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SEEA Experimental Ecosystem Accounts: A Proposed Outline, Road Map and List of Issues

Paper prepared by UNSD, EEA and the World Bank

SEEA Experimental Ecosystem Accounts: Concept note

A. Background

1. The United Nations Statistics Division (UNSD), the World Bank and the European Environment Agency prepared a proposed outline and road map for experimental ecosystem accounts at the request of the United Nations Committee of Experts on Environmental-Economic Accounting (UNCEEA) for its 6th meeting in June, 2011. The road map and general concept for experimental ecosystem accounts received broad support from the Committee. The Committee recognized the high policy demand for ecosystem accounts but stressed the need for some clarifications on underlying concepts and the links between ecosystem accounts and other parts of the SEEA. The Committee further stressed the importance of bringing together the different relevant communities given the multi-disciplinary nature of ecosystem accounts and the supporting data.

2. Coordination among the partners was initiated through several informal meetings in 2010, including in Santiago, Chile in September and at the UN Headquarters in New York in November. In 2011, so far two key meetings were organized that brought together the experts and practitioners from some of the leading institutions in this field. The first was a meeting in March hosted by the World Bank in Washington D.C. to kick-off the Global Partnership for Wealth Accounting and the Valuation of Ecosystem Services (WAVES). The second was the meeting of experts hosted by the EEA in May 2011 to further a consensus on the conceptual framework for ecosystem accounts and the strategy for its development within the context of the revision process of the SEEA. A convergence emerged in both of these recent meetings on the general principles and elements of the conceptual framework for ecosystem accounting, the proposed outline and road map.

3. Work in putting the conceptual accounting framework for ecosystem accounting to practice in the context of national accounting is still relatively new and therefore labelled as experimental. The status of the part on experimental accounts for ecosystem as well as its naming and approval process is currently being discussed by the Bureau. A proposal will be put forward to the UNCEEA.

4. This note provides a general overview of the purpose and policy relevance of ecosystem accounts, presents a proposed outline of the ecosystem accounts and elaborates on the preliminary road map discussed at the 6th meeting of the UNCEEA. A draft list of issues has been prepared in consultation with a number of partners and experts in the field for comments by various experts, including the London Group on Environmental Accounting and it is presented in the Appendix to this note.

B. Policy Demand

5. The proposal is that the part of the SEEA on ecosystem accounting will encompass a broad description of the conceptual framework, which will include the scope and purpose of the accounts along with the proposed accounts, the classification of ecosystem services, the definition and measurement for the ecosystem accounting units and the valuation and recording methods of physical and monetary flows and stocks.

6. The motivation for development of ecosystem accounts comes from a wide range of emerging demands for integrating information on the environmental aspects of sustainability and for information on the links between ecosystems and human well-being. The international initiatives driving this demand for environmental-economic accounting from an ecosystem perspective are many. They include the Millennium Ecosystem Assessment, The Economics of Ecosystems and Biodiversity (TEEB), the "Stiglitz Report" on Measurement of Economic Performance and Social Progress, the World Bank-led WAVES Global Partnership and a number of emerging regional projects like Europe's "GDP and Beyond". The UN, OECD and EU activities on making the transition to a green economy all recognise the importance of maintaining ecosystem health and the flow of ecosystem services that are essential for well-being. Increasingly, an ecosystems perspective is incorporated into the frameworks used by groups like the World Water Forum and for projects like the UN REDD+ initiative launched by Norway and now steered by FAO, UNEP and UNDP. An integrated response to these new demands on environmental and economic statistics requires a new attention to the roles and functions of ecosystems.

7. The Millennium Ecosystem Assessment (MA) began from a call by former United Nations Secretary-General Kofi Annan in 2000 in his report to the UN General Assembly titled: *We the Peoples: The Role of the United Nations in the 21st Century*. The MA received widespread support from governments and a long list of international agencies and NGOs and the MA reports are extensively cited in the vast literature on ecosystem assessments. The MA concepts have been adopted in literally hundreds of local and regional pilot studies, as well as national projects like the UK National Ecosystem Assessment (NEA) published in June.

