ENVIRONMENT & NATURAL RESOURCE ACCOUNTING

ENVIRONMENT AND NATURAL RESOURCE ACCOUNTING MODULE provides basic understanding of the application of ENRA in climate change adaptation and mitigation planning and orients the reader in developing municipal accounts.

TRAINING MODULE FOR LOCAL PLANNERS

CLIMATE CHANGE COMMISSION

The Climate Change Commission, an independent and autonomous body that has the same status as that of a national government agency, is under the Office of the President of the Philippines. It is the lead policy-making body of the government which is tasked to coordinate, monitor, and evaluate programs and action plans of the government relating to climate change pursuant to the provisions of the Republic Act No. 9729 or the Climate Change Act as amended by Republic Act No. 10174 or the People's Survival Fund.

GLOBAL GREEN GROWTH INSTITUTE

The Global Green Growth Institute (GGGI) is a new international organization committed to strong, inclusive green growth. GGGI assists developing and emerging countries with integrating their ambitions for strong economic performance and environmental sustainability with the goal of bringing about poverty reduction, job creation, social inclusion, and climate change mitigation and adaptation. Headquartered in Seoul, GGGI was established by treaty in June 2012 at the United Nations Rio+20 Conference by an initial group of eighteen nations who share the organization's vision. To date, there are a total of 24 Member Countries who joined the organization. GGGI has a diverse portfolio of programs in developing countries around the world. These in-country programs, together with global products and services, focus on delivering results through an integrated approach of evidence based green growth planning and implementation aligned to countries' development priorities. The organization also focuses on knowledge development and management activities which build a strong theoretical and empirical basis for green growth, while providing concrete options and guidance for policymakers; as well as building the conditions for public and private green infrastructure investments.

PREFACE

The Philippines is highly vulnerable to the impacts of climate change. As witnessed through the devastation from typhoons Yolanda (2013), Glenda (2014), and Lando (2015), millions of Filipinos were affected and communities incurred costly damages and forced to rebuild. In anticipation of stronger typhoons hitting the country, climate change adaptation and mitigation is vital to the development and preparedness of Local Government Units (LGUs) and the people they serve.

The methodologies and tools offered in this publication are intended to raise national awareness and competence among national and local government institutions, civil society, private sector, and communities. This publication provides information outlining mechanisms on how to develop capacities of decision makers, local planners and trainers in integrating science-based assessments into policies, plans, and programs to make communities adaptive and resilient to climate risks.

This module is one of the many references that the users may utilize in developing their respective development plans.

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Disclaimer

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List of Acronyms

ANI	Adjusted National Income
ANS	Adjusted National Savings
CCC	Climate Change Commission
CCDRA	Climate Change and Disaster Risk Assessment
CDP	Comprehensive Development Plan
CDRVA	Climate and Disaster Risk Vulnerability Assessment
CLUP	Comprehensive Land Use Plan
CORE	Communities for Resilience
CVM	Contingent Valuation Method
DENR	Department of Environment and Natural Resources
EDP	Environmentally Adjusted Gross Domestic Product
ENI	Environmentally Adjusted National Income
ENRA	Environment and Natural Resource Accounting
EEA	Experimental Ecosystem Accounting
FDES	Framework for the Development of Environment Statistics
GDP	Gross Domestic Product
GNP	Gross National Product
GGGI	Global Green Growth Institute
GHG	Greenhouse Gas
GIS	Geographic Information Systems
GVA	Gross Value Added
LCCAP	Local Climate Change Action Plan
LCEs	Local Chief Executives
LGUs	Local Government Unit(s)
MEB	Material Energy Balance
M & E	Monitoring and Evaluation
NCCAP	National Climate Change Action Plan
NEDA	National Economic Development Authority
NNP	Net National Product
NRA	Natural Resource Assessment
NSCB	National Statistical Coordination Board
PEENRA	Philippine Economic, Environmental and Natural Resources Accounts
SNA	System of National Accounts
SUCs	State Universities and Colleges
TEEB	The Economics of Ecosystems and Biodiversity
ToT	Training of Trainers
UN SEEA	United Nations System of Environmental and Economic Accounting
VRA	Vulnerability and Risk Assessment
WAVES	Wealth Accounting and Valuation of Ecosystem Services
WTA	Willingness to Accept

Definition of Terms

Ecosystem - is a dynamic complex of plant, animal, and micro-organism communities, and their non-living environment interacting as a functional unit.

Ecosystem accounting - is a coherent and integrated approach to the assessment of the environment through the measurement of ecosystems, and measurement of the flows of services from ecosystems to economic and other human activity.

Ecosystem Asset - naturally occurring entities that provide environmental "functions" or services.

Ecosystem Condition - is the capacity of that ecosystem to yield services, relative to its potential capacity.

Ecosystem Services - are the benefits provided by ecosystems that contribute to make human life both possible and worth living.

Environment and Natural Resources Accounting - integrating complex biophysical data, tracking changes in environment, and linking those changes to economic and other human activity.

Environmental Goods and Services - environmental products are goods and services that are produced for the purpose of preventing, reducing, and eliminating pollution and any other degradation of the environment (environmental protection - EP), and preserving and maintaining the stock of natural resources, hence safeguarded against depletion.

Exchange Value - the quantified worth of one good or service expressed in terms of the worth of another. In political economy and especially Marxian economics, exchange value refers to one of four major attributes of a commodity, *i.e.*, an item or service produced for, and sold on the market. The other three aspects are use value, economic value, and price.

Gross Value Added - (GVA) in economics, is the measure of the value of goods and services produced in an area, industry, or sector of an economy. In national accounts, GVA is output minus intermediate consumption; it is a balancing item of the national accounts' production account.

Land Accounting - Land accounting that measures the change in the land and its attributes resulting from the impacts of human and natural activities.

Market Value - the highest estimated price that a buyer would pay and a seller would accept for an item in an open and competitive market; the amount for which something can be sold in a given market.

Natural Capital – from the definition of the Wealth Accounting and the Valuation of Ecosystem Services (WAVES), natural capital is the world's stocks of natural assets, which include geology, soil, air, water, and all living things. It is from this Natural Capital that humans derive a wide range of services, often called ecosystem services, which make human life possible. Natural capital includes all of the resources that we easily recognize and measure, like minerals, energy, timber, agricultural land, fisheries, and water. It also includes the ecosystem services that are often “invisible” to most people, such as air and water filtration, flood protection, carbon storage, pollination of crops, and habitats for

wildlife. These values are not readily captured in markets, so how much these contribute to the economy are not really known. These services are often taken for granted, and humans don't know what it would cost if these are lost.

Natural resource accounting - is an accounting system that deals with stocks and stock changes of natural assets comprising biota (produced or wild), subsoil assets (proved reserves), water and land with its aquatic and terrestrial ecosystems.

Non-Market Value - most environmental goods and services such as clean air and water, and healthy fish and wildlife populations, are not traded in markets. Its economic value –how much people would be willing to pay for these- is not revealed in market prices.

Physical accounts - refer to the natural resource and environmental accounting of stocks and changes in stocks in physical (non-monetary) units, for example, weight, area, or number.

Resource Rent - in economics, rent is a surplus value after all costs and normal returns have been accounted, *i.e.,* the difference between the price at which an output from a resource can be sold and its respective extraction and production costs, including normal return.

Total Economic Valuation - total of the values including direct, indirect, option, and existence values of the natural resources; a concept in cost-benefit analysis that refers to the value derived by people from a natural resource, a man-made heritage resource, or an infrastructure system, compared to not having it. It appears in environmental economics as an aggregation of the (main function based) values provided by a given ecosystem. Those include use and non-use values.

