



Global
Green Growth
Institute

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 DECISION MAKERS

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.

The Climate Change Commission (CCC) is grateful to our partner, the Global Green Growth Institute (GGGI) – Philippines for providing the needed technical assistance in the development of this module together with the technical team composed of individuals from the Resources, Environment, and Economics Center for Studies, Inc. (REECS).

Disclaimer

This paper is a joint output of the Climate Change Commission (CCC) of the Government of the Philippines and the Global Green Growth Institute (GGGI) – Philippines. Neither the two parties nor any of its employees, nor any of its contractors, subcontractors or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or any third party's use or the results of such use of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the CCC and GGGI – Philippines or their contractors or subcontractors. The views and opinions of authors expressed herein do not necessarily state or reflect those of the CCC and GGGI – Philippines. Past performance is no guarantee of future results.

Module on Environment and Natural Resources Accounting for Decision Makers [electronic resource] / Published by the Climate Change Commission – Manila and the Global Green Growth Institute – Seoul: 2016.

Includes bibliographical references

ISBN 978-621-95650-0-4: Not for Sale

Contents

| | |
|--|------|
| PREFACE | iii |
| Disclaimer | iv |
| Contents | v |
| List of Figures | vi |
| List of Tables | vi |
| List of Acronyms | 7 |
| Definition of Terms | viii |
| I. Introduction | 1 |
| 1.1. Overview of the Module | 1 |
| 1.2. Objectives of the Module..... | 1 |
| 1.3. Brief Description | 2 |
| 1.4. Relevance of the Module for Trainers | 2 |
| 1.5. Summary of Topics | 3 |
| II. Module Content..... | 5 |
| 2.1. What is ENRA? Understanding the Link of Environment and Natural Resources to the Local Economy | 5 |
| 2.2. Why ENRA?..... | 5 |
| 2.3. How? | 6 |
| 2.4. Municipal and Sectoral Accounts | 15 |
| III. Reference List..... | 17 |

List of Figures

| | |
|---|----|
| Figure 1. Link of ENRA to economic wealth and accounts. | 5 |
| Figure 2. Schematic framework of the ENRA | 7 |
| Figure 3. Simplified environment and natural resources accounting process | 13 |
| Figure 4. Linking ENRA to policy and management decisions..... | 14 |
| Figure 5. Policy making plane and evidence-based policy and decision-making | 14 |

List of Tables

| | |
|--|---|
| Table 1. Key topics for training of local managers and decision-makers | 3 |
| Table 2. Drivers of ecosystem change and its impact accounts | 8 |

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. More recent materials on environment and natural resources accounting after the dissertation have been published, and these are available in various on-line resources.

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 ENRA 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, local decision makers will be able to:

- Acquire basic understanding of the importance of ENRA in local planning and decision-making;

- Appreciate and understand the usefulness of ENRA in assessing the impact of (local) policies on the local economy and sustainability of natural resources;
- Understand the basic concepts of valuation, accounting and environmental goods, ecosystem services, ecosystem assets, and ecosystem condition;
- Understand the economic contribution of natural capital to local economic and other human activities; and
- Acquire knowledge and understanding of developing ENRA tables and maps

1.3. Brief Description

Environmental and Ecosystem Accounting is a tool that can significantly help local managers make better decisions on natural capital sustainability. It aims to organize natural resources and ecosystem data within an internationally-recognized framework while also providing guidance for integration within local economic data. Such a framework allows a range of indicators to be constructed to complement current set of predominantly economic indicators. Environmental including ecosystem accounting complements other activities that assess the efficiency of natural resource use and the contribution of environmental goods to economic activities, and provide a better understanding of the impact of economic activities on the environment.

1.4. Relevance of the Module for Trainers

A key factor of resilience is to minimize impacts of disasters on livelihood and other human activities. Local decision makers take into account the contribution of environment and natural resources in Disaster Risk Reduction and Management Coordinating Council decision. Of particular emphasis is the reduction of damage, and information on availability of natural capital as fall back from deficiency of manufactured capital that are not easily available after a disaster strikes. Baseline accounts can be bases for assessment of environmental liabilities in cases of anthropogenic damages in which such decision criteria as trade-offs through cost-benefit analysis, multi-criteria analysis, and investment analysis. Hence, local decision-makers and managers are provided with information that will enhance their decisions and actions.

