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SEEA Experimental Ecosystem Accounts

Chapter 1: Introduction

(for discussion)

REVISION OF THE SYSTEM OF ENVIRONMENTAL - ECONOMIC ACCOUNTING (SEEA)

SEEA Experimental Ecosystem Accounts

Draft material prepared for the 7th Meeting of the Committee of Experts on Environmental-Economic Accounting (UNCEEA)

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DRAFT

Chapter 1: Introduction

Material prepared in consultation with the Editorial Board for the SEEA Experimental Ecosystem Accounts and following discussions at the Expert Meetings on Ecosystem Accounts.

The following text has been drafted for discussion among UNCEEA members as part of the process of developing the SEEA Experimental Ecosystem Accounts. The material should not be considered definitive and should not be quoted.

Status of Chapter 1

The material for Chapter 1 is reasonably well advanced and, in general, only requires ongoing feedback to ensure the appropriate coverage of the various issues raised. A particular aspect in this regard is to obtain feedback from a wide range of stakeholders to ensure that the objectives and policy relevance of ecosystem accounts are clearly explained and provide a motivation to continue to read the other chapters.

A specific area requiring further feedback concerns the short section on principles of ecosystem science. It is planned to obtain direct input from ecologists on this issue both for Chapter 1 and for a related section in Chapter 2.

More broadly it is noted that the text in Chapter 1 will need to be revisited once various measurement concepts and definitions have been resolved in the other chapters to ensure an alignment of terminology and expression.

Chapter 1: Introduction

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1.1 What is the SEEA Experimental Ecosystem Accounts?

1.1 The System of Environmental-Economic Accounting (SEEA) Experimental Ecosystem Accounts is a companion to the SEEA Central Framework – the international statistical standard for environmental-economic accounting. The SEEA Central Framework is a multi-purpose, conceptual framework that describes interactions between the economy and the environment, and the stocks and changes in stocks of environmental assets. It 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.

1.2 The SEEA Experimental Ecosystem Accounts extends the accounting described in the Central Framework to consider the measurement of flows of services to society provided by ecosystems and the measurement of ecosystem capital in terms of the capacity, and changes in capacity, of ecosystems to provide those services.

1.3 Ecosystem accounting is a new and emerging field of measurement and hence this work is considered experimental. At the same time, ecosystem accounting builds on two well-established disciplines – the science of ecosystems, and national accounting and its application to environmental measurement. The merging of these disciplines represents a considerable challenge in terms of language, concepts and statistical practice. However, the potential for work on the most significant public policy challenges of this century to be assisted by coherent information as presented in ecosystem accounts requires that this challenge be confronted.

1.4 The SEEA Experimental Ecosystem Accounts describe both the measurement of ecosystems in physical terms, and the valuation of ecosystems in so far as it is consistent with the market based valuation principles of the System of National Accounts (SNA). More generally, only those topics for which broad consensus has emerged has been included. In accounting terms, the ecosystem accounts build on the accounting structures and conventions presented in the SEEA Central Framework and linkages between these two parts of the SEEA are explained through the text.

1.2 Objectives of ecosystem accounting

Policy relevance

1.5 There are a range of motivations for the development of ecosystem accounts. A general motivation is that ecosystem accounts provide a tool for tracking changes in the environment and linking that change to economic activity. A particular motivation for the development of the SEEA Experimental Ecosystem Accounts stems from the understanding that economic activity is leading to an overall degradation of the environment and, consequently, there is a reduced capacity for the environment to continue to provide the services and benefits that our society is dependent on. Therefore, it we are to stay within the bio-physical bounds of our environment we must consider ways in which economic activity can continue in a manner that has a reduced impact on the environment.

1.6 This motivation also provides the underpinnings for policy in the broad area of sustainable development, and also in policy areas such as resource efficiency and energy use, water supply and use, conservation and biodiversity, cleaner and more environmental friendly technologies, waste management, climate change, health and security (in terms of protection from natural hazards or resource supply).

1.7 The information organised in the SEEA Central Framework provides a basis for monitoring the interactions between the economy and the environment and for assessing the extent to which individual natural resources are being depleted. However, the information in the SEEA Central Framework cannot provide answers relating to the degree of impact of economic activity on the environment as a whole. The understanding that the environment operates as a system necessitates the development of information that takes this into account.