Valuation - appraising or estimating the worth of something having economic or monetary value.

Wealth Accounting – is the measure of the value of all the assets of worth owned by a person, community, company, or country. Wealth accounting is measuring the physical and total market value of all the physical and intangible assets of the entity.

Willingness to accept (WTA) - is the minimum amount of money that a person is willing to accept to abandon a good or to put up with something negative, such as pollution.

Willingness-to-Pay - is the maximum amount an individual is willing to sacrifice to procure a good or avoid something undesirable. The price of any goods transaction thus is any point between a buyer's willingness to pay and a seller's willingness to accept.

I. Introduction

1.1. Overview of the Module

The conduct of Environment and Natural Resource Accounting (ENRA) is recommended to establish a baseline of resources and ecosystem services, provide basis for appropriate pricing of these resources and ecosystem services, to inform policy, initiate green income accounts, and monitor the impact of climate change adaptation on local economic development. The ENRA can also be used as a tool to support local actions that address the prevalence of poverty among communities living within various land-use zones in supposedly resource-rich areas. It is recognized that marginalized people are dependent on resources found within these areas. These residents are vulnerable to human-induced and natural disasters. Only when their vulnerable status is decreased can natural resources truly serve its purpose of providing resilience against the adverse impacts of climate change.

The goal is to develop an accounting framework at the local level to produce an estimate of the contribution of natural resources to local economic and other human activities. This estimate, for instance, the local Gross Domestic Product (GDP), should reflect or indicate sustainability of natural resources, and the contribution of ecosystem services in the local economy. A provincial, island, or municipal GDP, much less "green" GDP, is uncommon, and a review of literature revealed that none exists in the country. Readers may refer to the dissertation of Castillo (Castillo, 2001) for a review of natural resources accounting frameworks and related studies, and why is there a need for local environment and natural resources accounts.

Much of the efforts towards development of environment and natural resources accounts in the country were undertaken through the United States Agency for International Aid (USAID)-funded ENRAP projects, but its scope was either national, sectoral, or site-specific accounts, and much remains to be done. Inputs from environmental scientists, other social scientists and ecologists are needed to come up with physical estimates of regulating, cultural and supporting ecosystem services, after which, a valuation follows. Nonetheless, the accounts developed are flexible for future adjustments to include additional sectors and even ecosystem services.

What is important is that the accounts can be used for local planning and decision-making. Whether it is municipal or provincial is largely defined by the scope of decision-making. Much of the decision-making is at the municipal level, so much so that the ENRA was designed for use at the municipal level.

1.2. Objectives of the Module

At the end of the Communities for Resilience (CORE) Initiative training program, trainers will be able to:

- Acquire basic knowledge and understanding in developing ENRA for the local government unit's (LGU) area of jurisdiction;
- Acquire knowledge on the various processes of ENRA that can be used at the LGU;

- Acquire knowledge on the use of tools in order to develop ENRA at the local government unit level.

1.3. Brief Description

The entire training of LGU planners, to be facilitated by trainers, is designed to be experiential with technical inputs from resource persons on the methodologies and exercises from cases. The training for LGU planners includes a mix of participatory and adult learning approaches. The training will involve lectures and simple group interaction exercises. It begins with an orientation on the basic concepts of environmental and natural resources accounting, and ecosystems accounting. These methods and processes are largely based on the guidelines of the United Nations System of Environmental and Economic Accounting (UN SEEA) Central Framework and the UN SEEA Experimental Ecosystem Accounting. Emphasis on the UN SEEA guidelines is borne from the international imperatives to standardize accounting standards so that agreed indicators are comparable. Examples from prior ENRA projects and ecosystem accounting based on the Wealth Accounting and Valuation of Ecosystem Services (WAVES) methodology are included to provide participants with a breadth of tools and methods to use in ecosystem accounting. The emphasis for local planners is to learn the processes in developing the accounts.

1.4. Relevance of the Module

Planning by Local Government Units in view of climate change hazards and goals of resilience, must highlight natural resources as a capital to be sustained and thus, must be integrated in local planning and management. This requires assessment of ecosystems, identification of priority ecosystem services, and inform land use and development planning. Environment and Natural Resource Accounts are critical inputs in Forest Land Use Plans (FLUPs) and Comprehensive Land Use Plans (CLUPs), which integrate objectives of natural capital sustainability. From the river basin perspective, taking into account the integrated ecosystem and landscape approaches, understanding of ecosystems and its interrelations with the economy is vital in integrated planning. These approaches require the development of environmental statistics using a comprehensive and coherent framework based on the concept of ecosystems, and linked to socioeconomic data.

1.5. Summary of Topics

In view of the level of participants, this Module for Local Planners covers the foundations, origins, and concepts of environment and natural resource accounting, and the various frameworks presently accepted as international standards, such as the United Nation System of Environmental and Economic Accounting (UN SEEA) Central Framework, and the currently suggested Experimental Ecosystem Accounting (EEA) Guidelines. The training of local planners also covers methods and tools of physical and monetary accounting, and integrating the accounts in local development plans and programs. Participants are to experience at least one standard tool, and learn from cases of ENRA in the Philippines. The main topics covered are summarized in Table 1.

Table 1. Topics covered in the ToT with corresponding objectives and training approaches

Topics Covered	Objective	Learning Process/Method
Foundations of ENRA		
• **What is ENRA?** • **Use of ENRA for score-keeping and policy development**	At the end of the module, participants will acquire basic knowledge of the economic foundation of ENRA.	Prior to the lectures, there will be a diagnostic examination to gauge the knowledge of participants. There will be a written examination after the Module. Lecture-discussion and exercises.
Environment and Resource Accounting Processes		
• **Economic valuation approaches and Discounting**	At the end of the session, participants will acquire basic knowledge of valuation approaches.	Lecture-discussion prepared exercises.
• **Key Accounts for Local Government Units**	To highlight the importance of developing the accounts for local policy , plans, and programs	Lecture and demonstration
• **Land Resource Accounting**	At the end of the session, participants will acquire basic knowledge of the methodology on accounting and valuing land resources.	Lecture-discussion with prepared exercises.
• **Forest Resource Accounting**	At the end of the session, participants will acquire basic knowledge of the methodology on accounting and valuing forest resources.	Lecture-discussion with prepared exercises.
• **Fishery Resource Accounting**	At the end of the session, participants will acquire basic knowledge of the methodology on accounting and valuing fishery resources.	Lecture-discussion with prepared exercises.
• **Environmental Waste Disposal Services**	At the end of the session participants will acquire basic knowledge of the methodology on accounting and valuing EWDS.	Lecture-discussion with prepared exercises.
Integrating ENR in Municipal Accounts		
• **Social Accounting Approach to Generating the Municipal Accounts**	At the end of the session, participants will acquire basic knowledge of social accounting methodology.	Lecture
• **Generating Gross Value Added**	At the end of the session, participants will acquire basic knowledge on using social accounting data in building a municipal account.	Lecture-discussion in plenary followed by an exercise.

Topics Covered	Objective	Learning Process/Method
ENRA and Climate Change		
• **Use of NRA and ENRA for Local CC Mitigation & Adaptation Planning**	At the end of the module, participants will gain understanding on how NRA-ENRA can be used in CC adaptation and mitigation planning.	Lecture-discussion followed by an experts' panel discussion.
• **Use of NRA-ENRA in policy development**		Lecture-discussion followed by small group discussions on CC policy implication of ENRA.
• **Module Evaluation**		There will be self-evaluation and written examination to gain progress from the result of the diagnostic to knowledge after the training sessions. The participants will also be asked to evaluate the training program and suggest improvements.