8. The MA, and subsequently TEEB and other related publications, established a new conceptual framework for monitoring and evaluating the state of the environment and its relationship to the economy, namely in terms of ecosystem services, or the benefits people obtain from ecosystems. The MA and TEEB classified these flows of value as provisioning services (including food and water), regulating services (e.g. natural protections against flood, drought, degradation and disease), supporting services (such as nutrients cycling and pollination), and cultural services (including the recreational, spiritual, and religious benefits from nature).

9. The MA, TEEB and related initiatives respond to the growing requests from international conventions like the United Nations Convention to Combat Desertification, the Ramsar Convention on Wetlands, the Convention on Migratory Species, and the UN Framework Convention on Climate Change; requests that, increasingly, demand the attention of the official statistics community. For example, in October 2010 in Nagoya, Japan, the 193 member states of the Convention on Biological Diversity agreed to a new strategic plan (Decision X/2) in which a call is made to incorporate the values of biodiversity into national accounting and reporting systems. These demands create new challenges, but also new opportunities for environmental-economic accounting.

10. The central policy question underlying these new developments is the appeal to maintain (or improve) the capacity of ecosystems for delivering services to present and future generations. This implies a policy need for a better understanding of what ecosystems provide in terms of both market and non-market goods and services and what 'assets' or attributes of ecosystems are necessary for maintaining these flows of value.

11. This need for a better understanding on what ecosystems provide should be addressed through explicit measures of the contributions of these services to society and the impacts of our activities on them. As argued in a recent report by the Australian Government:

> *Many ecosystem services have not been easy to observe until they cease to flow, hence they have not been formally counted in economic systems, or the effects of their loss have been counted as 'externalities.' However, when these externalities become a significant cost burden to society, such as restoring degraded river systems, it becomes a priority to understand and value ecosystem services and to integrate them into economic frameworks.*
>
> - Excerpt from *Ecosystem Services: Key Concepts and Applications*, Department of the Environment, Water, Heritage and the Arts, Australian Government (2010)

12. An important element in the measurement of the ecosystem services and the impact of the economy on the capacity of ecosystems to generate these services also draws out the need for geospatial data and their integration with data on production, consumption and accumulation from institutional units undertaking economic activities. Remote sensing and satellite images can be used to produce a wealth of new information when converted into statistics. This conversion into statistics requires tools and skills familiar to official statistics - particularly the use of common classifications - for which best practices have emerged. By combining with data derived from remote sensing and satellites new utility can be derived from existing official statistics, including improvements in policy relevance at multiple scales (local, regional, national, and global). Such data should be produced regularly and consistently through an agreed conceptual framework for ecosystem accounting.

C. **Annotated Outline**

13. The annotated outline set out below is a reflection of the emerging conceptual framework for ecosystem accounting, including its purpose and scope. Further research will have to continue to resolve the outstanding issues, for which issue papers have to be prepared and consultations will have to be organised for their resolution (see Road map below).

14. The emerging consensus is that the purpose of ecosystem accounts should be to provide information for assessing the capacity of ecosystems for delivering services to present and future generations and to monitor and value the flows of services. The scope of the ecosystem accounts, in principle, should comprise all ecosystems including oceans and atmosphere, and all areas of land including urban or built-up environments. Moreover, the ecosystem accounts should describe three fundamental aspects of the ecosystems and their interactions with the economy: (a) the assets, (b) the flows of services, and (c) the overall health of ecosystems.

15. At this stage of development, the proposal is to organize the description of the conceptual framework for ecosystem accounting in the SEEA in four brief chapters:

(i) Overview of the conceptual framework
(ii) Physical asset accounts for ecosystems and measures of environmental health
(iii) Physical flow accounts for ecosystem
(iv) Monetary valuation

C 1. Overview of the framework

16. It is expected that this Chapter will set out the purpose, the scope, the principles and the elements of the conceptual framework. These aspects can be broadly described to cover:

The perspective of ecosystem accounts as compared to the SEEA Central Framework and describing how the systems relate to each other

17. The ecosystem perspective is explained in the context of using official statistics to inform land and environmental resource management policies designed to protect and maintain ecosystem services and health. This perspective can be broadly summarized in terms of measures of the health or capacity of ecosystems to provide services. This means looking at the functioning of the ecosystems as a complementary point of view to the economic perspective for assessing sustainable use of natural resources and resource efficiency.