1.8 The SEEA Experimental Ecosystem Accounts start from this premise of seeing the environment as a system. At a national and sub-national level, these accounts aim to organise information about ecosystems –the dynamic complexes of biotic communities interacting with their non-living environment. It is from ecosystems that many environmental inputs flow into the economy and it is into these ecosystems that residuals flow from the economy. Ecosystem accounts thus represent a completing of the environmental-economic accounting picture.

1.9 With an understanding of the extent to which ecosystems are impacted by economic activity it is possible to evaluate the potential for alternative patterns of consumption and production, for alternative uses of energy and the extent of decoupling of growth, the effectiveness of resources spent to restore the environment, and the trade-offs between alternative uses of the environment.

1.10 Increasingly, policy in different areas of public concern are being considered in a more integrated, multi-disciplinary fashion with economic, social and environmental factors being assessed in determining appropriate policy responses. In this regard the integrated structure of the ecosystem accounts, and the SEEA generally, is of particular relevance. For ecosystem accounts the joint presentation of both economic data, and scientific and physical data is a particular feature.

1.11 The development of the SEEA at an international level provides a base to build information sets for use in assessing cross-border environmental impacts and global environmental

challenges. At the same time the ecosystem accounting framework can be applied at a specific local level, for example in the management of river basins or protected areas.

1.12 The broad and integrated nature of the SEEA Experimental Ecosystem Accounts also makes it a relevant tool in the advancement of a number of international environmental frameworks including the Convention on Biodiversity and the UN Framework Convention on Climate Change (UNFCCC).

1.13 Overall, the policy relevance of the SEEA Experimental Ecosystem Accounts is very broad, real and increasing.

Accounting objectives

1.14 The particular focus in ecosystem accounting is on ecosystems and their relationship to the economy and society. Thus it represents a bringing together of ecosystems, economic and statistical perspectives on this relationship.

1.15 The over-arching objective of developing an accounting structure is the integration of environmental and economic information to inform policy discussion and environmental management. Within this, the more specific objectives in establishing an accounting structure are:

- Organising information on ecosystems in a coherent manner by developing conceptual linkages between ecosystems, economics and statistics
- Consistent application of a common set of concepts and terminology
- Allowing connections to be made to environmental/economic information compiled following the SEEA Central Framework
- Permitting integration with the standard national accounts (as described in the SNA) to aid the measurement of the production and consumption of ecosystem services, the attribution of the degradation of ecosystems to economic units, the recording of expenditure by economic units on the maintenance and restoration of ecosystem, and the development of wealth accounting.
- Identifying information gaps and key information requirements

1.16 In order to meet the various accounting objectives, there are some specific considerations that are the focus of the SEEA Experimental Ecosystem Accounts. These are:

- the objects of measurement – the ecosystems – need to be defined from a statistical perspective;
- the definition of, and relationships between, the relevant stocks and flows with consideration of appropriate measurement scope and coverage;
- common measurement units for the assessment of ecosystem capital need to be described;
- the structure of relevant accounts needs to be outlined including links to the core economic accounts of the SNA and accounts described in the SEEA Central Framework; and

- the use of valuation techniques needs to be explained

1.17 Central to the success in meeting these various accounting objectives is the involvement of a wide-range of professional communities, most notably scientists, economists and official statisticians. While all three of these communities come from differing perspectives, each group has an important role to play in developing the appropriate accounting framework and in populating that framework with meaningful information.

1.18 It is highly unlikely that any single agency or organisation can effectively cover all of the information requirements for a set of ecosystem accounts. This is particularly the case for the range of scientific and other environmental information which may be very localised. Consequently, the development and testing of ecosystem accounting will require the involvement of multiple disciplines across agencies and the establishment of appropriate institutional frameworks is likely to be important if the work is to be routinely implemented.

1.19 Given its new and emerging status there is strong potential to harness the research capability of the academic sector to develop and test aspects of the ecosystem accounting framework that is proposed. This engagement, in addition to the involvement of relevant government agencies, will provide a firm foundation for the development of ecosystem accounts.