II. Module Content

2.1. What is ENRA?

Environmental and natural resource accounting deals with measuring and valuing the stocks and stock changes of natural assets comprising biotic and abiotic resources, including subsoil assets, water and land with its aquatic and terrestrial ecosystems. Valuation in natural resources and its capital is emphasized in order to be linked to indicators of economic growth in order to support policies and decisions at the national and local level.

This module covers orientation on various economic indicators such as GDP, and Net National Product (NNP), which are used as indicators of economic growth, and its inadequacy as measures of growth, hence must be adjusted. Discussions on sustainability of environmental and natural capital and use of alternative measures of economic growth, in view of the goal of sustainable economic growth and climate change resilience, are covered by lectures. Historical discussions on environmental accounting and it origins provide the backdrop to the current demand for ENRA. Part of the discussion includes how the UN SEEA frameworks came about.

This includes presentation of various approaches used in different countries prior to the development of an internationally-accepted standard of environmental and natural resource accounting. The general categories of approaches include:

- Identification and reclassification of environmental expenditures;
- Physical resource accounting approaches;
- Depreciation of marketed natural resources (Adaza, 1992), including macro-economic aggregate adjustment (El Serafy and Lutz); and
- Full environmental and natural resource accounts with valuation, which is the approach promoted by The Economics of Ecosystem and Biodiversity (TEEB)

This section includes presentation of the UN SEEA Central Framework and the UN SEEA Experimental Ecosystem Accounting Guide, both of which are linked to the System of National Accounts.

UN SEEA Central Framework

The System of Environmental and Economic Accounting (SEEA) Central Framework is a multi-purpose conceptual framework that describes the interactions between the economy and the environment, and the stocks and changes in stocks of environmental assets.

- Using a wide range of information, the SEEA Central Framework provides a structure to compare and contrast source data and allows the development of aggregates, indicators, and trends across a broad spectrum of environmental and economic issues. Particular examples include the assessment of trends in the use and availability of natural resources, the extent of emissions and discharges to the environment resulting from economic activity, and the amount of economic activity undertaken for environmental purposes.

- At the heart of the SEEA Central Framework is a systems approach to the organization of environmental and economic information that covers, as completely as possible, the stocks and flows that are relevant to the analysis of environmental and economic issues. In applying this approach, the SEEA Central Framework integrates the accounting concepts, structures, rules, and principles of the System of National Accounts. In practice, environmental-economic accounting includes the compilation of physical supplies and use tables, functional accounts (such as environmental protection expenditure accounts), and asset accounts for natural resources.

- The integration of information concerning the economy and the environment requires an interdisciplinary approach. The SEEA Central Framework brings together, in a single measurement system, information on water, minerals, energy, timber, fish, soil, land and ecosystems, pollution and waste, production, consumption, and accumulation. Each of these areas has specific and detailed measurement approaches that are integrated in the SEEA Central Framework to provide a comprehensive view.

- The concepts and definitions that comprise the SEEA Central Framework are designed to be applicable across all countries, regardless of the level of economic and statistical development, economic structure, or composition of the environment.

- The SEEA Central Framework also provides a foundation for related topic and theme-specific statistical publications. There has already been substantial work on the topics of water and fisheries, a publication on energy is under development, and there are future plans for publications covering the topics of agriculture and land.

- The SEEA Central Framework is accompanied by two related parts: the SEEA Experimental Ecosystem Accounts, and SEEA Extensions and Applications. The expected content of these parts is outlined later in this section.

UN SEEA Experimental Ecosystem Accounting

- SEEA Experimental Ecosystem Accounting extends the range of flows measured in physical and non-monetary terms. The SEEA Central Framework focuses on the flows of materials and energy that either enter the economy as natural inputs, or return to the environment from the economy as residuals. Many of these flows are also included as part of the physical flows recorded in ecosystem accounting (*i.e.,* flows of timber to the economy). In addition, SEEA Experimental Ecosystem Accounting includes measurement of ecosystem services that are generated from ongoing ecosystem processes (such as the regulation of climate, air filtration, and flood protection) and from human engagement with the environment (such as through recreation activity).

- SEEA Experimental Ecosystem Accounting considers environmental assets from a different perspective compared to the SEEA Central Framework. Environmental assets, as defined in the Central Framework, "are the naturally occurring living and non-living components of the Earth, together comprising the biophysical environment that may provide benefits to humanity." This scope is broader than the physical asset boundary used in the System of National Accounts (SNA) which is limited to assets that have an economic value in monetary terms. Thus, for example, in the SEEA all land is included regardless of its value. This broad scope encompasses two complementary perspectives on environmental assets. The first perspective, which the SEEA Central Framework's focus, deals with environmental assets in terms of individual resources (*i.e.,* timber, fish, minerals, land, etc). The second perspective, which the SEEA Experimental Ecosystem Accounting's focus, considers the biophysical environment through the lens of ecosystems in which various biophysical components (including individual resources) are seen to operate together as a functional unit. Thus, ecosystem assets are environmental assets seen from a systems perspective.

2.2. Why ENRA?

As the national government pushes towards increasing autonomy in local governance, local government units are compelled to look at its internal resources if it can support the local economy. Compounding the pressure is the threat of climate change hazards that pose continuing threats to communities' resilience. Always, many economic production activities are severely hampered by such calamities increasingly degrading natural resources. It therefore imposes upon the municipality to have continuing information on the status of its resources, including all forms of local capital to sustain the local economy and strengthen community resilience. Knowing the condition and extent of an LGU's natural capital will help define alternatives when climate change hazards weaken its capacity. Beyond organizing the information, creating the link to local economy will help build concrete actions.

Accounting of the environment and natural resources is essential because the productivity of the ecosystems and its natural resources are linked to the productivity of economic production entities. The municipality must have an accounting of its natural resources in order to know if its economic activities can be sustained through local production to meet consumption needs. The results of accounting form the basis of every development plan. Consequently, effective policy responses must be

exhibited at all levels of governance. As bulk of decision making and direct control over natural resources are being exercised at the municipal level, a municipal account serves as a tool for decision-making and policy implementation.

This sub-topic discusses in brief detail the inadequacies of economic growth measures, and identifies the missing components of these indicators. This includes explanations on:

- How depreciation measures neglect other forms of capital such as a nations' stock of water, soil, air, non-renewable resources, and wildlands;
- Natural and environmental resources as generally not included in balance sheets;
- Failure of cleanup costs to take into account previous environmental damages; and
- Non-trading of many environment and natural resource goods and services in markets.

These constitute the main basis for the development of environment and natural resources accounting methods that are intended to be linked to economic indicators.

2.3. Application of ENRA

2.3.1 Overview of Process

The process of developing ENRA spins from the conceptual framework of the economy and environment linkage. The conceptual framework provides the main rational for the valuation method and natural resource accounting. The tools used in developing the environment and natural resources accounts at the municipal level includes focus group discussions, key informant interviews, household surveys, map analyses, and modelling of natural resource processes. Applying these tools require expertise from physical, biological, and social science disciplines working on forest, agriculture, coastal and marine, and water sector. Data collection requires field surveys, sampling, discussions with local managers and planners, conduct of workshops, household interviews, and analyses of remote sensing data and mapping. Details of each methodology are provided in separate reports by experts who undertook data collection and analysis of results.

