essential for ecosystem resilience and functioning.
Marine Conservation	The protection and sustainable management of ocean resources and habitats to prevent biodiversity loss and promote healthy marine ecosystems.
Marine Pollution	The introduction of harmful substances or agents into the marine environment, affecting water quality, marine life, and human health. Sources include plastic waste, chemicals, and oil spills.

Term	Definition
Marine Fisheries	The industry and practices related to the harvesting of fish and other marine organisms for food, recreation, and commerce. Sustainable fisheries management is crucial for maintaining marine biodiversity.
Marine Habitat	The specific environment in which marine organisms live, such as coral reefs, kelp forests, deep-sea environments, and coastal wetlands. Each habitat supports different species and ecological functions.
Marine Coastal Ecosystem	Ecosystems found at the interface of the land and sea, including estuaries, mangroves, and coral reefs, vital for biodiversity.
Marine Industries	Industries involved with the sea, ranging from boat building to fisheries.
Marine Shelf	The submerged border of a continent, extending from the shore to the continental slope, rich in biodiversity and resources.
Maritime Position	A location that is influenced by proximity to the ocean, impacting climate, biodiversity, and human activities.
Maritime	Connected with the sea or seafaring.
Maximun Canopy Tree Height	The tallest height reached by the uppermost layer of trees in a forest, affecting biodiversity and ecological dynamics.
Mean Sea Level (NN)	Normalnull (NN) is a reference datum for the standardization of elevation measurements in Germany, Switzerland and Austria. It is equivalent to the elevation of the mean sea level. Normalnull is also the reference used for designating elevations of buildings or mountains. It was originally derived from the Amsterdam Ordnance Datum (Normaal Amsterdams Peil – NAP) that has been used conventionally in the Netherlands since the nineteenth century, and was at that time equivalent to the average water level of the Zuiderzee, a marine inlet that lay largely in the area of the present-day IJsselmeer.
Megafauna	Large animal species that play significant roles in their ecosystems, including whales and large fish species.
Mesopelagic	Living in the open sea between 200 and 1000m depth
Meteorological	Relating to meteorology, the science that studies the atmosphere and its phenomena, including weather conditions, climate patterns, and atmospheric processes.
Methane Flux	The rate at which methane gas is released into the atmosphere from a given source. Methane flux is an important measure in studies of greenhouse gas emissions, particularly in relation to wetlands, agricultural practices, and fossil fuel extraction.

Term	Definition
Micro-organisms	Tiny living organisms, typically too small to be seen with the naked eye, including bacteria, archaea, viruses, fungi, and some protozoa. Micro-organisms play critical roles in ecosystems, including nutrient cycling, decomposition, and the functioning of food webs.
Microplastics	Small plastic particles less than 5 millimeters in size, often resulting from the breakdown of larger plastic items or manufactured as microbeads in products. Microplastics are a significant environmental concern, as they can be ingested by marine life and enter the food chain, posing risks to ecosystems and human health.
Midwater	Water that is between 1,000 and 5,000 feet (305 and 1,524 meters) deep.
Mitigation	A human intervention to reduce the human impact on the climate system; it includes strategies to reduce greenhouse gas sources and emissions and enhancing greenhouse gas sinks.
Mixed Substrate	An environment composed of different types of materials, such as sand, rocks, and vegetation, affecting the diversity of marine life.
N	
Natural Aquatic Resources	Resources found in aquatic environments that occur naturally, including fish stocks, water, and habitats.
Natural Process	Natural course, as opposed to human-made or human-induced series of changes.
Nautical Mile	A distance equal to one minute of latitude; equivalent to 1.15 land miles or 1.85 km
Nearshore	The part of a beach from the low tide line to the depth where wave action is no longer influenced by the bottom, i.e. to where the depth exceeds the wave base
Nearshore Surf Zone	The area of the ocean close to shore where waves break, crucial for various marine species and human activities.
Niche Habitats	Specific environments that support particular species or communities, emphasizing the importance of habitat diversity.
O	
Ocean Acidification	Increased concentrations of carbon dioxide in sea water causing a measurable increase in acidity (i.e., a reduction in ocean pH). This may lead to reduced calcification rates of calcifying organisms such as corals, molluscs, algae and crustaceans.
Ocean Deoxygenation	The decline of oxygen levels in the ocean, which can adversely affect marine life and ecosystems.

Term	Definition
Ocean Warning	The increase in ocean temperatures due to climate change, impacting marine ecosystems and species distributions.
Oceanic	The marine pelagic province representing the open ocean regions, i.e. beyond the neritic zone
P	
Pelagic	Living in the open sea, and not normally associated with the bottom.
Pelagic System (pelagial)	The term pelagic system is used to indicate the main body of the open water (pelagial) including all of its inhabitants. Pelagic organisms comprise the plankton and the nekton. The nekton includes organisms such as fishes and whales, which, in contrast to the plankton, are able to actively swim against the currents.
Photic	Relating to light. The photic zone in the sea is where light is strong enough to enable plants to photo-synthesise. Because some plants are more sensitive to light than others, it is difficult to say to which depth the photic zone extends. This is further complicated by plankton organisms migrating up and down and by water masses being mixed by currents.
Photic Zone	The upper regions of the ocean where there is enough light to support photosynthesis; approximately 0-200 m; also called the euphotic zone
Photophores	Light-emitting organs possessed by some fishes
Photosynthesis	The process by which plant cells make glucose from carbon dioxide, water and sunlight, using chlorophyll as catalyst. During the process, solar energy is stored in the carbohydrate molecules. This energy becomes available to animals eating and digesting the plant material, and to organisms which break down dead material.
Phyto-plankton	Suspended microscopic plant organisms, ususlly drifting in the sunlit surface waters.
Plankton	A collective term for the small plants and animals which float and drift in surface waters. Phytoplankton is the plant component and zooplankton the animal component. Netplankton is the plankton caught in a 70 micron mesh (a hair's width) and is easily visible under a good microscope. Nannoplankton comprises much smaller forms of plankton visible only with a very high-powered microscope, usually a scanning electron microscope (SEM). In geology nannoplankton is very important in correlating the oldest sedimentary rocks. Picoplankton is even smaller.

Term	Definition
Pollution	The contamination of a natural ecosystem by wastes from human activities. The contaminants may be nutrients, that initially stimulate growth of primary producers, or they may be chronic toxins.
Polychaete Worms	Segmented worms that inhabit marine environments, playing vital roles in the ecosystem as scavengers and prey.
Population Viability	The concept of a minimal number of individuals representing the threshold between survival versus extinction.
R	
Reclamation	To bring under cultivation what was under water. The shores of sheltered harbours are shallow and flat, ideal for expanding the city.
Reef	A mound of carbonate formed in shallow tropical marine environments by corals, algae and a wide range of other organisms
Resilience	The degree to which an (eco) system's structure and functioning can be disturbed and yet rebound to its original state. elasticity, flexibility.
Resource	1) The means availabe to fulfil an end, to fulfil a function 2) Stock or supply that can be drawn on.
Runoff	Flow of water down a slope, either across the ground surface, or within a series of channels
S	
Salinisation	Areas formed due to saline water intrusion in the coastal areas of arid and semi-arid regions which barely supports any grass.
Salinity	Salinity is the presence of soluble salts in soils or waters. Salinity in water is usually defined by the total dissolved solids content (TDS, mg/L or g/ L) or the chloride content (Cl, mg/L) although the chloride ion comprises only a fraction of the total dissolved salts in water.
Salt Marshes	Natural or semi−natural halophytic grassland and dwarf brushwood on the alluvial sediments bordering saline water bodies whose water level fluctuates either tidally or non− tidally.
Sand	Beach is an un−vegetated part of the shoreline formed of loose material, usually sand that extends from the upper berm (a ridge or ridges on the backshore of the beach, formed by the deposit of material by wave action, that marks the upper limit of ordinary high tides and wave wash) to low water mark. Beach comprising rocky material is called rocky beach.

Term	Definition
Saturation	The amount of a substance currently dissolved in the water, relative to the maximum possible content
Seabed	The ocean floor.
Seagrass ecotone	The transitional area between seagrass beds and other ecosystems, often rich in biodiversity and productivity.
Seagrass meadows	A group of flowering plants which typically grow in sandy sediment in coastal waters and on tidal flats. They have long, herb-like fronds and thus resemble – but are unrelated to – the grasses that grow onshore. They are important habitats, providing young fish with food and protection from predators. Various species of fish lay their eggs directly on seagrass, so these meadows are often described as nurseries for fish. They are also a vital foraging ground for birds, such as Brent geese, during their autumn migration across Western Europe's Wadden Sea.
Seaweeds	Any of various algae growing in the sea. Plants form the basis of all foodwebs. Seaweeds can be likened to the forests and pastures on the land. But there are major differences. Most marine plantlife is found in the phytoplankton drifting in the top layer of all oceans. On land no such equivalent exists. Seaweeds don't need roots to tap moisture and nutrients from the soil. They soak these up with their flat thin fronds.
Sediments	Matter that is carried by wind or water and is then deposited on the surface of the land or the sea bottom.
Sessile	Fixed, not mobile. Sessile animals include barnacles and corals.
Settlement	The process by which a larva or juvenile leaves the pelagic environment and adopts a benthic existence.
Shallow water	Water that is less than 1,000 feet (305 meters) deep. In shallow water, the shape of the seabed affects the propagation of waves.
Shallows	The marine environment located close to the surface. Here the influences of waves, wind, tides, sun and cooling are most pronounced. Yet in these exacting circumstances an amazingly rich community is found, which is easy to study.
Shelf area	The near-coastal, shallow part of the sea floor. The shelf falls gradually to an average depth of 130 m. The shelf ends at the continental slope.
Shoreline systems	The dynamic interfaces between land and sea, including beaches, dunes, and coastal wetlands, which are essential for both ecology and human activities.

Term	Definition
Silt	Sedimentary particles ranging is size from 1/256th to 1/16th of a mm
Soft substrate	A type of ocean floor made up of loose materials like sand or mud, providing habitat for various marine organisms.
Source	A place or thing from which something originates .
Spatial extent	The physical area covered by a particular ecological phenomenon or process, important for understanding ecosystem dynamics.
Spatio-temporal scales	The dimensions of space and time that ecological phenomena occur, critical for ecological modeling and understanding processes.
Species	Group of individual specimens having close resemblance but differing from others and belonging to the same genus
Spit	A sand or coarser deposit extending from shore out into open water
Sponge	Aquatic animal of the phylum Porifera, with pores in its body wall and a rigid skeleton. Sponges are very primitive animals, colonies of individuals, that evolved early in the history of the earth. They are attached to the substrate and filter the water for phyto plankton.
Sub-tidal	The area beneath low tide level.
Surf Zone	The near-shore zone where waves are breaking into surf
Surface Epipelagic	The uppermost layer of the ocean (0 to 200 meters deep), where sunlight penetrates and supports most marine life.
Suspended Sediment Concentration	The amount of sediment particles (such as silt, clay, and sand) suspended in a unit volume of water, typically expressed in milligrams per liter (mg/L). SSC is a critical parameter in water quality assessment, affecting aquatic life and ecosystem health.
Sustainable Development	Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
Sustainable Yield	The number of animals of the amount of plant material that may be periodically removed from a population without affecting total supply. The amount of exploitation that can be sustained.
Symbiotic Relationship	A close and long-term biological interaction between two different species, which can benefit one or both partners. These relationships are often categorized into three main types: mutualism, commensalism, and parasitism.
System	A set of processes and things working together. A complex whole of organised material and immaterial things.

Term	Definition
T	
Terrestrial	Of or living on the land.
Territory	The area of a habitat occupied by an individual or its social group.
Tidal Barriers	Natural or artificial structures that influence tidal movements, impacting coastal ecosystems and human activities.
Tidal Zone	The area of the coasts defined by the limits of high and low tide. The water level falls and rises here in phase with the tides. This creates some areas that are periodically not covered by water. Characteristic biotic communities often colonize these areas.
Tides	The periodic rise and fall of the sea due to the attraction of the moon and the sun.
Trophic	Pertaining to nutrition. Trophic level= the position of an organism in the food chain, determined by the number of transfers of energy that occur between the nonliving energy source and that position. Trophic levels include producers (photosynthesisers and chemosynthesisers) and several levels of consumers (animals eating plants, animals eating animals, etc.)
Tsunami	A long-wavelength wave produced by the vertical motion of the floor of the ocean, typically related either to an earthquake or other submarine seismic event
U	
Upwelling	Area in the ocean where nutrient-rich bottom water surfaces. It produces blooms of phytoplankton and with it dense populations of fast-reproducing fishes, preyed upon by carnivores, sea mammals and sea birds. The productivity of upwellings compares to that of estuaries, and is typically ten times higher than that of the continental shelf. Upwellings off Chile once supported 10% of the total world fishery.
V	
Vulnerable	Species believed likely to move into the endangered category in the near future if the causal factors continue operating. Included are species of which most or all the populations are decreasing because of overexploitation, extensive destruction of habitat or other environmental disturbance; species with populations that have been seriously depleted and whose ultimate security is not yet assured; and species with populations that are still abundant but are under threat from serious adverse factors throughout their range.
W	

Term	Definition
Wave Height	The distance between the crest and trough of a wave
Z	
Zooplankton	Small, sometimes microscopic animals that drift in the ocean. It includes protozoa, crustaceans, jellyfish and other invertebrates that drift at various depths in the water column. Compare with phytoplankton.

Annexures

Annexure 1.1

F. No. M-12012/18/2020/SSD-III
Government of India
Ministry of Statistics and Programme Implementation
National Statistical Office
(Social Statistics Division)
****

K. L. Bhawan, Janpath Road
New Delhi-110001
Dated: 11th July, 2023

ORDER

Subject: Constitution of Expert Group on Ocean Ecosystem Accounts in India

With the approval of Competent Authority, an Expert Group is hereby constituted for the compilation of Ocean Ecosystem Accounts in India under the chairship of Additional Director General, Social Statistics Division (SSD), National Statistical Office, Ministry of Statistics and Programme Implementation.

2. The Expert Group having the following composition would deliberate, develop and formulate the entire gamut of activities, as mentioned in the Terms of Reference (ToR) under point (3); within the stipulated time frame, for the compilation of Ocean Ecosystem Accounts for India.

S. No.	Name and Details	Role
1	Additional Director General, Social Statistics Division (SSD), NSO, MoSPI, New Delhi	Chair
2	Director, National Centre for Coastal Research (NCCR), Ministry of Earth Sciences (MoES), Chennai	Member
3	DDG (NAD), NSO, MoSPI, New Delhi	Member
4	Adviser, NITI Aayog, New Delhi	Member
5	Joint Secretary or equivalent officer from M/o Environment, Forest & Climate Change (MoEF&CC), New Delhi	Member
6	Joint Secretary or equivalent officer from Department of Fisheries, Ministry of Fisheries, Animal Husbandry & Dairying, New Delhi	Member
7	Cdr. P K Prashant Srivastava, Scientist-F, M/o Earth Sciences (MoES), New Delhi	Member
8	Member Secretary / Representative from Centre Pollution Control Board (CPCB), New Delhi	Member
9	Director, National Centre for Sustainable Coastal Management (NCSCM), M/o Environment, Forest & Climate Change (MoEF&CC), Chennai	Member
10	Director, Central Marine Fisheries Research Institute (CMFRI), Kochhi	Member
11	Dr. K S Kavi Kumar, Professor, Madras School of Economics (MSE), Chennai	Member (Non-Official)
12	Dr. Pranab Mukhopadhyay, Professor, Goa Business School, Goa University	Member (Non-Official)
13	Dr. V Selvam, Coastal / Mangrove Expert, Former Executive Director, M S Swaminathan Research Foundation, Chennai	Member (Non-Official)
14	DDG(Environment), SSD, NSO, MoSPI	Member Secretary

The Group can co-opt experts as members as per requirements.

3. **Terms of Reference (TOR)** is given below:

- To review the Global Methodology & Framework as well as countries practices, if any, on the compilation of Ocean Ecosystem Accounts.
- To develop the National Framework as well as periodicity for the Compilation of Ocean Ecosystem Accounts in India.
- To recommend statistics/indicators/parameters along with data sources to be used for the compilation of various dimensions of Ocean Ecosystem Accounts.

Page 1 of 3

- To identify the various ecosystem services related to oceans and to suggest suitable valuation techniques for them.
- To suggest relevant studies in case of any data gaps.
- To ensure consistency in the definitions/concepts in the National Framework developed and the data sources to be used for the compilation of the Ocean Ecosystem Accounts.
- To review and refine the National Framework and if required suggest for appropriate revisions in line with the global advancements.

4. **Tenure of the Group:** 2 years from the date of the constitution of Expert Group. It is expected that the group will have 4-5 meetings in a year. A draft Framework for Ocean Accounts will be developed in 6 months.

5. The expenditure of TA/DA of the official members will be borne by their respective Ministries/ Departments/ Organizations.

6. The payment of Sitting Fees and other allowances to the Non-Official members of the Expert Group; for attending the meetings; shall be regulated as the norms given below:

Sr. No.	Head	Rate / Norms
1	Sitting Fees	Rs. 4000/- per day of sitting irrespective of the number of meetings
2	Travelling Allowances	
	Outstation Members / Experts	**Travel by Air:** Economy Class & Journey is to be performed by Air on the Sectors where it operates. Instruction issued by Department of Expenditure OM No. 19024/02/2021-E. IV dated 16th June 2022 for booking of Air Tickets. **Travel by Train:** Entitled to travel in AC-II Class. **Local Travel:** Reimbursement of AC taxi charges as per actual for travel within the city.
	Local Members / Experts	Local Travel: Reimbursement of AC taxi charges as per actual for travel within the city
3	Other Allowances to Outstation Members /Experts	Reimbursement of **food bills** not exceeding **Rs.1200/- per day** Reimbursement for **hotel accommodation / guest house** of up to **Rs 7500/- per day**

6a. Lodging Charges are admissible subject to actual on production of receipt.

6b. Food Charges will be reimbursed on self-certification.

7. This issues with the concurrence of AS&FA vide **E-file No. M-12012/18/2020/SSD-III** dated 08/07/2023.

8. This Order comes into immediate effect.

Sudeepta

(Dr. Sudeepta Ghosh)
Director
Ph: 011-23455507

To:

1. Chairperson & Members of the Expert Group.
2. Vice Chairman, NITI Aayog, New Delhi
3. Secretary, Ministry of Environment, Forest & Climate Change, New Delhi
4. Secretary, Department of Fisheries, Ministry of Fisheries, Animal Husbandry & Dairying, New Delhi
5. Secretary, Ministry of Earth Sciences, New Delhi
6. Additional Director General, National Accounts Division, MoSPI, New Delhi
7. Chairman, Central Pollution Control Board, New Delhi
8. Director, Madras School of Economics (MSE), Chennai
9. Vice Chancellor, Goa University Taleigao Plateau Goa

Copy to:

1. PPS to CSI & Secretary (S&PI), MoSPI
2. PPS to DG(Statistics), MoSPI
3. PPS to AS&FA, MoSPI, New Delhi
4. PPS to JS(Admn.), MoSPI, New Delhi
5. Deputy Secretary (IFD), MoSPI, New Delhi
6. Pay & Accounts Officer (Statistics), MoSPI, New Delhi
7. Controller of Accounts, MoSPI, Yojna Bhawan, NITI Aayog, New Delhi
8. DDO, MoSPI, New Delhi
9. AD(OL), MoSPI, New Delhi for translation.

(Dr. Sudeepta Ghosh)
Director
Ph: 011-23455507

M-12012/18/2020/SSD-III-Part(1)
Government of India
Ministry of Statistics and Programme Implementation
National Statistical Office
(Social Statistics Division)
****

K. L. Bhawan, Janpath Road
New Delhi-110001
Dated: November 02, 2023

ORDER

Subject: Constitution of Sub-Groups of the Expert Group on Ocean Ecosystem Accounts in India

The Ministry of Statistics and Programme Implementation (MoSPI) constituted an **Expert Group on Ocean Ecosystem Accounts in India** under the chairpersonship of Additional Director General, Social Statistics Division (SSD), National Statistical Office, MoSPI vide this Ministry's Order F. No. M-12012/18/2020/SSD-III dated 11.07.2023 (enclosed).

2. The Group, in its first meeting, recommended to constitute two Sub-Groups to work on ToR (i) to ToR (iv). Accordingly, with the approval of competent authority, the following Sub-Groups are hereby constituted and the members of the Sub-group II, who are not yet the members of the Expert Group are hereby co-opted.

Sub-group I	Sub-group II
Lead: Dr. K.S. Kavi Kumar, Professor, Madras School of Economics	**Lead:** Dr. M.V. Ramana Murthy, Director, National Centre for Coastal Research (NCCR)
Focus Area: **ToR (i)-** To review the Global Methodology & Framework as well as countries practices, if any, on the compilation of Ocean Ecosystem Accounts. **ToR (iv)-** To identify, the various ecosystem services related to oceans and to suggest suitable valuation techniques for them.	**Focus Area:** **ToR (ii)-** To develop the National Framework as well as periodicity for the Compilation of Ocean Ecosystem Accounts in India. **ToR (iii)-** To recommend statistics/indicators/parameters along with data sources to be used for the compilation of various dimensions of Ocean Ecosystem Accounts.
Members: • Dr. V. Selvam, Former Executive Director, M.S. Swaminathan Research Foundation, Chennai • Dr. Pranab Mukhopadhyay, Professor, Goa University • Representatives from National Centre for Coastal Research (NCCR) • Representatives from National Centre for Sustainable Coastal Management (NCSCM) • Representatives from MoSPI	**Members:** • Dr. Pranab Mukhopadhyay, Professor, Goa University • Representatives from Central Marine Fisheries Research Institute (CMFRI) • Representatives from Ministry of Environment, Forest and Climate Change (MoEFCC) • Representatives from Central Pollution Control Board (CPCB) • Representatives from Indian National Centre for Ocean Info Service (INCOIS) **[co-opted]** • Representatives from Centre for Marine Living Resources and Ecology **[co-opted]**

	• Representatives from National Remote Sensing Centre (NRSC) **[co-opted]** • Representatives from Geological Survey of India **[co-opted]** • Representatives from Ministry of Petroleum and Natural Gases **[co-opted]** • Representatives from National Centre for Polar and Ocean Research **[co-opted]** • Representatives from MoSPI

2. The activities for the Sub-Groups are planned from the date of constitution of the Sub-Groups. It is expected that the Sub-Groups will meet virtually/physically as and when required. Reports of the Sub-Groups will be submitted to the Expert Group.