18. By way of example, the ecosystem accounts for terrestrial ecosystems incorporate information not only on land in economically productive use, but all land cover. From the ecosystem perspective, a forest is an asset not only in terms of its potential flows of timber and other resource inputs, but for all of the market and non-market services it provides as a naturally regenerating system.

The concepts and methods for identifying the statistical units of the accounts

19. The fundamental statistical unit is an ecosystem as a functional unit that has the capacity, in its own right, to provide services. These units are identified as spatial areas. Whereas the SEEA Central Framework takes mainly the national administrative perspective, information derived from ecosystem accounts can be assessed at the level of a functional ecosystem unit and at any geographic aggregation relevant for policy management, including river basins or regional administrative units.

20. The starting point for the identification of those functional units is land cover data derived from satellite images and remote sensing. From this basis, and in combination with additional dimensions such as the river basins and topography, elevation, and climate, a set of homogeneous functional landscape units that are mutually exclusive in terms of spatial area and can be derived for compiling and linking statistics obtained from the satellite images and from other data sources.

21. In the SNA, the statistical units are institutional units of the economy. These units utilize assets for production resulting in products that are classified according to the CPC. In the ecosystem accounts, the relevant units are ecosystems, which have the capacity to provide services, for which there is a draft classification called CICES.

The classifications for ecosystem services and assets

22. CICES, a draft classification for ecosystem services for the purpose of SEEA has been prepared and presented to the UNCEEA at its 5th meeting in 2010. CICES contains three categories of services: provisioning, regulation and maintenance, and cultural. Though there are some slight technical differences, in general CICES is derived directly from the predecessor framework of the MA and consistent with its successor in TEEB. As an additional dimension, there is a general agreement among experts to incorporate a scale attribute to this classification scheme.

The issue of scale

23. Statistics on ecosystems as derived from the accounts will have representation at different levels of geographical scale in order to address scale dependent services and policy questions. The issue of scale is addressed in the ecosystem accounts framework by compiling the accounts by geographic location or area. This means,

in some cases, re-scaling existing socio-economic data and presenting information spatially in ways that are logical and useful for policy complementing the national aggregates and indicators. The ecosystem accounts provide the framework for representing existing social and economic data alongside statistics on the health of ecosystems and the flows of ecosystem services.

C 2. Physical asset accounts for ecosystems and measures of health

24. Ecosystem assets function and provide services to humanity through complex and sustained interactions between biotic and abiotic resources. A clear analogy to the SNA follows: the statistical units of ecosystem accounts utilize their 'assets' for production of goods and services. The assets in ecosystems are assets from the economic perspective to the extent that in certain cases they can be owned and generate monetary benefits for institutional units. On the other hand, they are also assets from the ecosystem perspective in the sense that they are necessary components that create capacity for delivering services and for the continuous regeneration of that capacity. Asset accounts will therefore connect economic sectors and ecosystems.

25. The natural capital of ecosystems is unique in that when managed sustainably, it is not consumed or depleted because it is self-regenerative. Thus, degradation to the health of ecosystems is not inevitable from the ecosystem perspective, but can result either directly or indirectly from unsustainable use. Most of the negative externalities from economic production, consumption and accumulation become the immediate burden of ecosystems. But there are limits to an ecosystem's capacity for generating services and absorbing the outputs of materials and pollution from the economy. Exceeding the limits affects the capacity of the ecosystem to continue to provide services. Thus, there is a direct policy need for the measurement of the capacity of ecosystems to continue functioning and, where possible, to link this capacity to economic activity.