2.3.2 The Conceptual Framework

It is recognized that economic activities use the environment and natural resources (ENR) for inputs in production activities, and as sink of its byproducts. Figure 1 shows the link of environment and natural resources to economic and other human activities. For purposes of clarity, ENR is disaggregated into the different major ecosystems that provide services to these human activities. In the context of economic activities, ENR is distinguished from ecosystems. The former are treated as source of natural capital, whereas the latter provide both natural resources and services needed not only in economic but also other human activities. Terrestrial, aquatic, and marine ecosystems provide renewable and non-renewable resources to support economic activities and also provide ecosystem services, which in most cases are not accounted in economic valuation.

Ecosystems' goods and services enter almost all economic production, consumption, aesthetic, and/or cultural needs, and are therefore essential to sustain the well-being of communities. However, the ability of ecosystems to sustain its inputs is governed and influenced by natural processes, climatic changes, extreme or natural calamities, and by human exploitation activities.

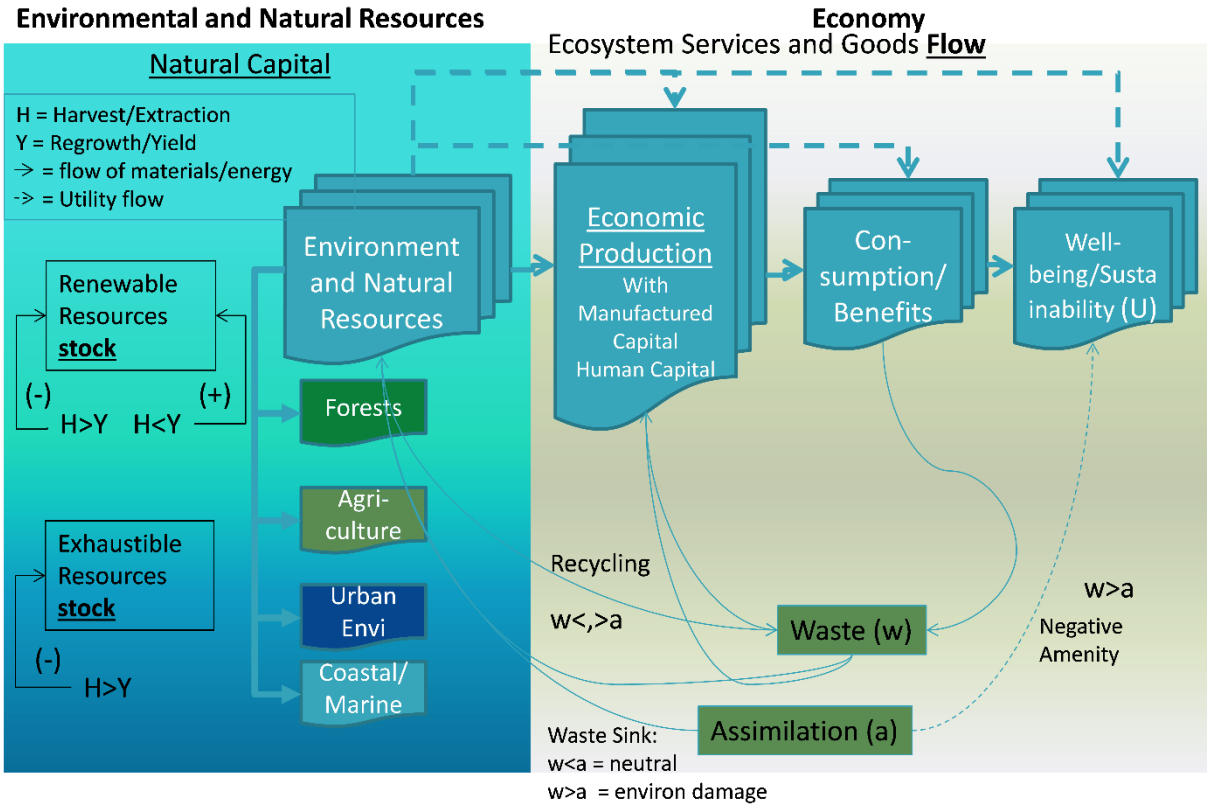

Figure 1. Schematic Framework of the NRA

Changes due to normal natural processes are of less concern because its effects are regulated and steady. Of greater concern is the exploitation caused by economic and human activities. In the case of renewable resources, the harvest or draw down is replenished by natural growth, provided that sufficient mass or growing stock of resources remains after each event of human exploitation. If human exploitation of the resource exceeds its rate of recovery, the resource stock declines. Once the renewable resource stock declines beyond the threshold or its ability to recover, the result is depletion. In the case of non-renewable resources, recovery takes a longer gestation period so that over the human horizon, it trends towards depletion. The stock of non-renewable resources can rapidly decline if human exploitation intensifies and where exploitation technologies are resource-intensive and inefficient, thereby not maximizing the extraction of the vital resource.

Ecosystem capacity is also impacted by byproducts and wastes of human and economic activities, such that if waste discharges exceed its assimilative capacity, the ability to provide inputs is reduced. In turn, a compromised assimilative capacity produces negative amenity such as air, land, and water pollution, thereby reducing human welfare. Thus, the usefulness of natural resource assessment is in documenting the link of economic and human activities via the drivers and pressures of ecosystem change, and measuring the impacts on the state of the ecosystem.

A forward-looking process of assessment begins with identifying the **DRIVERS (D)** of changes in ecosystems and its provision of services. These drivers are largely dictated by population dynamics, including migration and technological changes. Among the many drivers are agriculture, forestry, fisheries, mineral production, housing and settlements, manufacturing and processing, and urbanization coupled with transportation and energy demands. The intensification of these drivers increases the pressures on the ecosystems and its services. The **PRESSURES (P)** come through different means such as clearing of vegetation, land conversion, logging, farming, infrastructure development, water use and abstraction, waste water discharges, release of pollutants, solid waste discharges, reclamation, expansion of plantations, intensified transportation, discharge of sediments to water bodies, and the likes.

The key element of NRA is to measure the current **STATE (S)** of the ecosystem and its ability to provide ecosystem services in the face of these pressures. The assessments also identify **IMPACT (I**) indicators (*i.e.,* declining, increasing, or sustaining the quantity, quality, and trend) in both physical and monetary terms to provide managers, policy and decision makers with information to make the appropriate **RESPONSES (R)** in order to sustain or conserve the ecosystem and its services. The biological, physical, and monetary accounts developed through the natural resource assessment become the information system that serves as basis for solutions in terms of plans, programs, and legislations at the local, sub-national, and national scale. The information system combines spatial (*i.e.,* maps, images) and time series information (both cross section and panel data), and are presented in appropriate scale, form, and structure understandable for meeting economic growth targets, climate change adaptation measures, assessment of different aspects of resiliency, poverty alleviation, and food security. Thus, natural resource assessment is an essential step in development planning, especially green development.