3. The expenditure of TA/DA of the official members will be borne by their respective Ministries/ Departments/ Organizations.

4. This Order comes into immediate effect.

(Dr. Sudeepta Ghosh)
Director
Ph: 011-23455507

To:

1. Chairperson & Members of the Expert Group.
2. Director, Centre for Marine Living Resources and Ecology, Kochi **[with a request to nominate a suitable officer for Sub-Group II]**
3. Director, Indian National Centre for Ocean Information Services (INCOIS), Hyderabad **[with a request to nominate a suitable officer for Sub-Group II]**
4. Director, National Remote Sensing Centre, Hyderabad **[with a request to nominate a suitable officer for Sub-Group II]**
5. Director General, Geological Survey of India, 27 Jawaharlal Nehru Road, Kolkata **[with a request to nominate a suitable officer for Sub-Group II]**
6. Secretary, Ministry of Petroleum and Natural Gases, New Delhi **[with a request to nominate a suitable officer for Sub-Group II]**
7. Director, National Centre for Polar and Ocean Research, Goa **[with a request to nominate a suitable officer for Sub-Group II]**

Copy to:

1. PS to ADG, SSD, MoSPI
2. PPS to DG(Statistics), MoSPI
3. AD(OL), MoSPI, New Delhi for translation.

(Dr. Sudeepta Ghosh)
Director
Ph: 011-23455507

Annexure 1.3

Minutes of Meetings of Expert Group

Minutes of the First Meeting of the 'Expert Group on Ocean Ecosystem Accounts in India' held on 06.10.2023 at Conference Room, 2nd Floor, Khurshid Lal Bhawan, Janpath, New Delhi

The first meeting of the 'Expert Group on Ocean Ecosystem Accounts in India' was held under the Chairpersonship of the Additional Director General (SSD), National Statistical Office (NSO), Ministry of Statistics and Programme Implementation (MoSPI) on October 6, 2023. The list of participants is at **Annex**.

1. At the outset, Smt. Geeta Singh Rathore, Additional Director General (SSD) welcomed all the participants and briefly discussed about the importance of ocean and the pressing need and relevance of compiling Ocean Ecosystem Accounts. She also highlighted the tasks and responsibilities of the Expert Group. Thereafter, in order to set the context, Shri Rakesh Kumar Maurya, DDG, SSD briefed on the background of the constitution of the Expert Group.

2. It was informed that MoSPI started the process for compilation of Ocean Ecosystem Accounts in accordance to its mandate for 'Development of Environment Statistics, development of methodology, concepts and preparation of National Resource Accounts for India' and following the recommendations of Sir Prof. Partha Dasgupta report titled 'A Green National Accounts in India: A framework'. The report recommended implementation of System of Environmental Economic Accounting (SEEA) in a phased manner and accordingly, MoSPI adopted SEEA in 2018.

3. A presentation highlighting the work related to the various ToRs of the Expert group was made by the Division. India is positioned in such a way that it is covered by ocean on its three sides and oceans are a crucial natural resource contributing enormously not only to the economy but also to the social, environmental and the cultural sectors. In addition, the current ongoing efforts made by the GoI also targets towards efficient ocean governance and expansion of the contribution of the blue economy. It was informed that in the current meeting, emphasis will be given to the tasks related to following first four ToRs of the group and its associated timelines:

    - ToR-1: Review of global and country-level methodologies, practices, and framework on Ocean Ecosystem Accounts,
    - ToR 2: To develop the National Framework for Ocean Ecosystem Accounts in India,

- ToR 3: To recommend statistics/indicators/parameters along with data sources to be used for the compilation of various dimensions of Ocean Ecosystem Accounts and
- ToR 4: To identify various ecosystem services related to oceans and suggest suitable valuation techniques for them

The following points were deliberated in detail during the meeting:

i. Since there is no standard International Framework available for the Ocean Accounts, the group agreed to adhere to the SEEA framework as a starting point for compilation of the Ocean Accounts- including Asset Accounts, Extent Accounts, Condition Accounts and Flow of Services and Pressures on the Ocean.

ii. Regarding the global practices and efforts of the International agencies and other NSOs on Ocean Accounts, the division presented efforts made by Indonesia, Fiji Islands, Canada, Australia and Norway. It was suggested to include more country practices/experiences/on-going efforts in this direction for instance the pilot study undertaken by of Sri Lanka which will help in broadening the framework and making it more comprehensive. It was decided to circulate the draft chapter on the global efforts to get the comments from the Expert Group and to complete the chapter by February 2024.

(Action: MoSPI)

iii. The Group suggested bringing forth ocean accounting in the context of government's current priorities touching upon important related aspects such as Blue Economy and the contribution of the Blue Economy in the GDP. It was decided to have a chapter touching on linkages of Ocean Accounts with the ongoing Government's efforts such as MSP and Blue economy in line with Government's priorities.

(Action: MoSPI)

iv. Around six boundaries of ocean were discussed viz. Territorial Sea, Contiguous Zones, Exclusive Economic Zones (EEZ), Continental Shelf, High seas & Deep Ocean Floor and Coastal Regulation Zone. For the Extent accounts, Group suggested EEZ to be considered as the boundary, the data for which is available with M/o Earth Sciences and MoES may provide the data.

(Action: MoES)

v. However, the members were also in agreement that majority of the data pertaining to the ocean resources are available within 12 nautical miles from the baseline (i.e. territorial sea) and therefore it would be appropriate to start accounting for 12 nautical miles and gradually expand the boundary. It was also informed that up to 12 nautical miles, the nodal agency is MoEFCC and they may possess relevant information. The MoEFCC may share the data with MoSPI.

(Action: MoEFCC)

vi. For the ocean extent, ocean asset and ocean condition accounts, it was decided that an initial list providing the different ecosystems types, different ocean extent parameters, ocean resources and ocean condition parameters including their data frequency will be prepared and circulated to the members for getting their inputs. The agency responsible for providing data on a particular parameter may also be identified.

(Action: All the members of the Group)

vii. The issue of stock of dynamic and static resources and the biodiversity was also highlighted during the meeting. The Group felt to list out all the possible parameters/indicators in the framework and the actual compilation may be undertaken for those on which data is already available. For the biodiversity, it was suggested that initially a part of condition accounts starting especially with the key-stone species may be considered.

viii. For the standard definition of technical terms, it was suggested to contact Indian National Centre for Ocean Information Services (INCOIS) for the meta data. INCOIS being the crucial agency having huge data repository including digital globe and expertise on ocean ecosystem, it was agreed to co-opt representative from INCOIS as member in the Expert Group. The group also agreed to have an annexure providing the relevant definitions of the parameters and the technical terms. Keeping the expertise of various specialized organizations in view, it was also decided to co-opt representatives from Centre for Marine Living Resources and Ecology, NRSC, Geological Survey of India, Ministry of Petroleum and Natural Gases and National Centre for Polar and Ocean Research in the Expert Group.

(Action: MoSPI)

ix. Regarding Ocean Pressure, it was informed that NCCR has some information on the Coastal Water Quality and CPCB may have some other data which may be useful for the compilation of the Ocean Accounts. It was suggested that MoES and MoEFCC may provide the requisite data.

(Action: MoES and MoEFCC)

x. Regarding the level of spatial disaggregation, it was decided to build the framework at the National level and the actual computation part may be taken up for a smaller region based on the data availability.

xi. Regarding the Ecosystem Services, the Group suggested listing out the different ecosystem services categorizing them into provisioning, regulatory and cultural services along with the possible valuation technique. Also, a list may be included regarding the possible ecosystem disservices. Both the valuation of the ocean resources and the ecosystem services will be taken up at a later stage.

(Action: All the members of the Group)

xii. In order to have focussed discussion, it was decided to form the following two sub- Groups to work on first four ToRs:

(a) Subgroup 1 (ToR 1 and ToR 4): Led by Dr. K.S. Kavi Kumar, Professor, Madras School of Economics

(b) Subgroup 2 (ToR 2 and ToR 3): Led by Dr. M.V. Ramana Murthy, Director, NCCR

xiii. Based on the suggestions received from the members the composition of the sub-groups will be as follows:

Subgroup 1 **TOR 1 and TOR 4:** Led by Dr. K S Kavi Kumar, Professor, MSE Other Members • Representatives from NCCR • NCSCM • Dr. V. Selvam • Dr. Pranab Mukhopadhyay • Representatives from MoSPI	Subgroup 2 **TOR 2 and TOR 3:** Led by Dr. M V Ramana Murthy, Director, NCCR Other Members • CMFRI • Dr. Pranab Mukhopadhyay • MoEFCC • CPCB • INCOIS • Centre for Marine Living Resources and Ecology • NRSC • Geological Survey of India • Ministry of Petroleum and Natural Gases • National Centre for Polar and Ocean Research • Representatives from MoSPI

xiv. The following plan of work was also agreed by the Expert Group:

(a) Sub-Groups will present their reports to the Expert Group by Feb, 2024.

(b) The decisions along with the draft Framework for testing as recommended by Expert Group will be placed before the IMG in March 2024.

(c) Extent and Condition Accounts based on framework suggested by Expert Group will be attempted.

(d) The draft results will be discussed in Expert Group before presenting to the Inter-Ministerial Group (IMG) in September, 2024 for inclusion in the publication EnviStats India Environment Accounts 2024.

(e) The data gaps can be then addressed through some studies, if the group recommends.

4. The meeting ended with vote of thanks to the chair.

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Annex

List of participants of the first meeting of 'Expert Group on Ocean Ecosystem Accounts in India' held on 06/10/2023:

1. Ms. Geeta Singh Rathore, Additional Director General, National Accounts Division, Ministry of Statistics & Programme Implementation, Khurshid Lal Bhawan, Janpath, New Delhi - 110001
2. Shri Rakesh Kumar Maurya, Deputy Director General, Social Statistics Division, Ministry of Statistics & Programme Implementation, Khurshid Lal Bhawan, Janpath, New Delhi - 110001
3. Shri Dilip Kumar Sinha, Deputy Director General, National Accounts Division, Ministry of Statistics & Programme Implementation, K L Bhawan, Janpath, New Delhi – 110001
4. Dr. Sanjay Kumar, Deputy Director General, Social Statistics Division, Ministry of Statistics & Programme Implementation, Khurshid Lal Bhawan, Janpath, New Delhi - 110001
5. Dr. Sudeepta Ghosh, Director, Social Statistics Division, Ministry of Statistics & Programme Implementation, Khurshid Lal Bhawan, Janpath, New Delhi - 110001
6. Shri A. K. Bhattacharyya, Under Secretary, Ministry of Environment, Forests and Climate Change, Indira Paryavaran Bhawan, Jor Bagh, Lodhi Colony, New Delhi 110003
7. Dr. Pranab Mukhopadhay, Professor, Goa University, Taleigao, Panaji, Goa 403206
8. Dr. Asir Ramesh, Scientist E, National Centre for Sustainable Coastal Management, Ministry of Environment, Forests and Climate Change, NCSCM Rd, Anna University, Kotturpuram, Chennai, Tamil Nadu -600025
9. Dr. Anil Kumar Vijayan, Scientist E, Centre for Marine Living Resources and Ecology (CMLRE), Atal Bhavan, Ministry of Earth Sciences, Government of India, LNG Road, Puthuvypin South, Ochanthuruthu PO, Kochi-682508
10. Dr. M.V. Ramana Murthy, Director, National Centre for Coastal Research, Ministry of Earth Sciences, 2nd Floor, NIOT Campus, Velachery - Tambaram Main Rd, Pallikaranai, Chennai, Tamil Nadu 600100
11. Dr. K. S. Kavi Kumar, Professor, Madras School of Economics, Gandhi Mandapam Rd, Behind Government Data Center, Surya Nagar, Kotturpuram, Chennai, Tamil Nadu 600025
12. Dr. Vinod K., Principal Scientist, Indian Council of Agricultural Research- Central Marine Fisheries Research Institute, Post Box No. 1603, Ernakulam North P.O.,Kochi-682018
13. Dr. Ziaul Haque, Director, Social Statistics Division, Ministry of Statistics & Programme Implementation, Khurshid Lal Bhawan, Janpath, New Delhi - 110001
14. Ms. Neha Singh, Deputy Director, Social Statistics Division, Ministry of Statistics & Programme Implementation, Khurshid Lal Bhawan, Janpath, New Delhi - 110001

15. Dr. Ruchi Mishra, Deputy Director, Social Statistics Division, Ministry of Statistics & Programme Implementation, Khurshid Lal Bhawan, Janpath, New Delhi - 110001
16. Shri J. P. Kushwaha, Senior Statistical Officer, Social Statistics Division, Ministry of Statistics & Programme Implementation, Khurshid Lal Bhawan, Janpath, New Delhi - 110001
17. Ms. Dipika Gupta, Junior Statistical Officer, Social Statistics Division, Ministry of Statistics & Programme Implementation, Khurshid Lal Bhawan, Janpath, New Delhi - 110001
18. Shri Praful Nigam, Junior Statistical Officer, Social Statistics Division, Ministry of Statistics & Programme Implementation, Khurshid Lal Bhawan, Janpath, New Delhi - 110001

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Record of Discussion of Meetings of the Sub-Groups of the Expert Group on Ocean Ecosystem Accounts in India

The first meetings of Sub-Groups 1 of Expert Group on Ocean Ecosystem Accounts in India led by Dr. K.S. Kavi Kumar, Professor, Madras School of Economics and Sub-group 2 led by Dr. M.V. Ramanamurthy, Director NCCR was held on 15/12/2023 in virtual mode at 2.30 PM and 4.00 PM, respectively. The list of participants is at Annexure. The following points emerged during the discussion:

2. At the outset, DDG(SSD), MoSPI welcomed all the participants and briefed the participants about the background of the Expert Group as there were some new members who joined the sub-group 2. A short presentation highlighting the agenda of the meetings and progress of the work done till date was made by MoSPI.

3. A draft structure of the report of the Expert Group as given below was presented by the SSD, which was agreed by all the members.

Chapter 1: Introduction and Background- This chapter will be introductory in nature

Chapter 2: Global Practices- This chapter would provide a review of work done for Ocean Ecosystem Accounts globally.

Chapter 3: This chapter would provide the overview of the framework.

Chapter 4: Framework (Asset, Extent and Condition) - This chapter will focus on structure and parameters required for Extent and Condition of Ocean Ecosystems and Assets. The associated accounts will be in physical units.

Chapter 5: Framework (Ecosystem Services): This chapter will specifically focus on the Ocean Ecosystem Services and their appropriate valuation techniques. The associated accounts will be in both physical and monetary units.

Chapter 6: Linkages of Ocean Ecosystem Accounts with other ongoing Efforts of Government: This chapter will help in building linkages with

the ongoing efforts of the government towards the oceans such as Marine Spatial Planning, Blue Economy, Coastal Regulatory Zones and Marine Protected Area etc.

Chapter 7: Policy Perspective of Ocean Ecosystem Accounts (OEA): This chapter will highlight how OEA would be helpful in deriving Sustainable Development Goals (SDG) indicators and will discuss other policy relevance of OEA.

Annexures: OM regarding Constitution of the Group, Meeting Agendas, Meeting Minutes, detailed country practices etc.

4. MoSPI presented a comparative table of countries by the level of work done for Ocean Ecosystem Accounting. It was agreed upon to keep the comparative table in the main text of the Chapter 2 of the report on Global Review. Members also suggested to have a similar ecosystem wise table which would highlight the various ecosystem types for which the countries have compiled accounts.

5. It was suggested to keep the earlier circulated draft chapter on global review in the Annexure of the report.

6. Further, it was suggested to have a comparative table of ecosystem services and their valuation, if done, by other countries. It was agreed that the review should focus primarily on the Government endorsed projects and research studies on Ocean Ecosystem Accounting, rather than individual research studies published in peer-reviewed journals (or otherwise).

7. It was suggested to keep a summary of the work done by countries on Marine Spatial Planning and Blue Economy in chapter 2 of the Report. This could then provide a useful link for the subsequent chapter on the Linkages of Ocean Ecosystem Accounts with other ongoing Efforts of Government.

8. For the valuation of ecosystem services, it was suggested to highlight the ecosystem services along with their respective valuation techniques which will eventually help in highlighting the important ecosystems in Indian context and will guide towards their valuation. In addition, a description of the ecosystem valuation methodology along with an illustration will help in better understanding of the concept.

9. It was also highlighted that the valuation of Ocean Ecosystem Assets may also be included in the framework. The same may be discussed in the subsequent meetings.

10. MoSPI presented a draft structure of extent, condition and asset accounts to the members for their suggestions. Regarding the framework and the indicators to be considered for the same, it was decided to circulate the framework along with the list of indicators to the members of the sub-groups for the assessment of data availability and other related inputs. It was suggested to circulate the list to other stakeholders not included as the member of this group also for getting their suggestions.

11. It was also decided to prepare and circulate a draft list of all ecosystem services and other indicators by the end of December, 2023 to all the members of the Expert Group for their inputs/suggestions.

12. It was decided that the System of Environment Economic Accounting (SEEA) Ecosystem Accounts framework will be adhered to for the development of the Ocean Accounts Framework to the extent possible.

13. Tentative timelines for the finalization of chapters was proposed by MoSPI to which the members agreed. It was decided to have the 2nd meeting of the sub-groups tentatively during the 3rd week of January, 2024. It was decided to finalize Chapter 1 and 2 of the report by the end of January, 2024 and finalize the structure and format of framework by the end of February, 2024.

Another meeting of expert group may be planned for in March, 2024 and the status of the work would be presented before the Inter-Ministerial Group (IMG) which will be organized during March-April, 2024.

Annexure

List of participants for 1st meeting of Sub-group 1 of 'Expert Group on Ocean Ecosystem Accounts in India' held on 15/12/2023:

1. Dr. K.S. Kavi Kumar, Professor, Madras School of Economics, Chennai
2. Dr. Sanjay Kumar, DDG, SSD, MoSPI
3. Dr. V. Selvam, Former Executive Director, M.S. Swaminathan Research Foundation, Chennai
4. Dr. Pranab Mukhopadhyay, Professor, Goa Business School, Goa University, Goa
5. Dr. Priya Parasuram, Scientist B, Integrated Social Sciences and Economics Division, NCSCM
6. Dr. Sudeepta Ghosh, Director, SSD, MoSPI
7. Dr. Ruchi Mishra, Deputy Director, SSD, MoSPI
8. Ms. Kulpreet Sokhi, SSO, SSD, MoSPI
9. Mr. Praful Nigam, JSO, SSD, MoSPI

List of participants for 1st meeting of Sub-group 2 of 'Expert Group on Ocean Ecosystem Accounts in India' held on 15/12/2023:

1. Dr. M.V. Ramana Murthy, Director, National Centre for Coastal Research, Chennai
2. Dr. Sanjay Kumar, DDG, SSD, MoSPI
3. Dr. K.S. Kavi Kumar, Professor, Madras School of Economics, Chennai
4. Dr. Pranab Mukhopadhyay, Professor, Goa Business School, Goa University, Goa
5. Shri B.S. Bora, Executive Director, Chief Geophysical Services, ONGC

6. Dr. Venkat Shesu R., Scientist E, Indian National Centre for Ocean Information Services, Hyderabad
7. Shri Vijay Kumar Mishra, Deputy Director, E & S Division, Ministry of Petroleum & Natural Gas, New Delhi
8. Dr. Grinson George, Principal Scientist, Central Marine Fisheries Research Institute, Kochi
9. Dr. U. S. Panda, Scientist F, National Centre for Coastal Research, Chennai
10. Dr. John Kurian P, Scientist F, National Centre for Polar and Ocean Research, Goa
11. Shri Sendhil Kumar, Scientist-D, Centre for Marine Living Resources and Ecology, Ministry of Earth Sciences, Kochi
12. Shri P. V. Nagamani, Scientist - 'SG' & Group Head, Ocean Sciences Group, Earth and Climate Science Area, National Remote Sensing Centre, Indian Space Research Organisation
13. Dr. Shinoj P., Senior Scientist, Central Marine Fisheries Research Institute, Indian Council of Agricultural Research, Kochi
14. Shri Anjan Jyoti Phukan, Executive Director KGB&MBP, Oil India Limited, New Delhi
15. Dr. Sudeepta Ghosh, Director, SSD, MoSPI
16. Dr. Ruchi Mishra, Deputy Director, SSD, MoSPI
17. Ms. Kulpreet Sokhi, SSO, SSD, MoSPI
18. Mr. Praful Nigam, JSO, SSD, MoSPI

Record of Discussion of 2nd Meetings of the Sub-Groups of the Expert Group on Ocean Ecosystem Accounts in India

The second meetings of the Sub-Group 1 and 2 of Expert Group on Ocean Ecosystem Accounts in India led respectively by Dr. K.S. Kavi Kumar, Professor, Madras School of Economics and Dr. M.V. Ramanamurthy, Director, NCCR was held on 21st February, 2024 in hybrid mode from 3.00 PM at Rajendra Chola Hall, National Center for Coastal Research, NIOT Campus, Chennai. The list of participants is Annexed. The following points emerged during the discussion:

2. At the outset, DDG (SSD), MoSPI and Dr. Ramanamurthy, Director, NCCR welcomed all the participants. DDG (SSD) briefed the participants about the background of the Expert Group and the constitution of the sub-groups. Thereafter, a short presentation highlighting the agenda of the meetings and progress of the work done till date was made by MoSPI. Also, the draft structure of the report of the Expert Group was presented by the SSD, highlighting the proposed chapters along with their broad content which was agreed by all the members.
3. MoSPI presented the list of indicators identified till date for the extent, condition and asset accounts. A draft list of ecosystem services for various ocean ecosystems along with their possible valuation techniques was also presented and comments/feedback by the members were sought on these.
4. It was informed that the first two draft Chapters of the report (Background and Global Practices) along with the list of indicators, list of ecosystem services and with appropriate valuation techniques have been circulated to the members for their feedback and the comments are awaited from some of the agencies.
5. A short presentation was made by National Accounts Division, MoSPI on the status of work done on 'Blue Economy' since there is a close connection with the Blue Economy and the Ocean Accounts.
6. Members felt that in order to proceed further with the work of drafting the Framework, it is necessary to initially identify the significant ecosystems

associated with Ocean and then identify key parameters (primary and secondary) for each of these ecosystems. The key ecosystems and their associated parameters can be selected on the basis of priority and significance of the ecosystems and data availability. The ecosystems and the parameters may be added/deleted subsequently based on further discussions.

