



Ministry of Environment,
Climate Change
and Technology



ENDhERI



Technical Scope Report

Submitted 30 April 2023

Consultancy Service for Development of Natural Capital Accounting with initiating pilot testing of the SEEA Ecosystem Accounting (SEEA EA) in Laamu Atoll



UNSW
SYDNEY



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UNIVERSITY
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UNIVERSITY



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Consultancy Service for Development of Natural Capital Accounting with initiating pilot testing of the SEEA Ecosystem Accounting (SEEA EA) in Laamu Atoll

Consultants:

This report was prepared by the University of New South Wales (UNSW), with support from the Rekam Nusantara Foundation (RNF) and experts from the Maldives National University (MNU) per the Terms of Reference 438-ENV/438/2022/27.

Executive summary

This report provides:

- An overview of the scope of definitions, concepts, and activities required to meet the activities and deliverables required for the project, as defined by the Terms of Reference.
- An overview of the international standard used to define works, namely the System of Environmental Economic Accounts (SEEA) Ecosystem Accounting standard (2021).
- A list of the required methods and materials required to complete the deliverables, per the Terms of Reference.
- A comprehensive overview of the project's anticipated outcomes, impacts, and sustainability considerations, while also identifying preliminary lessons learned and providing recommendations for future actions.

Abbreviations

GEF Global Environment Facility

EEA Environmental Economic Accounting

ENDhERI Enhancing National Development through Environmentally Resilient Islands

IUCN International Union for the Conservation of Nature

MECCT Ministry of Environment, Climate Change and Technology

MNU Maldives National University

NCA Natural Capital Accounting

SEEA System of Environmental Economic Accounting

RNF Rekam Nusantara Foundation

UNSW University of New South Wales

Introduction

The Government of the Republic of Maldives through the Ministry of Environment, Climate Change and Technology is implementing Enhancing National Development through Environmentally Resilient Islands (ENDhERI) project financed by Global Environment Facility (GEF) and assisted by United Nations Environment Program (UNEP). The ENDhERI project aims to enhance reef protection, resilience and ecosystem recovery by reducing development impacts in a selected project site in the Maldives, enabled for replication nationally through public awareness and integrating the values of marine biodiversity and other natural capital.

The project on **Natural Capital Accounting (NCA)** will assist the Maldives government to implement new environmental policies and transition towards the national adoption of Green Growth atoll development to sustain marine Natural Capital and strengthen the resilience and recovery of reef and associated coastal ecosystems. The project focuses on **Laamu Atoll** and aims to minimize pollutants from land and marine-based activities, reduce drivers of reef degradation, and enhance reef ecosystem integrity and resilience through sustainable management.

This project aims to assist the government of the Maldives in atoll-wide integrated coastal zone¹ management within a Managed Marine Area / Biosphere Reserve framework, and the application of innovative sustainability practices and standards. Overall, the project seeks to enhance reef ecosystem integrity and resilience through sustainable management, reducing development impacts and integrating NCA into national planning. Additionally, it seeks to incorporate initiatives that raise awareness about the importance of marine biodiversity and the role of natural capital in supporting the well-being of both ecosystems and human communities.

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Objectives

This **Technical Scope Report** provides an overview of the scope of definitions, concepts, and actions required to meet the activities and deliverables required for the project, as defined by the Terms of Reference. In particular, this includes:

1. Support the development of activities and work programme in accordance with development of NCA
2. Support the development of a National Road Map for Advancing Environmental Economic Accounts (EEA)
3. Establishment of NCA for Laamu Atoll for selected ecosystems (coral reefs, seagrass, and mangroves) and their services, including detailed description of the ecosystems covered, the scale and extent and frameworks for monitoring

¹ The coastal zone refers to the area that extends from the shoreline inland, encompassing the land and sea interface as defined by national legislation and administrative boundaries.

4. Indicators and business accounts
5. GIS Mapping and management
6. Communication, dissemination and outreach

Determining priorities

As the SEEA Ecosystem Accounting standard was only released in 2021, there is limited capacity globally in performing ecosystem accounting. Knowledge of foundational concepts such as **natural capital** and **ecosystem services** was present within the Maldives, although familiarity with the SEEA standard was still emergent. Given this context, the inception workshop and meetings with stakeholders identified key priorities in NCA, aligned with SEEA Ecosystem Accounting. The [Inception report](#) contains further details.

1. Building capacity with institutions within the Maldives, including the government, Maldives National University and other non-government organizations,
2. Selecting and prioritizing the accounting of ecosystems and ecosystem services with direct and measurable links to economic sectors (e.g., fisheries and tourism) through existing data or data which may easily be acquired (e.g., remote sensing), and
3. Maximizing the capacity, quality and standardization of data collection in support of accounting activities, through engagement with the Maldives National University, Local Atoll council, and other important stakeholders (e.g., civil society, citizen scientists).

Overview of Accounting scope

An outline of the accounting activities are provided, with further information under methods. The project will focus on (i) enhancing the capacity of the Maldives in Natural Capital Accounting, and (ii) performing a pilot study specifically for Laamu Atoll. The NCA activities will follow the UN SEEA Ecosystem Accounting standard, with the initial pilot focusing on coral reefs, mangroves, and seagrass. The accounts will cover the extent and condition of these ecosystems, where measures of condition will vary per ecosystem.

The study will also compile preliminary estimates of ecosystem services in physical (e.g., tons) and monetary terms (i.e., Rufiyaa, USD), depending on data availability. The project will also attempt to bridge the Ecosystem Accounts with National Accounts for economic sectors.

Outcomes

The report will describe:

- the technical basis for NCA, giving an overview of the System of Environmental Economic Accounting,

- the materials needed to accomplish each activity and deliverable, and
- inform the reader of the actions within and out of scope of the present project.

Technical standards and guidelines

Natural Capital Accounting (**NCA**) describes accounting frameworks used to measure and report on stocks and flows of natural capital. There are many methods for NCA, many of which lead to outputs that cannot be compared regionally and over time. Considerable efforts have been made to produce **international guidance** on comparable statistics that link to existing national accounts maintained by countries. This project performs NCA aligns with the standard, the **System of Environmental Economic Accounts (SEEA)**.

The SEEA is an international statistical framework developed by the United Nations and other international organizations to measure and account for relationships between the environment and economy. It is a comprehensive system that provides a standardized approach for integrating economic and environmental information to facilitate policy-making, monitoring, and reporting.

The main components of SEEA consists of:

1. **SEEA Central Framework (SEEA CF)**, and
2. **SEEA Ecosystem Accounting (SEEA EA)**.

The SEEA CF provides a thematic approach to accounting, with guidance for resources including water, energy and agriculture, forestry and fisheries products.

The SEEA EA, **and the focus of the project for Laamu Atoll**, provides a spatial approach, in accounting for the extent and condition of ecosystems and their supply of services over time. Ecosystem Accounting includes accounts in physical (e.g., hectares) and monetary terms, where flows of ecosystem services are monetary valued through various market and non-market valuation techniques (see Figure 1). The valuation of ecosystem services subsequently supports the valuation of ecosystem assets.