2.3.3 Physical Processes Modelling

In implementing the framework, the natural resource assessment has both spatial and temporal dimensions. The spatial dimension of the assessment covers natural resources from the “ridge to the reef” –including those in the upland, lowland, coastal and marine ecosystems, or in terms of areas covered such as forests, agriculture, urban, and coastal and marine areas. The temporal dimension requires assessing the changes in condition and capacity of these resources and ecosystems over time. Table 2 summarizes the components that link drivers and associated pressures of ecosystem change to the state and impacts on natural resources. The table is further extended so that data requirements, assessment tools and techniques for NRA are listed:

Table 2. Drivers of ecosystem change and its impact accounts

Drivers of ENR and Ecosystem Changes	Pressure Accounts	State Accounts	Impact Accounts (Ecosystem Services, Condition, Capacity)	Data Needs, Tools and Techniques
A. Terrestrial/ Land-based Drivers (Upland and Lowland Ecosystems)				
1. Agriculture	Clearing of vegetation (Logging, slash and burn, cultivation)	Land cover extent	Land cover change, siltation	Land cover map, two periods
	Monoculture cropping	Pesticide residues	Acid soils and pollution	Land use map
	Irrigation systems and discharges	Water and soil resources	Sedimentation, eutrophication, water deficits	Water balance; Water quality assessment
	Large-scale agriculture discharges	Water resources	Algal bloom, etc.	Water balance; Water quality assessment
	Small-scale farming erosion	Soil erosion/ Surface run-off	Anaerobic conditions reduce oxygen level, leading to fish kills;	Land use maps Total suspended solids, soil erosion
		Nutrient and sediment deposits	Increasing alkalinity, thereby promoting anaerobic conditions	
2. Forestry	Logging: Clearing and erosion	Timber and non-timber resources; Land cover and soil erosion control	Land cover change Land cover change; Rising methane, nitrates, phosphates	Land cover map; Timber and non-timber assessment
	Slash and burn (Kaingin): Clearing and erosion	Land cover and soil erosion control	Shallowing of water bodies	Remote sense data, FGDs, and household surveys
	Infrastructure: Clearing and concreting of open areas	Soil erosion, flooding, sediment transport	Water bodies-level rise resulting to flooding of coastal settlements	Remote sense data, FGDs, site visits, and surveys
			Flooding of coastal settlements	Hydrologic modelling, precipitation,

Drivers of ENR and Ecosystem Changes	Pressure Accounts	State Accounts	Impact Accounts (Ecosystem Services, Condition, Capacity)	Data Needs, Tools and Techniques
				and other climate data
3. Housing and Settlements	Clearing and concreting of uplands and lowlands	Sediment load	Reduction of population of aquatic life	Locations of settlements; land use maps
	Abstraction of water	Seasonal volume of surface water	Increase in population of species (invasive species)	Supply and Use data on water (Supply and Use Accounts)
	Waste water/effluent discharges	Chemical deposits in water bodies		Field surveys, and remote sensing
	Land development with infrastructures and discharge systems	Volume of solid wastes		Land use maps, field surveys, and household surveys
		Soil erosion/ Surface run-off		Sediment modelling
4. Livestock and poultry	Waste water discharges	Biochemical composition of water bodies	Reduction in water quality/ Eutrophication	Sources and Production; Energy sources (ES) used
	Solid wastes	Depth of water bodies	Shallowing of water bodies bed	
		Increasing alkalinity	Reduction of water bodies biodiversity and wildlife	
5. Mining	Open-pit mining: Clearing and soil erosion, sediment transport	Sediment loads	High concentration	Sources and Production; Energy sources used
	Discharge of mine tailings	Chemical deposits in water bodies		Monitoring reports on discharges
6. Services	Waste water discharges	Chemical deposits in water bodies		

Drivers of ENR and Ecosystem Changes	Pressure Accounts	State Accounts	Impact Accounts (Ecosystem Services, Condition, Capacity)	Data Needs, Tools and Techniques
	Transport intensification	Chemical deposits in water bodies		
	Expansion of commercial centers	Air and water quality	Air and water pollution impacting health and work hours	
7. Energy	Drilling, release of toxic chemicals	Air and water quality	Land cover change, erosion and sedimentation, air and water quality	Air and water quality sampling, soil erosion and sedimentation modelling
8. Manufacturing and Processing	Extraction of natural resource inputs, release of byproducts to air, soil, and water	Air, soil and water quality, and land productivity	Land cover change, erosion and sedimentation, air and water quality	Air and water quality sampling, soil erosion, and sedimentation modelling
9. Transportation	Vehicle discharges; Intensified road infrastructures	Chemical deposits in water bodies	Air and water pollution, congestion	Air and water quality sampling
10. Tourism	Construction of infrastructure for resorts	Solid wastes		
	Waste water/effluent discharges	Easements and flood regulation		
11. Urbanization	Clearing and concreting of uplands: Rapid water flow and sediment discharges	Soil erosion control	Sedimentation	
	Reclamation programs and projects: Landscape change, water bodies area reduction	Rate of sediment flows	Shallowing of some areas	Bathymetry
	Waste water discharges disposal	Chemical deposits in water bodies		

Drivers of ENR and Ecosystem Changes	Pressure Accounts	State Accounts	Impact Accounts (Ecosystem Services, Condition, Capacity)	Data Needs, Tools and Techniques
	Intensified infrastructures, highways bordering water bodies			
12. Fishery	Uncontrolled open-capture fishery and extensive use of efficient gears	Fishery species stock		
	Expansion of cage culture	Habitat quality		
	Excess feeds deposition	Fish kills		
	Expansion of mariculture	Mangrove conversion, land cover change	Mangrove extent decline	Mangrove mapping
13. Navigation/ Transportation	Intensified transportation: Congestion and habitat disturbance	Habitat quality		
	Transportation infrastructure: Landscape change	Water quality		
	Waste water discharges	Chemical deposits		
14. Expansion of coastal settlements	Foreshore infrastructure development			
	Clearing of coastal/ mangrove vegetation			
	Introduction of exotic species	Fish stock/ biomass		
	Introduction of invasive species	Fish composition		
B. Natural Drivers				
1. Precipitation	Flooding	Water level, inundated areas and duration	Loss of productive areas	

Drivers of ENR and Ecosystem Changes	Pressure Accounts	State Accounts	Impact Accounts (Ecosystem Services, Condition, Capacity)	Data Needs, Tools and Techniques
2. Sea Level Rise	Tidal intrusion and salinization of farms	Water level, inundated areas and duration; habitat condition	Loss of habitat, reduced productivity	
3. Storm Surge	Tide intrusion and flooding			
4. Drought	Reduced water availability			
5. Others				

2.3.4 Accounting Process

Figure 2 below summarizes the processes of environment and natural resources accounting, which is similar in many ways with ecosystem accounting processes. These processes are briefly discussed during the training process.