7. It was decided that the following members will help in identification of the relevant ecosystems, the critical parameters associated with them and the available methodology for the selected ecosystems within a two - weeks' time. They would develop a draft framework and the parameters and present to the main group. The group members can then provide their feedback, finalize the framework and indicate the data availability after which the data collection work can be commenced. To expedite the process, members can convene meetings online if necessary.
   i. Dr. V. Selvam-lead
   ii. Dr. Ramanamurthy
   iii. Dr. K.S. Kavi Kumar
   iv. Dr. Pranab Mukhopadhyay
   v. Dr. Asir Ramesh
   vi. Dr. Sudeepta Ghosh
   vii. Dr. U.S. Panda
8. Dr. Ramanamurthy suggested making a presentation in the next meeting on the work done by Ministry of Earth Science and NCCR which might provide useful insights relevant for the Framework. He also suggested inclusion of linkages with climate change and data uncertainties in the report.
9. MoSPI informed the members that the work done by the expert group will be presented before the members of Inter-Ministerial Group in its upcoming meeting tentatively scheduled to be held in March. Therefore, members were requested to expedite the process and send their comments at the earliest on the draft chapters and other indicators so that the same may be finalized.

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Annexure

List of participants for 2nd meeting of Sub-group 1 and 2 of 'Expert Group on Ocean Ecosystem Accounts in India' held on 21st February, 2024:

1. Dr. M.V. Ramana Murthy, Director, National Centre for Coastal Research, Chennai.
2. Dr. K.S. Kavi Kumar, Professor, Madras School of Economics, Chennai
3. Dr. Sanjay Kumar, DDG, SSD, MoSPI
4. Shri Rajiv Kumar, DDG, NAD, MoSPI
5. Dr. V. Selvam, Former Executive Director, M.S. Swaminathan Research Foundation, Chennai
6. Dr. Pranab Mukhopadhyay, Professor, Goa Business School, Goa University, Goa
7. Shri B.S. Bora, Executive Director, Chief Geophysical Services, ONGC
8. Shri Sendhil Kumar, Scientist-D, Centre for Marine Living Resources and Ecology, Ministry of Earth Sciences, Kochi
9. Dr. P. V. Nagamani, Scientist - 'SG' & Group Head, Ocean Sciences Group, Earth and Climate Science Area, National Remote Sensing Centre, Indian Space Research Organisation
10. Shri Anjan Jyoti Phukan, Executive Director KGB&MBP, Oil India Limited, New Delhi
11. Dr. Shinoj P., Senior Scientist, Central Marine Fisheries Research Institute, Indian Council of Agricultural Research, Kochi
12. Dr. Grinson George, Principal Scientist, Central Marine Fisheries Research Institute, Kochi
13. Shri Vijay Kumar Mishra, Deputy Director, E & S Division, Ministry of Petroleum & Natural Gas, New Delhi
14. Dr. Sudeepta Ghosh, Director, SSD, MoSPI
15. Dr. U.S. Panda, Scientist –F, NCCR
16. Dr. Nisha N.V., Director MCSD, GSI, Mangalore
17. Dr. Ruchi Mishra, Deputy Director, SSD, MoSPI
18. Dr. Venkat Shesu R., Scientist E, Indian National Centre for Ocean Information Services, Hyderabad
19. Dr. Asir Ramesh, Scientist E, NCSCM
20. Ms. Aanchal Jain, AD, MoEFCC
21. Ms. Amrita Gupta, Scientist –B, MoEFCC
22. Dr. Pandiyar Rajan, NCCR
23. Dr. Naidusa, NCCR
24. Dr. P. Ezhilarasan, NCCR
25. Dr. Damodara Rao
26. Dr. Akhilesh Vijay, NCCR
27. Dr. Kumara Swamy, NCCR
28. Ms. Dipika Gupta, JSO, SSD, MoSPI

Minutes of Meeting of 2nd Meetings of the Expert Group on Ocean Ecosystem Accounts in India

The second meeting of Expert Group on Ocean Ecosystem Accounts in India under the chairpersonship of Additional Director General (SSD) was held on 23rd August 2024 in hybrid mode from 11.00 AM at Conference Hall, 2nd Floor, Khurshid Lal Bhawan, MoSPI, New Delhi. The list of participants is at Annexure.

2. At the outset, ADG (SSD), MoSPI welcomed all the participants. He briefed the participants about the background of the Expert Group and sub-groups and expressed sincere thanks to the members of the Group for their support and guidance. It was also informed that the draft report of the Group was already circulated to the members for seeking their feedback and comments. Thereafter, a presentation highlighting the progress of the work done till date and the comments received from the members on the draft report was discussed.
3. Thereafter, SSD presented the draft chapters of the report of the Expert Group along with its broad content. The same was agreed by all the members. Further, MoSPI informed the members that a chapter on Ocean Ecosystem Accounting will be included in its upcoming annual publication 'EnviStats India 2024 Environment Accounts'
4. The following deliberations were made during the meeting:
   (i) It was decided to change the existing sequence of accounts and have Asset Account after Extent, Condition and Services accounts. Also, it was decided to keep the Monetary Asset Accounts beyond the purview of the report due to lack of standard valuation technique and desired data.
   (ii) Keeping the voluminous content in view, it was decided not to include description of methodologies, data collection processes, and monetary valuation techniques employed by global studies as a part of the report. It was highlighted that relevant references for the same has already been provided in the relevant chapters of the report.

(iii) A paragraph on basic spatial unit in line with SEEA EA may be added as a part of report. It was suggested that for spatial datasets, 10*10 km resolution may be taken as standard. However, this may vary among spatial datasets of different agencies.

(iv) It was decided to keep 'Coastal Ocean Water' which extends up to 12 nautical miles as one of the ecosystems and not the 'open sea' as the boundaries of open sea are not very distinct and the framework is currently considering EEZ as boundaries. 'Coastal Ocean Water' is also defined as per the International Union for Conservation of Nature Global Ecosystem Typology (IUCN GET) classification. Since ocean has a large number of ecosystems, only those ecosystems may be considered in the report which are IUCN GET classified. Other crucial ecosystems such as atoll ecosystems may be mentioned in one of the paragraphs.

(v) For the Tier I condition parameters (various indices), it was decided that NCCR and MoEFCC may share the detailed methodology for the compilation of the same. As regards the pollution index which is one of the Tier-I condition parameters, separate meeting with MoEFCC may be planned in presence of Central Pollution Control Board.

(vi) Regarding the periodicity of accounts, it was decided to keep it as 5 years. This may be revised once the account compilation starts and may help in assessing ecosystems wise periodicity.

(vii) Regarding the Asset Accounts for Fish and Minerals, it was decided that species-wise and sub-asset wise (minerals) account may be compiled provided data is available at the granular level.

(viii) Petroleum Hydrocarbon and several other minerals/metals like copper, Iron, manganese, Cadmium, Lead, Mercury, given as condition parameters may be removed from the table.

(ix) Instead of considering ecotourism as separate ecosystem services, Tourism as a whole may be considered as cultural services as data for ecotourism and tourism are indistinguishable.

(x) Shipping and Mineral provisioning services, though fall outside the scope of SEEA ecosystem services, are crucial from marine economic point of view, may be considered as 'Other Services' in the framework.

(xi) For following the 'directly observed price valuation techniques', the Group suggested to take the basic price.

(xii) It was decided that MoSPI would share the list of Tier II and III condition parameters and the concerned Ministry/Department may indicate whether to add/delete parameters from the list. However, Geological Survey of India (GSI) informed that it has evaluated the mineral resources and made an inventory of off shore minerals and the data is handed over to the M/o Mines and if auctioned, private parties extract/mine these minerals. As GSI does not keep any stock details of Marine Mineral Commodities, it will not be feasible for GSI to provide data on the mineral assets.

(xiii) The data source agencies of the expert group may indicate the scale, periodicity and availability for the data on extent and condition parameters of the ocean ecosystem accounts so that data gaps may be identified and work may be initiated on the remaining ToRs of the Expert Group:

(xiv) INCOIS was requested to share the Glossary of technical terms related to ocean and other relevant information regarding the data.

(xv) For periodically reviewing the framework in line with the global advancement, constitution of a sperate Group may be considered.

5. The meeting ended with a vote of thanks to the chair.

Annexure

List of participants for 2nd meeting of 'Expert Group on Ocean Ecosystem Accounts in India' held on 23/08/2024:

1. Dr. Praveen Shukla, Additional Director General, Social Statistics Division, MoSPI
2. Dr. M.V. Ramana Murthy, Director, National Centre for Coastal Research, Chennai.
3. Dr. K.S. Kavi Kumar, Professor, Madras School of Economics, Chennai
4. Dr. Pranab Mukhopadhyay, Professor, Goa Business School, Goa University, Goa
5. Shri C. S. Mishra, Statistical Advisor, MoEFCC
6. Dr. Ashutosh Ojha, Deputy Director General, Social Statistics Division, MoSPI
7. Shri Siljo V.K., Deputy Director General, Social Statistics Division, MoSPI
8. Shri Sundeep, Scientist-F, Ministry of Environment, Forest and Climate Change
9. Dr. Sanjay Kumar, DDG, SSD, MoSPI
10. Shri Rajiv Kumar, DDG, NAD, MoSPI
11. Shri B.S. Bora, Executive Director, Chief Geophysical Services, ONGC
12. Dr. U.S Panda, Scientist –F, NCCR
13. Dr. Nisha N.V., Director MCSD, GSI, Mangalore
14. Dr. Venkat Shesu R., Scientist E, Indian National Centre for Ocean Information Services, Hyderabad
15. Shri R. Sendhil Kumar, Scientist-D, Centre for Marine Living Resources and Ecology, Ministry of Earth Sciences, Kochi
16. Dr. P. V. Nagamani, Scientist - 'SG' & Group Head, Ocean Sciences Group, Earth and Climate Science Area, National Remote Sensing Centre, Indian Space Research Organisation
17. Shri Anjan Jyoti Phukan, Executive Director KGB&MBP, Oil India Limited, New Delhi
18. Shri Sidharth Sattiraju, Deputy Chief Engineer, Oil India Limited
19. Dr. Grinson George, Principal Scientist, Central Marine Fisheries Research Institute, Kochi
20. Dr. Shinoj P., Senior Scientist, Central Marine Fisheries Research Institute, Indian Council of Agricultural Research, Kochi
21. Dr. Anil Kumar Vijayan, Scientist-E Ministry of Earth Science
22. Shri Vijay Kumar Mishra, Deputy Director, E & S Division, Ministry of Petroleum & Natural Gas, New Delhi
23. Shri B.K. Tripathi, Technical Officer, M/o Petroleum & Natural Gas.
24. Shri R.Chandra Prabhu, Deputy Director, Ministry of Fisheries
25. Representatives from National Centre for Sustainable Coastal Management, Chennai
26. Shri R.P. Gurung, Scientist E, Central Pollution Control Board, New Delhi
27. Ms Deepa Kumari, Senior Scientific Assistant, Central Pollution Control Board
28. Dr. Sudeepta Ghosh, Director, SSD, MoSPI

29. Dr. Ziaul Haque, Director, SSD, MoSPI
30. Ms. Divya Chauhan, Director, SSD, MoSPI
31. Ms. Kirti Gaikwad, JD, SSD, MoSPI
32. Dr. Ruchi Mishra, Deputy Director, SSD, MoSPI
33. Ms. Anjali Maurya, Deputy Director, SSD, MoSPI
34. Ms. Kulpreet Sokhi, SSO, SSD, MoSPI
35. Ms. Dipika Gupta, JSO, SSD, MoSPI

Minutes of Meeting of the 3rd Meeting of the Expert Group on Ocean Ecosystem Accounts in India

The third meeting of Expert Group on Ocean Ecosystem Accounts in India under the chairship of Additional Director General (SSD) was held on 18th December 2024 in hybrid mode from 11.00 AM in the Committee Room (Manthan), 3rd Floor, Telecom Engineering Centre, Janpath Road, New Delhi. The list of participants is at Annexure.

2. At the outset, ADG (SSD), MoSPI welcomed all the participants. ADG (SSD) briefed the participants about the background of the Expert Group and sub-groups and thanked the members of the expert group for their support and guidance. MoSPI informed the members that the draft report of the group has been circulated to the members for seeking their feedback and comments. Thereafter, a presentation highlighting the progress of the work done till date and the comments received from the members on the draft report was made.
3. The following points emerged during the discussion:
   (i) A presentation on the progress of the report was made by the Division. A detailed discussion followed regarding the inputs received and the revised format of the extent, condition, and services accounts.
   (ii) It was discussed that if required the tenure of the Expert Group may be extended.
   (iii) The Chair highlighted that once the suggestions are incorporated, the report will be presented for necessary approvals.
   (iv) The revised format of the Extent Account was reviewed and agreed upon by all members.
   (v) From the Extent Accounts, the percent cover of coral reefs and seagrass, along with shipping lanes, were removed due to the lack of clarity regarding their definitions.

(vi) It was decided to limit the number of parameters for Tier 1 condition accounts for each ecosystem and it was suggested to maintain a uniformity across ecosystems regarding the number of parameters.

(vii) The revised format of the Condition Account was discussed where set of parameters were proposed for each ecosystem instead of Index as proposed earlier for Tier 1. Members provided inputs on the parameters for each of the ecosystems, and the final format was agreed upon. The parameters removed from Tier 1 condition accounts was moved to Tier 2 accounts. Earlier Tier 2 and 3 are merged together in the current Tier 2 condition accounts.

(viii) It was agreed that no new ecosystems, as previously decided, would be added at this point. New parameters suggested would be added in Tier 2 accounts.

(ix) It was agreed that international definitions; (IUCN GET classification) for defining the ecosystems should be closely followed to ensure robustness of the framework and enable international comparison, while national regulations and data availability should be considered during implementation. Subsequently, any deviations from the international standards or data limitations may be highlighted while implementing the framework. It was suggested that existing definitions may be shared with the members for their reference and further inputs.

(x) It was suggested that due care may be taken to avoid double counting in the ecosystem accounts.

(xi) MoPNG suggested further classification of minerals in Asset Accounts into two categories: 'fuel minerals' and 'non-fuel minerals,' which was agreed upon.

(xii) It was suggested to conduct pilot studies for Ocean Ecosystem Accounts. It was suggested that the pilot studies be conducted based on geographical locations rather than ecosystem-wise.

(xiii) It was agreed to add few paragraphs in Chapter 6 to address waste flows, oceanic pressures, and pollution to provide a comprehensive picture of environmental economic accounts.

(xiv) It was suggested that agencies be designated as Knowledge Partners for specific ecosystems, with a mandate to compile ecosystem accounts. This would ensure responsibility and accountability, while enhancing the capacity of the agencies.

(xv) Efforts may be taken towards creation of awareness about ocean accounting, its need and relevance to the coastal states through hand-holding/capacity-building workshops so that they may also initiate maintaining requisite database for ocean accounts.

4. The meeting concluded with a vote of thanks to the Chair.

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Annexure

List of participants for the 3rd meeting of 'Expert Group on Ocean Ecosystem Accounts in India' held on 18/12/2024 in hybrid mode:

1. Shri Subash Chandra Malik, Additional Director General, Social Statistics Division, MoSPI
2. Dr. K.S. Kavi Kumar, Professor, Madras School of Economics, Chennai
3. Dr. Pranab Mukhopadhyay, Professor, Goa Business School, Goa University, Goa
4. Dr. V. Selvam, Mangrove Expert, Ex- ED, M. S. Swaminathan Research Foundation
5. Ms. Sandhya Singh, Deputy Director General, Social Statistics Division, MoSPI
6. Shri Siljo V.K., Deputy Director General, Social Statistics Division, MoSPI
7. Shri Vikas Mohan, Chief Geophysical Services, ONGC
8. Shri Sanjib Kumar Gogoi, Chief General Mangarer, KGB&MBP, Oil India Limited, New Delhi
9. Dr. Shinoj P., Senior Scientist, Central Marine Fisheries Research Institute, Indian Council of Agricultural Research, Kochi
10. Shri Sundeep Scientist-F, Ministry of Environment, Forest and Climate Change
11. Dr. U.S Panda, Scientist –F, NCCR
12. Dr. Nisha N.V., Director MCSD, GSI, Mangalore
13. Dr. Venkat Shesu R., Scientist E, Indian National Centre for Ocean Information Services, Hyderabad
14. Ms. Smitha B.R., Centre for Marine Living Resources and Ecology, Ministry of Earth Sciences, Kochi
15. Dr. P. V. Nagamani, Scientist - 'SG' & Group Head, Ocean Sciences Group, Earth and Climate Science Area, National Remote Sensing Centre, Indian Space Research Organisation
16. Ms. K.R. Mangala, Scientist-D, Ministry of Earth Science
17. Shri Vijay Kumar Mishra, Deputy Director, E & S Division, Ministry of Petroleum & Natural Gas, New Delhi
18. Shri B.K Tripathi, Technical Officer, M/o Petroleum & Natural Gas.
19. Dr. Asir Ramesh, National Centre for Sustainable Coastal Management, Chennai
20. Dr. Priya, National Centre for Sustainable Coastal Management, Chennai
21. Dr. Sudeepta Ghosh, Director, SSD, MoSPI
22. Dr. Ziaul Haque, Director, SSD, MoSPI
23. Shri Ashwani Kanaujia, Director, SSD, MoSPI
24. Shri Kuwar Alok Singh Yadav, JD, NAD, MoSPI
25. Dr. Ruchi Mishra, Deputy Director, SSD, MoSPI
26. Ms. Aastha Gaur, Deputy Director, SSD, MoSPI
27. Ms. Anchal Jain, AD, MoEFCC
28. Ms. Amrita Gupta, Scientist B, MoEFCC
29. Ms. K. Deepshikha Ganesh, Professional/ Consultant Grade-1, SSD, MoSPI
30. Ms. Kulpreet Sokhi, SSO, SSD, MoSPI
31. Ms. Nikita Kumari, JSO, SSD, MoSPI

Annexure 2.1

A.2.1.1 The Appendix 2.1 provides in detail the efforts being made by various countries and several international organizations for bringing forth their set of ocean accounts. The methodologies adopted and data used may vary from one endeavour to another; nonetheless, the overview of these efforts provides useful highlights on the countries' efforts towards ocean related accounts.

The United Nations Statistical Commission and SEEA Ocean

A.2.1.2 March 2018: In the 49th Session, the UNSC[65] requested that ocean statistics be integrated in the work of the revision process of System of Environmental-Economic Accounting (SEEA) Experimental Ecosystem Accounting and noted the interest of the UN Economic and Social Commission for Asia and the Pacific (ESCAP) and the United Nations Environment Programme (UNEP) in taking the lead in this work.

A.2.1.3 March 2020: At the 51st Session, the United Nations Statistical Commission (UNSC) commended the work led by ESCAP and the Global Ocean Accounts Partnership (GOAP) for the work on Technical Guidance on Ocean Accounting[66] and progress made through country piloting in China, Malaysia, Thailand, Samoa, and Viet Nam, and recognized the Technical Guidance that provides a solid foundation for integrating ocean accounts into SEEA.

A.2.1.4 Some of the global efforts focusing on oceans include the UN Decade of Ocean Science for Sustainable Development (https://www.oceandecade.org/); the High Level Panel for a Sustainable Ocean Economy (https://www.oceanpanel.org/) and the World Ocean Assessments (https://www.un.org/regularprocess/woa2launch). In particular, the High-Level Panel identified a "complete sequence of national ocean accounts that are actively used" as one of its transformational priority actions for a sustainable ocean economy. Pilot ocean accounting activities responding to this priority are already underway globally.

A.2.1.5 The UNSC has also discussed the approaches towards developing the SEEA Oceans as the agreed methodology for ocean accounting on the basis of the progress made on the development of the Technical Guidance on Ocean Accounting for Sustainable Development[67] including its testing and experimentation at the

[65] https://seea.un.org/sites/seea.un.org/files/unceea_nov_2020_seea-ocean_report_0.pdf
[66] https://www.oceanaccounts.org/technical-guidance-on-ocean-accounting-2/
[67] https://www.oceanaccounts.org/technical-guidance-on-ocean-accounting-2/

country level. The report to the 52nd UN Statistical Commission (Item 3f on the agenda: Developing a SEEA Ocean) set out the approach to develop SEEA Oceans as adopted by the UN Committee of Experts on Environmental-Economic Accounts (UNCEEA), and the approach was supported by UNSC who further highlighted the importance of SEEA Oceans framework being fully aligned with the SEEA Central Framework and SEEA Ecosystem Accounting[68].