The SEEA EA framework includes the following data over an accounting period:

- the stock and change in the stock of each ecosystem asset, incorporating ecosystem enhancement and degradation; and
- flows from that asset in the form of ecosystem services. The flows of ecosystem services are linked to the ecosystem type, size or extent and its condition or state, as well as features that determine levels of use of the ecosystem.

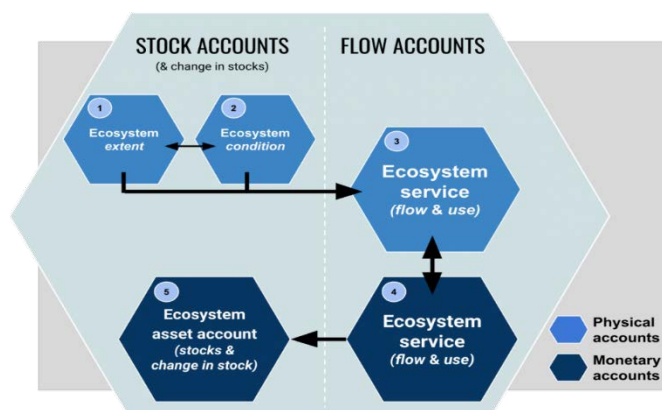


Figure 1: Ecosystem accounts and how they relate to each other. See Table 1 for definitions. Source: SEEA EA

Example for the Maldives

An example of the use of SEEA EA in understanding links between socio-economic and environmental components of the marine environment can be seen in an accounting for a **coastal tourism** destination.

As a tourism destination, a proportion of the local economy **directly** depends on ecosystem services provided by ecosystems such as coral reefs, mangroves, and seagrass. For example, a [study](#) by the Ministry of Housing, Transport and the Environment in 2009 provided preliminary estimates of the value of biodiversity. Further, many sectors are interconnected, where impacts to one sector may also have consequences for many others.

These ecosystems provide services to multiple sectors, such as:

- Provisioning of food (e.g., reef fish biomass for consumption),
- Mitigating coastal erosion (e.g., beach erosion) and wave energy,
- Amenity for recreational values (e.g., water quality for in-water activities, picturesque areas)

The SEEA EA can help quantify dependencies of the local economy on these ecosystem services, especially if these ecosystems are exploited or impacted by other economic activities (e.g., waste treatment, fisheries etc.). For example, eutrophication from farming practices may degrade the nearby water quality and health of the coral reef, which may reduce the number of tourists who visit.

The accounts assist in identifying these relationships over time and assist in identifying the alternative strategies that could reduce negative impacts while maintaining economic benefits. It could further be evidence for investment in sustainable agricultural practices that benefit the tourism industry.

By using the SEEA EA to assess the sustainability of the marine ecosystem and the well-being of the community, policymakers and other stakeholders can make informed decisions about how to balance economic development with environmental protection and social equity. This can help ensure that the community's reliance on ecosystem services is sustained over time and that its economic, social, and environmental needs are met.

Table 1. Definitions of terms to be used within the study, as used within the Ocean Accounting Framework (GOAP, 2021), and aligned with SEEA EA (UNSD, 2021) and SNA (UN, 2008) statistical accounting standards.

Term	Definition	Example
Ecosystem	A contiguous space of a specific ecosystem type characterized by a distinct set of biotic and abiotic components and their interactions	Mangrove, coral reef, seagrass
Basic Spatial Unit	The subdivision of the accounting area spatially to align data	1 km ² square grid
Ecosystem Extent	The range and extent of ecosystems within an accounting area. Ocean Accounts endorses the use of the IUCN Global Ecosystem Typology	Cover of seagrass (in - km ²). Cover of coral reefs (km ²), where this study aims for depths up to 20 m.
Ecosystem Condition	The quality of an ecosystem measured in abiotic and biotic characteristics. Note that there are no standardised indicators for each ecosystem, although the SEEA EA provides guidance for the development of condition accounts	Mangrove tree height, above ground biomass; Seagrass cover (%); Coral reef live coral cover (%), Ratio of herbivorous to carnivorous fish.
Ecosystem Services	The contributions of ecosystems to the benefits that are used in economic and other human activity. Services are categorised broadly into provisioning, regulating and cultural services. Services are measured either as a good or intangible product of the system	Wild fish and other natural aquatic biomass provisioning services, coastal protection services (regulating), Recreation-related services (related to tourism, cultural services)
Accounting period	The time period for which the account spans. There is no strict definition for the period, which could be quarterly, annual, or every 5 years, depending on country needs. Most countries, however, aim to report annually by calendar year (January – December).	Coral extent accounts for 2017 – 2022.

Technical scope

The project scope is defined within the Terms of Reference, and concerns the following overarching activities and representative actions:

1. Support the development of activities and work programme in accordance with development of NCA

- Building inter-governmental capacity and data sharing, through coordination mechanisms and standard operating procedures,
- Liaise with stakeholders and technical committee on NCA,
- Develop supporting materials for the adoption of SEEA in programmatic documents.

2. Support the development of a Road Map for Advancing EEA

- Through developing an assessment report to develop a national plan for advancing EEA in the Maldives (aligned with country priorities and interests)

3. Establishment of NCA for Laamu Atoll for selected ecosystems and their services

- Establishment of NCA related to SEEA for priority ecosystems² and their services for Laamu Atoll, for at least two years.
- Support the integration of data collection, processing and its maintenance of MECCT,
- Support the mainstreaming and knowledge transfer of NCA within MECCT and MBS

4. Indicators and business accounts

- Assess SEEA-relevant indicator sets,
- Identify and liaise with private sector initiatives in Laamu Atoll concerning NCA,
- Provide inputs in identifying a monitoring program (including procurement of required equipment, tools and training)

5. GIS Mapping and management

- Facilitate a national GIS map showing all PAs and key areas within Laamu Atoll,
- Habitat mapping across Laamu Atoll, aligned with SEEA Ecosystem Accounts and using the IUCN Global Ecosystem Typology and National Classification developed for the Maldives.
- Collate, collect and analyse available secondary data for habitat restoration, and management of ICZM

² Ecosystems are classified using the IUCN Global Ecosystem Typology (<https://portals.iucn.org/library/node/49250>) with boundaries determined by the extent of the benthic habitat type.

6. Communication, dissemination, and outreach

- Support the development of a national communication strategy for NCA,
- Organise stakeholder consultations and coordinate a national forum to disseminate results of the pilots,
- Develop and conduct a training of trainers,
- Support the organisation of a national training workshop.

In summary, activities to advance the capacity for NCA within the Maldives are in scope of the project. For the present project, SEEA-aligned accounts will be compiled specifically for Laamu Atoll, with accounts that will examine the extent, condition and ecosystem services of mangroves, coral reefs and seagrass. The ecosystem services will be valued monetarily (to the extent possible), with preliminary links drawn with the National Accounts that describe Maldives economic activity. The extent to which the links are drawn depends on data quality and availability.