26. The approach for physical asset accounts is to identify simple yet agreed proxies for the assessments of health of ecosystems and their assets. Ecosystem health is assessed in terms of observing changes in the assets and proxies of the general capacity of the systems for delivering the services; a dashboard or health check-list of indicators derived from the accounts. Essentially, the idea is to carry over ecosystem health diagnoses based on observable symptoms.

27. The measures used as the proxy signals, or symptoms, of ecosystem health include the changes in stocks of biomass (growth, as measured by net primary production, less the removals through agricultural harvests, forestry, and grazing), measures derived from the land cover, protection of natural areas and fragmentation, indicators of availability or of stress derived from water accounts by ecosystems, and indices of biodiversity. The carbon accounts, representing the beginning and end of period changes in carbon fixed in vegetation, provide a general indication of health and sustainability over time because all terrestrial

ecosystems rely on the carbon cycle for the primary source of food and energy for all forms of life and growth. Statistics on the attributes of land use and land cover are also useful given some basic assumptions of the typical factors correlated to ecosystem health related to the size of unbroken areas of natural vegetation and the degree of its protection. The combination of quantity and quality of water is a central factor to the health of all ecosystems and data are available globally for monitoring relevant changes over time to individual systems. Biodiversity is a critical attribute of ecosystem resilience and therefore an important item on the health check-list and a powerful proxy indicator for assessing changes and risks over time. Disease prevalence of human, animal and vegetal populations is an indirect indicator of ecosystem health correlated to high environmental stress such as excessive waste dumping, lack of wastewater treatment or use of chemicals.

C 3. Physical flow accounts for ecosystems

28. In concept, all relevant flows of services from all ecosystems within the territory of reference are recorded in the physical flow accounts. However, in practice, it is clear that identifying and measuring all services is a significant challenge and there are not yet sufficiently robust methodologies for all ecosystem services in the classification. Therefore, the strategy for the experimental accounts will be to begin by selecting a small number of services of high relevance to the particular context. For services that can be identified, the objective is to record in each account the relevant physical flow measures for the purposes of assessing them over time.

29. In addition, ecosystem service flows cannot always be separately attributed to individual ecosystem units, but instead need to be identified at different scales as relevant for the particular type of service (note: the relevant scales will be indicated as a dimension within the classification of ecosystem services so that there is consistency in interpretation across accounts). For example, the filtration and assimilation services provided by a river or watershed may be more reasonably attributed to an entire river basin rather than to individual adjacent ecosystem units. Another example is services involving climate regulatory services that may not respect the boundaries of the ecosystem units. The ecosystem accounts framework should allow for these services to be attributed to the appropriate scale or spatial area.

C 4. Monetary valuation

30. The calculation of prices or monetary valuations for stocks and flows otherwise not explicitly identified through the market has become one of the most active areas of research in environmental economics. The key question is what is needed for integrating into policies and what can be achieved at different geographical scales. Some ecosystem services are already valued implicitly in the market, and thus in the national accounts, but they are embedded in the valuation of economic assets and production. Provisioning services, for example, such as food and

timber, are ultimately market goods and thus market price information can be used to calculate values for these types of services individually. But for other types of ecosystem services, such as the regulating functions, there are no individually observed market prices to indicate the value in monetary terms. Therefore, to incorporate these services into a monetary accounting framework, it is necessary to conduct valuations of the flows of benefits at a scale which is feasible, credible and policy relevant. In order for these valuations to be consistent with the SNA, they will need to approximate prices, and not attempt to represent a holistic or social identity of value.

31. Experience thus far with monetary valuation of ecosystem services consistent with the SNA shows that there are significant challenges. Hence, a combination of methods is needed (with different types of services subject to different and sometimes non-market valuation methodologies). Therefore, the proposal is to focus initially on a few key services for which reliable valuations can be produced for the purpose of regular accounts. In principle, in order to derive new aggregate measures of wealth, all services should be valued so that these measures can be used to calculate and aggregate the value of ecosystems and their assets. However, in practice the current approach for ecosystem accounts is to focus on a few selected services for which reliable and consistent valuations are most feasible.