A.2.1.6 Recently in recognition of the importance of coordinating the efforts to refine definitions and concepts for the ocean, the SEEA Ocean Working Group (SEEA-OWG) was established. The group aims to address the challenges in the implementation of the SEEA, providing guidance and clarity on the issues that may prevent the compilation and maintenance of SEEA accounts.

Countries Efforts towards Ocean Accounting

China

A.2.1.7 China has placed emphasis on natural capital accounting as one of the three governance measures alongside natural resource balance sheets and the audit of outgoing officials responsible for natural resource management. The country has extensive experiences in terrestrial environmental and ecosystem accounting including the project on Natural Capital Accounting and Valuation of Ecosystem Services (NCAVES) being coordinated by National Bureau of Statistics (NBS). However, applications and extensions to coastal and marine ecosystems in China are presently limited but are receiving increased attention with its marine economy accounting for 9.3% of GDP in 2018. The growing concerns are particularly related to:

- land reclamation from the sea
- impacts from coastal development
- fishing intensity
- marine pollution including plastic debris
- loss of ecosystem services, and oil spills

A.2.1.8 In China, pilot study was conducted in the Beihai Guangxi[69], famous for its subtropical coastal ecosystem such as mangroves, seagrasses, tidal marshes and

[68] For more details on the proposed plan see the UNSC background paper on Developing a SEEA Ocean at https://unstats.un.org/unsd/statcom/52nd-session/documents/BG-3f-SEEA_Ocean_background_paper_final-E.pdf.

[69] https://www.unescap.org/sites/default/d8files/2022-06/Ocean_Accounts_China.pdf

coral reefs. The area was especially chosen due to the importance of mangrove forests and the availability of the data in the area.

A.2.1.9 New techniques, such as satellite remote sensing, light detection and ranging remote sensing methods and hyperspectral techniques, were used. Field studies and ground truthing exercises were conducted to test these techniques. The following results were obtained from the pilot study:

(i) Asset accounts for mangroves were created by linking ocean assets to existing environment asset categories, and then designing a classification of ecosystem services of mangroves.
(ii) Using satellite data, a matrix showing the change in sea area from 1998 to 2018 was developed. This analysis shows an increase in total mangrove area from 4.68 km to 32.79 km.
(iii) The total carbon stock of Beihai's mangroves was calculated at 0.67 million tC, based on in-situ sample collection. The metrics assessed will be used to compile a Green House Gases Inventory and to better understand the impact of climate change, and biodiversity conservation/ losses.

A.2.1.10 China planned to extend the ocean accounts pilot study to other areas and other coastal ecosystems of the country, and link carbon accounting to the national and local greenhouse gas inventories, with a particular focus on coastal wetlands.

Malaysia

A.2.1.11 Malaysia's concerns regarding the mismanagement of their ocean economy chiefly relate to marine litter, overfishing, and lack of policy coordination. This is especially true along Malaysia's western coast (Malacca Strait), which is the most productive in terms of fisheries and natural resources but shares territory with bordering nations, making it strategically important to the Malaysian economy. It is one of the main international shipping waterways connecting the Indian Ocean and the Pacific Ocean. It also yields one of the highest fish landings, including both commercial and traditional fisheries, in the country contributing to overall economic growth as well as livelihoods of coastal fishermen. At the same time, Malaysia is facing a number of ocean related challenges including Illegal, Unreported and Unregulated (IUU) fishing, overfishing, land-based and sea-based pollution especially marine litter. In the Straits of Malacca in particular, the expansion of the fisheries sector, rapid coastal development and urbanization, and issues surrounding climate change further

exacerbate the problems and pose a serious concern to the sustainability of living resources in the area.

A.2.1.12 The Straits of Malacca[70] which is a narrow stretch of water, 930 km in length between the Malay Peninsula and the Indonesian island of Sumatra was chosen as a pilot area. The area is the main shipping channel between the Indian and the Pacific Oceans and is important for fishing. The pilot focused on the sustainability of fisheries in the Straits of Malacca, and the effect of atmospheric and climatic phenomenon on fisheries.

A.2.1.13 The study investigated factors contributing to the fluctuation in fish landings – number of vessels and gear, type of vessel and gear, land-use change, sea surface temperature (SST), chlorophyll (Chl) concentration (an indication of primary production) and total suspended matters (TSM – indication of river runoffs i.e., nutrient input).

A.2.1.14 Apart from information on the fish landings and the mangrove cover area, the study also helped in understanding the fact that the biggest driver of fish landings is phytoplankton biomass which, is in turn is influenced by temperature and river runoffs. Also, the lower Sea Surface Temperature (SST) could lead to increased production of phytoplankton, which can be harmful to fish.

The Maldives

A.2.1.15 The Maldives has recently committed to several policy changes to improve ocean economy management. In keeping with the President's direction and the 2019-2023 Strategic Action Plan (SAP) of "sustainable development in harmony with ocean-friendly practices", as well as addressing key national concerns such as loss of habitats due to tourism, intensive use of chemicals in the agriculture sector, marine pollution particularly due to plastics, coastal erosion and sea level rise, several policies have been put in place to ensure that economic growth is accompanied by progress in ocean management.

A.2.1.16 One illustrative example is the case of a tourism sector. As the top income generating (26% of GDP in 2019) and resource intensive industry, the Maldives plans to further increase tourist arrivals by 20% and 35,000 more tourism beds by 2023 while ensuring the sustainable use of natural resources, environmental protection from waste pollution and damage to marine ecosystems, and use of renewable energy across the sector. The country also aims to promote blue economy

[70] https://www.unescap.org/sites/default/d8files/2022-06/Ocean_Accounts_Malaysia.pdf

initiatives, develop Marine Spatial Planning, declare at least 20% of its waters as protected areas, and protect and manage at least 10% of coral reefs and 20% of wetlands and mangroves in each atoll. In addition, the Government has put particular emphasis on improving the evidence base, including ocean data and statistics, necessary for informing the implementation, monitoring and reporting of its integrated policies and programmes.

A.2.1.17 The Maldives' statistical system has already geared towards supporting these efforts. GDP compiled by National Bureau of Statistics (NBS) provides disaggregation for fisheries, tourism, transportation, as well as travel agencies and support services. The NBS has piloted SEEA-CF accounts (water and solid waste) and has planned to develop the Tourism Satellite Accounts (TSA) on a regular basis, which are core elements underpinning the production of TSA-SEEA accounts. In addition, Ministry of Environment (MoEn) is in the process of developing a State of the Environment (SoE) database as well as implementing a natural capital accounting project which will have a strong ocean focus. The Maldives also has extensive experience in scientific assessments and measurements of coral reef ecosystems and has recently launched the completed assessments of 39 coral species [71] . In addition, Maldives has recently come up with a preliminary survey of ecosystem extent and condition in Laamu Atoll [72]especially for the Seagrass and the Mangrove Ecosystems.

Myanmar

A.2.1.18 Myanmar's management and protection of its coastal natural capital has been recently supported through its plan in sustainable development. Conserving and protecting coastal and marine areas through integrated resource planning and sustainable use practices is one of the key goals of recently released 2018-2030 Myanmar Sustainable Development Plan. This is largely due to a particular concern regarding coastal and marine resources and ecosystems especially the loss of mangrove areas due to rapid economic development that would undermine the mangroves' ability to provide essential goods and services particularly to coastal population in Ayeyarwady Delta and along the Tanintharyi and Rakhine Coastlines.

A.2.1.19 The Ministry of Planning and Finance, the Central Statistical Organization, and the Ministry of Environmental Conservation and Forestry have

[71] https://www.iucn.org/story/202211/maldives-launches-assessments-39-coral-species

[72] https://oceanaccounts.atlassian.net/wiki/spaces/WD/pages/982286372/Preliminary+survey+of+ecosystem+extent+and+condition+in+Laamu+Atoll+Maldives?ref=oceanaccounts.org

begun the assessment of values of mangrove ecosystem services in coastal areas. It is expected that the assessment will provide solid economic arguments for conservation and restoration efforts and inform coastal development planning processes.

The Philippines

A.2.1.20 The coastal and marine resources play a pivotal role in the Philippine economy, with the majority of population living in coastal zones. The Philippines began the measurement of the contribution of ocean-based industries to the economy in 2009 with the estimates of revenues, costs of goods sold and employment of selected maritime industries. The most recent revision in 2019 benefited from methodological improvements following a satellite accounting approach that expands the economic activities to include those that either take place in the ocean, receive input from the ocean, and/or provide goods and services to the ocean. The results indicated that, in 2018, the share of the ocean economy to GDP was 3.6% with a 7.8% year-on-year growth and accounted for 6.0% of total employment. The fishing sector contributed the largest share of the Philippine ocean economy at 29% in 2018. The ocean economy satellite accounts are instrumental in the monitoring and assessment of ocean-related economic targets set in the 2017-2022 Philippine Development Plan (PDP).

A.2.1.21 In addition, the Philippines has had a long history of environmental and economic accounting implementation since the first project led by Department of Environment and Natural Resources (DENR) in 1991. These efforts have led to the production of a series of pilot accounts that support national resources management policies and integration of natural capital accounting in development planning and policy analysis – of relevance to the ocean is fisheries and mangrove asset accounts led by the Philippines Statistics Authority and its predecessors.

Republic of Korea

A.2.1.22 The Republic of Korea has engaged in both the maintenance of ocean economy satellite accounts and changes in ocean governance to improve management of its ocean economy. Korea Maritime Institute (KMI) maintains ocean economy satellite accounts for Republic of Korea in response to the need for assessing the size and composition of its ocean economy to inform marine and fisheries sector development planning. The latest estimates for 2015 indicated that the country's ocean economy accounted for 3.98% of Gross Output, 2.52% of GVA and 2.5% of total employment.

A.2.1.23 In terms of ocean governance, the KMI is working towards shifting the national coastal and marine management model from Integrated Coastal Management (ICM) that resulted in complex zoning schemes to the evidence-driven Coastal and Marine Spatial Planning (CMSP) Management using Marine Ecosystem Service (MES) based approach. The development of CMSP is based on a spatial assessment of marine ecosystem assets and services – provisioning, regulating, supporting and cultural – as a basis for delineating use zones in Korea's waters. The MES-based CMSP will also be a key spatial decision-making tool for evaluating the suitability of new use/development activities based on the potential costs measured by changes in ecosystem service values and benefits of the use of the area. The MES-based CMSP is a part of the national and sub-national implementation of the 2019-2028 Master Plan on Marine Spatial Management for sustainable use of coastal and marine resources.

Samoa

A.2.1.24 Coastal and marine resources are the main component of the Samoan economy and the country is highly concerned about how both internal (e.g., over tourism, waste management) and external (e.g., sea level rise, warming) processes affect these resources. For Samoa, improved management of these resources through an accounting framework begins in the tourism sector. The tourism industry plays a vital role in the Samoan economy in terms of contribution to GDP and job creation. As a small island nation, however, growth of the industry means that already scarce natural resources need to be shared between visitors and local population. The tourism industry, while benefitting from ocean and marine resources, also contributes to the degradation of marine ecosystems. Understanding these inter-relationships through integrated statistics is key to proper policy planning towards sustainable management and development of the tourism industry and Samoa's natural resources, including the ocean, in accordance with the Strategy for the Development of Samoa, Samoa Ocean Strategy, the National Environment Sector Plan and the Tourism Sector Plan.

A.2.1.25 The pilot study in Samoa[73] focused on developing a tourism satellite account as a step towards assessing the full economic impact of tourism. The satellite accounts were developed and then used to analyze the impact on and use of resources by the tourism industry. The first experimental tourism accounts were built, and the tourism product ratio (the proportion of an industry's output that is consumed by

[73] https://www.unescap.org/sites/default/d8files/2022-06/Ocean_Accounts_Samoa.pdf

tourists) and the tourism industry ratio (the ratio of tourism sales to total industry sales) were calculated. These ratios link the water and energy accounts with the tourism sector, so that estimates of usage of water and energy by the tourism sector could be estimated

Thailand

A.2.1.26 Thailand's coastline extends 3,010 km along the Andaman Sea [74] and the Gulf of Thailand, with a maritime area exceeding 323,000 km^2. Thailand's marine environment and coastal areas are hence vital to the country's society and economy. The development of tourism in Thailand has caused degradation of coastal resources, exerting pressure on the marine resources and marine environment.

A.2.1.27 Thailand's advances toward improved management of its coastal and marine resources is driven by its National Strategy and Development Plans. The key objective of environmentally friendly growth in the 20-year National Strategy (2018-2037) and the 12th National Economic and Social Development Plan (2017-2021) is to promote mutual and balanced growth in economic, environmental – both terrestrial and marine – and quality of life aspects. Thailand recognizes the tourism sector as the main engine of inclusive growth but at the same time it is one of the main contributors to the imbalanced use of natural resources and environmental degradation particularly along the coastal provinces.

A.2.1.28 The pilot study investigated the linkages between tourism and the environment with the aim of identifying locations at risk of environmental degradation, priority sites for conservation and potential new tourism destinations. The geographical area studied was the Andaman Cluster – Phuket, Krabi, Phang Na, Trang, Saturn Provinces – with 2016 as the reference year. Data was organized in accounts following the international statistical standards for national accounting for tourism satellite accounts and environmental-economic accounting.

A.2.1.29 Four core accounts for the year 2016 were built: water, energy, solid waste and greenhouse gas emissions. The five provinces in the pilot (out of a total of 77 provinces) generated 50% of the total Gross Domestic Product from tourism, valued at approximately as US$ 7,270 million in 2016. However, tourism accounted for:

- 21% of the total water used;
- 57% of the total energy used;
- 26% of the waste generated; and

[74] https://www.unescap.org/sites/default/d8files/2022-06/Ocean_Accounts_Thailand.pdf

- 72% of the GHGs.

A.2.1.30 Based on this assessment, there is no clear relationship between income generation from tourism and the use of water and energy, and the generation of waste and greenhouse gas emission. Mapping was done to show the areas at risk of excessive tourism and the linkages with improper waste collection, treatment and disposal and flow of waste to the environment.

A.2.1.31 The study revealed that tourism accounted for half of the air pollution and energy consumption in the five provinces in the pilot. There is a strong link between excessive tourism and improper waste collection and disposal and declining water quality.

Viet Nam

A.2.1.32 Issues of concerns regarding the ocean in Viet Nam include marine pollution (land-based and sea-based) particularly plastics, sea level rise, seawater intrusion, disasters, IUU fishing and overfishing. With half of the country being coastal, there are many stakeholders with mandates and initiatives relevant to the ocean.

A.2.1.33 The coastal region of Quang Ninh[75] in the northeast of Viet Nam was selected as the study area. The Quang Ninh Province in Viet Nam is a very active sea-transportation area, with 10 large seaports located within its border. The province is an area rich in biodiversity and features tropical coral, seagrass and mangroves. There is one terrestrial protected area, a national park and two marine protected areas. Tourism is important to the economy of Quang Ninh. However, tourism activities have led to several environmental impacts caused especially due to unmanaged solid waste and other marine pollution from land-based and marine-based sources. These issues are further amplified by rapid urbanization and economic growth with rising coal mines and heavy industrial parks. In 2018, tourism accounted for 11% of Gross Regional Domestic Production. The ocean is thus a vital source of livelihood, employment, nutrition and economic growth.

A.2.1.34 The study identified the main sources of land pollution identified as domestic wastewater, industrial wastewater, surface run-off water from coal mining sites, improperly disposed off waste and garbage, waste from inland aquaculture and freshwater fish production cage culture. The main sources of ocean pollution identified were pollution from ships and fishing boats and waste from coastal

[75] https://www.unescap.org/sites/default/d8files/2022-06/Ocean_Accounts_Viet_Nam.pdf

aquaculture and marine fish cages. A loss of area and/or degradation of ecosystems – mangroves, seagrasses, coral reefs – was also assessed due to the development of coastal construction, aquaculture and sedimentation. In recent years, protection and reforestation efforts have stabilized and there has been an increase in the total forest area between 2016 and 2019.

Indonesia

A.2.1.35 National concerns related to the ocean in Indonesia include marine plastic debris, illegal, unregulated, and unreported (IUU) fishing, overfishing, and the loss of coastal and marine resources due to unsustainable use and exploitation and livelihoods of small-scale fishermen. Indonesia has an overarching Ocean Policy that establishes the highest policy framework to coordinate the implementation of government institutions' programmes and activities in the area of ocean affairs towards sustainable management and utilization of marine resources. The Policy's seven pillars and 76 strategies are in line with and elaborate on the "marine goal" set forth in the 2005-2025 long-term development plan (RPJPN) – the latter have been translated into a series of national medium-term development plans (RPJMN).

A.2.1.36 The Government of Indonesia commits to align economic growth with the sustainable development principles, hence the environmental health is fundamental for long-term economic development. The 2020-2024 National Medium-Term Development Plan (RPJMN) has established agendas and priorities on the provision of data and information on biodiversity and ecosystems, which can be achieved through the completion of Natural Resource Accounts. In the global scheme, agenda related to the preparation of Natural Resources Accounts has become an agreement in the Convention on Biological Diversity (CBD Aichi Target 2), in which target is to integrate the value of biodiversity into development strategies, particularly through the national accounting system.

A.2.1.37 For two decades, Indonesia has used the System of Environmental-Economic Accounting (SEEA) to quantify environmental assets, particularly in terrestrial areas, by compiling the Integrated System of Environmental - Economic Accounts of Indonesia. Given the complexity of its preparation, the implementation of Ocean Accounts in Marine Protected Areas (MPA)[76] as pilot sites is considered a strong starting point. Among all established MPAs, Gili Matra- West Nusa Tenggara has been selected as a pilot site for Ocean Accounts implementation in Indonesia. This

[76] https://oceanaccounts.atlassian.net/wiki/spaces/WD/pages/941555779/Indonesia+Development+Report?ref=oceanaccounts.org

project was undertaken by the Ministry of Marine Affairs and Fisheries with the Ministry of Finance, the Central Statistics Agency (BPS), the National Planning and Development Agency (Bappenas), and the Geospatial Information Agency (BIG) to develop ocean accounting in Indonesia. The projected was also supported by the Global Ocean Account Partnership and the Indonesian Rekam Nusantara Foundation.

A.2.1.38 Four accounts have been prioritized to be developed, namely ecosystem assets, flows to the economy, flows to the environment, and ocean governance. The assessment involved desk studies, field surveys, interviews, and image processing and analysis to presenting the results through maps.

Table A.1: Parameters observed for ecosystem assets in Gili Matra MPA

Agenda	Parameter Observed	Methods
Ecosystem extent and condition		
Survey of coral reef extent and condition	Coral reef extent (validation)	Rapid survey, Coral Point Count with Excel extensions (CPCe)
	Diversity	Underwater photo transects
	Coral reef condition	Recruitment
	Reef fishes	Underwater visual census, timed swim, habitat complexity
Survey of seagrass extent and condition	Seagrass extent (validation)	Rapid survey
	Diversity	Quadratics transect
	Seagrass condition	Diversity analysis
Survey of mangrove extent and condition	Mangrove extent (validation)	Rapid survey
	Diversity	Quadratics transect
	Seagrass condition	Diversity analysis
Biophysical/Water quality		
Analysis and survey of biophysics condition	Sea surface temperature	Landsat 8 satellite imagery
	Chlorophyll-a	Landsat 8 satellite imagery
	Total suspended solids (TSS)	Landsat 8 satellite imagery
	Acidity (pH)	Water quality instrument
	Dissolved oxygen (DO)	DO Meter
	Biological oxygen demand (BOD)	Laboratory analysis

A.2.1.39 Changes in ecosystem extent were identified by comparing the opening stock in 2015 with the closing stock in 2021 and its implications to the economic value; changes in coral reefs, seagrass, and mangrove areas and its economic value from 2015 to 2021. An assessment of flows to the economy was carried out in accordance with the role and functions of those ecosystems to identify the overall monetary value. The assessment of tourism activities was estimated. Residual waste resulting from economic activity in the area was estimated to assess the flows to the environment accounts. For ocean governance accounts, Management and Zoning Plan of Gili Matra MPA 2014 – 2034 was used to assess the current spatial use and arrangements, as well as taking the management measures that have been undertaken by a designated

working unit (Satker). Indonesia has generated a wealth of publicly accessible ocean-related data and maps that could provide integrated evidence towards informing the implementation of Indonesian Ocean Policy.

Japan

A.2.1.40 Promoting secure and sustainable use of the ocean while protecting the marine environment are key policy directions stipulated in Japan's third Basic Plan on Ocean Policy (May, 2018). With the estimated contribution of marine sector at 1.6% of GDP in 2005, the Ocean Policy prioritizes harnessing marine energy, securing and growing maritime transport, and targeting fisheries as a rising industry for ocean development in the next 10 years. These strategic directions were set in recognition of the new potential of marine energy development, the major role of maritime transport in Japan's trade as well as concerns over declining fish stock.

A.2.1.41 In terms of statistical foundation for ocean accounts, Japan's 187 sector Input-Output tables include detailed information adequate for distinguishing land-based and ocean-based activities for the proper derivation of the contribution of the ocean to the economy such as differentiating marine from inland water fisheries in the fisheries' component of national accounts. Other time series information related to fisheries is also maintained by the Ministry of Agriculture, Forestry and Fisheries. Additionally, Japan incorporated selected non-produced assets (land, mineral and energy resources, and non-cultivated biological resources) in its Balance Sheet where their granular data could contribute to measuring non-produced ocean assets in the context of overall national wealth.