A prime motivation for environmental, natural and ecosystem accounting is that the separate analysis of ecosystems and the economy does not reinforce the vital nature of the relationship between economic and other human activities, and the environment in which we live. Standard approaches to the measurement of the economy focus largely on economic and other human activity reflected in the activity of markets. Ecosystem accounting aims to shed light on the non-market activity that relates to ecosystems and integrate this information with relevant market-related data. It is hoped that individual and social decisions concerning the use of the environment may be better informed by developing information sets based on recognition of the relationship between ecosystems, economic, and other human activities.

1.5. Summary of Topics

The major topics for local decision-makers and managers include:

- Overview and introductory concepts of environmental, natural resources (ENR) and ecosystem accounting;
- Simplified processes of ENR and ecosystem accounting beginning with prioritizing ENR and ecosystem for accounting, then measuring and physical accounting, and converting physical accounts into monetary accounts;
- Demonstration of the process, and discussion of accounting outputs; and
- Processes of developing municipal accounts. The orientation-training for local managers and decision-makers emphasizes where the accounts are used and how to interpret results of accounting, and its local to local and other human economic activities.

The contents of the training for Local Managers and Decision-makers though are generally similar to the ToT but focused on understanding the concepts and use of the ENRA in local policy and management decisions. The topics that will be covered are shown in Table 1.

Table 1. Key topics for training of local managers and decision-makers

| Topics Covered | Objective | Learning Process/Method |
|---|---|---|
| Foundations of ENRA | | |
| <ul style="list-style-type: none"> • What is ENRA? • Use of ENRA for score-keeping and policy development | At the end of the session, participants will acquire basic knowledge of the economic links of ENRA. | Prior to the lectures, there will be a diagnostic examination to gauge the knowledge of participants. |
| <ul style="list-style-type: none"> • Environment and Resource Accounting Processes | At the end of the session, participants will acquire knowledge and understanding of the tools and processes of ENRA. | Interactive discussion with brief lecture. |
| <ul style="list-style-type: none"> • Economic valuation approaches | At the end of the session, participants will acquire basic knowledge of valuation approaches. | Lecture-discussion prepared exercises. |
| <ul style="list-style-type: none"> • Key Accounts for Local Government Units | To highlight the importance of developing the accounts for local policy , plans, and programs | Lecture and demonstration |
| <ul style="list-style-type: none"> • 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. |
| <ul style="list-style-type: none"> • Forest Resource Accounting | At the end of the session, participants will acquire basic knowledge of the methodology on | Lecture-discussion with prepared exercises. |

| Topics Covered | Objective | Learning Process/Method |
|--|---|---|
| | accounting and valuing forest resources. | |
| <ul style="list-style-type: none"> 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. |
| <ul style="list-style-type: none"> 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 | | |
| <ul style="list-style-type: none"> Social Accounting Approach to Generating the Municipal Accounts | At the end of the session, participants will acquire basic knowledge of social accounting methodology. | Lecture |
| <ul style="list-style-type: none"> 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. |
| ENRA and Climate Change | | |
| <ul style="list-style-type: none"> 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. |
| <ul style="list-style-type: none"> Use of NRA-ENRA in policy development | | Lecture-discussion followed by small group discussions on CC policy implication of ENRA. |
| <ul style="list-style-type: none"> 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? Understanding the Link of Environment and Natural Resources to the Local Economy

Local managers must recognize that the system of national accounts do not provide explicit accounting of stock and flows of natural capital and ecosystem services. The SEEA Central Framework and the Experimental Ecosystem Accounting (EEA) serves as extension of the System of National Accounts (SNA). In order to align these accounts, physical accounts and the principles of valuation must be aligned with the SNA. It is important to note that Ecosystem Accounting extends measurement boundaries (*i.e.*, ecosystem services) beyond economic values, and hence need to establish valuation methods that are consistent with economic transactions.