The following activities, however, are considered **not within scope** of the present project:

- Data collection for areas outside of Laamu Atoll,
- Compilation of NCA for areas outside of Laamu Atoll, and
- Estimation of economic activity for ocean sectors (although linking to national accounts to ecosystem accounts is within scope).

Site Context: Laamu Atoll

In addition to capacity building activities and training for NCA, the project will compile several NCA for Laamu Atoll, which is in southern part of the Maldives. It is comprised of 88 islands, of which only 10 are inhabited. Its natural formation is characterized by its elongated shape, stretching over 48 kilometers from north to south and 28 kilometers from east to west. The atoll is surrounded by a shallow lagoon that varies in depth from just a few meters to over 50 meters and is dotted with numerous coral reefs and sandbanks. The islands within the atoll are low-lying and covered in lush vegetation, with the tallest point reaching only about 2.5 meters above sea level. The waters around Laamu Atoll are home to a diverse array of marine life, including extensive coral reefs and seagrass, which are home to reef sharks, sea turtles, and a wide variety of tropical fish. Overall, Laamu Atoll is ecologically important and supports several economic activities, such as tourism and fisheries.

Methodology

When initiating the NCA process (aligned with SEEA EA), it is key to first scope the priority ecosystems and available data to guide the selection of accounts for compilation. Once priority ecosystems, main human interactions with the environment and policy areas have been determined, the NCA methodology can be applied by:

- a. designing and conducting data collection,
- b. desk studies and literature review,
- c. surveys (e.g., ground truthing), and
- d. interviews to assess the different accounts included in the SEEA EA framework.

Figure 2 below gives an overview of the type of data and analyses that will be conducted to record the different accounts covered in NCA.

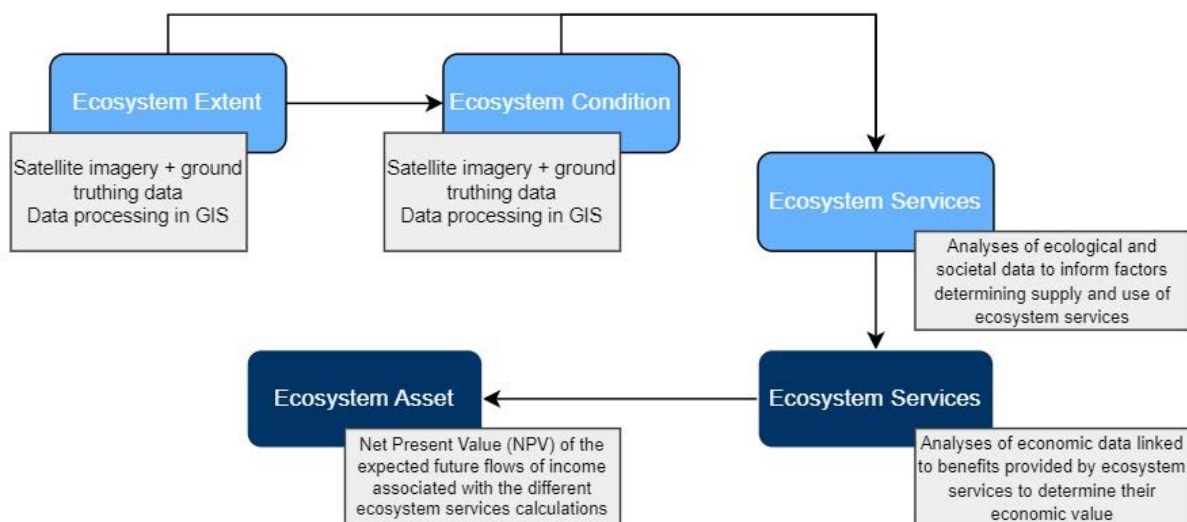


Figure 2: SEEA EA framework components and the necessary data or analyses to compile the accounts

Scoping assessment

Following the Ocean Accounts Framework (GOAP 2021b) and with reference to the Terms of Reference, scoping of accounts followed the following steps:

- Identified links to existing policies and initiatives,
- Compilation of a data inventory, literature review and shortlist of key contacts,
- Selection of relevant ecosystems and their services, constrained by data availability,
- Formed preliminary strategy for account compilation, including an assessment of the relevant techniques and methods.

Primary data collection

Primary data collection will address data needs for **ecosystem extent and condition**. Ecosystem extent data will be procured through high resolution satellite imagery (resolution of ~50 cm) using a UNSW subscription to the Pleiades satellite constellation. To relate satellite images to specific ecosystems, ground truthing will be conducted to acquire the GPS position and images of ecosystems.

Condition measures require field visits to gather data on the functioning of specific ecosystems. The specific methods are based on international standards (Seagrass Watch, Mangrove watch) and national standards within the Maldives. The below **annex** describes the specific methods for condition measures within the Maldives.

There is currently no international consensus on the variables needed to measure condition. Each ecosystem will have specific measures, which can be related to their supply of ecosystem services.

Secondary data collection

To create an inventory of datasets on ecosystem extent and condition in the Maldives for coral, seagrass, and mangrove ecosystems, the following selection process was implemented:

- a. Literature review: A literature review was conducted to identify available published data sources related to coral, seagrass, and mangrove ecosystems in the Maldives. Include government reports, academic publications, and grey literature.
- b. Stakeholder consultation: Stakeholders including the government, island councils, NGOs, and research institutions were consulted to identify any additional datasets that may not have been captured in the literature review. This included contacting relevant institutions and organizations working on environmental conservation and management in the Maldives.
- c. Inception workshop: An inception workshop was held in the Maldives to present the inventory to stakeholders and to gather feedback on the datasets and their suitability for the intended purpose. This also provided a great opportunity to identify any additional data sources that may have been missed during the previous steps.

- d. Data extension: Following the inception workshop, any new datasets identified was added to the inventory.
- e. Data assessment and integration: Once all available datasets have been identified, a data assessment is conducted to determine the suitability and quality for NCA of each dataset and for inclusion in the inventory. Once the datasets have been assessed, they will be integrated into a single database using appropriate data standards and formats. This would involve standardizing data formats and resolving any inconsistencies or errors in the data.

The open access datasets found during literature review are available at a global level. To get access to national, regional or local level in the Maldives both stakeholder consultation and the inception workshop were needed. We are establishing data sharing agreements with stakeholders to ensure that the data is used appropriately and effectively.

A preliminary data inventory is provided within the **Annex**.

Ecosystem Service Assessment

After the compilation of extent and condition accounts, ecosystem services can be estimated. The extent and condition of an ecosystem are combined to estimate the service, as well as understanding the user of the service.