Canada

A.2.1.42 The Canadian System of Environmental-Economic Accounts provides a conceptually integrated framework of statistics (in physical and monetary terms) and analysis for studying the relationship between the environment and human and economic activity. It presents detailed statistics describing (i) the size of Canada's natural resource stocks and their contribution to national wealth; (ii) the extraction of these same resources and their disposition among businesses, households, governments and the rest of the world; (iii) the generation of various wastes (liquid, solid and gaseous) by industries, households and governments and the management of these wastes; and (iv) the expenditures made by businesses, households and governments for the purposes of protecting the environment. The accounts are, to the greatest extent possible, compatible with the Canadian System of Macroeconomic

Accounts (CSMA). They were developed in response to the need to better monitor the relationship between economic activity and the environment.

A.2.1.43 Statistics Canada's Census of Environment Program reports on ecosystems in Canada, providing information to help Canadians make evidence-based decisions to protect and enhance the environment. It follows the internationally accepted environmental economic standard for producing information on ecosystems' extent, their condition and the services they provide. Ecosystem extent accounts organize data on the size and location of different types of ecosystems, and their change over time. Ocean and coastal areas are classified by ecosystem type, including seagrass meadows, kelp forests, coral and sponge ecosystems, and by substrate type and ocean water layer, for each marine bioregion of Canada.

Table A.2: Structure of Extent Accounts for Ocean and Coastal Areas

Geography[1]	Ocean and coastal ecosystems	2020
		Square kilometres
Canada, ocean and coastal areas	Surface epipelagic (0 to 50 m), ocean water layer[2]	5,758,773
	Lower epipelagic (50 to 200 m), ocean water layer[2]	4,937,581
	Mesopelagic (200 to 1,000 m), ocean water layer[2]	3,067,901
	Bathypelagic (1,000 to 4,000 m), ocean water layer[2]	1,608,281
	Abyssalpelagic (deeper than 4,000 m), ocean water layer[2]	122,533
	Coastal and ocean floor ecosystems[3]	5,760,753
	Salt marsh	1,017
	Seagrass meadow	1,326
	Salt marsh seagrass ecotone	97
	Kelp forest	597
	Cold-water coral and sponge ecosystems	293,346
	Soft substrate	117,113
	Mixed substrate	53,658
	Hard substrate	116,086
	Unassigned marine area	5,177,512
Pacific Ocean - Canada, ocean and coastal areas	Surface epipelagic (0 to 50 m), ocean water layer[2]	453,724
	Lower epipelagic (50 to 200 m), ocean water layer[2]	423,977
	Mesopelagic (200 to 1,000 m), ocean water layer[2]	369,358
	Bathypelagic (1,000 to 4,000 m), ocean water layer[2]	336,824
	Abyssalpelagic (deeper than 4,000 m), ocean water layer[2]	0
	Coastal and ocean floor ecosystems[3]	454,647
	Salt marsh	641
	Seagrass meadow	618
	Salt marsh seagrass ecotone	97
	Kelp forest	597
	Cold-water coral and sponge ecosystems	2,832
	Soft substrate	48,688
	Mixed substrate	22,125
	Hard substrate	31,406
	Unassigned marine area	347,643

Table A.2: Structure of Extent Accounts for Ocean and Coastal Areas (Contd.)

Arctic Ocean - Canada, ocean and coastal areas	Surface epipelagic (0 to 50 m), ocean water layer[2]	3,597,202
	Lower epipelagic (50 to 200 m), ocean water layer[2]	2,946,593
	Mesopelagic (200 to 1,000 m), ocean water layer[2]	1,736,803
	Bathypelagic (1,000 to 4,000 m), ocean water layer[2]	701,810
	Abyssalpelagic (deeper than 4,000 m), ocean water layer[2]	0
	Coastal and ocean floor ecosystems[3]	3,597,226
	Salt marsh	..
	Seagrass meadow	277
	Salt marsh seagrass ecotone	..
	Kelp forest	..
	Cold-water coral and sponge ecosystems	56,281
	Soft substrate	..
	Mixed substrate	..
	Hard substrate	..
	Unassigned marine area	3,540,668
Atlantic Ocean - Canada, ocean and coastal areas	Surface epipelagic (0 to 50 m), ocean water layer[2]	1,707,847
	Lower epipelagic (50 to 200 m), ocean water layer[2]	1,567,011
	Mesopelagic (200 to 1,000 m), ocean water layer[2]	961,739
	Bathypelagic (1,000 to 4,000 m), ocean water layer[2]	569,648
	Abyssalpelagic (deeper than 4,000 m), ocean water layer[2]	122,533
	Coastal and ocean floor ecosystems[3]	1,708,881
	Salt marsh	376
	Seagrass meadow	431
	Salt marsh seagrass ecotone	..
	Kelp forest	..
	Cold-water coral and sponge ecosystems	234,234
	Soft substrate	68,425
	Mixed substrate	31,533
	Hard substrate	84,680
	Unassigned marine area	1,289,201

A.2.1.44 Salt marshes are important coastal wetlands that provide benefits, such as global climate regulation, coastal protection against storms and flooding, and provision of habitat for many species of plants and animals. To measure the ecosystem benefits from salt marshes, Statistics Canada is releasing an accounting framework for measuring salt marsh extent, condition and ecosystem services. These accounts are a part of Statistics Canada's new Census of Environment program, which will eventually report on all ecosystems in Canada.

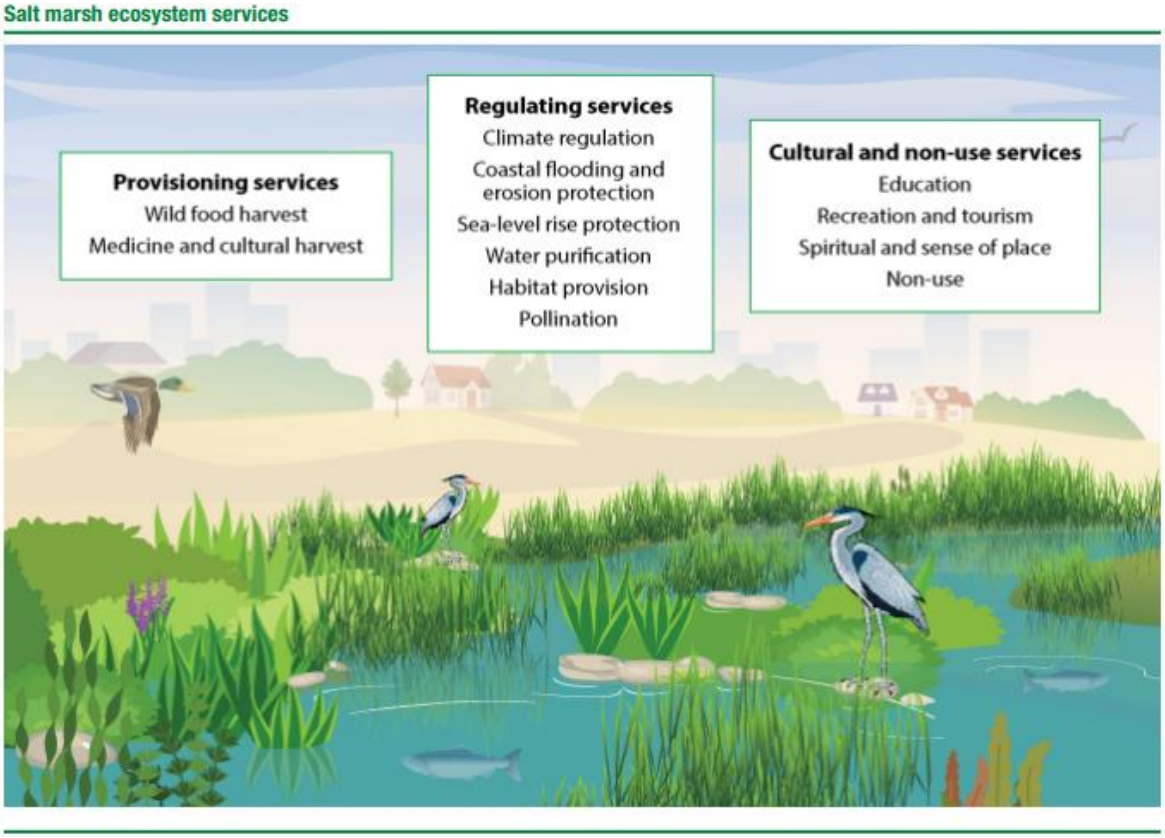
Table -A.3: Proposed Variables for Salt Marsh Condition Accounts

Proposed variables for salt marsh condition accounts, grouped by SEEA–EA ecosystem condition typology

Group	Class	Variable
A: Abiotic ecosystem characteristics	A1: Physical state	Marsh surface elevation change (accretion, erosion, water channels, depressions)
		Tidal hydrology
	A2: Chemical state	Salinity
		Pollution
B: Biotic ecosystem characteristics	B1: Compositional state	Vegetation community patterns (dominant and invasive species, zonation)
		Animal biodiversity (native and invasive species)
	B2: Structural state	Vegetation structure (stem density, biomass)
	B3: Functional state	Disturbance events (wrack, ice, herbivory)
C: Landscape level characteristics	C1: Landscape and seascape characteristics	Tidal barriers and restrictions
		Surrounding land uses
		Landscape configuration

A.2.1.45 Ecosystem services are broadly defined as the ecosystem contributions to the benefits that humans gain from the natural environment. Ecosystems with healthier condition provide more services than ecosystems which are in poor condition or degraded. The SEEA–EA framework categorizes ecosystem services into three main groups: provisioning, regulating and maintenance, and cultural (United Nations et al., 2021). Services are provided by ecosystems have beneficiaries belonging to a local or global population as well as another ecosystem. Services are final services if humans benefit from them, and intermediate or supporting if another ecosystem or species benefits from them. Ecosystem services provided by salt marshes are presented in the following figure.

Figure A.1: Salt Marsh Ecosystem Services



Source: Valuing the Salt Marsh Ecosystem: Developing Ecosystem Accounts, Statistics Canada

A.2.1.46 A discussion of ecosystem services would not be complete without mentioning services that some may not see as benefits. These few disservices tend to be only perceived as negative at the local level but support the regional and global services discussed above. First, as large areas of salt marshes are flooded regularly by tides and contain decomposing plant matter, oxygen levels in soils are low. This can lead to bacteria build up, particularly in marshes with low levels of tidal flushing, which can cause a sulfurous rotten-egg smell (Friess et al., 2021). This odor may be unpleasant to visitors or local residents. However, this is not commonly reported and this same process allows salt marshes to store carbon, ultimately reducing greenhouse gas concentrations in the atmosphere. Second, small pockets of water in salt marshes may provide breeding habitat for mosquitoes, which could be a nuisance for the local population (Friess, et al., 2021). Mosquitoes, however, are an important part of the food chain as a food source for birds, fish and other insects. Mosquitoes may also provide some pollination services, depending on the local floral community (Peach & Gries, 2016). Methods of mosquito control when applied to marshes (altering hydrology or spraying pesticides) could impact the entire insect community of the marsh and thus a number of ecosystem services (Rochlin et al., 2011). As ecosystem

disservices are not included in the SEEA–EA accounts, metrics for these two disservices are not proposed.

Table A.3: Ecosystem Services Logic Chain

Ecosystem services logic chain

Service type	Service	Factors determining supply		Factors determining use
		Ecological	Societal	
Provisioning	Wild food harvest: Plants	Ecosystem condition; climate; hydrology	Ecosystem management; harvesting practices	Local demand
	Wild food harvest: Fish	Panne structure; hydrology; local biomass of fish populations; chemical state of water	Ecosystem and stock management; harvesting practices	Local demand
	Medicinal; cultural; other	Ecosystem condition; climate; hydrology	Ecosystem management; harvesting practices	Local demand
Regulating	Climate regulation	Structural state of marsh; sediment supply and depth; vegetation structure; atmospheric carbon concentrations	Ecosystem management; greenhouse gas emissions	Vulnerability to climate change
	Coastal flooding protection	Vegetation extent and structure; marsh structure; local tide and storm conditions	Ecosystem management	Areas of economic value at risk of flooding; Extent of other flood barriers (e.g. dykes)
	Coastal erosion protection	Marsh structural state; sediment depth; vegetation extent and structure	Ecosystem management	Areas of economic value; infrastructure; buildings and population in proximity to coast
	Sea-level rise protection	Marsh surface change rate (accretion, erosion), sediment availability	Ecosystem management	Areas of economic value; infrastructure; buildings and population in area at lower elevation than expected sea-level rise
Intermediate regulating	Water purification	Vegetation structure; soil depth; condition of soil	Ecosystem management; location, type and quantity of released pollutants	Location, type and volume of pollution emitted
	Habitat provision: Fish nursery	Ecosystem condition; panne structure; hydrology; biodiversity; presence of invasive species	Ecosystem and stock management and protection	Demand for biomass of species depending on the nursery habitat
	Habitat provision: Terrestrial	Ecosystem condition; local environmental conditions; presence of invasive species	Ecosystem management and protection	Other ecosystems demand for pest control; biomass; and functional requirements reliant on biodiversity
	Pollination	Ecosystem condition; pollinator abundance; vegetation types	Ecosystem management and protection	Location of crops benefitting from wild pollination
Cultural and non-use	Education	Extent; condition; structural state; landscape/ seascape characteristics	Site access; ecosystem management	Education policy; research funding
	Recreation and tourism	Extent; condition; landscape/seascape characteristics	Site access; ecosystem management	Accessibility
	Spiritual and sense of place	Extent; condition	Ecosystem management; cultural practices	Local population count; accessibility
	Non-use	Extent; condition; services	Ecosystem/site management; societal connection to salt marsh	Knowledge and awareness of ecosystem and its services

Table A.4: Ecosystem Services Logic Chain (Contd.)

Service type	Metrics or proxies for service quantification	Benefits	Main users and beneficiaries
Provisioning	Harvested biomass; sales data, foraging behaviour	Harvested products	Local population; restaurants and other businesses
	Harvested biomass; foraging behaviour	Harvested products	Recreational fishers; Local population and restaurants
	Harvested biomass; foraging behaviour	Harvested products	Local population
Regulating	Estimated carbon sequestration and carbon storage by area	Atmospheric greenhouse gas reduction leading to less climate change and fewer adverse effects	Global population, businesses and government
	Indicator using marsh width and length, wind speed, vegetation index, and topography	Decrease in storm surge damage and costs	Local population and businesses; infrastructure
	Indicator using marsh length and width, soil type and vegetation index	Lowers risk of flooding and removal of property; infrastructure and agriculture in coastal area	Local population and businesses; infrastructure
	Marsh surface change rate and sediment availability	Decreased future flood risk and need for expensive protective infrastructure; reduction in damage from sea-level rise	Local population and businesses; infrastructure
Intermediate regulating	Indicator using vegetation index, soil type and depth	Improved water quality in surrounding ocean and agricultural lands	Other ecosystems and beneficiaries of the services they provide
	Fishery recruitment biomass adjusted by percentage of nursery habitat area that is salt marsh	Continuing supply of provisioning ecosystem services in ocean	Industry and individual fisherpeople; indirect household consumption
	Count of species individuals in area; biodiversity index of key species using marsh	Continuing supply of pest control; supports other ecosystem services; intrinsic value of ecosystem	Local agricultural and built-up land (insect control by birds); other ecosystems
	Area of crops pollinated by wild pollinators using salt marsh	Reduced need for alternative forms of pollination, including paid pollination services	Local agricultural land (commercial, subsistence and household); indirect household consumption
Cultural and non-use	Indicator including count of salt marsh researchers, research grants, published papers and student theses and count of maintained salt marsh walks and education programs	Intellectual development, advancement of knowledge and understanding	Education and research organizations; general population especially students; industry
	Visitor numbers; recreation potential based on accessibility; citizen science and social media post counts	Physical and mental health of users	Local population; recreational organizations; tourists and tourism companies
	Condition indicator, potential supply based on accessibility	Sense of well-being; continued cultural practices; spiritual health of users	Local population
	Percentage of salt marsh area that is protected or conserved; count of species protected in Canada that use salt marsh	Sense of well-being	Global population

Norway

A.2.1.47 Norway's ocean interests are related to value creation, clean and healthy oceans, and the sustainable use of ocean resources, as outlined by Norway's Ocean Strategy 'New Growth, Proud History' (2017)[77]. A subsequent update of the Ocean Strategy in 2019 further emphasized Blue Opportunities, identifying future priorities

[77] https://www.regjeringen.no/en/dokumenter/the-governments-commitment-to-the-ocean-and-ocean-industries/id2857445/?ch=2

in skills and digitalisation, climate change, and green shipping. More specifically, the Norwegian government has committed to protect blue vegetation and blue forests; and has formed an action plan for green shipping to halve emissions by 2030, and promote sustainability and blue economy as a key area of Norway's Arctic policy. To accomplish these strategic goals, the government has further committed to establish and maintain an integrated ecosystem-based management for ocean-based industries and contribute to international developments in sustainable ocean management.

A.2.1.48 A priority of Norway is the development of future-oriented ocean industries, considering the established/ emerging ocean industries, supporting growth through a regulatory framework and policy instruments. Sectors of interest include, inter alia, oil and gas, shipping, seafood, and tourism. Within the context of Norway, several sectors are exclusively marine, and disaggregation is unnecessary (e.g. mining and oil extraction). Therefore, data for many economic activities measured within the national accounts may be readily used towards ocean economy accounting.

A.2.1.49 Norway has a long history of environmental accounting towards sustainability. Norway's priority in addressing climate change is focused in part on 'blue forests', recognising that marine ecosystems play a key role in sequestering carbon. The Norwegian Government seeks to protect 'blue' vegetation to maintain carbon storage and to safeguard marine biodiversity. A pilot study on Kelp environmental accounting was recently performed, detailing the loss of kelp between 1970 and 2010.

A.2.1.50 In order to make visible the size and structure of the mainland industries linked to the ocean, the first Norwegian satellite accounts was published in the spring 2022 based on the framework presented in the OECD's Blueprint for improved measurement of the international ocean economy: An exploration of satellite account for ocean economic activity (OECD 2021). The satellite ocean account was co-financed by the Research Council of Norway and Statistics Norway (SSB). It is a part of the fourth phase of the OECD project "Future of the Ocean Economy" in which Norway has participated since the beginning in 2013.The satellite ocean accounts are based on figures and concepts from the national accounts but that are processed and reclassified. The figures in the satellite accounts for the ocean are thus consistent with the national accounts, but the presentation is more detailed.

A.2.1.51 Statistics Norway is participating in the MAREA Research Project (MARine Ecosystem Accounting), which is exploring the potential for regional marine

ecosystem accounting for the Oslo Fjord. The ecosystem condition of the Oslo Fjord, including the coastal areas, has degraded due to several pressure factors such as polluting emissions including nitrates, overharvesting, destruction of underwater habitats, invasive species, and real estate development. The Government wishes to improve the condition of the Oslo Fjord and has made an integrated plan that describes measures that can be used. MAREA explores how ecosystem accounting can contribute to decision-making in the context of the integrated plan for the Oslo Fjord by taking advantage of science-local planning collaborations. The project also aims to find potential solutions for handling the uncertainty of monetary value estimates when these estimates are used for accounting purposes. The project aims to contribute to ecosystem accounting research by producing results that can be transferred to other settings. The MAREA project (2021-2025) is being led by the Norwegian Institute of Water Research in collaboration with the Norwegian Institute of Nature Research.

Fiji Islands

A.2.1.52 Ocean economy is fundamental to Fiji's national economy, and for supporting the livelihoods of the Fijian people. However, until recently, its value to the real economy and the society remains less readily realized. The National Ocean Policy (NOP) defines Fiji's agenda and initiatives on the Ocean and its management. It defines Fiji's focus on marine conservation, ocean development and related advocacy. Ocean accounts (OA) are an important tool for evaluating progress towards Fiji's global and domestic ocean commitments. Mangrove ecosystem accounts are compiled and linked to economic activities. Mangroves were selected for this study because of data availability and their economic significance in Fiji as Fiji has one of the highest mangrove coverage in the South Pacific region.

A.2.1.53 The approach to ocean accounting as an integrated statistical framework that supports the commitments of the Fijian Government in ensuring a balance between economic development, environmental conservation, and the maintenance of ecological integrity. As a member country of the High-Level Panel for a Sustainable Ocean Economy, Fiji has committed to several transformations, including the compilation of national ocean accounts. This aligns with several national policies, including strategic and legal frameworks such as:

- the National Ocean Policy (NOP),
- the 5-year and 20-year National Development Plan (that stresses the need for sustainable development and management of Fiji's marine ecosystems),
- the Marine Economy Plan,

- the Fiji National Biodiversity Strategy and Action Plan 2020-2025,
- the Environment Management Act 2005,
- the National Climate Change Policy, and
- the National Action Plan for the Implementation of Agenda 2030 for Sustainable Development.

Table A.5: Overview of the techniques used to record the extent and condition of mangroves

Measurement technique	Units	Pros	Cons
Aerial imagery	Area (m^2, Ha, Km^2)	- Covers large spatial scale	- Potentially low spatial resolution - No associated biodiversity or density data - Significant expertise required to process images.
Satellite imagery	Area (m^2, Ha, Km^2)	- Covers large spatial scale	- Errors produced by classification of cells to mangroves - Significant expertise required to process images.
On-ground surveys	Area, percent cover, density	- Highly accurate - Can obtain biodiversity and density data. - Low training to process	- Limited spatial and temporal coverage.