The experimental nature of SEEA Experimental Ecosystem Accounts

1.20 The SEEA Experimental Ecosystem Accounts have been labelled "experimental" because they represent a summary of the state of play of an emerging area of research. The emerging area of research is in the combination of principles from ecosystem science, economics, national accounts and official statistics. Strong progress has been made in combining these various streams which has permitted the writing of these chapters. While a broad consensus exists on the purpose and general framework for measurement, there remain a number of areas in which further investigation of alternative approaches to measurement is required.

1.21 It is emphasised that the experimental label should not be applied to any of the individual disciplines that are being brought together in the context of ecosystem accounting. All of the disciplines noted have long-standing concepts, frameworks and perspectives on the world in which we live. It is the integration of these well-established concepts within the discipline of accounting that is the new element being considered here. Of course, each area will continue to advance and develop and resolve outstanding issues and, in the fullness of time, these refinements and advances will play a role in advancing ecosystem accounting.

1.22 In this context, the SEEA Experimental Ecosystem Accounts is conservative in nature, and does not seek to incorporate the leading edge (or all) aspects of each discipline. Rather it restricts itself to offering direction based on broadly accepted consensus within each of the disciplines. Nonetheless, by presenting each of the disciplines in an integrated fashion, the approach clearly opens up new avenues for investigation and experimentation.

1.23 A full articulation of ecosystem accounts will, inevitably, require the use of a significant amount of data. However, although this is a new area of accounting, it is the case that a large amount of information for populating ecosystem accounts can be accessed from existing data sources. Inevitably, some of the data may be proxies of the "ideal" measures but this, in itself does not invalidate the accounting framework or the potential to use carefully organised and

structured information. In general, the population of the basic datasets for ecosystem accounting can be done using common scientific and statistical methods, although, there may be a need for some experimentation in the development of data at finer levels of spatial detail (i.e. for small areas). In this regard, there is a significant opportunity to take advantage of emerging spatially specific datasets and related analytical techniques.

1.3 The relationship of ecosystem accounts to ecosystem science and national accounts

1.24 While ecosystem accounting is a new and emerging field of measurement its foundation in both ecosystem science and national accounts is strong. Research in both of these foundation areas continues to deal with the ever increasingly complexity of economic activity and our ever increasing understanding of the world in which we live. At the same time there are some core understandings of ecology and national accounts that are accepted and hence form a base for ecosystem accounting.

Core principles of ecosystem science

1.25 An ecosystem can be broadly defined as a community of organisms, together with their physical environment, viewed as a system of interacting and interdependent relationships and including such processes as the flow of energy through the food chain and the cycling of carbon, water and nutrients through living and non-living components of the system.

1.26 Key processes in ecosystems include the capture of light, energy and carbon through photosynthesis, the transfer of carbon and energy through food webs, and the release of nutrients and carbon through decomposition. Biodiversity affects ecosystem functioning, as do the processes of disturbance and succession. The principles of ecosystem management suggest that rather than managing individual species, natural resources should be managed at the level of the ecosystem itself.

1.27 Ecosystems provide a variety of goods and services upon which people depend, known as ecosystem services. The capacity of the ecosystem to provide ecosystem services depends on the area covered by an ecosystem (its extent), and the condition of the ecosystem. This capacity is modified through human behaviour. Through land use conversion, ecosystems have been replaced by different ecosystems supplying a different set of ecosystem services, as in the case of forest converted to cropland. The supply of ecosystem services is also influenced by the changing condition of an ecosystem, which in turn is a function of ecosystem structure, components and processes.

1.28 Ecosystems are often subject to complex, non-linear dynamics involving negative or positive feedback loops. These complex dynamics include, for example, the presence of multiple steady states, irreversible change or stochastic (random) behaviour. It is now recognised that many types of ecosystems are influenced, and often dominated by complex dynamics, including temperate and tropical forests, rangelands, estuaries, and coral reefs. Resilience is an important property of ecosystems in this regard. Resilience indicates the propensity of ecosystems to withstand pressure or to revert back to its original condition following a disturbance.