Using carbon sequestration as an example, the size of the ecosystem and its condition (e.g., density, cover) can be used to estimate the amount of carbon that is (i) within the living components of the ecosystem (i.e., biomass) and (ii) stored in surrounding soils (i.e., burial). A seagrass that is unhealthy, due to stressors such as fertilizers from the island, may reduce the amount of carbon being captured.

Another example are coral reefs and nursery services. The amount of live coral may be related to the amount of fish supported. If live coral cover were to decrease, the amount of fish (measured in biomass) within the stock may fall, leading to lower catch in the future.

It is important to note that there is only an ecosystem service if there is a **user** of the service. In considering flood mitigation, if there are no buildings next to and protected by mangroves, it does not provide a service for a user.

As ecosystems vary in the services provided, in consulting with stakeholders the following have been selected for further exploration (Table 2). Each service will require specific methods to calculate the service in physical terms. Selection of appropriate methods for Laamu Atoll will be explored within the project.

Table 2. Ecosystems and ecosystem services for exploration within the project.

Ecosystems	Ecosystem Services	Examples
Coral reefs	Food provisioning	Commercial fish (biomass, kgs)
Coral reefs	Nursery services	Commercial fish juveniles (biomass, kgs)
Coral reefs	Coastal protection	Wave energy attenuation
Coral reefs	Sediment provisioning	Coral sand flux onto beaches
Coral reefs	Recreational services	Tourism visitation
Seagrass	Nursery services	Commercial fish juveniles (biomass, kgs)
Seagrass	Coastal protection	Sediment stabilization
Seagrass	Carbon sequestration and capture	tons C within biomass and sediments
Seagrass	Recreational services	Tourism visitation
Mangroves	Coastal protection and flood mitigation	Sediment stabilization
Mangroves	Nursery services	Commercial crab (biomass, kgs)
Mangroves	Carbon sequestration and capture	tons C within biomass and sediments
Mangroves	Recreational services	Tourism visitation

Economic Valuation methods

Ecosystem Accounting compiles accounts in both physical terms (e.g., hectares, tonnes) and monetary terms. The flows of ecosystem services are valued monetarily through various market and non-market valuation techniques. The valuation approach used in the SEEA EA

framework is established on **existing concepts adopted by the System of National Accounts (SNA)** and adapted to the environmental context. Therefore, to maintain consistency with the SNA, monetary valuation in SEEA is based on exchange prices.

Exchange and welfare values

The valuation concept used in the SEEA is consistent with SNA and therefore is based on **exchange values / prices**, which are:

The prices at which goods, services, or assets are or could be transacted.

It is important to **differentiate** the exchange values **from welfare values**. Welfare values also consider the benefit that individuals who obtain the good or service enjoy over and above what is paid, called the consumer surplus. Thus, consumer surplus includes a higher value non-consistent with accounting purposes.

An important issue in monetary valuation is the selection of methods to estimate the monetary value of each ecosystem service, since that choice may have a significant impact on the results obtained. These methods vary in terms of the data and indicators used, and it is important to consider both market-traded goods and services (e.g., fish landed, natural resources) and non-marketed services (e.g., coastal protection), in the valuation process.

Market and non-market valuation techniques

Whilst there exist different options and perspectives, an exchange value-based approach is widely supported. Most times exchange values are measured using data from observed transactions involving market prices revealed by market-traded goods and services. **Market-based valuation** employs prevailing **market behaviour** and transactions as the foundation for the valuation process. It determines economic values based on **actual market prices** (directly observed values) for ecosystem services, both as inputs for production processes (production values) and as direct outputs (consumption values).

Non-market-based valuations estimate the transactions for which markets prices are not observed, need to be estimated using alternatives valuation methods (e.g. from similar markets or cost-based techniques). Numerous ecosystem services lack direct markets and their corresponding prices. In such cases, the value of changes in the quality or supply of these services is determined using indirect market valuation methods, also known as revealed preference (RP) methods. RP methods identify the ways in which non-market goods affect the actual markets for some other goods and are based on the actual behaviour of consumers or producers.

There is an extensive literature on ecosystem services valuation. However, many methods are not compatible with established national accounting and other statistical principles. The general advice of the SNA is that where directly observed market prices are not available, they may be estimated by prices from similar markets; from related markets or using costs of production. Following a similar framing, SEEA recommends that valuation methods are applied in the following order:

- a. Methods where the price for the ecosystem service is directly observable.

- b. Methods where the price for the ecosystem service is obtained from markets for similar goods and services.
- c. Methods where the price for the ecosystem service is embodied in a market transaction.
- d. Methods where the price for the ecosystem services is based on revealed expenditures (costs) for related goods and services.
- e. Methods where the price for the ecosystem service is based on expected expenditures or markets.

	Direct market methods ^a			Indirect market methods ^a		Non-market methods ^a	
	MP	PF	CB	HP	TC	CV	CE
<i>Provisioning services</i>							
Food	X	X				X ^b	X ^b
Freshwater	X	X				X ^b	X ^b
Wood and fiber	X	X				X ^b	X ^b
Fuel	X	X				X ^b	X ^b
<i>Regulating services</i>							
Climate regulation			X			X ^b	X ^b
Flood regulation			X	X		X ^b	X ^b
Disease regulation	X		X			X ^b	X ^b
Water purification	X	X	X			X ^b	X ^b
<i>Cultural services</i>							
Aesthetics				X		X ^c	X ^c
Recreation				X	X	X ^c	X ^c
Education						X ^c	X ^c
Spiritual						X ^c	X ^c
<i>Supporting services</i>							
Nutrient cycling	X	X	X				
Soil formation	X	X	X				
Primary production	X	X	X				

^a MP = market price method; PF = production function method; CB = cost-based methods; HP = hedonic pricing method; TC = travel cost method; CV = contingent valuation method; CE = choice experiment method.

^b Although markets exist for most provisioning and regulating services, valuation of hypothetical changes and changes that have not yet taken place can only be done through non-market valuation methods.

^c For most cultural services markets do not exist, implying that the valuation of both current and hypothetical situations and changes can only be done through non-market valuation methods.

Figure 3: Valuation methods for different ecosystem services

Linking Ecosystem Services to the National Accounts

There are several methods to link ecosystem services to existing accounting and reporting systems. The direct method, aligned with the SEEA EA standard, is understanding the use of an economic sector per ecosystem service. For example, in Figure 4, an economic sector may draw from a service provided by several ecosystems. Compiling these tables, however, are difficult and require high resolution data, supported by scientific studies.

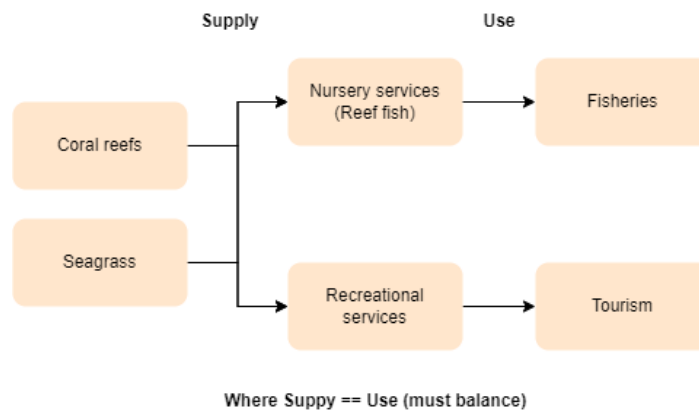


Figure 4. Conceptual overview of the supply and use of ecosystems services.