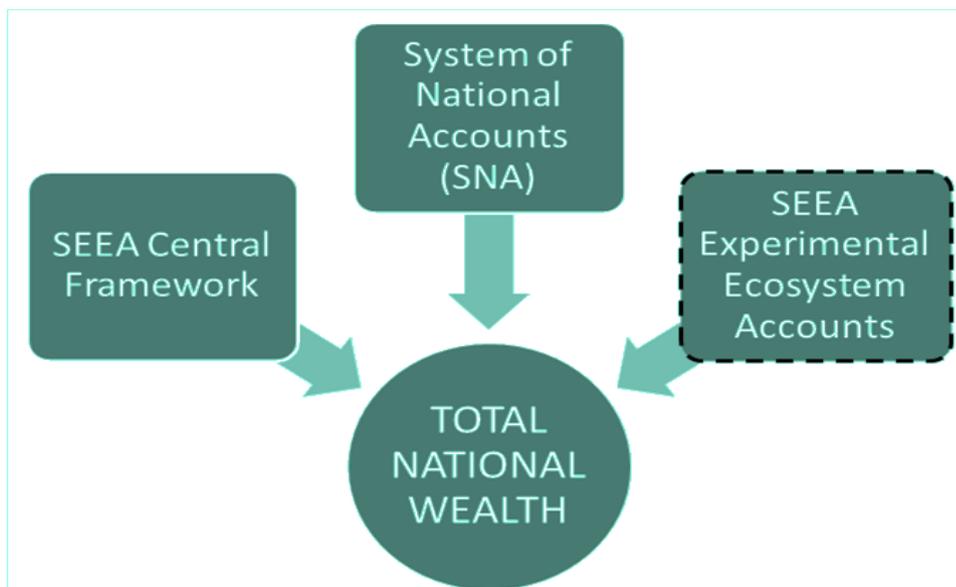


Figure 1. Link of ENRA to economic wealth and accounts.

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 danger 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.

2.3. How?

2.3.1 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 2 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.

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.

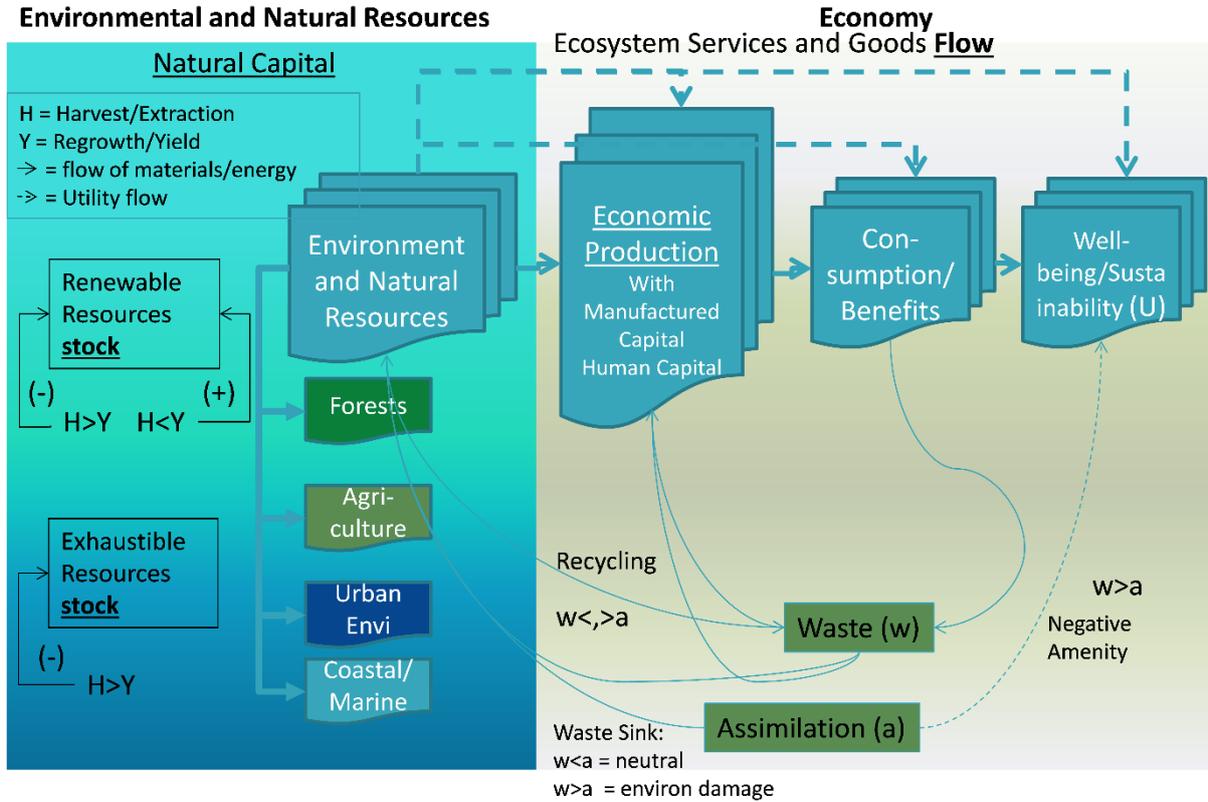


Figure 2. Schematic framework of the ENRA

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.