1.29 The relationship between biodiversity and ecosystem functioning and resilience is still debated. While a range of theories has been formulated, the dominant view at present implies that genetic and species diversity within functional groups is an essential element of ecosystem resilience. Thus, in case one of the species in a functional group is strongly reduced in number, for example because of a pest or disease, species diversity within this functional group increases the chance that other species can substitute its role in ecosystem functioning.

Core principles of national accounts

1.30 At the heart of national accounting is the ambition to record, at a national, economy-wide level, measures of economic activity and associated stocks and changes in stocks of economic assets. The accounting approaches are described at length in the System of National Accounts (SNA). The SNA is the international statistical standard for national accounting, first released in 1953 and most recently updated in 2008 and released jointly by the United Nations, the European Commission, the International Monetary Fund, the Organisation for Economic Co-operation and Development (OECD) and the World Bank. In turn, the SNA provides the conceptual underpinnings of the new international standard, the SEEA Central Framework.

1.31 Following the SNA, economic activity is defined by the activities of production, consumption and accumulation. Measurement of each of these activities over an accounting period (commonly one year) is undertaken within the constraint of a production boundary which defines the scope of the goods and services considered to be produced and consumed.[1] Accumulation of these goods and services in the form of economic assets (for example, through the construction of a house) is recorded in cases where production and consumption is spread out over more than one accounting period. Further, non-produced economic assets may be accumulated (for example, through the purchase of land). At its core, national accounts is the reporting of flows relating to production, consumption and accumulation, and stocks of economic assets.

1.32 Central to the measurement of economic activity and economic assets is the recognition of economic units – i.e. the different legal and social entities that participate in economic activity. At the broadest level these entities are categorised as enterprises, governments and households. The economy of a given territory is defined by the set of economic units (referred to in the SNA as institutional units) that are resident in that territory.

1.33 The national accounts thus aim to organise and present information on the transactions and other flows between these economic units (including flows between units in different territories), and on the stocks of economic assets owned and used by economic units.

1.34 There are strong similarities between national accounting and the accounting that is undertaken for an individual business. However, the main distinctions are that (i) national accounting requires consideration of the accounting implications for more than one business (thus the recording must be consistent for both parties to a transaction without overlaps or gaps); and (ii) national accounting operates at a far larger scale in providing information for a

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[1] This boundary also defines the measurement scope for the most widely known national accounts aggregate, Gross Domestic Product (GDP).

country and encompassing a wide variety of types of economic units that play quite distinct roles in an economy.

Creating linkages between ecosystem science and national accounting

1.35 Placing ecosystems in a national accounting context requires both disciplines to consider measurement in new ways. For ecologists, this requires creating clear distinctions between stocks and flows within an ecosystem and to differentiate between those aspects of ecosystems that provide direct benefits to society and those aspects of ecosystems that, effectively, support the provision of these benefits.

1.36 For national accounts, it is necessary to consider the set of goods and services produced and consumed in the context of the set of benefits provided by ecosystems and also to see the ecosystem as a complex, self-regulating system that, while influenced by economic activity, also operates outside of traditional economic management regimes.

1.37 Fundamentally, both ecosystem science and national accounting are disciplines that recognise the significance of systems and the mass of relationships that comprise their fields of interest. Ultimately, it is the aim of the SEEA Experimental Ecosystem Accounts to take advantage of this common approach and present a system based approach to recording the relationships between society and ecosystems that is useful for public policy making and environmental management.

1.4 Relationship between the SEEA Experimental Ecosystem Accounts and the SNA and the broader SEEA

1.38 The SEEA Experimental Ecosystem Accounts are a companion to the SEEA Central Framework – the international statistical standard for environmental-economic accounting. These two parts of the SEEA are complemented by a third part titled SEEA Extensions and applications. This third part presents a range of monitoring and analytical approaches that could be adopted using information that has been brought together within the SEEA accounting frameworks and describes ways in which SEEA can be used to inform policy analysis.

1.39 As an accounting framework for use in public policy, the SEEA Experimental Ecosystem Accounts has strong connections to the System of National Accounts (SNA). It is the SNA that provides the basic accounting rules and principles, and the underlying systematic approach to the recording of stocks and flows at a national level.