A preliminary method, which will be attempted by this study, is to determine the dependencies of ecosystem services by economic sectors using expert elicitation (i.e., surveys). The method will:

- Identify relevant economic sectors,
- Create a survey asking experts about the percentage of the sector may be dependent on each ecosystem service, and
- Use a workshop to develop a consensus for such values.

The resulting values may be used as a preliminary way to estimate the amount of value within a sector at risk from impacts to ecosystems.

Table 3. Example table of estimated dependency value for fisheries and fish landed on coral reefs.

Sector	Product / Service	Ecosystem service	Prompt	Estimated value from coral
Fisheries	Fish landed	Nursery service	% of fish landed that require coral reefs to survive	40%

Indicators and business accounts (derived from NCA)

To effectively manage nature risk and promote sustainable investment practices, identifying relevant indicator sets, for different applications, are essential. Here, we provide example indicators that could reflect nature risk in finance in assessing portfolios or individual entities. Many of these indicators could draw from information from the accounts.

Nature risk can be understood as:

- **Dependencies on nature** for organizations to function (e.g., natural resource and service inputs),
- **Impacts on nature** posed by organizations, which impact nature's ability to support social and economic functions need by other entities, and
- **Impact drivers of nature change** measured in terms of the use of natural resources as an input for production and non-product outputs (e.g., residuals) that affect nature.

Measuring the dependencies and impacts of businesses through drivers provides an understanding of risk to functions and but also opportunities to engage with other nature-based financial instruments. These indicators could be applied to individual entities.

In drawing from global reporting frameworks, such as the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), broad indicator sets may be identified, that include:

- **Climate change:** Environmental risks such as extreme weather events, sea level rise, and temperature changes, with indicators such as emissions production and emissions reduction (e.g., carbon sequestration and capture).
- **Land use change:** Changes in land use, such as deforestation and urbanization, and its follow-on impacts to ecosystem services, and natural resources. This includes the degradation of natural asset quality (e.g., loss of ecosystem area), and regeneration of natural assets (e.g., conservation and restoration of ecosystem areas).
- **Resource use and replenishment:** measuring natural inputs and waste generation. For example, natural inputs (e.g., biomass, water) and related depletion from resource use, and replenishment (e.g., ecosystem restoration, water return),
- **Pollution and pollution remediation:** measuring the emissions and wastes produced by business functioning and/or the actions to mitigate their production. For example, pollution sourced from production (e.g., air emissions, wastes), and circular economy metrics (e.g., reduction, reuse, recycling, transformation of wastes and emissions).

The individual metrics for disclosure are presented in Table 4. Measuring such metrics requires a comprehensive understanding of the complex relationships between natural systems and business activities.

Not all indicators draw from Ecosystem Accounts and other data collection will need to be performed.

Table 4. Related metrics to measure the dependencies and impacts on nature.

Theme	Indicator	Measurement
Climate change	GHG emissions	Direct and indirect emissions (i.e., Scope 1 and 2), Emissions across the value chain (Scope 3)
Climate change	Carbon sequestration and capture	Capture of carbon into biomass and sediments within managed assets
Land use change	Extent change per selected ecosystem	Mapped change (km ²) per accounting period
Pollution/pollution removal	Pollutants released to soil	Pollutant by type (e.g., pesticides, fertilizers), sector specific guidance
Pollution/pollution removal	Wastewater discharge	Volume and concentration of key pollutants
Pollution/pollution removal	Hazardous waste generated	By type, sector specific guidance
Pollution/pollution removal	Plastic wastes generated	By polymer
Pollution/pollution removal	Non GHG air pollutants released	Reporting on particulate matter, nitrogen oxides, volatile organic compounds, sulfur oxides and ammonia.
Resource use/replenishment	Water drawn from areas of known water stress	Total volume drawn (in cubic meters)
Resource use/replenishment	Quantity of high-risk commodities from ecosystems	Quantity of high-risk commodities, following sector-specific guidance (e.g., threatened species fish stocks, threatened forestry timber etc.)
Resource use/replenishment	Quantity of natural commodities sourced from priority ecosystems	Quantity and share of natural commodities sourced from priority ecosystems split into types

Relevant stakeholders

The relevant stakeholders are detailed in Table 5.³

Table 5. Relevant stakeholders for the project at Laamu Atoll

Stakeholder	Role	Related initiatives to NCA project
Ministry of Environment, Climate Change and Technology (MECCT)	Responsible for the management of the health of the environment of the Maldives.	ENDhERI project, a GEF 6 STAR project which also includes social components for island resilience.
Environmental Protection Agency (EPA), Ministry of Environment, Climate Change and Technology (MECCT)	Involved in the monitoring and evaluation of protected areas and environmental health across the Maldives, per laws and regulations of the Maldives.	-
Ministry of Finance (MoF)	Responsible for integrated finance initiatives, that align finance flows and mainstream sustainability.	Implements the Maldives Integrated National Financing Framework (INFF).
Maldives Bureau of Statistics, Ministry of National Planning, Housing and Infrastructure (MNPFI)	MBS is responsible for compiling statistics and accounts for the Maldives.	SEEA Central Framework Water and waste accounting.
Ministry of Fisheries, Marine Resources and Agriculture	Fisheries and marine resource management and governance. Responsible for relevant data on those resources.	-

³ The table provided includes only formalized groups. As such stakeholders such as fisher people, women, and youth have not been included in this specific table. However, it is important to note that active engagement with these stakeholders has taken place through various engagement processes and through the groups listed in the table. This footnote acknowledges that although not listed in the table, efforts have been made to engage and involve these stakeholders in relevant discussions and decision-making processes.