2.3.2 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 |

| Drivers of ENR and Ecosystem Changes | Pressure Accounts | State Accounts | Impact Accounts (Ecosystem Services, Condition, Capacity) | Data Needs, Tools and Techniques |
|--------------------------------------|---|--|--|---|
| | | 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, 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 |

| Drivers of ENR and Ecosystem Changes | Pressure Accounts | State Accounts | Impact Accounts (Ecosystem Services, Condition, Capacity) | Data Needs, Tools and Techniques |
|--|--|--|---|---|
| | | 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 | | |
| | 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 |

| Drivers of ENR and Ecosystem Changes | Pressure Accounts | State Accounts | Impact Accounts (Ecosystem Services, Condition, Capacity) | Data Needs, Tools and Techniques |
|---------------------------------------|--|--|---|----------------------------------|
| 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 | | |
| | 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 quality | | |

| Drivers of ENR and Ecosystem Changes | Pressure Accounts | State Accounts | Impact Accounts (Ecosystem Services, Condition, Capacity) | Data Needs, Tools and Techniques |
|---|---|--|---|----------------------------------|
| | habitat disturbance | | | |
| | 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 | |
| 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 | | | | |

2.3.3 Accounting Process

Figure 3 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.

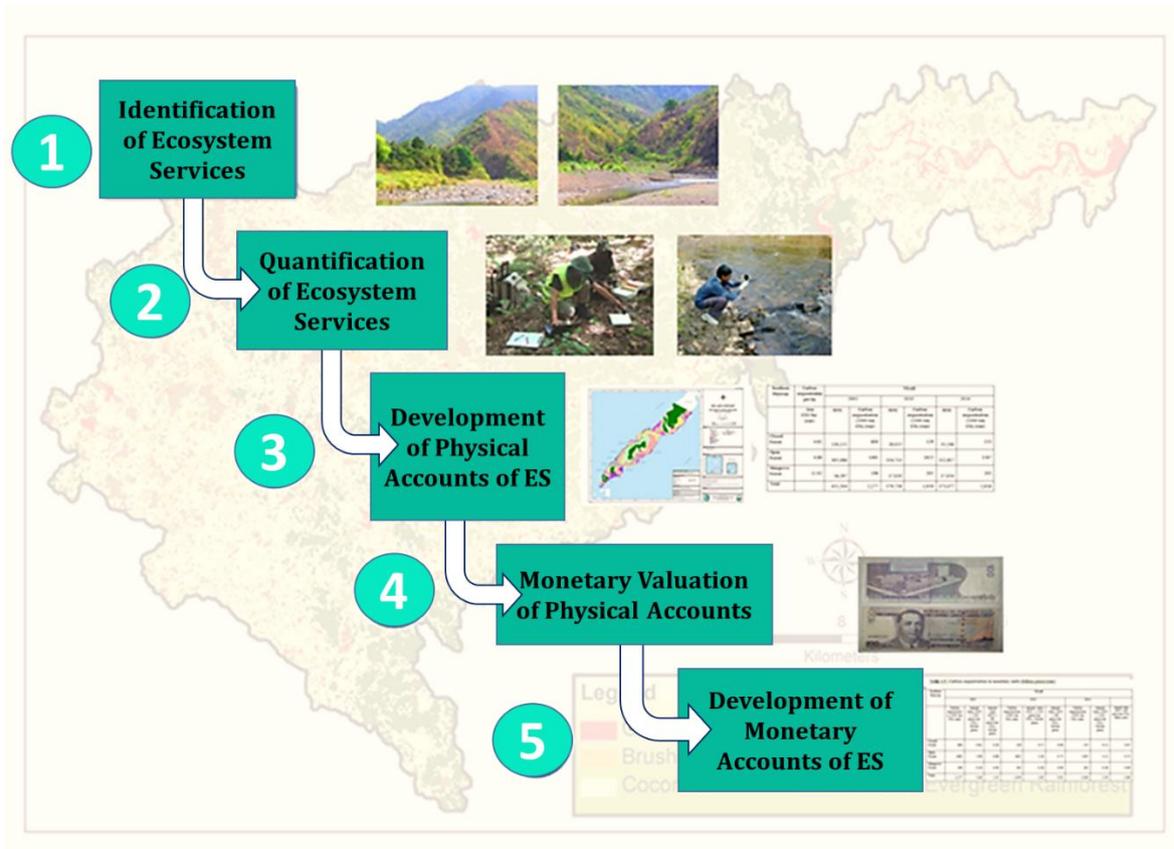


Figure 3. Simplified environment and natural resources accounting process

2.3.4 Linking ENRA to Policy and Management Decisions

Information from ENRA can be used to:

- Assess sustainability of resource use *i.e.*, for certification of forest;
- State of the environment reporting;
- Economic-ecological modelling;
- Input-output analysis;
- Environmental statistical systems; and
- Link to policy impact analysis and policy development.