1.40 This section describes the links between the SEEA Experimental Ecosystem Accounts and the SNA and its links to the SEEA Central Framework.

Relationship between ecosystem accounts and the SNA

1.41 As for the SEEA Central Framework, the SEEA Experimental Ecosystem Accounts uses the SNA as the source of accounting rules and principles. As well, the SNA provides the underlying systematic approach to measuring stocks and flows at a national level and it is this systematic approach that is applied in the ecosystem accounts.

1.42 While some core elements of the SNA are retained in the ecosystem accounts there are some particular accounting treatments in defining measurement boundaries that are applied in the SEEA Experimental Ecosystem Accounts that are different from the SNA. The following are of most relevance.

1.43 First, the SEEA Experimental Ecosystem Accounts encompass measures in both physical and monetary terms whereas the SNA covers only estimates in monetary terms. This extension in coverage is a significant one from the perspective of interpreting and integrating environmental information and aligns with the direction set out in the SEEA Central Framework. As with the SEEA Central Framework the aim in ecosystem accounting is to present physical information following a structure that is compatible with the structures used for presenting economic data in monetary terms.

1.44 Second, regarding valuation, -- to be completed once discussion on Chapter 5 is complete --.

1.45 Third, the asset boundary applied in the SEEA Experimental Ecosystem Accounts is broader that that used in the SNA. In the SNA the asset boundary with respect to environmental assets is limited to those assets that have economic value in the sense that they have an expected stream of benefits (in the form of income) to be received in the future. This boundary is defined in monetary terms but implicitly applies in physical terms. Thus physical features of the landscape without economic value are excluded from the SNA.

1.46 In the ecosystem accounts this asset boundary is extended in two respects. First, as in the SEEA Central Framework, the coverage of environmental assets in physical terms is extended to encompass all naturally occurring living and non-living components of the Earth although it is a sub-set of this that is incorporated into ecosystem accounts (for example mineral and energy resources are not considered part of ecosystems). Second, a broader set of benefits from ecosystems are recognised in the SEEA Experimental Ecosystem Accounts thus expanding the concept of value relative to the SNA.

1.47 Fourth, related to the recognition of a broader set of benefits from ecosystems, the SEEA Experimental Ecosystem Accounts applies a modified production boundary such that the full range of flows from ecosystems that benefit society can be accounted for. Examples include the provision of clean air and flood protection via the existence of well-functioning ecosystems.

1.48 Although there are some differences in the scope of ecosystem accounts relative to the SNA, the extensions are applied in a manner which permits the integration of ecosystem accounts with the SNA accounts. This feature is important in the development of integrated measures of economic activity that take into account the consumption of ecosystem capital and the compilation of wealth accounts that contrast ecosystem capital with other assets such as produced assets and financial assets that are recorded in the SNA.

Relationship between ecosystem accounts and the SEEA Central Framework

1.49 The SEEA Central Framework consists of three broad areas of measurement (i) physical flows between the environment and the economy, (ii) the stocks of environmental assets and changes in these stocks; and (iii) economic activity and transactions related to the environment. The ecosystem accounting described in the SEEA Experimental Ecosystem Accounts provides additional perspectives on measurement in these three areas.

1.50 First, the SEEA Experimental Ecosystem Accounts extend the range of physical flows that are accounted for to include non-material benefits that are obtained from the environment. The focus in the SEEA Central Framework is 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 accounts (e.g. flows of timber to the economy). The SEEA Experimental Ecosystem Accounts add to this by including the measurement of the non-material benefits that emerge from ongoing ecosystem processes (such as the regulation of climate, air filtration and flood protection) and the non-material benefits from human engagement with the environment (such as recreation activity).

1.51 Second, the SEEA Experimental Ecosystem Accounts consider environmental assets from a different perspective compared to the SEEA Central Framework. Environmental assets, as defined in the Central Framework, have a very broad scope. Environmental assets are the naturally occurring living and non-living components of the Earth, together comprising the bio-physical environment, that may provide benefits to humanity (SEEA Central Framework, 2.17). This broad scope encompasses both a view of environmental assets in terms of individual resources (e.g. timber, fish, minerals, land, soil, water) and a view of environmental assets as ecosystems in which the various bio-physical components are seen to operate together as a functional unit. Thus, in principle there is no further extension of the bio-physical asset boundary in the SEEA Experimental Ecosystem Accounts.