32. Therefore, no comprehensive valuation of the ecosystem capital is foreseen at this stage beyond the valuation of those assets which are at the same time economic assets and recorded in the SNA. However, the possibility of collecting data from existing statistics and administrative reports on the benefits of the services and costs necessary to restore ecosystem capital from degradation will be explored.

D. Road map

33. The UNSD, the EEA and the World Bank were given the task from the UNCEEA to lead the development of the experimental accounts for ecosystems to serve as an input in the drafting of Part II of the revised SEEA.

34. The roadmap for the preparation of Part II of the SEEA involves the following activities and timeline:

    (a) Preparation of an issue list which will serve as the main inputs in the drafting of the text. (September 2011) The list of issues has been prepared in consultation with several experts and is presented in the annex of this paper. The list of issues will be presented for consultation to a wide range of stakeholders starting from the meeting of the London Group on Environmental Accounting (Stockholm, 12-15 September 2011).

    (b) Establishment of a technical expert group (TEG) on ecosystem accounting consisting primarily but not exclusively of authors of the issue papers and

which will provide the technical input to the process including drafting of the papers, reviewing of the papers, reviewing of the draft text and providing other inputs as needed (September 2011). The group will consist of experts from the statistical community, scientific community and ecological economics community. UNSD, EEA and the World Bank are in the process of identifying authors for the issue papers. Considering the nature of the material to be covered in Part II, it was considered necessary to establish a technical group that include a multidisciplinary group of experts and report directly to the Committee of Experts. The group will continue to work in close consultation with the London Group on Environmental Accounting to ensure that the views of official statistical community are taken into account.

(c) Meeting of the Technical Expert Group on ecosystem accounting in early December 2011. The meeting will bring together a multidisciplinary group of participants together ranging from statisticians, economists and ecologists from both from the official statistical community, academia, civil society, business and public sector. The objective of the meeting will be to discuss issue papers prepared to address the issues in the issue list and to obtain a consensus on the issues.

(d) Reporting on progress of work on the development of experimental accounts for ecosystems in the Report of the Committee of Experts on Environmental-Economic Accounting to the UN Statistical Commission in February 2012.

(e) Drafting of outcome papers by the authors of the issue papers. On the basis of the discussions during the Technical Expert Group meeting, outcome papers will be prepared by the authors of the issue paper for review and commenting by the TEG (January 2012).

(f) Establishment of the Editorial Board for Part II of the revised SEEA (September/October 2011). Considering that the content of Part II of the revised SEEA is different in nature to the content of Volume 1, the Bureau of the UNCEEA may need to consider a different composition of the Editorial Board. The Editorial Board for the central framework of the revised SEEA consisted of experts nominated by the Bureau members and by those international agencies not part of the Bureau that elected to be part of the board. Using the same process and considering the multidisciplinary nature of the content of Part II on experimental ecosystem accounts, it is advised that members of the Bureau, where feasible, may select two representatives, one from the statistical community and the other from the scientific or ecological economics communities.

(g) Drafting of the text for Part II of the revised SEEA on experimental accounts for ecosystems (February to September 2012). The drafting of the text for Part II will be undertaken by the editor, Carl Obst, with the assistance of the Editorial Board and other experts as necessary. The editor will prepare a first

draft of the text by May 2012 which will be sent out to the members of the technical expert group for review and comments.

(h) Global consultation on the text for Part II (September 2012). The editor in consultation with the editorial board will draft a new version of the text to be submitted for global consultation in September 2012. Upon analysis of the comments received, the editor and editorial board will draft the final version of Part II of the SEEA on experimental ecosystem accounts to be completed in December 2012 and submission to the UN Statistical Commission.

(i) Broad consultation and communication of the work on ecosystem accounts. It is envisaged that consultation with the various stakeholders need to take place. Possible opportunities to consult and inform about the work being done are the meetings of WAVES, side events during the UN Statistical Commission (February 2012) and the UN Commission for Sustainable Development (May 2012), United Nations Conference on Sustainable Development (Rio +20) (June 2012) and other appropriate international meetings.