Maldives Marine Research Institute (MMRI) of the Ministry of Fisheries, Marine Resources and Agriculture (MoFMRA)	MMRI is responsible for planning, coordinating and conducting scientific research on marine resources of the Maldives.	The MMRI maintains the Coral Database containing data of coral ecosystems.
Laamu Atoll Council (Hadhdhunmathi Atoll Council)	Atoll council composed of an elected president and local council members. Responsible for environmental protection across Atoll.	-
Women's Development Committee	Laamu Maavah women's committee operating under the Secretariat of the Maavah Council	-
Japan International Cooperation Agency (JICA)	Bi-lateral funder supporting coastal development within the Maldives.	Building Climate Resilient Safer Islands in the Maldives
World Bank	Multilateral funder	Project of digitalization and centralization of available data for the Maldives: Digital Maldives
Noo Raaje	Implements spatial planning of marine and coastal areas.	Noo Raaje project for coastal and marine spatial planning of the Maldives.
Blue Marine Foundation,	A UK-based charity working from Six Senses Laamu, compiling data on ecosystems and fisheries.	Manta Trust, Oliver Ridley Project, and Maldives Resilient Reefs projects
Maldives Underwater Initiative	Marine conservation initiative based at Six Senses Laamu	Three partner NGOs: The Manta Trust, Blue Marine Foundation and The Olive Ridley Project

Technical Committee on Natural Capital Accounting

The project also supports a Technical Committee on Natural Capital Accounting for the Maldives, chaired by MECCT. The project deliverables will be assessed by the committee. According to the Terms of Reference for the Committee, key activities included the:

- Review planned activities [of the present project] and ensure that they are technically sound and that, wherever possible, there is integration and synergy between the project outputs and components during planning and implementation.
- Enable and formally agree mechanisms for data sharing, linkages between data & information systems, and data access, specifically towards the national SEEA-based NC accounting framework.
- Promote technical coordination between institutions, where such coordination is necessary and where opportunities for synergy and sharing of lessons exist.
- Provide technical advice and guidance on specific issues within the scope of the technical committee.
- Share information on project progress and lessons learned with related stakeholders.
- The technical committee or a subset of its members may be requested to undertake specific project-related tasks, such as preparing or reviewing analytical reports, strategies and action plans, etc.

The committee will also serve to disseminate information and requests to the relevant member institutions. The project will support the government in increasing its staff and core government funding capacity (i.e., additional staff and/or changes in responsibilities) so that NC accounting is absorbed and sustained as part of its organizational structure in respective offices and included in departmental plans. The current composition is provided in Table 6.

National Roadmap Development

The project will assist in the development of a national roadmap for Natural Capital Accounting in the Maldives, drawing on the lessons learnt from the Laamu Atoll pilot.

Before establishing a roadmap, the project will assist in understanding:

- Existing overlaps between Natural Capital Accounting and the Maldives' existing environmental data infrastructure, policies, and institutional framework.
- Data gaps, institutional barriers, and other challenges, and
- Key stakeholders, including government agencies, environmental organizations, academia, and industry representatives, to ensure a holistic and inclusive approach.

The Technical Committee will assist in guiding the development and implementation of the accounting system. This includes ensuring the accounts align with methodologies, classifications and standards, and guidelines for data collection, analysis, and reporting, that have already been established.

The project will also propose key steps to scaling the accounting framework nationally, identifying:

- Suggest future improvements to the preliminary Laamu Atoll accounts,
- Selected ecosystems and ecosystem services,

- Key milestones that could be pursued,
- Preliminary goals and targets,
- Immediate use cases for decision making.

This includes establishing concept notes and summaries for establishing a future implementation plan and supporting future accounting efforts.

Table 6. Composition of the Technical Committee on Natural Capital Accounting (June 2023).

Organization / Institution
CHAIR - Ministry of Environment, Climate Change and Technology (MECCT)
Environmental Protection Agency (EPA), Ministry of Environment, Climate Change and Technology (MECCT)
National Centre for Information Technology (NCIT)
Laamu Atoll Council
Maldives Marine Research Institute
Ministry of Tourism
Ministry of Planning
Ministry of Finance
Maldives National Association of Construction Industry
Maldives Association of Tourism Industry
Maldives National University
Support from the University of New South Wales

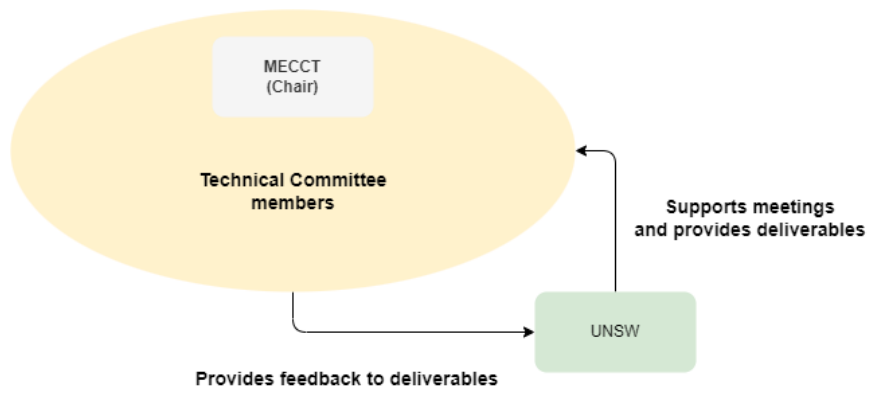


Figure 3: Flows between UNSW (project implementation team) and the Technical Committee on Natural Capital Accounting in the Maldives.

Risks and Mitigation

The team identified risks to the project, as well as mitigation strategies, listed in Table 7.

Table 7. Risks and their mitigation strategies for the project.

Risk	Description	Mitigation strategy
Lack of field materials	The inception trip identified the lack of field collection materials for sampling mangroves and seagrass.	Together with REKAM, the project team constructed and provided the necessary materials for field collection.
Technology limitations	The MNU team may not have access to suitable mapping software and computer hardware.	The UNSW team will identify strategies to overcome technology limitations within MNU and other organizations.
Limited capacity for training	Current staff in the government and MNU may not be able to attend training.	Materials will be prepared in a modular manner and available online, with logical flow to complete at their own pace.
Limited ability to engage with MNU students	MNU students may not be able to attend training.	The team will identify sustainable finance models that may assist students in learning NCA techniques.
Data limitations	Data on key ecosystems and their services may not be available.	We are in constant communication with stakeholders to identify relevant data sources. If no data is available, it will be noted as a priority for further research and investment.
Timeline constraints	Unforeseen delays in deliverables.	Recurring meetings with the PMU of MECCT will ensure clear lines of communication, to raise awareness and adapt the project as necessary.
Limited stakeholder engagement and community support	Limited support from relevant stakeholders and community.	We have started the project by engaging with key stakeholders and consulted on their needs, concerns and aspirations relevant to the project. The project has been adapted to better reflect the values of stakeholders.

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Technical actions

The following section details the technical actions needed to deliver the activities and deliverables defined within the Terms of Reference.

Activity 1 & 2: Development of activities and work programme for NCA and support the development of a roadmap for EEA

In support of developing a work programme and national roadmap for environmental economic accounting, this project will:

- Develop an inventory of available data,
- Identify relevant policies and processes that could benefit from EEA,
- Communicate the utility of EEA with key stakeholders, including MECCT, MBS, as well as local and island councils through briefs (already provided within workshops), technical reports and other outputs (teaching and training materials),
- Work with the technical committee to develop a process that ensures continued development of NCA post-project completion, including milestones that provide the foundation for a roadmap.