1.52 However, while the bio-physical starting point may be the same, the characteristics of environmental assets that are considered in ecosystem accounting are different from those considered in the SEEA Central Framework. This relates to the incorporation of non-material benefits that are generated from ecosystems (as noted above). This expansion in the set of asset characteristics in scope of ecosystem accounting is the most significant extension and has implications for the way in which the measurement of assets in physical terms is undertaken (in particular it is essential to take into account any changes in the quality or condition of ecosystems) and the way in which valuation of ecosystems is considered.

1.53 Accounting for specific elements, such as carbon, or environmental features, such as biodiversity, are also covered in the SEEA Experimental Ecosystem Accounts but again these are specific perspectives taken within the same bio-physical environment as defined by environmental assets in the SEEA Central Framework.

1.54 While there is, in principle, no extension in the bio-physical environment that is in scope, there are some particular boundary issues that needs consideration, particularly concerning marine ecosystems and the atmosphere. The ocean and the atmosphere are excluded from the

measurement scope in the SEEA Central Framework and their treatment in the context of ecosystem accounting requires further consideration.

1.55 Third, the SEEA Central Framework outlines clearly the types of economic activity that are considered environmental and also describes a range of relevant standard economic transactions (such as taxes and subsidies) that are relevant for environmental accounting. In also shows how these flows may be organised in functional accounts – the main example being Environmental Protection Expenditure Accounts.

1.56 For the purposes of ecosystem accounts, there are no additional transactions that are theoretically in scope since the SEEA Central Framework has, in principle a scope that covers all economic activity related to the environment including protection and restoration of ecosystems. At the same time, the SEEA Experimental Ecosystem Accounts will include a discussion on the appropriate accounting treatment for emerging economic instrument related to the management of ecosystems, for example the development of markets for ecosystem services. There is no specific discussion on these types of arrangements in the SEEA Central Framework.

1.5 Structure of the SEEA Experimental Ecosystem Accounts

1.57 Chapter 2 "Principles of ecosystem accounting" presents the model of ecosystem operation that underpins the accounting framework and places into context ecosystems, ecosystem services, ecosystem capital and consumption of ecosystem capital. These various elements are subsequently described in greater detail in later chapters. Chapter 2 also discusses the definition of statistical units for ecosystems that become the focus for measurement and accounting, and outlines some general measurement issues that apply to all areas of ecosystem accounting.

1.58 Chapter 3 "Accounting for ecosystem services in physical terms" discusses the measurement of ecosystem services highlighting key issues of scope and coverage, presenting a common classification of ecosystem services, proposing basic accounting structures for recording flows of ecosystem services, and describing a range of examples of the measurement of ecosystem services in physical terms.

1.59 Chapter 4 "Accounting for ecosystem capital in physical terms" considers measures of ecosystem capital in physical terms comprising measures of ecosystem extent, condition and capacity. It explains approaches to measuring ecosystem capital, the organisation of this information into ecosystem capital accounts, and the measurement challenges involved in making overall assessments of ecosystems. Chapter 4 also highlights some specific areas of accounting, namely carbon accounting and accounting for landscape and species biodiversity, and the relationship of these specific areas to ecosystem accounting.

1.60 Chapter 5 "Approaches to valuation for ecosystem accounting" introduces the principles of valuation that are applied in the SEEA and outlines a range of ways in which valuation of ecosystem services and ecosystem capital might be undertaken and the relevant measurement issues. The chapter also considers the organisation of information estimated in monetary terms and issues of aggregation and scaling estimates for individual ecosystem services and individual ecosystems.

1.61 Chapter 6 “Accounting for ecosystems in monetary terms” shows how estimates of ecosystem services and ecosystem capital in monetary terms can be integrated with information in the core national accounts, including via a sequence of accounts and via wealth accounts. This chapter also highlights the way in which standard monetary transactions associated with ecosystems can be recognised and recorded.