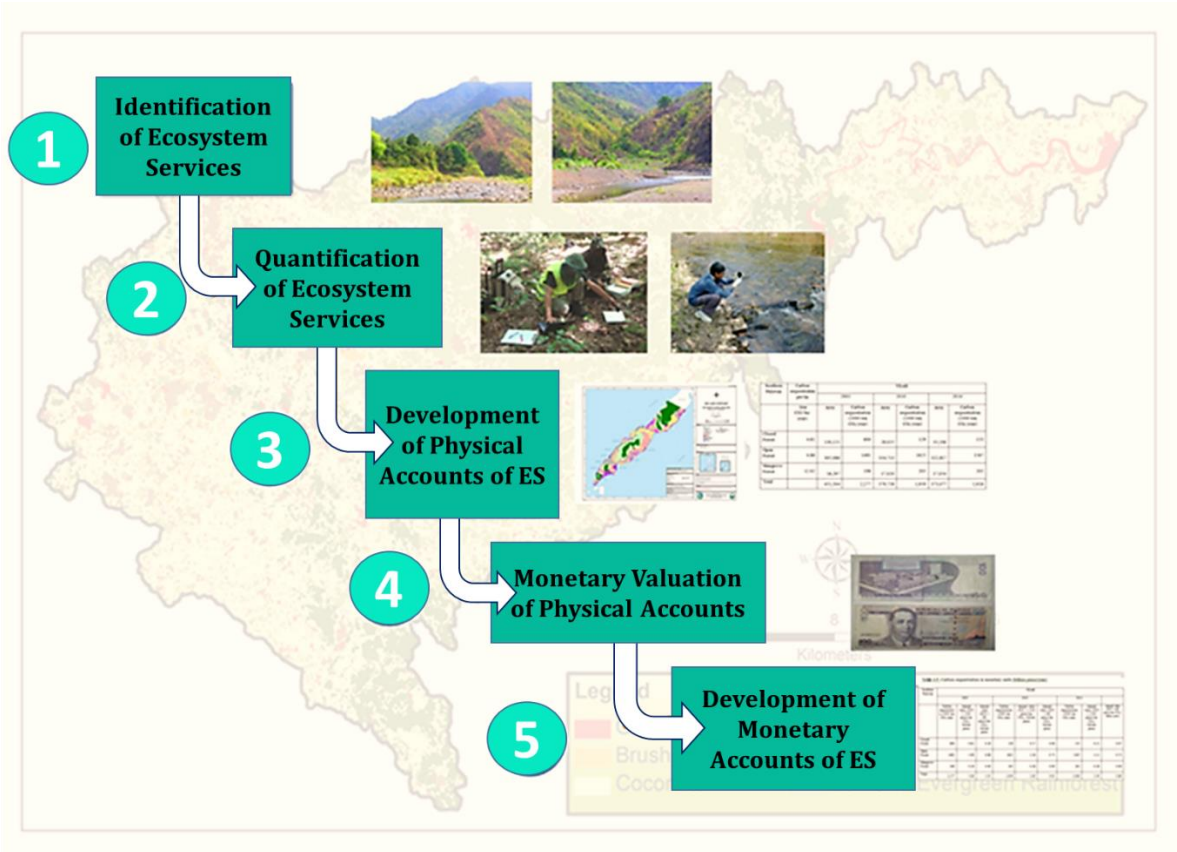

Figure 2. Simplified environment and natural resources accounting process

2.3.5 Familiarization on Ecosystem Goods, Ecosystem Services, Ecosystem Assets, and Ecosystem Condition

Participants need to fully understand and distinguish ecosystem and ecosystem services. This is presented through a PowerPoint presentation of ecosystem goods, ecosystem services, ecosystem assets, ecosystem condition, and categories of ecosystem services and examples. Figure 3 summarizes the relations of environmental goods, services, assets, and ecosystem services and its link to economic accounts.

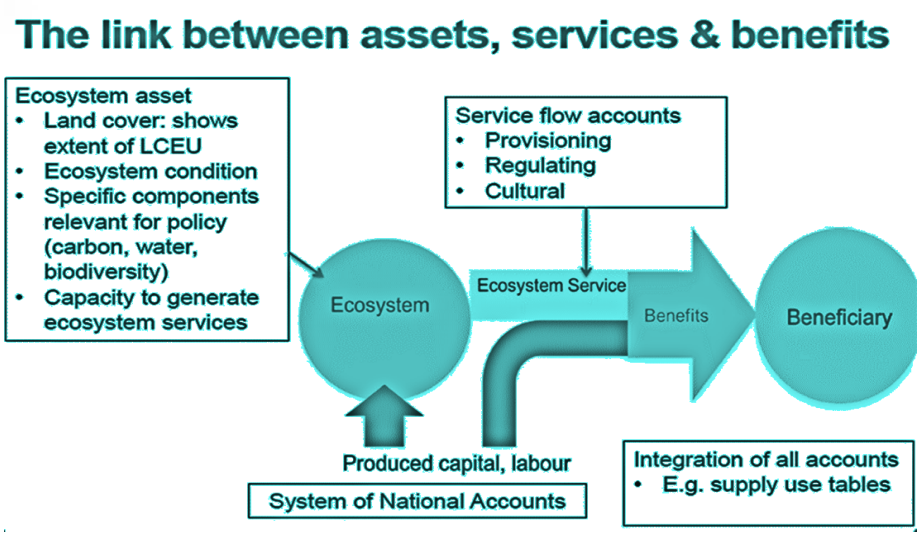

Figure 3. Overview of environmental goods, services, benefits and ecosystems

2.3.6 Physical Accounting Approaches

Prior to the development of the UN SEEA, several countries developed methodologies on physical accounting. Among those that are discussed:

- Material Energy Balance (MEB) approaches, which analyzes material flow between environment and economy;
- Framework for the Development of Environment Statistics (FDES), promoted by the UN Statistical Division that aims to measure the emission of certain residuals of economic activities and its impact on the quality of environment, media; and
- Natural Resource Accounting approaches by various entities, an approach that complements MEB.

Physical accounting is not independent of any government policy or program.

The training uses guidelines in the UN SEEA Central Framework and Experimental Ecosystem Accounting, in developing the accounts. The ENR accounts support local policy and management decisions. In which case, the policy question determines the account to be developed. Subsequently, data collection methods and tools are dictated by the environmental and natural capital and ecosystem services most prioritized. It then follows that the accounting begins with select ENR and ecosystem services to be measured,

as not all can be covered. The basic accounting unit and scale of the accounts then follows the priority ecosystem services.

Figure 4 illustrates the scale and detail of the accounting structure. The proposed scheme is based on how the different land use policies are implemented within the municipality. In this example in Palawan, the accounts have spatial details for: a) Environmentally Critical Areas Network zones (an implementation mechanism of the Strategic Environmental Plan law specific to Palawan); b) national land classification based on Presidential Decree 705 and subsequent land use laws and administrative orders; c) existing tenure within the area; and 4) tenure and community land entitlements.

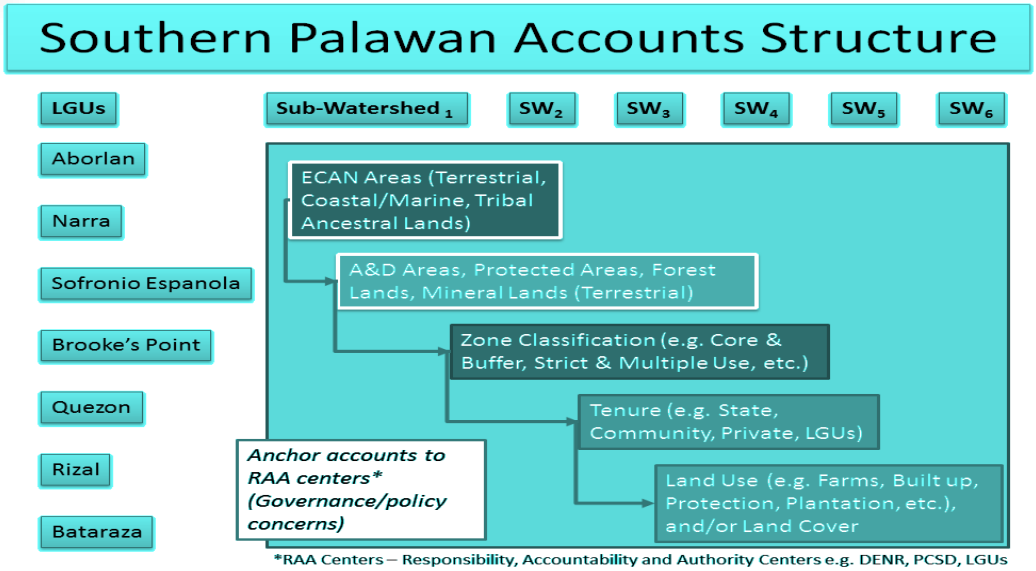

Figure 4. Model structure of local ENR aligned with national and local land use policies

At site level, using the same example for Southern Palawan, the ecosystem account can provide spatial details by land use through the Basic Spatial Unit (BSU), in accordance with UN SEEA Guidelines. The accounts can include ecosystem services and ecosystem assets. The latter can include both ecosystem condition and ecosystem capacity as shown in Figure *5*.