Table A.6: Measures of the condition (state and pressures) on mangroves ecosystems

Condition	Environmental indicators
State	- Measures of density - Measures of biomass - Measures of Percent cover - Chemical composition - Biodiversity - Growth rate
Pressures	- Tropical cyclones - Land clearing / urbanisation - Eutrophication

A.2.1.54 Mangrove condition: The distribution of mangrove species depends on site-specific environmental (physical), chemical and biological conditions. These conditions are collectively referred to as ecosystem conditions. Generally, ecosystem condition is used to describe the state of an ecosystem, and as such, ecosystem condition is represented in different ways (O'Brien et al., 2016). Physical indicators are related to substrate composition, primary habitat indicators (density, height, biomass), proximity to disturbance factors, or environmental variables (e.g.,

temperature, wave current). Chemical indicators relate to contaminant levels in water, nutrient loads, primary production (chlorophyll), and physicochemical parameters (e.g., salinity, pH). Lastly, biological indicators refer to the biodiversity in the ecosystem, either at the community, individual, or population level (O'Brien et al., 2016).

A.2.1.55 Ocean economy is fundamental to Fiji's national economy, and for supporting the livelihoods of the Fijian people. However, until recently, it is felt that its value to the real economy and the society is under estimated. The National Ocean Policy (NOP) defines Fiji's agenda and initiatives on the Ocean and its management. It defines Fiji's focus on marine conservation, ocean development and related advocacy. The policy framework governs coordinated action towards sustainable use and conservation of Fiji's ocean. It sets to manage 100% of its ocean with 30% declared as marine protected areas by 2030. The NOP also places emphasis on incorporating ocean values into development planning processes and national accounts that supports alignment between ocean management objectives and development strategies.

A.2.1.56 Several initiatives focusing on ocean data integration and analysis have been undertaken in Fiji. Such initiatives include, but not limited to, marine atlas database, identification of marine bioregions and biophysically special unique marine areas, and national marine ecosystem service valuation.

A.2.1.57 Ocean accounts (OA) are an important tool for evaluating progress towards Fiji's global and domestic ocean commitments. Mangrove ecosystem accounts are compiled and linked to economic activities. Mangroves were selected for this study because of data availability and their economic significance in Fiji as Fiji has one of the highest mangrove coverage in the South Pacific region.

A.2.1.58 The approach to ocean accounting as an integrated statistical framework that supports commitments of the Fijian Government in ensuring a balance between economic development, environmental conservation, and the maintenance of ecological integrity.

Australia

A.2.1.59 The WRI Ocean Panel – High level panel for a sustainable ocean economy (Ocean Panel) is an initiative of 16 world leaders who are building momentum for a sustainable ocean economy in which effective protection, sustainable

production and equitable prosperity go hand in hand. As a member of the Ocean Panel, the Australian Government has supported a range of priority actions outlined in the "The Agenda – WRI Ocean Panel". The Australian Government has invested $1.1 million over 2 years (commencing 2021-22) to support planning for the roll out of ocean accounting at a national scale. National ocean accounting provides robust measurement of the blue economy and ecosystem services which supports decision-making in relation to the use and management of ocean resources.

A.2.1.60 The Australian Bureau of Statistics (ABS) and the Department of Climate Change, Energy, the Environment and Water are partnering to develop Australia's first National Ocean Ecosystem Account, which focuses on blue carbon ecosystems and their climate mitigation and resilience benefits. The accounts capture information on mangroves, seagrass and saltmarshes, their location and condition as well as the carbon stocks they sequester and store, and the coastal protection services they offer. The accounts have been published by the Australian Bureau of Statistics (ABS) in two phases:

- Mangrove and seagrass accounts - August 2022
- Saltmarsh accounts with an update to the first phase mangrove and seagrass accounts - November 2022

A.2.1.61 Blue carbon ecosystems are key features of coastal marine environments that provide a range of benefits to communities, including supporting marine industries such as commercial and recreational fishing, filtering sediment and pollutants from tidal water, and protecting coastal infrastructure and housing from storm surge and flood. These ecosystems offer critical habitat for biodiversity, providing essential breeding and nursery grounds for fish and crabs, food for threatened marine species such as turtles and dugongs, and feeding and staging grounds for migratory birds. The first National Ocean Ecosystem Account aims to strengthen decision making about the sustainable use and management of blue carbon ecosystems.

A.2.1.62 The mangrove and seagrass accounts released in August 2022 include:

- the location and condition of Australia's mangrove forests and seagrass meadow
- the number of people living near mangroves who are benefiting from storm surge protection;

- the dollar value of mangrove coastal protection services (sea wall replacement cost)
- the tonnes of carbon stored in seagrass beds and mangroves, considering annual sequestration flows.

A.2.1.63 The saltmarsh account released in November 2022 includes:

- the location of saltmarshes in Australia and various land use types it is located in
- the number of people benefiting from storm surge protection provided by saltmarsh
- the dollar value of replacing saltmarsh coastal protection services with a sea wall
- the tonnes of carbon stored in saltmarsh, considering annual sequestration flows
- intertidal seagrass meadow location.

A.2.1.64 In November 2020, an ocean accounting pilot project was completed for Geographe Marine Park in Commonwealth waters of Western Australia. This was the part of Australia's participation in the High Level Panel for a Sustainable Ocean Economy. The objectives of the ocean accounting pilot project were to:

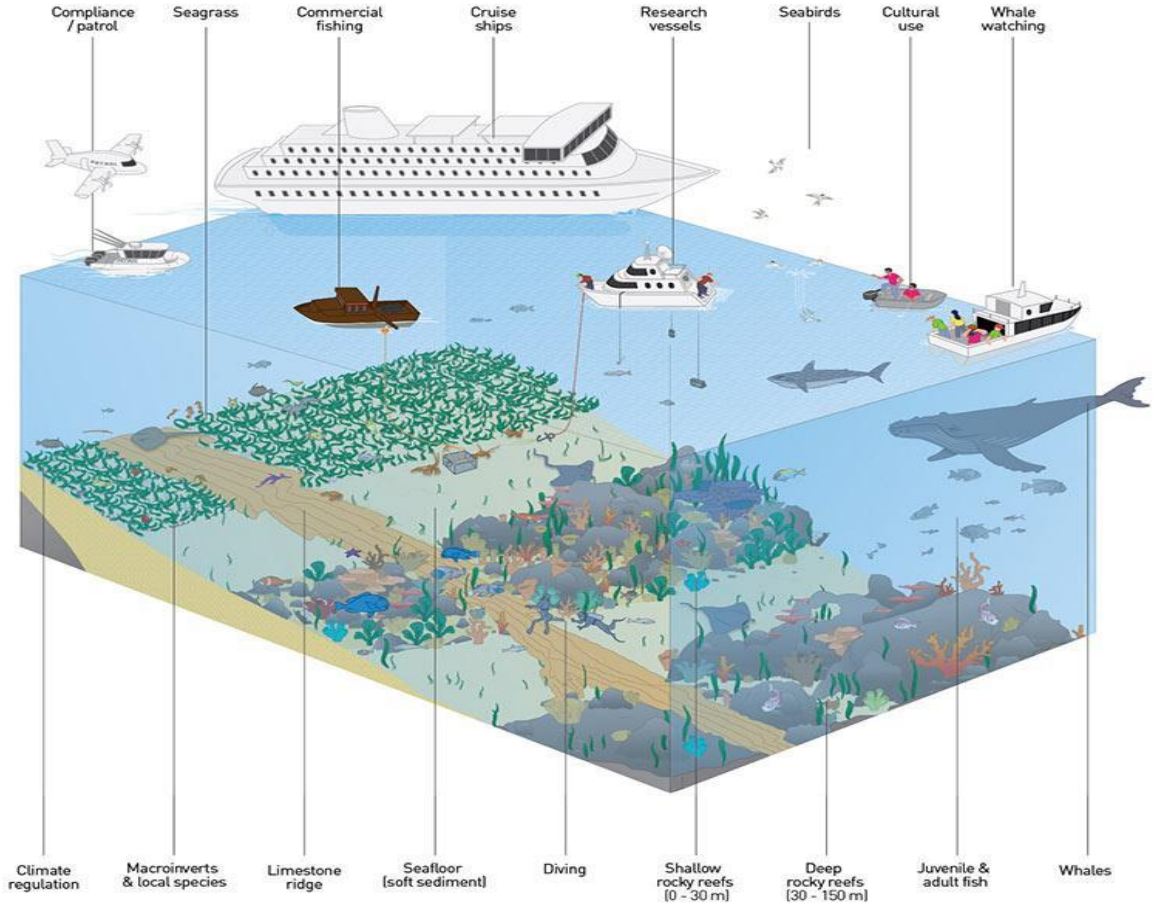
- provide structured environmental, social and economic information to inform ongoing management of the marine park
- improve understanding of how ocean accounts can help us sustainably manage marine resources
- test the Technical Guidance on Ocean Accounting for Sustainable Development in an Australian context.

A.2.1.65 People come to the park for commercial and recreational activities, such as fishing and whale watching. The park is home to many species of fish and other marine animals such as whales. Habitats in the park include extensive seagrass beds, sandy bottoms, rocky reef and kelp. These habitats and species are also classified as 'assets' providing important 'services'. For example, services provided by the park's natural systems include nursery grounds for fish species, benefits to tourism operations, and carbon storage in seagrass beds. Located inshore from Geographe Marine Park are also many coastal assets. These include the WA State-managed Ngari

Capes Marine Park and the iconic Busselton Jetty. These assets add to the local economy and influence activity within Geographe Marine Park, and vice versa.

A.2.1.66 A conceptual model shows the marine park's ecosystems alongside the activities that occur in the area.

Figure A.2: Conceptual model of the Geographe Marine Park and its ecosystems



South Africa

A.2.1.67 South Africa have advanced the ocean accounting efforts by employing remote sensing technologies and spatial analysis to map and assess marine ecosystems and their extent in the pilot area of Table Bay. The pilot study is for the period 2021-2024[78]

[78] https://www.oceanaccounts.org/south-african-ocean-accounts-project/

A.2.1.68 Through stakeholder consultation, Marine Ecosystem Accounting (MEA)[79] was identified and selected as the initial primary accounts to be developed with further expansion to blue carbon accounts (focusing on kelp forests), tourism accounts, and pressures accounts related to tourism, shipping and port infrastructure, wastewater and pollutant effluents (both within and outside of the Marine Protected Area (MPA) regions delineated by both the Table Mountain National Park and the Robben Island MPAs). Importantly, MEA encompasses several different accounts, namely ecosystem extent and condition accounts, and ecosystem services accounts. The project's initial focus was aimed at the first component, extent accounts. Additionally, an integral aspect of the longer-term implementation plan is the development of an ocean accounting toolkit based on experiences gained through these pilot accounts. The following figure presents a stepwise approach for the development of the Marine Ecosystem Accounts.

Figure A.3: Stepwise Approach for the Development of the Marine Ecosystem Accounts

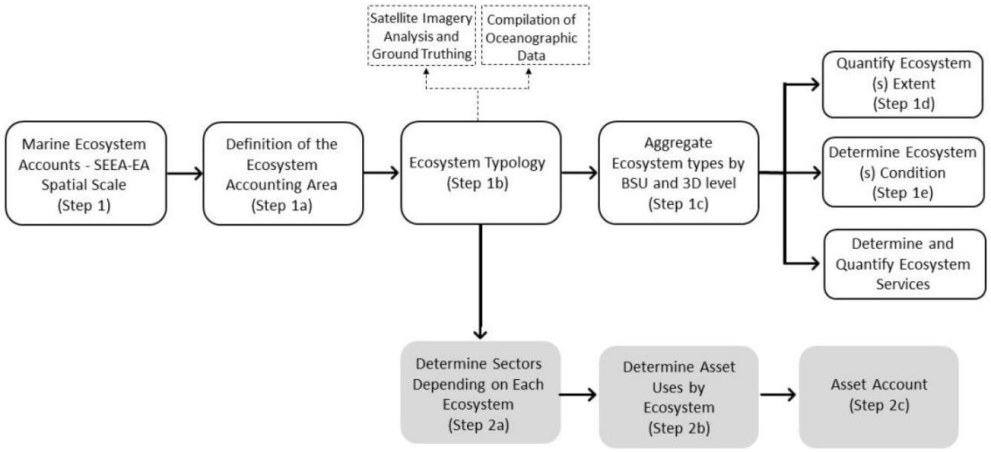


Figure 2. *Stepwise approach for the development of Marine Ecosystem Accounts. Each step is defined by a block (solid line). The dashed blocks represent potential ways of classifying ecosystem types. Grey blocks represent steps linked to the System of Environmental-Economic Accounts – Central Framework (SEEA - CF) component of Environmental accounts. System of Environmental-Economic Accounts – Ecosystem Accounts (SEEA – EA); Basic Spatial Unit (BSU). The typology and extent accounts presented in this study align with the Satellite imagery analyses of Step 1b.*

Source: Marine Ecosystem Accounting, Table Bay, South Africa, GOAP

A.2.1.69 Through the pilot work, typologies and extents of physical features, ecosystems, resource uses, and protected areas have been determined through supervised pixel-based remote sensing and investigations of digital data availability

[79] https://oceanaccounts.atlassian.net/wiki/spaces/WD/pages/953876481/South+Africa+Ocean+Accounts?ref=oceanaccounts.org

for the Table Bay. Also, typologies and extents of physical features has been determined through object-based remote sensing for the Study Area.

A.2.1.70 South Africa provides a prominent early example of ocean accounting, providing lessons and opportunities for using remote sensing to assess the ecosystem's extent. South Africa has also pioneered the inclusion of novel elements such as social, risk and governance accounts within its ocean accounting framework.

A.2.1.71 Despite challenges with water clarity and penetration, the analysis of remote sensed imagery provided considerable advantages for relatively low-cost development of marine ecosystem accounts that once verified, allow for scaling across much broader geographic ranges. Challenges with depth penetration may be overcome by the selection of adequate imagery and mosaicking and appropriate analytical bandwidths.

Mexico

A.2.1.72 Mexico's concerns related to the ocean and its resources include overfishing, illegal fishing, climate change and sea level rise, land-use changes and mismanagement (agricultural runoff), and habitat degradation due to ocean warming. To help address these concerns, Mexico became a member of the High-Level Panel (Ocean Panel) for the Sustainable Ocean Economy. The emphasis behind ocean accounting work under the ongoing national environmental accounting efforts of Mexico stems from the following priorities:

- Increasing the economic benefits of small-scale fisheries (without increasing take),
- Increasing the sustainability of these small-scale fisheries,
- Increasing the sustainable harvest of ocean-based renewable energy sources.

A.2.1.73 Mexico participated in the Natural Capital Accounting and Valuation of Ecosystem Services (NCAVES) project which aims to develop SEEA ecosystem accounts. Specifically, in Mexico, this project developed pilot accounts for the states of Aguascalientes, Colima, and Veracruz and compiled ecosystem extent, condition, and services accounts at the state and national level. The Colima and Veracruz pilot project are particularly relevant to the Ocean Accounts, since both of these states contain coastal geography. These pilots demonstrated the progress in spatial mapping and remote sensing along coastal regions of Mexico and specifically highlighted the need to incorporate ecosystem services and expand mapping efforts to ocean and coastal ecosystems.

A.2.1.74 In addition to nationally directed pilot studies to advance ecosystem accounts, there are numerous sub-national ocean-related pilot studies lead by various non-profit groups. While some of these projects may not apply an accounting approach, each can provide a statistical foundation for ocean accounts. While Mexico has a long history of incorporating ocean-related data (e.g., fisheries) next steps include expanding pilot work to ocean ecosystems to develop extent and condition classifications and to continue to engage non-profits at the subnational level in order to see which data types they are collecting that may be of value to ocean accounting.

Costa Rica

A.2.1.75 Costa Rica's concerns related to management of its ocean capital stem from ongoing signs in the coastal environment of overfishing, coastal runoff pollution (human and cattle waste management), and global climate change (ocean warming and sea level rise) and seeks to manage these issues by building off its history in environmental accounting. Costa Rica has a relatively long but intermittent history of environmental accounting beginning in 1991. In 2014, the Central Bank of Costa Rica (BCCR) adopted the SEEA Framework and began developing two separate accounts (Water and Land Cover/Forest) supported by the Wealth Accounting and the Valuation of Ecosystem Services (WAVES) partnership which later expanded to include Energy and CO_2 emissions in 2016, and ecosystem accounts for carbon sequestration and pineapple crops in 2018.

A.2.1.76 The emphasis behind the creation of these accounts, as they relate to the management of Costa Rica's ocean resources, is driven by the need for a more sustainable management of artisanal, commercial, and aquaculture fishery industries and to ensure continued provision of seafood for the population. These efforts were most recently supported by the release (Feb, 2019) of the Ocean Governance in Costa Rica report, which provides an overview on the legal and institutional framework in ocean affairs and will provide the structure for future spatial planning efforts related to ecosystem account building. National concerns related to the ocean (see 2019 governance report linked above) include decline in fish and invertebrate stocks, improper governance/zoning of fishing regions, climate change, and water pollution.

A.2.1.77 In addition, there are numerous sub-national ocean-related pilot studies lead by various non-profit groups, such as the WAVES partnership. These initial works in terrestrial-based environmental accounting established a framework for the incorporation of other ecosystem-types. Following the International Conference:

environmental accounts towards an Inclusive Blue Economy in March of 2019, the process of developing an aquatic resources account was initiated. Early works of this technical group include engagement with the commercial and artisanal fishery industries. Similarly, in 2019 the International Institute for Environment and Development (IIED) developed a toolkit which provides the framework to mainstream values of small scale fisheries in national accounts.

A.2.1.78 Moving forward, given the close focus on fisheries data, Costa Rica may have a "Fisheries Account" well before they have a total "Ocean Account". However, Costa Rica's 2019 ocean governance report provides invaluable framework to bootstrapping more ocean economy metrics outside fisheries. Ocean Accounts could be adopted as a common framework to begin compiling fisheries data while providing the flexibility to incorporate other, equally important, data-types later in time which are currently lagging in their organization and collection execution under the Costa Rican government.

Chile

A.2.1.79 Chile's national concerns related to the ocean and its resources include overfishing, climate change and habitat loss, overexploitation of ocean-derived minerals and energy resources, and pollution from the energy industry. Chile released an environmental account plan in 2016 as a part of the UN Advancing Natural Capital Accounting (ANCA) project. This plan is titled the **SICAEE: Comprehensive System of Environmental, Ecosystem, and Economic Accounts** (Spanish Acronym for SEEA). The emphasis behind the creation of these accounts, as they relate to the management of Chile's ocean resources, stems from a national directive to place environmental quantification and statistics on ocean activities (fishing) and resources (minerals, water, energy) to further Chile as a leader among Latin American countries in green growth and sustainable development. Chile is also a High-Level Panel (Ocean Panel) member for the Sustainable Ocean Economy.

A.2.1.80 Under the currently adopted SEEA structure, there is no specific distinction of marine/ocean data from overall aquatic/water use classification. Ocean data would be included under Ecosystem Assets: Water Resources and Fishing Resources. Goals and objectives outlined in the most recent SICAEE identify the need to create an information technology system to integrate environmental information. Specifically, achieving these goals is proposed in a 3-year plan (ending in 2021) is divided into two parts: Promoting pilot environmental accounts (including ocean

ecosystems) and developing a public communication system to relay the results of pilot studies and further engage citizens in the development of satellite environmental accounts. Initially listed pilot projects in the 2016 SICAEE did not include an ocean-specific project, however the framework developed by several of these initially proposed pilot projects in the categories of water quality and environmental protection expenditures will lend toward future necessary data-compilation structures for ocean-specific pilot accounts.

A.2.1.81 In addition to nationally directed work to advance ecosystem accounts, there are numerous ocean-related pilot studies lead by various non-profit groups or outside international organizations. Collectively efforts by the Chilean government and internationally supportive organizations have helped shape Chile's 2030 National Biodiversity Strategy (in accordance specifically with the UN FAO National Biodiversity Strategy; see diagnostic for specific targets). Ocean Accounting can be presented as a tool to monitor and track progress toward achieving these targets while balancing environmental sustainability and economic viability.

United States of America

A.2.1.82 The US's concerns related to ocean resource management include ocean pollution (plastics, pesticides, and other agricultural products), ocean acidification, overfishing, mismanagement of ocean resources (energy and minerals), sea level rise and other climate change impacts, increasing storm frequency, and population growth. Traditionally, the development of ocean accounting approaches to manage these issues has occurred in the academic sector but has recently gained practical application in government managed ocean satellite accounts.

A.2.1.83 The US uses the SNA as a general accounting framework and has only recently begun testing the use of SEEA Ecosystems. Although the US has not formally adopted the SEEA, the US already provides substantial information on the economic activity related to the ocean in their national accounts. These data were first utilized in the academic sector rather than through national mandates for environmental accounting. Academic exercises conducted and published by Dr Colgan created the framework to compile national datasets which measure economic activity related to the oceans and great lakes of the US. These approaches were revisited more recently and were the basis of the first nationally-directed projects that can be considered "ocean ecosystem accounts".

A.2.1.84 Specifically, in 2019, these approaches were adopted by the Bureau of Economic Analysis (BEA) in partnership with the National Oceanic and Atmospheric Administrations (NOAA) to create the Ocean Economy Satellite Account (OESA), who's mandate is to develop prototype statistics to measure the ocean's contribution to US GDP. These prototype statistics collaboratively developed by BEA and NOAA provide the opportunity for stakeholders to help refine the methodology and approaches of ocean-related economic and environmental data gathering.