Activity 3: Establishment of the select ecosystem and their services accounts in Laamu Atoll

To achieve **Activity 3**, the team will collect primary data from Laamu Atoll and data from secondary sources to produce the Ecosystem Accounts. This includes:

- At least four field visits to Laamu Atoll to collect primary data,
- Coordinating training for personnel within Maldives (and targeting Laamu Atoll) to learn data gathering techniques and conduct data collection,
- Identifying potential collaborations with existing data producers (identified in Inception Report), including forming data sharing agreements, coordination, and other actions,
- Conducting the Ecosystem Accounting, in collaboration with MNU and RNF,

Once field and satellite imagery data have been collected, the data will be processed spatially using Geographic Information Systems (GIS) mapping software such as **ArcGIS Pro (ESRI)**. The data may then be extracted and processed within a statistical computing language (e.g., 'R') with outputs and the compilation of data tables in **Microsoft Excel**.

The field surveys require the hardware and materials detailed in Table 7.

Activity 4: Indicators and business accounts

Relevant indicators for businesses within the Maldives will be identified using previous works of the GOAP, detailed in the previous section. The indicators will be presented at a workshop and discussed, with guidance on compilation and data gathering written for those most relevant. These indicators will align, where possible, with the actions identified by the Ministry of Finance's Integrated National Financing Framework (INFF).

Table 7. Hardware and materials needed for field surveys.

Data collection	Materials required
Coral reef surveys	Handheld GPS, underwater camera, transect lines, quadrats, data sheets, and related scuba diving gear. Materials described in: Montano S, Siena F, Amir FH (2022) Coral Reef Restoration Monitoring Manual-Maldives. University of Milano-Bicocca, Milano, Italy
Seagrass surveys	Handheld GPS, underwater camera, transect lines, quadrats, data sheets, per the SeagrassWatch method .
Mangrove surveys	Handheld GPS, sectioned rope, data sheets.
Ground truthing	Handheld GPS, Dinghy, related snorkelling gear.

Activity 5: GIS Mapping and Management

The datasets will be mapped spatially using ArcGIS and stored as shapefiles within a spatial database. Once outputs for the project have been finalized, they will be stored on a sharable folder (OneDrive) between the project team and the MECCT. The inventory will contain the relevant metadata to facilitate the reuse of the spatial datasets.

Activity 6: Communication, dissemination, and outreach

A major component of the project will be the production of training materials and training of trainers across schools, the Maldives National University, the government and island and atoll councils. Specifically, the project will:

- Derive a step-by-step guide to develop the accounting with training materials for MECCT, MBS, local councils and island councils,
- Provide workshops for knowledge transfer and mainstreaming of NCA across stakeholders, specifically the training of trainers,
- Produce bespoke briefs for stakeholders, identifying relevant use cases and opportunities to embed into existing processes,
- Produce education materials for a variety of contexts, including primary, secondary and university level, to increase knowledge of concepts such as natural capital, ecosystem services, and environmental economic accounting.

Outcomes, impact, and sustainability

This section provides a comprehensive overview of the project's anticipated outcomes, impacts, and sustainability considerations, while also identifying preliminary lessons learned and providing recommendations for future actions. It also highlights the project's contribution to existing goals and targets outlined within relevant policy of the Government of the Maldives, including conservation, resource management, and climate action (Table 8).

The project is expected to provide the foundation and momentum for scaling NCA beyond Laamu Atoll, in providing:

- a data foundation to compile data across knowledge domains,
- methods relevant to Maldives ecosystems and their services,
- capacity building and training of trainers,
- developing a roadmap, supported by a technical committee on Natural Capital Accounting.

Table 8. Expected outcomes, impact, and sustainability from project actions.

Outcome, impact and sustainability	Description
Roadmap for scaling NCA across the Maldives	The experiences and lessons learnt from the project will inform the formation of a roadmap to scale findings to further locations across the Maldives. This includes the data foundation for ecosystem accounting, building capacity across the relevant stakeholders, and establishing an inter-departmental committee on NCA.
Developing methods for the Maldives	The project draws from global methods to produce guidance relevant for the Maldives. The project will test valuation and assessment of natural capital assets, and environmental monitoring resulting from the project.
Sustainability of NCA through capacity building	The project will engage with all relevant stakeholders, to build institutional capacity in NCA. Stakeholders include MECCT, MNU and the local Atoll council. The next generation of experts will also be engaged through capacity building activities with MNU students.
Linking NCA to key plans and policies	The outputs documents will provide a clear link between Maldives Government policies, plans and other frameworks to NCA.
Strengthening evidence for	The project will account for ecosystems and ecosystem services with direct and measurable links to economic sectors such as

sustainable development	fisheries and tourism in addition to a literature review and stakeholder consultation to identify relevant datasets.
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Conclusion

In conclusion, the MDV Technical Scope Report provides an overview of the scope of definitions, concepts, and activities required for natural capital accounting (NCA) of Laamu Atoll in the Maldives. The report outlines the project's scope, in line with enhancing reef ecosystem integrity and resilience through sustainable management, through the integration of NCA into national planning. The report also outlines the technical standards and guidelines required for NCA, including the System of Environmental Economic Accounts Ecosystem Accounting (SEEA EA).

The report provides a methodology for primary and secondary data collection, economic valuation methods, and other requirements. The report also outlines potential risks and mitigation strategies as well as relevant stakeholders and resources required for the project. Overall, the report provides a comprehensive assessment of the expected outcomes, impacts, and sustainability considerations of the project to demonstrate its environmental and social responsibility. The next steps for the project include the implementation of the proposed activities and deliverables within the established timeline and budget.

Annex

 **Defining decision-grade data for Natural Capital Accounting**

 **Domains and definitions**

[Maldives Datasets inventory](#)

Defining decision-grade data for Natural Capital Accounting

The following information is drawn from documentation on the System of Environmental Economic Accounts and the Taskforce for Nature Disclosures.

In thinking about the characteristics of decision-grade data, reference must be made back to the decision in question, but there are likely to be general characteristics which are common across all types of decision. When considering data quality, the compilers of Natural Capital Accounts should consider issues of:

- **Relevance:** Formal recognition as appropriate to the decision context (e.g., multilateral agreements, national policy) including the mechanism of recognition and the role of third parties in formal recognition of specific datasets.
- **Resolution (spatial and non-spatial) and scalability:** Fit for use at the right scale for the decision. A balance may be struck between the resolution and the complexity of processing the data. For example, sourcing may not be better informed by <1km resolution geospatial data, where sub-regional data may be easier and more straightforward to process.
- **Temporality:** Time series data can support trend analyses or real-time decision-making but must reflect the appropriate time scales for the indicator of interest (including forward looking analysis where relevant), but also the feasibility of collecting data using current or emerging technologies and collection techniques (e.g., species abundance).
- **Frequency of update:** Regularly updated or updated at appropriate timescales for the subject matter.
- **Geographic coverage:** including globally consistent and comprehensive. Data should be collected in a fashion and using metrics that permit aggregation and disaggregation to allow for attribution across portfolios, corporate footprints etc.
- **Accessibility:** Decision-grade data must be easily accessible online in different formats (e.g., direct downloads, web services, APIs), including considerations of costs were not open and freely accessible, as well as available in multiple languages.
- **Comparability:** Decision-grade data must facilitate comparison through interoperable formats and consistent methods that enable integration of financial, socio-economic and ecological data across sectors to inform outcomes. Data should be comparable across and within industries.
- **Thematic coverage:** Addressing specific components of nature (encompassing species, ecosystems and contributions to people), pressures on nature (point and non-point source direct and indirect) and responses (private, government, societal).