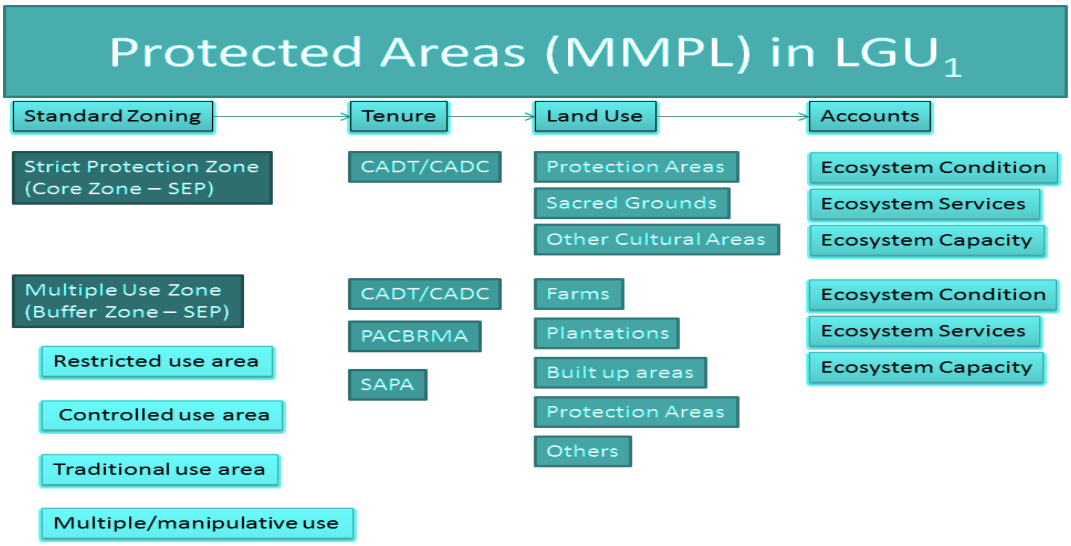

Figure 5. Model structure of site-based ENR Accounts for land use planning

2.3.7 Monetary valuation and accounting

The training provides an orientation on valuation methods that range from market to non-market, but the discussions on valuation emphasizes exchange values, in view of the UN SEEA's use of market or exchange value approaches. Nonetheless, non-market valuation methods, and its differences with market approaches are explained. Figure 5 shows the valuation process which applies to other environment and natural capital.

2.3.7.1 Valuation Approaches

The appropriate valuation approach differs by type of ecosystem service since different ecosystem services contribute to economic and other human activities linked to benefits and well-being in different ways.

In the context of comparing values of ecosystem services with values in the national accounts, the objective is to value the quantity of ecosystem services at market prices that would have occurred if the services had been freely traded and exchanged. This market price reflects consumers' marginal willingness to pay for the ecosystem service at market equilibrium quantity of services. In the case of ecosystem services not traded in a market, alternative approaches to establish a price for the ecosystem, in line with SNA accounting principles, need to be found.

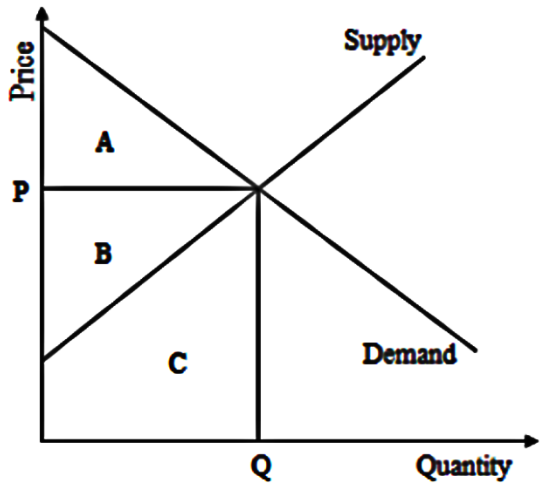

Figure 6. Basic supply and demand curve

For national accounting purposes, the focus of valuation is on the area of producer surplus plus costs of production, *i.e.,* areas B and C. This reflects a concept of exchange value in which, while different consumers may have been willing to pay different prices for a good or service, in practice all consumers pay the same price *P*. Thus, the total outlays by consumers and the total revenue of the producers is equal to the area B plus C, or equivalently, is equal to *P* times *Q*. For accounting purposes, this approach to valuation enables a consistent

recording of transactions between economic units since the values for supply and use of products are the same.

1. Consider economic considerations that apply to each of the different broad types of ecosystem services, and then discuss specific approaches that have been developed for the valuation of quantities of ecosystem services:

    a. Provisioning services
    b. Regulating services
    c. Cultural services

2. Identify the most appropriate approach for pricing of ecosystem services:

    a. Valuation of ecosystem services that focus on the measurement of direct and indirect use values (relatively fewer studies including the non-use and option components of total economic value);
    b. Valuation approaches that focus on the extent to which consumers are willing to pay for ecosystem services; and
    c. Valuation approaches that measure the value of degradation of ecosystem services separately (*i.e.,* restoration cost, value of ecosystem resilience, some revealed preference studies):

        i. Combine these approaches which reflect assumptions regarding future degradation, with approaches used to value the current level of ecosystem services; or

        ii. Develop valuation methods that do not require assumptions about current and future use of the ecosystem.

3. Valuation Approaches

    a. Pricing using the unit resource rent - under this approach to valuation, the unit resource rent represents an estimated price for the ecosystem service.
    b. Replacement cost methods - these estimate the value of an ecosystem service based on the costs that would be associated with mitigating actions if it would be lost, as in the case of constructing a water purification plant if the water filtration service of an ecosystem supplying groundwater to an aquifer used for drinking water is impaired.
    c. Revealed preference methods - these determine the value of an ecosystem service based on observations of related market goods.

        i. Production function methods estimate the contribution of ecosystem services to production

processes in terms of its contribution to the value of the final product being traded in the market.

ii. Hedonic pricing methods analyze how environmental qualities affect the price people pay for market products or assets.

iii. Averting behavior methods are used as an indirect method to evaluate the willingness of individuals to pay for improved health or to avoid undesirable health consequences.

iv. Travel cost methods are often used to value ecosystem services associated with recreational sites. These methods estimate the value of the ecosystem services based on the amounts consumers may be willing to pay, as reflected in the costs of visiting a recreational site (*i.e.,* transport costs, travel time, visiting time).

d. Stated preference methods are designed to capture information on people's willingness to pay for ecosystem services without observing an actual payment or transaction.

i. Contingent valuation studies typically ask respondents to state a value they attribute to a certain ecosystem asset, ecosystem characteristic or ecosystem service, or the value they place on a project that will preserve that asset, characteristic or service.

ii. Choice experiments ask respondents to select from a range of available options with varying levels of ecosystem services, and corresponding prices for the associated bundle of services.

e. Approaches to modelling exchange values

i. Benefit transfer - much work on valuation has focused on the valuation of ecosystems and ecosystem services in smaller, more targeted settings for specific ecosystems or in relation to particular events, for example the valuation of damages caused by oil spills. There are three main types of approaches to benefit transfer:

- Value transfers
- Benefit function transfers; and
- 'Meta-analysis' function transfers.

4. The choice of valuation method is defined by the natural capital or ecosystem services being valued and its connection with economic and other human activities, *i.e.,*

tourism and recreation. The following valuation methods are discussed:

a. If goods are connected with market transactions: market valuation;
b. If the use of natural assets is not connected with market transactions, valuation methods include: welfare approaches based on Willingness to Pay/ Willingness to Accept (WTP/WTA), Hedonic Property prices, Wage-risk, Travel Cost Method and related methods. Other indirect methods are indirect cost measurement, opportunity cost approach, defensive expenditures, prevention costs, and damage cost approaches. Figure 7 shows a dichotomy of valuation methods.