A.2.1.85 Thus, OESA has begun pilot studies and data gathering divided among 10 subgroups. Moving forward, suggestions include expanding these categories to include more ocean sectors (e.g., Blue Technology), encouraging feedback to BEA by account users, and a goal to develop web-based tools (i.e., online dashboarding) to begin to interpret and communicate data collected by the OESA. Additional priorities include the development of prototype statistics to value non-market sectors such as recreational activities and the environment, which will require the development of more pilot studies under the OESA in collaboration with the National Ocean Economics Program (NOEP). Although not officially a GOAP member at the national level, individuals developing the US-based ocean accounts are GOAP collaborators and it is expected their work will continue in parallel with that of GOAP members, providing channels to share progress.

Jamaica

A.2.1.86 Jamaica has not adopted the SEEA but has made several efforts toward the valuation of marine natural capital, creation of blue economy satellite accounts, and joining the High-Level Panel (Ocean Panel) for the Sustainable Ocean Economy over the last decade. These include efforts directed by the World Bank Group and other NGOs to evaluate the marine capital and blue economy of the greater Caribbean Region and more, recently (2019) at the national level by the Jamaican government (lead by STATIN).

A.2.1.87 At the Caribbean regional level, the World Bank Group 2016 report "Toward a Blue Economy: A Promise for Sustainable Growth in the Caribbean"for sustainable growth in the Caribbean reported that the ocean economy represents more than 17% of the region's GDP and identified that in order to sustain or increase this contribution the following issues need to be addressed: growing population, seafood demand, increased shipping traffic, coastal development, and land-based pollution.

A.2.1.88 At the Jamaican national level, the Jamaican government has created satellite tourism and fisheries accounts, as these two industries have been identified as the main focal areas for developing a Blue Economy and contribute to 10% of GDP. Moving forward, priorities outlined by the STATIN includes further disaggregation of satellite accounts based on the following industries already outlined in Jamaica's SNA which contribute to the Blue Economy: Fishing (Aquaculture + Fisheries), Transport (Storage + Communication), Arts/Recreation, and Manufacturing (Seafood Processing and Energy). Examples of specific case studies to advance these priorities and strategies include the mapping of coastal protection benefits of coral reefs and mangroves along the Jamaican coastline, led by the Nature Conservancy and World Bank Group and the valuation of Jamaica's coastal capital by the World Resources Institute.

A.2.1.89 It is strongly recommended that efforts to increase the capture and use of the ocean's resources for economic gains are accompanied by improvements in the statistical system to monitor and evaluate the resulting impacts on national output and supply of other productive sectors. This does not imply pursuing new activities or industries but rather increasing the sustainability and efficiency of pre-existing marine-related industries. Once this is complete, then Jamaica can better estimate trade-offs associated with investing in new industries (e.g., marine renewable energy and marine aquaculture).

Portugal

A.2.1.90 Portugal's priority actions for the sea include the sustainable and efficient use of ocean resources, in addition to other thematic domains such as competitiveness and internationalization, social inclusion and employment, and human capital.

A.2.1.91 Portugal's National Ocean Strategy (ENM, 2013-2020), a component of the Portugal 2020 partnership agreement with the European Commission, calls for sustained growth, guided by the European Commission's vision for 'Blue Growth'. The strategic plan focuses on three 'Action axes', concerning innovation and research, exploration and use of ocean resources and the preservation of ocean environments. These actions encompass strategic goals, including understanding and monitoring resources and promoting and conserving the environment and marine biodiversity. For living resources, goals include promoting sustainable fishing, developing aquaculture in line with regional development and supporting the development of a marine biotechnology industry. Goals related to non-living resources include exploration of seabed mining and developing offshore marine energy.

A.2.1.92 Portugal is an international leader in the implementation and maintenance of an ocean economy satellite account and is the model for many accounts under development. Portugal maintains a complete set of production, expenditure, and income accounts able to produce a set of balanced national aggregates for the ocean economy. The ocean economy satellite account considers 65 different products and services, capturing traditional industries (ports, shipping, and fisheries), in addition to recreational, sports, culture and tourism-related activities. The country further maintains a tourism satellite account, which distinguishes the contribution of ocean-related products and services (including state spending on advertising and imputed rents from second homes on the coast) that contribute to the economy.

A.2.1.93 One of the challenges recognized by Portugal in implementing their strategic plan is the overlapping responsibilities of administrative departments and agencies, which limit the speed in implementation, transparency in decision making and accountability of monitoring and control efforts. This was addressed in part by Portugal's Law no. 17/2014/April 10, which established the legal basis for Portugal's policy on marine spatial planning and management of the national maritime space.

Netherlands

A.2.1.94 The Netherland's priority actions for the Dutch North Sea include the conservation and recovery of marine ecosystems, promoting 'blue growth' opportunities, managing flood risk and improvement of water quality.

A.2.1.95 The Dutch area of the North Sea is one of the most intensely used marine areas in the world and home to Europe's largest port. As in other North Sea coastal states, the Netherlands has emphasised the need for integrated spatial planning due to new uses requiring ocean space, such as offshore wind farms and marine protected areas. Further, considerable growth is forecasted for mineral extraction, water sport recreation, and possibly mariculture. The Dutch government is also concerned by the impacts of climate-change and sea level rise, which threaten its ports and coastal infrastructure. To combat greenhouse gas emissions, the Netherlands has committed to a 'Green Deal' to substantially reduce emission by the shipping sector, aiming for a 40% decrease by 2030.

A.2.1.96 In the long-term vision of the North Sea 2050 Spatial Agenda, with 2021 policy targets outlined in the National Water Plan, there is a specific focus on energy transition, where the Netherlands aims to have space for operational capacity of 4,450

MW of wind energy at sea by 2023. There is also a focus on sustainable fisheries, in meeting commitments made to the EU's Common Fisheries Policy (CFP) and balancing the requirement of shipping with emerging activities (e.g. marine protected areas, seabed mining and offshore wind farms).

A.2.1.97 To support integrated decision making, Statistics Netherlands released natural capital accounts of the North Sea, based on SEEA-EEA physical accounts. Ecosystem extents were based on water depth, water count stratification and sediment types. Condition accounts were informed by indicators of 'Good Environmental Status' (GES) defined by the European Marine Strategy Framework Directive. The Natural Capital Accounts further consisted of physical supply and use tables of selected biotic and abiotic ecosystem services relevant to the North Sea and Dutch continental shelf (marine fishing, extraction of sand and gravel, extraction of oil, provision of wind, provision of space and nature-related tourism and recreation). Ecosystem services related to recreation focused on beach tourism and coastal hiking were supported by Tourism Satellite Accounts (Statistics Netherlands).

A.2.1.98 The recent publication includes 'SEEA Ocean Ecosystem Accounting for the Dutch North Sea: towards a first full implementation' represents a pioneering application of the SEEA Ecosystem Accounting framework to marine environments. It offers detailed insights into marine ecosystems' extent, condition and services, alongside the pressures they face, and emphasizes the integration of existing environmental data sets within a structured accounting format, promoting the use of these accounts in policy-making and sustainable management of the marine resources.

A.2.1.99 For future works, Statistics Netherlands is considering the development of Monetary Supply and Use tables for marine ecosystem services, with terrestrial tables at national and regional scales produced in 2020.

France

A.2.1.100 France's long-term strategy for its seas and coastlines involves four 'complementary and inseparable' objectives, namely ecological transition [towards sustainable development], development of a sustainable blue economy, good environmental status of the marine environment and France's influence. Data from the maritime and coastal economy is estimated to support over 460,000 jobs and generate a value added of EUR 30 billion (1.5% of France's GDP), and further recognised the potential of maritime activities to stimulate further growth into the future.

A.2.1.101 In support of these priorities, France released the National Strategy for the Sea and Coast (Stratégie nationale pour la mer et le littoral, SNML) a reference document for the protection of marine environments and integrated management of the sea and coast. The SNML provides guidance and interpretation of the National Strategy for the Ecological Transition to Sustainable Development, the National Research Strategy and the National Biodiversity Strategy within the context of the sea and coastline. The SNML emphasises the need to address pressures related to the impacts of climate change (including loss of biodiversity and increasing environmental health risks), urbanisation and coastal erosion, and their subsequent impacts on the economy and social wellbeing. To mitigate pressures and monitor the state of the environment, the SNML lists 26 priority actions, including defining relevant maritime policy monitoring indicators.

A.2.1.102 In support of indicator production, France has a developed ecosystem monitoring system, resulting from the Marine Strategy Framework and Water directives, although it has yet to develop natural capital accounts. L'Institut national de la statistique et des études économiques (INSEE) performed a pilot study examining the contribution of the maritime economy to society. The report assessed the maritime economy of Provence-Alpes- Côte d'Azur (SE France), examining ocean-related sectors.

A.2.1.103 With regards to an accounting framework, the Ministry for Ecological Transition has committed to the maintenance of satellite accounts in line with SEEA. France currently maintains or is developing energy, land, subsoil assets, and non-cultivated bio and water resources. In addition, the Ministry is exploring methods to estimate ecological damage (degradation) and its reparation. With regards to ecosystem services, current efforts are focused on reviewing ecosystem condition, associated ecosystem service values and developing valuation methodologies for decision support.

A.2.1.104 In France under the project 'MAIA' (Mapping and Assessment for Integrated Ecosystem Accounting)[80], the following accounts are planned to be developed; some of which pertains to the Oceans/marine sector. Ecosystem asset account in monetary terms using 'unpaid ecological cost account' has been applied to the marine ecosystems in France.

[80] https://maiaportal.eu/storage/app/media/MAIA_FR_Factsheet_Final.pdf

Figure A.4: Pilot Accounts under development: Summary Table of Accounts

Account		Ecosystem Types / Ecosystem Services	Link to research
Accounts for ecosystem assets	Ecosystem extent account	**Marine ecosystems***	Comte et al., 2020
	Ecosystem condition account	**Marine ecosystems***	Comte et al., 2020
	Ecosystem monetary asset account	**Marine ecosystems***	Comte et al., 2020
		Forest ecosystems*	CGDD, 2018
Accounts for ecosystem services	Ecosystem services supply and use table - physical terms		
	Ecosystem services supply and use table - monetary terms	Cultural ES	Martin et al., 2018
Thematic accounts			

Scale	State of development
National	Finished
Regional	Ongoing
Local	None ongoing or published
*Highlighted in the fact sheet	

United Kingdom

A.2.1.105 The United Kingdom (UK), in recognising the importance of the environment and biodiversity to society and the economy, has committed for a net gain in healthy, well-functioning ecosystems and ecologically coherent protected area networks.

A.2.1.106 In UK, several frameworks and policy reform have been implemented in order to navigate the departure from the previously established framework around marine environmental law and governance, for instance the release of the UK Government's 'A Green Future: Our 25 Year Plan to Improve the Environment (25YEP)', the advent of a new UK Marine Strategy, a Fisheries Bill, and an Environment Bill, introduced to UK parliament in January 2020. The general ambition of the expected legislation is noted as 'the improvement and restoration of the environment and better outcomes for fish stocks, ecosystem health, livelihoods, human health and wellbeing'. Of note, the key UK framework for marine management retains alignment with achieving 'Good Environmental Status' (GES) in marine habitats as defined in the European Commission's Marine Strategy Framework Directive. In support of achieving GES, integrated decision making and sustainable development within the marine space, the UK released the Marine Policy Statement, the policy framework for the marine planning system.

A.2.1.107 The UK's natural capital accounts include marine examples through wild fish catch and recreation, although marine and coastal habitats were excluded from the carbon accounts. In terms of Ocean-related ecosystem accounts, the UK provided exploratory monetary accounts for carbon sequestration and recreation, fish

(marine only), and sea defence and air quality regulation (coastal margin study only). Saltmarsh also featured in the marine scoping study, together with offshore sediments in two depth ranges, maerl beds, and a general marine category. The marine study also considered the role of the water column in terms of calculating the value of the North Sea carbon pump to carbon sequestration.

Columbia

A pilot project "Scientific Research Towards the Generation of Information and Knowledge of Marine and Coastal Zones of National Interest" was conducted by the Ministry of Environment and Sustainable Development and The Institute of Marine and Coastal Research from 2019 to 2022 in Columbia[81]. Under the project, the first account of marine and coastal ecosystems developed in Colombia at the Cienaga Grande de Santa Marta following the SEEA EA framework. Accounts for extent and condition of ecosystems, biophysical and monetary flows of climate regulation and fishing supply and the monetary account of ecosystem assets have been developed. Condition accounts for Mangrove and Lagoons are considered and services such as wild fish catch, aquatic biomass provisioning and Carbon Sequestration have been considered.

Guatemala

In 2019, the WAVES program in Guatemala was completed[82]. The WAVES partnership has enabled Guatemala to update and publish accounts on forest, fisheries and aquaculture, energy and emissions, ecosystems and environmental-agriculture. Guatemala has a fair share of coastline boundary. Much of its eco-regions are coastal areas. The accounts developed for land-use in eco-regions, also reflect coastal area

[81] Gomez Cardona CJ, Moreno JY, Contreras A, Sanchez-Nuñez DA, Arciniegas Moreno N, Guerrero D, Viloria Maestre EA, Lopez Navarro J (2023) Accounting of marine and coastal ecosystems at the Ramsar Site, Estuarine Delta System of the Magdalena River, Ciénaga Grande de Santa Marta, Colombia. One Ecosystem 8: e98852. https://doi.org/10.3897/oneeco.8.e98852

[82] https://www.wavespartnership.org/sites/waves/files/kc/WAVES%20Annual%20Report%20Nov%2014%202019.pdf

land use[83]. Similarly, other accounts have components of coastal area or ocean related ecosystems.

Grenada

Grenada is one of the Small Islands Developing States (SIDS). Considering that a large portion of their population live along the coast, SIDS would greatly benefit from systematically assessing and recording the condition and services provided by marine and coastal habitats in ecosystem accounts. Through a case study in the Caribbean Island of Grenada, the readiness for marine and coastal accounts has been explored[84]. In Grenada, extent and condition accounts have been developed with the help of spatial datasets for selected ecosystems such as Seagrasses, Mangroves, Coral reefs, Coasts and Beaches, Littoral forests, Shelf sea and Deep sea, following SEEA EA framework.

Bahamas, Trinidad and Tobago & Barbados

As a Small Island Developing State (SIDS), The Bahamas' geographical area is largely covered by water. The Bahamas' geography and climate give it enormous potential in the blue economy, which is an approach that contributes to economic growth, environmental sustainability and healthy marine ecosystems by maximizing the value of ocean, marine and coastal resources. Following the adoption of the National Maritime Policy in 2015, The Commonwealth of the Bahamas is now promoting the Blue Economy for the valorisation of its ocean space and the diversification of its economy[85].

Trinidad and Tobago have always had a prosperous ocean economy. The twin-island State has a land-sea ratio of 1:15 and its Exclusive Economic Zone (EEZ) encompasses approximately 77,502 km2. Marine resources, most notably oil and gas, tourism, shipping, and fisheries contribute significantly to the revenue of the country. This SIDS country has identified the challenges and way forward for moving towards

[83] https://www.wavespartnership.org/sites/waves/files/kc/WAVES_Towards-Natural-Capital-Accounting-in-Guatemala-Synthesis-Report.pdf

[84] Mengo E, Grilli G, Luisetti T, Conejo Watt H, Harper Jones C, Posen P (2022) Marine and coastal accounts for Small Island Developing States: A case study and application in Grenada. One Ecosystem 7: e84865. https://doi.org/10.3897/oneeco.7.e84865

[85] https://www.researchgate.net/publication/368608078_Bahamas_Strategy_for_Blue_Economy_Activities_Final_version

sustainable Blue Economy by highlighting contribution of various marine and coastal ecosystems[86].

The economy of Barbados is highly dependent on the marine and coastal environment and the activities and resources it supports. Like many Caribbean islands, Barbados is exploring opportunities to diversify and strengthen its economy through inter alia strategies linked to the "blue economy" - an evolving development approach centred on creating greater value through sustainable utilisation of ocean resources.

A Scoping Study[87], under the joint UWI-UNDP Think Tank on Public Policy for a Blue Economy, provides information on what areas of the blue economy Barbados is exploiting, those areas that are less well developed and approaches that could be adopted achieve more sustainable utilisation of the marine environment.

Tanzania and Zanzibar

Tanzanian coastal resources are of immense strategic importance to many social and economic sectors such as shipping, fishing, tourism, trade, agriculture, settlements and industrial developments. The Development Partners Group on Blue Economy (the DPG-BE) was formally established in May 2022 with the aim to build a coordinated and integrated development partner response to the Government's targeted efforts on the BE development, within the overarching framework of the National Development Plans of both Zanzibar and Mainland Tanzania[88]. In Tanzania's National Marine Ecosystem Diagnostic Analysis (MEDA)[89] published in 2012, many of the coastal and marine ecosystem and activities have been considered.

Seychelles

The Seychelles Government has played a leading role in promoting the Blue Economy concept, especially on the international scene. It has consistently championed the principles of sustainable development and the protection of biodiversity since the launching of Agenda 21 at the 1992 Rio de Janeiro Earth Summit. Like many other

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[86] https://unesdoc.unesco.org/in/documentViewer.xhtml?v=2.1.196&id=p::usmarcdef_0000375761&file=/in/rest/annotationSVC/DownloadWatermarkedAttachment/attach_import_749175ed-a6bc-4cfd-9e9b-de97f3b47765%3F_%3D375761eng.pdf&locale=en&multi=true&ark=/ark:/48223/pf0000375761/PDF/375761eng.pdf#1153_20%20E%20MSP%20Global%20Technical%20Report%20TS-166-Int-EN.indd%3A.1022004%3A1908

[87] Barbados Blue Economy Scoping Study | United Nations Development Programme (undp.org)

[88] https://tzdpg.or.tz/clusters/blue-economy/#:~:text=Blue%20Economy%20Working%20Group,both%20Zanzibar%20and%20Mainland%20Tanzania.

[89] https://nairobiconvention.org/clearinghouse/node/301

island nations, Seychelles has jurisdiction over a large area of ocean, claiming a vast Exclusive Economic Zone (EEZ) of 1.37 million square kilometres. The country adopted Blue Economy Roadmap in January 2018[90].

Benin, Côte d'Ivoire, Senegal and Togo, Ghana

Cote d'Ivoire has set up a marine initiative to conserve marine ecosystems and biodiversity through the Integrated Management of the Marine and Coastal Area of Abidjan to Assinie (GIAMAA). The initiative's objective is to promote responsible and sustainable utilization of resources while ensuring that ecosystem services continue to be available in the long run, thereby supporting economic growth and the wellbeing of coastal communities[91]. Another initiative is the Marine Turtle Conservation Project (The Small-Scale Initiatives Program, 2014).

In Ghana, the Coastal and Marine Conservation Drive Project has been embarked on to promote local economic development and nature protection and contribute to the achievement of some sustainable development goals 1, 2, 8, and 14, which are to reduce poverty, reduce hunger, provide decent work and economic growth, and life below water (Lighthouse Foundation., 2021). Another initiative in Ghana is the Ecosystem-based approach to Integrated Marine and Coastal Environment Management (EIMCEM). This initiative adopts a marine spatial planning approach that is expected to enable Ghana to use integrated management tools inclusively to reduce excessive human pressures on marine resources for sustainable use (Mami Wata., 2018b).

Togo has an active Early Career Ocean Professional (ECOP) that supports ocean conservation and sustainable development (Early Career Ocean Professional, 2022; Dossavi, 2023). Togo has already developed a marine spatial planning (MSP) roadmap under the MSPGLOBAL2030 initiative to manage its marine resources sustainably[92].

Benin's focus on fisheries, tourism, and aquaculture aligns with its goals of increasing economic growth and reducing poverty. The country has a Community-Based Coastal and Marine Biodiversity Management Project that aims to promote the conservation and responsible utilization of biological diversity of coastal wetlands and marine resources while supporting the livelihood and economic opportunities of the coastal and marine communities (Agence Beninoise pour l'Environnement, 2010). Benin has also embarked on the Integrated Marine and Coastal Zone Management (GIZMaC)

[90] https://www.nairobiconvention.org/seychelles-country-profile/ocean-economy-seychelles/
[91] https://mamiwataproject.org/pilot-projects/pilot-projects-ghana-context/
[92] https://www.mspglobal2030.org/msp-roadmap/msp-around-the-world/africa/togo/

project to promote sustainable management of marine and coastal resources (Mami Wata., 2018c).

Kenya

Most of Kenya's coastal population lives in rural areas and engage primarily in fisheries, agriculture and mining for their livelihoods. The main economic activities in the coastal region are tourism, maritime activities especially port and shipping, agricultural industry, fisheries, agriculture, forestry, and mining. Kenya has an integrated coastal zone management policy paper[93] outlining the framework intended to guide actions and policies related to the use and management of Kenya's coastal zone resources, including their protection and restoration.

Madagascar

Madagascar has established standards to manage the coastal resources and environmental quality through both domestic and international laws. Some of the laws such as Fisheries Act, 1993, Integrated Coastal Zone Management (GIZC), National Environmental Action Plan (PNAE), in 1989 have certain guidelines on protection and conservation of coastal and marine areas.