- **Authoritativeness including traceability:** If data have been through a peer-review process, whether published in the scientific literature, reviewed by peers, or a mandated process (e.g. CBD), and are recognised as accurate and authoritative. To assess authoritativeness, the data must also be traceable. Data is traceable if the original data source is clear as well as the “data trail” which lays out how the data has been translated by different users to arrive in its final format.

Domains and definitions

Definitions

The following section provides detailed scope considerations of domains for Natural Capital Accounting, and specifically ecosystem accounting, within Laamu Atoll.

- Environment,
- Society,
- Economy,
- Metrics and data.

For each domain, we:

- Provide a definition, and
- Identify the technical scope of the domain within the SEEA EA.

Environmental domain

The SEEA [defines](#) an **ecosystem** as “a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit”.

Ecosystems can be considered **natural capital**, that is responsible for the benefits to people that are contributed by nature. The specific benefits and contributions to individuals and society are called **ecosystem services**.

The area covered by ecosystems (i.e., extent) and measures of ecosystem health and functioning (i.e., condition) are within scope of the SEEA EA. Measurement of both extent and condition are needed to determine the supply of ecosystem services spatially.

Ecosystem services are the direct and indirect contributions of ecosystems to the benefits that are used in economic and other human activity. These services can be divided into three categories:

- provisioning services (e.g., fish provision),
- regulating and maintenance services (e.g., global climate regulation),
- and cultural services (e.g., recreation-related).

Ecosystem services are associated with the ecosystem's **biotic** components and processes. Note that the environment also provides **abiotic flows**. The abiotic flows are the benefits from the environment that are not supported by or dependent on ecological characteristics and processes (e.g. capture of wind, solar, tidal, geothermal, etc. or the extraction of fossil fuel, mineral, sand, or gravel).

Society domain

Ecosystem services are benefits that are used in economic and other human activity (i.e., society). In this sense, society is understood as the **users and beneficiaries** of ecosystem services.

In SEEA EA, society is defined as:

"the collection of individuals, organizations, and institutions that use and benefit from ecosystem services. It includes both the local and global communities and encompasses both current and future generations."

The SEEA EA recognizes that societies depend on the natural environment for their well-being and economic development. It also acknowledges that the use of ecosystem services can have impacts on the environment, and that these impacts can affect the sustainability of ecosystems and the provision of ecosystem services over time.

The SEEA EA identifies and quantifies flows from nature to the various stakeholders who use and benefit from ecosystem services. There are three main categories: **households, economic sectors, and government**. Ecosystem Accounting may also be used to identify the drivers of ecosystem change and the impacts of human activities on the environment. It considers how different economic sectors, such as agriculture, forestry, and mining, affect the continued supply of ecosystem services.

Economic domain

The SEEA uses concepts and definitions that align with the System of National Accounts, which provides guidance for compiling accounts for national economic activity (i.e., output, expenditure and income as both stocks and flows). Ecosystem Accounting links the supply of ecosystem services to their use by economic sectors, households and government. Linking Ecosystem Accounts to National Accounts is facilitated by accounts produced in monetary terms.

All economic activities that generate income and create wealth, such as the production of goods and services, investment, trade, and consumption, with inputs of goods or services from the environment are within scope. By linking the economy to the environment, **dependencies** may be identified, which further highlights the impact of changing environments to economic sectors. Further, the impacts of sectors to the environment may also be identified (i.e., emissions, solid wastes).

The difference between the society and economy domains in SEEA EA is that the former focuses on the use and benefit of ecosystem services by individuals and communities, while the economy domain focuses on economic activities that generate income and create wealth. The society domain looks at the distributional aspects of ecosystem services and

their impacts on different groups within society, whereas the economy domain looks at the production and consumption of goods and services, and their impacts on the environment. By integrating information from both domains, the SEEA EA framework provides a comprehensive understanding of the interactions between the economy, society, and the environment, which can inform policies and decision-making for sustainable development.

Metrics and data domain

While considerable nature-relevant data exists, current use by decision-making institutions is typically fragmented, disparate and inconsistent, as that data is not integrated into metrics and measures appropriate for these actors. Significant information and knowledge silos exist between institutions. Moreover, there is no comprehensive platform that standardises and aggregates data and metrics in a way that is relevant for decision makers.

The “metrics and data” domain considers which metrics and data are in scope, requirements for spatial resolution, and the data quality requirements to calculate the metrics required by its framework.

Data relevant to state, pressure and response: Metrics and data relevant to the state of nature, pressure on nature, and response to nature are in scope. The state-pressure-response progression may be helpful:

- State of nature: Data relevant to the extent and condition of ecosystems as natural capital assets, site importance and protection status, and conservation priority. This would not only provide information on ecosystems, but their governance and risks, to contextualize accounts for decision making.
- Pressure on nature: Data relevant to pressures on nature include the economic activities and the relevant **impacts** and/or **dependencies** this process has on nature.
- Response to nature: Data relevant to the response to nature include reporting on mitigation measures in response to the identified state and pressures on nature.

Other considerations include:

- Geospatial standardisation - Given the importance of spatially explicit data for NCA, SEEA EA should draw from existing frameworks and guidance to standardise units for geolocation (longitude and latitude) and define a framework for different scales of spatial resolution.
- Data quality and auditing: Consideration of data quality is in scope. This includes guidance to reporting entities on how to evaluate, the acceptability of, and a strategy to improve access to, the following dimensions of data quality: relevance, resolution, temporality, frequency of update, geographic coverage, accessibility, comparability, thematic coverage and authoritativeness (see **Annex**).

Staged approach

At all stages, data quality should be assessed according to predetermined criteria. See **Annex**)

Basic

- Data on state, pressure, and response to nature, for a specific ecosystem, linked to a relevant economic activity through a specific ecosystem service.
- For example, accounts could focus on coral reefs and their links to fisheries, through their ecosystem service of nursery habitats for commercial fish species.

Intermediary

- Data on state, pressure, and response to nature, for multiple ecosystems, linked to multiple relevant economic activities through ecosystem services.
- For example, accounts could focus on sub-tidal ecosystems (i.e., seagrass, coral reefs) and their links to fisheries, tourism and other dependent sectors through multiple ecosystem services.

Comprehensive

- Data on state, pressure, and response to nature, for all ecosystems, linked to all relevant economic activities through ecosystem services.
- Establishment of strategy for monitoring, data access and improving data quality.