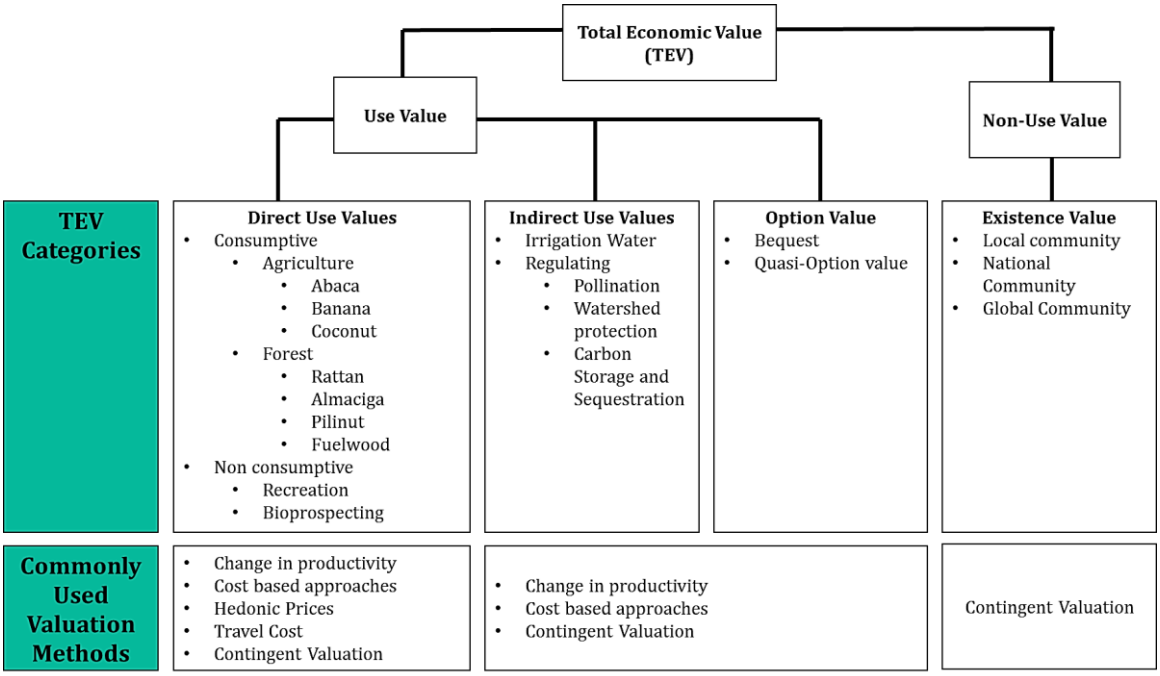

Figure 7. Typology of valuation methods applied in ENRA

2.3.7.2 Approaches in Monetary Accounting

1. One way of bringing this information together is to create combined presentations that integrate measures in physical terms for ecosystem services and ecosystem assets with standard economic measures, such as value added, income, and employment.

2. A second way of considering ecosystem accounting in monetary terms is to bring together valuations of stocks and flows of ecosystem assets into an ecosystem asset account following the standard asset account structure, outlined in the SEEA Central Framework.

3. A third approach is to use valuations of ecosystem services and ecosystem assets in monetary terms to augment the standard national accounts and aggregates.

2.3.8 Integrating Physical and Monetary Accounts

A suggested approach is to combine physical measurements and monetary values for use in local planning and decision i.e., integrating physical and monetary accounts into local municipal or provincial accounts.

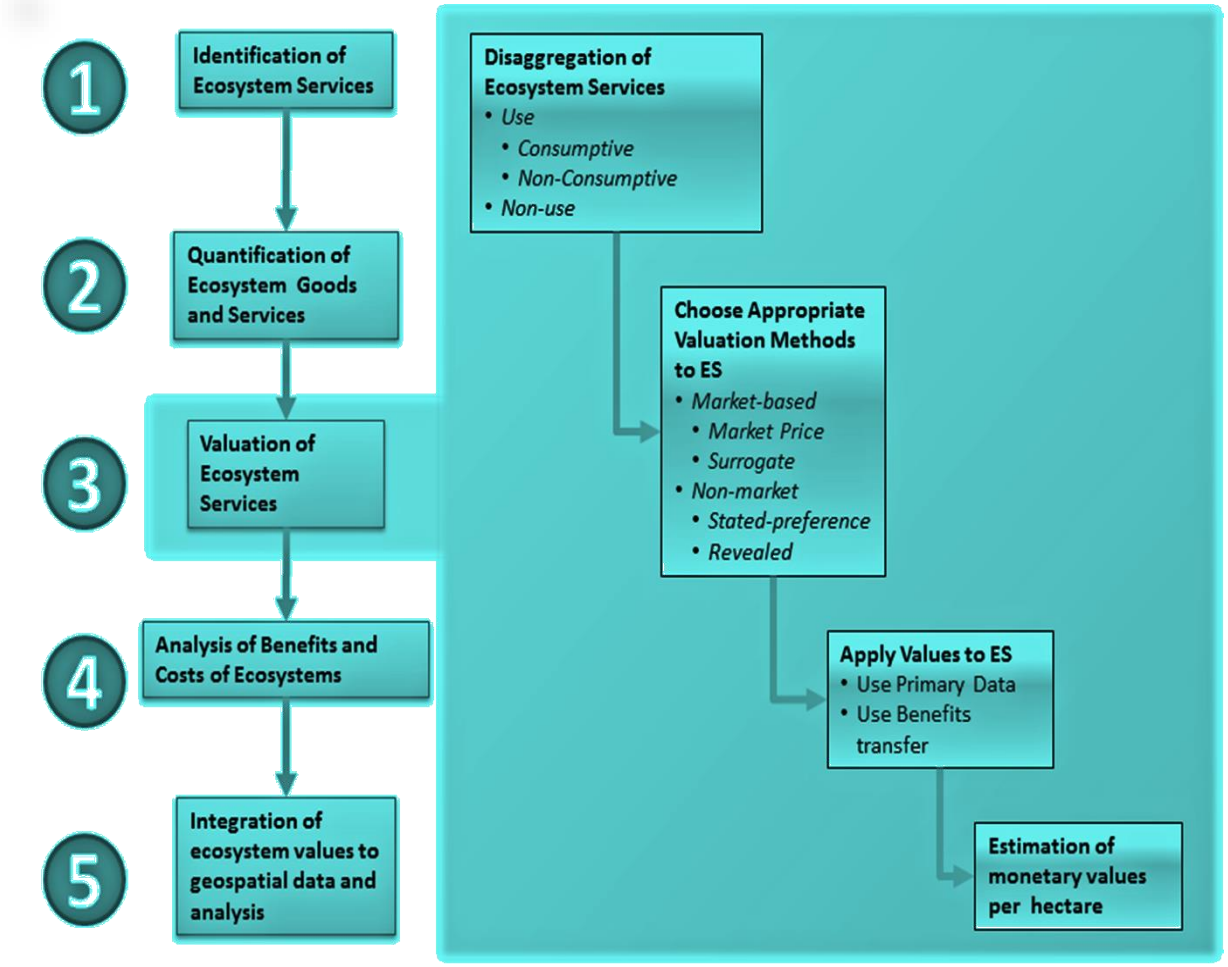

Figure 8. Framework for valuation of environment goods and services

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