Appendix 1

Draft, 25 August 2011

Ecosystem Accounts Issue List

Introduction

The outline below presents the current draft basic structure for presenting the conceptual framework for ecosystem accounts in the SEEA proposed in UNCEEA/6/6[1]. The issues listed within the outline may not be comprehensive of all technical questions or areas needing further work towards an agreed approach. However, these ten issues are believed to be particularly crucial for the development of ecosystem accounts in the SEEA.

On the following pages the reasoning and general background for each issue is elaborated along with general tasks that are expected to be undertaken A non-comprehensive list of references are provided under certain issues to elaborate on the background for the description of the issue.

(i) Overview of the conceptual framework

Issue 1 - Policy applications of ecosystem accounts
Issue 2 – Structure of accounts
Issue 3 - Land cover mapping, land cover classifications, and accounting units

(ii) Physical asset accounts for ecosystems and measures of environmental health

Issue 4 – Net ecosystem carbon accounts
Issue 5 – Landscape accounts and landscape ecological potential
Issue 6 – Biodiversity accounts and indexes
Issue 7 - Ecosystem Health/Total ecological potential

(iii) Physical flow accounts for ecosystems

Issue 8 - Classification of ecosystem services
Issue 9 –Prioritization of ecosystem services

(iv) Monetary valuation

Issue 10 – Principles of monetary valuation

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[1] http://unstats.un.org/unsd/envaccounting/ceea/meetings/UNCEEA-6-6.pdf

1. Policy applications of ecosystem accounts

The introduction to the Conceptual Framework for Ecosystem Accounts should include a clear articulation of how ecosystem accounts can be used to inform policy on the contribution of ecosystem services to the well being of the present and future generations. In other words the introduction to the document needs to lay out the basic questions or problems addressed by ecosystem accounts. A broad multi-purpose policy perspective should form the basis for the structure and scope of the ecosystem accounts in understanding the interrelationship between the economy and the health or state of the ecosystems in producing benefits. Therefore, a primary purpose is the assessment of the impact of economic activities on the health (or state, capacity, functioning) of ecosystems. Such assessments would allow for the establishment of interrelationships between the activities of production, consumption and accumulation by the various actors in the economy and their use of environmental assets and ecosystem services. It is expected that statistics from the accounts will inform formulation and impact assessments for land and ecosystem management, regulatory and fiscal policies at multiple scales but particularly at the national and international levels.

The scope of the ecosystem accounts will include the terrestrial and aquatic ecosystems and their exchange with the atmosphere, at global, national and local level, whereby the health of ecosystems is described in key flows of ecosystem services. These flows are described in physical terms and where possible these physical flows are monetized. The growing interest in monetary valuation of non-market services of ecosystems should allow for an assessment for payments or compensation for ecosystem services and indeed schemes of this sort are rapidly emerging as part of local, national and international governance related to climate change, biodiversity and sustainable development.

Elaboration and extensions with specific examples is needed on how ecosystem accounts contribute to the monitoring of ecosystem health and flows of key ecosystem services in relation to the development of the economy. These elaborations and extensions have to take the accounting principles and structure of the SEEA Central Framework as the initial point of reference.

Tasks:

- Explain the underlying general purpose of ecosystem accounts, why they are necessary, and elaborate with examples of policy applications
- Explain the conceptual relationship between the proposed ecosystem accounts and the SEEA Central Framework and the advantages of compiling information on the state of health and flows of services of ecosystems in an integrated accounting system

References:

- EEA (2010) Ecosystem Accounting and the Cost of Biodiversity Losses: The case of coastal Mediterranean Wetlands, EEA Technical Report No.3/2010
- UNEP (2010) The Economics of Ecosystems and Biodiversity, Synthesis, conclusions, and recommendations (http://www.teebweb.org/LinkClick.aspx?fileticket=bYhDohL_TuM%3d&tabid=1278&mid=2357)

2. Structure of accounts

The starting point for the structure of ecosystem accounts should be the principles and structure of accounts in the SNA and SEEA Central Framework. This issue will include assessments of comprehensiveness of the proposed accounts, analysing whether there are missing elements or redundancies and how information is organized and linked.. Critical is the introduction (akin to institutional sectors in the SNA) of ecosystem accounting units that in their own right can hold and maintain environmental assets and produce ecosystem services to structure the asset and flow accounts. These accounts should include physical and monetary accounts. It is important to reach a general agreement on the scope and purpose for monetary accounts or valuation, with particular attention to policy relevance of the various possibilities.