Figure 4 summarizes how ENRA is linked to policy and management decisions.

Key concepts and links to policy

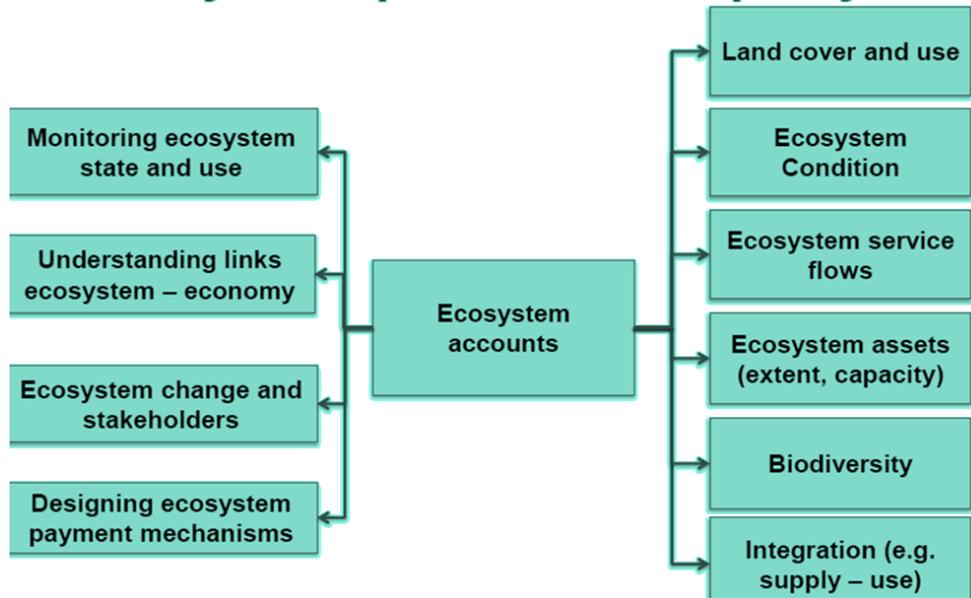


Figure 4. Linking ENRA to policy and management decisions

The relevance of ENRA is in evidence-based policy and decision-making. Evidence-based policy is defined as an approach which “helps people make well informed decisions about policies, programs and projects by putting the best available evidence at the heart of policy development and implementation” (Davies, 1999a). A policy-making plane in Figure 5 shows the role of environmental and economic accounting in policy and decision-making.

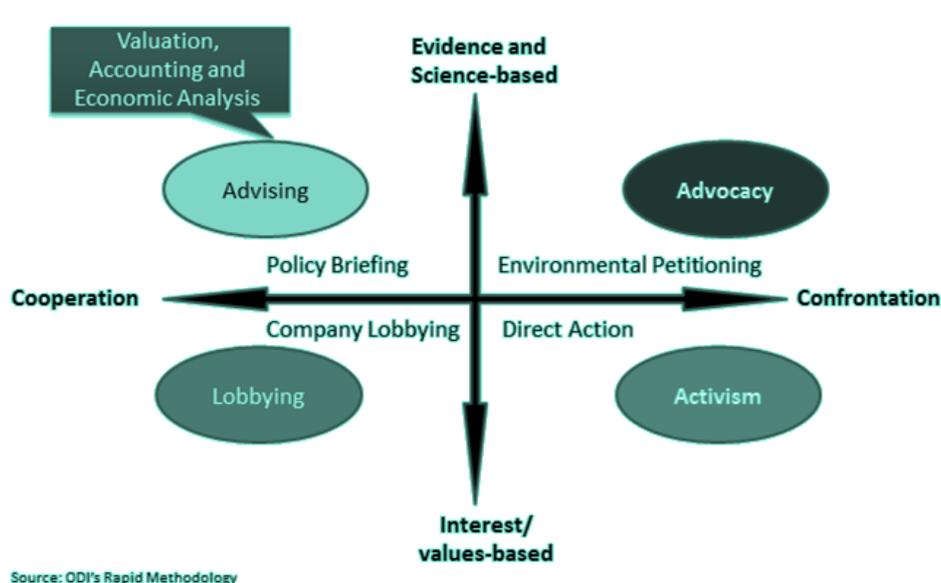


Figure 5. Policy making plane and evidence-based policy and decision-making

2.4. Municipal and Sectoral Accounts

Municipal accounts integrate all accounting activities in the municipality. Sectoral accounts are developed in view of the interest for specific set of accounts.