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93 https://www.nema.go.ke/images/Docs/Legislation%20and%20Policies/ICZM%20Draft%20Policy%20.pdf

Annexure 4.1

Table A.7: Framework for Extent Accounts for Ocean Ecosystems (Tier 2)

S. No.	Ecosystem Extent Parameters	Opening Extent at time (t1)	Additions	Reductions	Closing Extent at time (t2)	Changes over time (t2-t1)
	Mangroves					
1	Tree Cover					
2	Protected Area					
2.1	Marine Parks Area					
2.2	Sanctuary					
2.3	Reserved Forest					
3	Coastal and marine infrastructure Area					
4	Coastal Regulatory Zone					
5	Coastline Length having Mangrove (km)					
6	Fishing Zones Area					
7	Length of Engineered Coastal Barriers					
8	Water Spread Area					
	Coral reefs					
1	Bathymetry					
2	Marine Parks					
3	Other benthic extent					
4	Protected Area					
5	Shoreline Length					
	Seagrass					
1	Coastal and marine infrastructure					
2	Coastal Regulatory Zone					
3	Fishing Zones					
4	Marine Parks					
5	Protected Area					
6	Shoreline Length					
	Estuaries					
1	Shoreline Length					
2	Area Conserved					

S. No.	Ecosystem Extent Parameters	Opening Extent at time (t1)	Additions	Reductions	Closing Extent at time (t2)	Changes over time (t2-t1)
3	Coastal and marine infrastructure					
4	Coastal Regulatory Zone					
5	Marine Parks					
6	Ocean energy assets area					
	Lagoons					
2	Coastal and marine infrastructure					
3	Coastal Regulatory Zone					
4	Dry area					
5	Protected Area					
6	Reserved forest					
8	Sanctuary					
10	Shoreline Length					
11	Water spread area					
	Sandy Coast					
1	Area Conserved					
2	Bathymetry					
3	Coastal and marine infrastructure					
4	Coastal Regulatory Zone					
5	Coastline length					
6	Fishing zones					
7	Marine Parks					
8	Marine Protected Area					
9	Shoreline Length					
10	Territorial Water					
11	Upwelling Areas					
	Coastal Ocean Water					
1	Bathymetry					
2	Coastal and marine infrastructure					
3	Coastal Regulatory Zone					
4	Fishing zones					
5	Marine Protected Area					
6	Open Sea					
7	Territorial Water					

S. No.	Ecosystem Extent Parameters	Opening Extent at time (t1)	Additions	Reductions	Closing Extent at time (t2)	Changes over time (t2-t1)
8	Trawling Area					
9	Upwelling Areas					
	Mudflats					
1	Area Conserved					
2	Bathymetry					
3	Coastal and marine infrastructure					
4	Coastal Regulatory Zone					
5	Coastline length					
6	Fishing zones					
7	Marine Parks					
8	Marine Protected Area					
9	Shoreline Length					
10	Territorial Water					
11	Upwelling Areas					

Annexure 4.2

Table A.8: Framework for the Condition Accounts for different Ocean Ecosystem Types (Tier 2)

S. No	Ecosystem Condition Parameters	Condition at time (t1)	Condition at time (t2)	Changes over time (t2-t1)
Mangroves				
1	Benthic Community			
2	Biodiversity (Crustaceans, Fish, Molluscs, …)			
3	Biological Oxygen Demand			
4	Carbon Dioxide Flux			
5	Chemical Oxygen Demand			
6	Density			
7	Dissolved Inorganic Carbon			
8	Dissolved Oxygen			
9	Distance to Human Settlement			
10	Eutrophication			
11	Freshwater flux			
12	Gross Mangrove Removal			
13	Leaf Area Index			
14	Mean Sea Level			
15	Methane Flux			
16	Nutrients (Ammonia, Nitrate, Nitrite, Phosphate, …)			
17	Odour			
18	Phytoplankton			
19	Primary Productivity Rate			
20	Roughness			
21	Secchi Depth			
22	Sediment deposition rate			
23	Sediment Erosion Rate			
24	Slope			
25	Soil Organic Matter			
26	Soil pH			
27	Suspended Sediment Concentration			
28	Temperature			
29	Tidal regime			

S. No	Ecosystem Condition Parameters	Condition at time (t1)	Condition at time (t2)	Changes over time (t2-t1)
30	Water Colour			
31	Zooplankton			
Coral Reefs				
1	Alkalinity			
2	Aragonite Saturation State			
3	Biodiversity (Fish, other species, …)			
4	Biological Oxygen Demand			
5	Carbon Dioxide Flux			
6	Chemical Oxygen Demand			
7	Concentration of Nutrients (Ammonia, Nitrate, Nitrite, Phosphate, pCO2,…)			
8	Coral abundance (Living/Non-living)			
9	Density			
10	Dissolved Inorganic Carbon			
11	Dissolved Oxygen			
12	Eutrophication			
13	Faecal Coliform			
14	Mean Sea Level			
15	Methane Flux			
16	Phytoplankton			
17	Primary Productivity Rate			
18	Secchi Depth/Transparency			
19	Sediment deposition rate			
20	Sediment Erosion Rate			
21	Suspended Sediment Concentration			
22	Tidal regime			
23	Wave Direction			
24	Wave Height			
Seagrass				
1	Nutrients (Ammonia, Nitrate, Nitrite, Phosphate,			
2	Biological Oxygen Demand			
3	Carbon Dioxide Flux			
4	Chemical Oxygen Demand			

S. No	Ecosystem Condition Parameters	Condition at time (t1)	Condition at time (t2)	Changes over time (t2-t1)
5	Dissolved Inorganic Carbon			
6	Dissolved Oxygen			
7	Eutrophication			
8	Methane Flux			
9	Primary Productivity Rate			
10	Seagrass Density			
11	Secchi Depth			
12	Sediment deposition rate			
13	Sediment Nutrient (Carbon, Nitrogen, …)			
14	Surface Temperature			
15	Suspended Sediment Concentration			
16	Water Colour			
17	Wave Direction			
18	Wave Height			
Estuaries				
1	Acidification			
2	Alkalinity			
3	Benthic Community			
4	Biological Oxygen Demand			
5	Chlorophyll Pigment Conc.			
6	Chemical Oxygen Demand			
7	Dissolved Inorganic Carbon			
8	Eutrophication			
9	Faecal Coliform			
10	Biodiversity (Fish, Other Species…)			
11	Freshwater flux			
12	Mean Sea Level			
13	Methane Flux			
14	Net Accretion Rate			
15	Nutrients (Ammonia, Nitrate, Nitrite, Nitrogen, pCO2, Phosphate, …)			
16	Phytoplankton			
17	Primary Productivity Rate			
18	Mean Sea Level			

S. No	Ecosystem Condition Parameters	Condition at time (t1)	Condition at time (t2)	Changes over time (t2-t1)
19	Secchi Depth			
20	Sediment deposition rate			
21	Sediment Erosion Rate			
22	Suspended Sediment Concentration			
23	Sediment Nutrient (Carbon, Nitrogen, …)			
24	Slope			
25	Tidal regime			
26	Water Colour			
27	Zooplankton			
28	Sea Surface Temperature			
29	Wave Height			
29	Wave Direction			
Lagoon				
1	Acidification			
2	Alkalinity			
3	Benthic Community			
4	Biodiversity (Fauna, Flora, Fish,...)			
5	Biological Oxygen Demand			
6	Carbon Dioxide Flux			
7	Chemical Oxygen Demand			
8	Chlorophyll Pigment Conc.			
9	Density			
10	Dissolved Inorganic Carbon			
11	Eutrophication			
12	Faecal Coliform			
13	Freshwater flux			
14	Mean Sea Level			
15	Methane Flux			
16	Net Accretion Rate			
17	Nutrients (Ammonia, Nitrate, Nitrite, Nitrogen, pCO2, Phosphate,			
18	Phytoplankton			
19	Primary Productivity Rate			
20	Production Rate			

S. No	Ecosystem Condition Parameters	Condition at time (t1)	Condition at time (t2)	Changes over time (t2-t1)
21	Secchi Depth			
22	Sediment deposition rate			
23	Sediment Erosion Rate			
24	Sediment Nutrient (Carbon, Nitrogen, …)			
25	Surface Temperature			
26	Suspended Sediment Concentration			
27	Tidal regime			
28	Wave Height			
29	Wave Direction			
30	Water Colour			
31	Zooplankton			
Sandy Coast				
1	Acidification			
2	Benthic Community			
3	Carbon Dioxide Flux			
4	Chemical Oxygen Demand			
5	Chlorophyll Pigment Conc.			
6	Concentration of Nutrients (Ammonia, Bicarbonate, Nitrate, Nitrite, Nitrogen Phosphate, pCO_2, Phosphorous, …)			
7	Density			
8	Dissolved Inorganic Carbon			
9	Eutrophication			
10	Faecal Coliform			
11	Freshwater flux			
12	Mean Sea Level			
13	Megafauna Abundance Counts			
14	Methane Flux			
15	Odour			
16	Phytoplankton			
17	Primary Productivity Rate			
18	Roughness			
19	Secchi Depth			
20	Sediment deposition rate			
21	Sediment Erosion Rate			

S. No	Ecosystem Condition Parameters	Condition at time (t1)	Condition at time (t2)	Changes over time (t2-t1)
22	Slope			
23	Suspended Sediment Concentration			
24	Tidal regime			
25	Water Colour			
26	Wave Direction			
27	Wave Height			
28	Zooplankton			
Coastal Ocean Water				
1	Acidification			
2	Alkalinity			
3	Benthic Community			
4	Biodiversity (Flora, Fauna, …)			
5	Carbon Dioxide Flux			
6	Chemical Oxygen Demand			
7	Chlorophyll Pigment Conc.			
8	Density			
9	Dissolved Inorganic Carbon			
10	Dissolved Oxygen			
11	Eutrophication			
12	Faecal Coliform			
13	Freshwater flux			
14	Mean Sea Level			
15	Methane Flux			
16	Nutrients (Ammonia, Bicarbonate, Nitrate, Nitrite, Nitrogen, pCO2, Phosphate, Phosphorous, Silicate …)			
17	pH			
18	Phytoplankton			
19	Primary Productivity Rate			
20	Secchi Depth			
21	Sediment deposition rate			
22	Sediment Erosion Rate			
23	Sediment Nutrient (Carbon, Nitrogen, …)			
24	Suspended Sediment Concentration			
25	Tidal regime			

S. No	Ecosystem Condition Parameters	Condition at time (t1)	Condition at time (t2)	Changes over time (t2-t1)
26	Water Colour			
27	Wave Direction			
28	Wave Height			
29	Zooplankton			
Mudflats				
1	Acidification			
2	Benthic Community			
3	Biodiversity (Flora, Fauna, …)			
4	Carbon Dioxide Flux			
5	Chemical Oxygen Demand			
6	Chlorophyll Pigment Conc.			
7	Concentration of Nutrients (Nitrate, Nitrite, Nitrogen, Phosphate, Ammonia, Bicarbonate, pCO2, Phosphorous …)			
8	Density			
9	Dissolved Inorganic Carbon			
10	Eutrophication			
11	Faecal Coliform			
12	Freshwater flux			
13	Mean Sea Level			
14	Methane Flux			
15	Odour			
16	Phytoplankton			
17	Primary Productivity Rate			
18	Roughness			
19	Secchi Depth			
20	Sediment deposition rate			
21	Sediment Erosion Rate			
22	Slope			
23	Soil Nutrients			
24	Suspended Sediment Concentration			
25	Tidal Condition			
26	Tidal regime			
27	Water Colour			
28	Wave Direction			

S. No	Ecosystem Condition Parameters	Condition at time (t1)	Condition at time (t2)	Changes over time (t2-t1)
29	Wave Height			
30	Zooplankton			

Annexure 5.1

Table A.9: List of Various Ocean Ecosystem Services

Services Category	Services	Mangrove	Lagoon	Coral reef	Seagrass	Estuary	Sandy Coast	Coastal Ocean	Mudflats
Provisioning	Fish nursery	✓		✓	✓	✓		✓	
	Biomass (Live stock, Halophytes, Macro Algae, Wild Plants,	✓	✓	✓		✓	✓		✓
	Medicinal plants and products	✓			✓		✓		✓
	Minerals Resources	✓	✓	✓		✓	✓	✓	✓
	Nontimber forest products (Gums and resins etc.)	✓							
	Cultivated Biomass (Plants, corals, Other Species,	✓	✓	✓	✓	✓	✓	✓	✓
	Water Resources	✓		✓		✓	✓	✓	✓
	Coastal and marine water used as energy source		✓	✓		✓	✓	✓	✓
	Energy resources	✓					✓	✓	✓
	Genetic Material Provision	✓	✓	✓		✓	✓	✓	✓
	Desalination	✓	✓			✓			
	Wave energy	✓	✓	✓		✓	✓	✓	✓
Regulating	Climate regulation	✓	✓	✓	✓	✓	✓	✓	✓
	Nutrient flux	✓	✓	✓	✓	✓	✓	✓	✓
	Air/Atmospheric Purification	✓	✓	✓	✓	✓	✓	✓	✓
	Natural hazard Mitigation (Flood, Storm, Wind…)	✓	✓	✓	✓	✓	✓	✓	✓
	Erosion Prevention/Accretion		✓			✓	✓	✓	✓
	Waste treatment	✓	✓	✓		✓	✓	✓	✓
	Pest and Disease control (Plant, Animal, …)	✓	✓	✓			✓	✓	✓
	Pollination	✓							
	Seed dispersal	✓	✓						
	Soil Nutrient Regulation quality	✓				✓			
	Decomposition	✓	✓	✓		✓	✓	✓	✓
	Salt waters Regulation	✓	✓	✓			✓		✓
	Hydrological cycle	✓	✓	✓	✓	✓	✓	✓	✓
	Nutrient cycling					✓		✓	

Services Category	Services	Mangrove	Lagoon	Coral reef	Seagrass	Estuary	Sandy Coast	Coastal Ocean	Mudflats
	Sediment transport					✓		✓	
Cultural	Spiritual Value (Pilgrimage/Heritage, Sacred/religious sites, Abiotic spiritual interactions)	✓	✓	✓		✓	✓		✓
	Educational values (Scientific knowledge, Experimental use, Abiotic intellectual interactions)	✓	✓	✓	✓	✓	✓	✓	✓
	Aesthetic values	✓	✓	✓	✓	✓	✓	✓	✓
	Existence/ Bequest values (Abiotic existence, bequest value, Abiotic physical and experiential interactions …)	✓	✓	✓	✓	✓	✓	✓	✓
	Symbolic	✓	✓	✓	✓	✓	✓	✓	✓

Annexure 7.1

Table A.10: Global and National Indicators under SDG 14

S. NO.	NATIONAL INDICATORS	GLOBAL INDICATORS
1	14.1.1: Coastal Water Quality Index 14.1.2: Percentage use of nitrogenous fertilizer to total fertilizer (N, P & K)	14.1.1: (a) Index of coastal eutrophication; and (b) plastic debris density
2	14.2.1: Percentage change in area under mangroves, (similar to 14.5.2) 14.2.2: Percentage of coastal marine protected areas in relation to Territorial Seas (Similar to 14.5.1)	Indicator 14.2.1: Number of countries using ecosystem-based approaches to managing marine areas
3	14.3.1: Average marine acidity (pH) measured at agreed site of representative sampling stations	14.3:1: Average marine acidity (pH) measured at agreed suite of representative sampling stations
4	14.4.1: Maximum Sustainable Yield (MSY) in fishing, (in Million Tonne/Year)	14.4.1: Proportion of fish stocks within biologically sustainable levels
5	14.5.1: Percentage of coastal marine protected areas in relation to Territorial Seas (Similar to 14.2.2) 14.5.2: Percentage change in area under mangroves, (similar to 14.2.1)	14.5.1: Coverage of protected areas in relation to marine areas
6		14.6.1: Degree of implementation of international instruments aiming to combat illegal, unreported and unregulated fishing
7		14.7.1: Sustainable fisheries as a proportion of GDP in small island developing States, least developed countries and all countries
3	14.a.1: Allocation of budget resources (Budget Estimates) for Ocean Services, Modelling, Applications, Resources and Technology (OSMART) scheme (in Rs. crore)	14.a.1: Proportion of total research budget allocated to research in the field of marine technology

	14.b.1: Assistance to the traditional/artisanal fishers for procurement of FRP boats and other associated fishing implements, (in Number & in Rs. lakh)	14.b.1: Degree of application of a legal/regulatory/ policy/institutional framework which recognizes and protects access rights for small-scale fisheries
4	14.c.1: Compliance of international laws	14.c.1: Number of countries making progress in ratifying, accepting and implementing through legal, policy and institutional frameworks, ocean-related instruments that implement international law, as reflected in the United Nations Convention on the Law of the Sea, for the conservation and sustainable use of the oceans and their resources

Annexure 7.2

Table A.11: National Indicator Framework on SDG 14

Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development			
SL	**NATIONAL INDICATOR**	**VALUE OF THE INDICATOR**	
Target 14.1: By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution			
1	14.1.1: Coastal Water Quality Index *Source: Ministry of Earth Sciences / Periodicity: Annual*	**Year**	**Value**
		2015-16	Out of 9 Coastal States, Number of States in the category of: Moderate = 7 Good = 2
		2020-21	Out of 9 Coastal States, Number of States in the category of: Moderate = 9 Good = 0
		2021-22	Out of 8 Coastal States, Number of States in the category of: Moderate = 7 Good = 1
		2022-23	Out of 13 Coastal States/ UTs, Number of States/ UTs in the category of: Moderate = 8 Good = 3 Very Good = 2

		2023-24	Out of 12 Coastal States/ UTs, Number of States/ UTs in the category of: Moderate = 10 Good = 2
2	14.1.2: Percentage use of nitrogenous fertilizer to total fertilizer (N, P & K) *Source: INM, DAC&FW, Ministry of Agriculture and Farmers' Welfare / Periodicity: Annual*	**Year**	**Value**
		2015-16	64.94
		2016-17	64.49
		2017-18	63.77
		2018-19	64.39
		2019-20	65.04
		2020-21	62.71
		2021-22	65.24
		2022-23	67.71
		2023-24	66.76
Target 14.2: By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans			
1	14.2.1: Percentage change in area under mangroves, (similar to 14.5.2) *Source: Ministry of Environment Forest and Climate Change / Periodicity: 2 Years*	**Year**	**Value**
		2013-15	2.43
		2015-17	3.82
		2017-19	1.10
		2019-21	0.34
2	14.2.2: Percentage of coastal marine protected areas in relation to Territorial Seas (Similar to 14.5.1) *Source: Ministry of Environment Forest and Climate Change / Periodicity: 2 Years*	**Year**	**Value**
		2020	5.47
		2022	4.60

Target 14.3: Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels			
1	14.3.1: Average marine acidity (pH) measured at agreed site of representative sampling stations *Source: Ministry of Earth Sciences / Periodicity: Annual*	**Year**	**Number of sites having average pH value (coastal waters)**
		2019-20	Less than 8: 4 Greater than 8: 12
		2020-21	Less than 8: 10 Greater than 8: 44
		2021-22	Less than 8: 8 Greater than 8: 54
		2022-23	Less than 8: 18 Greater than 8: 47
		2023-24	Less than 8: 14 Greater than 8: 34
Target 14.4: By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics			
1	14.4.1: Maximum Sustainable Yield (MSY) in fishing, (in Million Tonne/Year) *Source: Department of Fisheries, Ministry of Animal Husbandry, Dairying & Fisheries /Periodicity: Annual*	**Year**	**Value**
		2015-16	3.078
		2016-17	3.078
		2017-18	5.311
		2018-19	5.311
		2019-20	5.311
		2020-21	5.311
		2021-22	5.311
		2022-23	5.311

		2023-24	5.311
Target 14.5: By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information			
1	14.5.1: Percentage of coastal marine protected areas in relation to Territorial Seas, 2020 (Similar to 14.2.2) *Source: Ministry of Environment Forest and Climate Change / Periodicity: 2 Year*	**Year**	**Value**
		2020	5.47
		2022	4.60
2	14.5.2: Percentage change in area under mangroves, (similar to 14.2.1) *Source: Ministry of Environment Forest and Climate Change / Periodicity: Two years*	**Year**	**Value**
		2013-15	2.43
		2015-17	3.82
		2017-19	1.10
		2019-21	0.34
Target 14.6: By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World trade 0rganization fisheries subsidies negotiation			
	National Indicator is under development		
Target 14.7: By 2030, increase the economic benefits to small island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism			
	National Indicator is under development		
Target 14.a: Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental oceanographic Commission Criteria and Guidelines on the transfer of Marine technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries			
1	14.a.1: Allocation of budget resources (Budget Estimates) for Ocean Services,	**Year**	**Value**
		2019-20	445

	Modelling, Applications, Resources and Technology (OSMART) scheme (in Rs. crore) *Source: Ministry of Earth Sciences / Periodicity: Annual*	2020-21	567	
		2021-22	528.59	
		2022-23	498.95	
		2023-24	460	
Target 14.b: provide access for small-scale artisanal fishers to marine resources and markets				
1	14.b.1: Assistance to the traditional/artisanal fishers for procurement of FRP boats and other associated fishing implements, (in Number & in Rs. lakh) *Source: Department of Fisheries, Ministry of Animal Husbandry, Dairying & Fisheries / Periodicity: Annual*	**Year**	**Boats**	**Project Cost**
		2016-17	259	1,098.25
		2017-18	285	1,012.5
		2018-19	560	1,930
		2019-20	110	500
		2020-21	1851	7755
		2021-22	1358	6790
		2022-23	2266	8409.05
		2023-24	1023	1373.85
Target 14.c: Enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in the United Nations Convention on the Law of the Sea, which provides the legal framework for the conservation and sustainable use of oceans and their resources, as recalled in paragraph 158 of "the future we want"				
1	14.c.1: Compliance of international laws *Source: Ministry of Earth Sciences / Periodicity: Annual*	Yes		

Source: Sustainable Development Goals National Indicator Framework, MoSPI, https://www.mospi.gov.in/sites/default/files/publication_reports/SDG-NIF-ProgressReport-FullFile-v4N.pdf

Social Statistics Division

5th Floor, Khurshid Lal Bhawan, New Delhi-110001,
Email: ssd-mospi@gov.in

www.mospi.gov.in @GoIStats /GoIStats
Ministry of Statistics and Programme Implementation Ministry of Statistics & PI