The SEEA Ecosystem Accounts should provide a basic set of accounts that can support assessments of the state of ecosystems and their main flows of services to the economy that are integrated with the other accounts and tables of the SEEA. The basic accounts should include flows of non-market ecosystem services otherwise not captured in the SNA or the SEEA Central Framework. In principle, this could be accomplished by extending the production boundary of the system in order to account for public services that are not owned or transferred directly from one economic agent to another. A perhaps more fundamental innovation of ecosystem accounts would be more related to assets accounts, in which measures of the state or health of ecosystems, defined in terms of capacity for delivery all types of ecosystem services, are compiled in terms of beginning and end-of-period stocks or diagnostic measures.

It is expected that both physical and monetary accounts will be described in the ecosystem accounts but further investigation is needed in terms of the details of the structure, scope and relationships to the SEEA Central Framework.

Tasks:

- Provide general guidance on the structure of the accounts, i.e. what is included at the most basic level and how these accounts are related, focussing on identifying potentially missing elements or redundancies and other issues of how the sequence of accounts may be organized at an aggregated level.
- Review the options for the ecosystem accounting units for the compilation in accounts.

- Clarify the types of accounts that are included: asset accounts, flow accounts, and/or something else?
- Clarify how the information in the accounts are organized and linked together and explain the relationship with the SEEA Central Framework

References:

- Wentworth Group of Concerned Scientists (2011) Draft Standards and Accreditation Manual for Australian Regional Environmental Accounts Trials 2011

3. Land cover mapping, land cover classifications, and accounting units

The fundamental units in the ecosystem accounts should proxy basic functional units of the environment that have the capacity, in their own right, to provide services to humanity. As in the SNA, the units of ecosystem accounts need to be defined according to a set of simple rules that approximate their principle functions, behaviour and objectives. The accounting units are distinct from reporting units, which could be virtually any type of aggregation of the accounting units on a spatial frame. For inland ecosystems, land cover data, in addition to other landscape traits, are used as building blocks for identifying the units. The approach should build upon existing studies, such as EEA's Simplifed Ecosystem Accounts, which utilizes CORINE land cover information. The SEEA land cover classification developed within the Central Framework is applicable but more details on 'operationalization' for ecosystem accounts are needed, both for the purpose of establishing units and for deriving (and in some cases re-scaling) statistics. To achieve some commonality in approaches will require an understanding of what is feasible given current remote sensing technology and data availability internationally.

Tasks:

- Identify criteria for remote sensing data for use in ecosystem accounts
- Review and propose core concepts and approach for aggregating land cover data from a 1km grid and identifying the accounting units

References:

- EEA, Land Accounts for Europe, 1990-2000 (http://www.eea.europa.eu/publications/eea_report_2006_11)
- Weber, Jean-Louis (2011) Approach to Simplified Ecosystem Capital Accounts, Presentation to UNCEEA, 15-17 June 2011, New York (http://unstats.un.org/unsd/envaccounting/ceea/meetings/UNCEEA-6-33.pdf)

4. Net ecosystem carbon accounts

From very early in the history of the development of the concept, ecosystems have been described fundamentally as energy transforming machines. Primary production is the

process whereby the primary producers (plants, algae, and some bacteria) capture energy from light and transform it into the energy bonded in carbohydrates. Primary production represents the primary source of energy for all other living things in the food web. Humans appropriate a portion of primary production through harvesting crops and timber and raising livestock. Overharvesting of crops and timber and overgrazing by livestock have had severe impacts on ecosystems. The net ecosystem carbon balance, calculated as net primary production less removals, provides a general measure of the energy left in the system for all other functions so that adverse and long-term impacts may be avoided. Therefore, it is believed that changes in the net ecosystem carbon balance over time can provide a general proxy measure on the state of ecosystems. In addition, statistics on stocks of carbon, or biomass, in forests are critical for implementing programs like the global REDD+, which essentially aims to establish international payments for the service of carbon sequestration provided by standing forests.