2.4.1 Agriculture Accounts

The agricultural resource account component of the environment and natural resources accounts focuses on three basic questions: 1) How do production activities support local consumption?; 2) Can the agricultural resource base able to sustain these consumption needs? (3) Is the agricultural resource base appreciating or depreciating, and how fast does it depreciate as consumption increase? Accounting of agriculture lands and production from these lands, which are the primary source of municipalities' consumption and trade goods within Philippine islands, provide some answers to these questions.

2.4.2 Forest Resource Accounts

Forest resource accounts summarize analyses of forestland cover, accounting of forest resources, physical accounts tables, monetary accounts of timber, carbon, and other ecosystem services.

2.4.3 Water Resource Accounts

Water resource accounts include estimates of the supply and use of water resources within the municipality. These include estimating the water balance, and assessment of water quality. Outputs are supply and use tables of water. Data sources come from government agencies and modelling of watersheds that translate to the water balance model.

2.4.4. Coastal and Marine Resources Accounts

The coastal and marine accounts cover extent and condition of coastal and marine habitats, estimation of total users of coastal resources, volume and value of coastal and marine resources, and estimation of resource rent from municipal fishing. Outputs are supply and use tables of coastal and marine resources, as well as spatial distribution of fishing gears and zonation in coastal areas.

2.4.5. Urban Environment Accounts

Urban environment accounts include accounts related to human health, which includes morbidity, sanitation, types and spatial distribution of illnesses, and infrastructure and facilities related to health in the municipality. The urban environment account data is generated through surveys and collection of secondary from municipal offices. These accounts are then linked to other accounts, or serve as supplement to natural resources accounts.

2.4.6. Municipal Accounts

One of the key objectives is to develop an accounting framework at the local level. Resource accounts should provide initial information to estimate a "green" municipal gross domestic product (GDP), *i.e.*, a municipal GDP that

incorporates an accounting of non-marketed natural resource capital and the contribution of ecosystem services.

Two approaches for ENRA may be considered for municipal accounts development. One approach makes use of Municipal Statements of Receipts and Expenditures (SRE) structure. The other approach that is more scholastic and technical, makes use of the Social Accounting Matrix (SAM) framework popularized by the World Bank (Pyatt & Round, 1985). The advantage of the latter comes in the scrutiny of impacts of interventions such as by government or other external entities interested in natural resources sustainability (Pyatt & Round, 1985).

III. Reference List

Resources, Environment and Economics Center for Studies 2013. Natural Resource Assessment of Siargao Island, Surigao Del Norte as Part of Demonstrating the Climate Change Commission's Ecotown Framework Main Report. Submitted to the USAID as part of project report

Resources, Environment and Economics Center for Studies 2013. The Municipal Income Accounts and the Final Asset and Municipal Accounts of San Vicente, Palawan. Final Report submitted to Global Green Growth Initiative and Climate Change Commission

Resources, Environment and Economics Center for Studies (date). ENRAP Shelf. A compilation of report of the Environment and Natural Resource Accounting Project in the Philippines supported by the USAID.

UN et al., 2009. System of National Accounts 2008. 2009: New York

UN et al., 2014a. System of Environmental-Economic Accounting 2012, Experimental Ecosystem Accounting. 2014, United Nations: New York, USA

UN et al., 2014b. System of Environmental-Economic Accounting, Central Framework. 2014: New York, USA.



Address: Bulwagan Ninoy, Ninoy
Aquino Parks And Wildlife Center,
North Avenue, Quezon City,
Philippines

Tel/FaxNo.: (02) 925-8954
Website: www.climate.gov.ph



Global
Green Growth
Institute

Address: 19F Jeongdong Bldg.
21-15 Jeongdong-gil
Jung-gu Seoul 04518
Republic of Korea

Tel. No. +82-2-2096-991
Website: www.gggi.org