In summary, the carbon accounts, representing the beginning and end of period changes in carbon fixed in vegetation, provide a general indication of health and sustainability over time because all ecosystems rely on the carbon cycle for the primary source of food and energy for all forms of life and growth.

Tasks:

- Describe measures for net primary production (NPP) and for the net carbon balance by accounting units.
- Outline the data requirements for compiling the underlying stocks and flows for net ecosystem carbon (asset) accounts
- Investigate current data availability to meet these requirements and identify potential data gaps or related challenges for producing the accounts globally

5. Landscape accounts and landscape ecological potential

Land cover change is an important indicator for the potentials for delivery of ecosystem services. Physical restructuring can have two types: a complete change from one type of system to another (e.g. from forest to field or field to urban) or a more partial restructuring of an existing system to facilitate delivery of additional services. Both types of physical restructuring can impact the long-term capacity of the system for delivery of both market and non-market services to humanity. Beyond the mere quantities of land cover change, the details of the conversions are important in this context. For example, urban development in a broadly developed area does not have the same consequences as if it took place in the countryside, or against a high nature value site. Attributes of partial restructuring, such as fragmentation from constructing roads or other transportation corridors, or degrees of protection for landscapes can be important factors of landscape ecological potential. A simple and reproducible way of characterising landscapes from an ecological point of view is proposed in EEA's *Land Accounts for Europe, 1990-2000*.

Tasks:

- Propose landscape and land cover measures and propose a structure for a possible landscape or landscape ecological potential account
- Outline the data requirements for compiling the landscape accounts
- Investigate current data availability to meet these requirements and identify potential data gaps or related challenges for producing the accounts globally

References:

- EEA, Land Accounts for Europe, 1990-2000 (http://www.eea.europa.eu/publications/eea_report_2006_11)

6. Biodiversity accounts and indexes

Biodiversity is a critical attribute of ecosystem resilience and therefore an important proxy indicator for assessing changes and risks over time. The purpose of ecosystem accounts of biodiversity is not to assess biodiversity itself but to assess the state or health of the ecosystems, noting that biodiversity is a powerful indicator of healthy functioning and resilience. A *diagnostic account* for which regular information on biodiversity is compiled by accounting units could be a useful approach for integrating biodiversity information into economic and environmental asset management.

Information on biodiversity for compilation in ecosystem accounts is available but often the data have problems with consistency and completeness from a national accounting point-of-view. There have been many studies and indicators or indices have produced in many different contexts for biodiversity. These studies can be reviewed for their applicability to compiling regular ecosystem accounts. Particular attention will have to be paid to micro-biodiversity, such as the decomposers, which attract less public attention but are of vital importance. In the identification of indicators, it is crucial to consider data availability in different parts of the world upfront in order to ensure that no indicators are proposed for which there are insufficient data.

Tasks:

- Propose methods for calculation of a biodiversity index and propose the structure of a biodiversity diagnostic account
- Outline the data requirements for compiling biodiversity accounts
- Investigate current data availability to meet these requirements and identify potential data gaps or related challenges for producing the accounts globally

7. Ecosystem Health/Total ecological potential

A key objective for the ecosystem accounts is to derive information for monitoring the general health, or state, of ecosystems in their capacity to provide services to humanity, now and in the future. Reference to the health (or state, or capacity, or potential, or functioning) of a system implies a goal or objective, namely to achieve or maintain a minimum level of health given current scientific knowledge and societal values for a healthy system. If ecosystem health or potential is intrinsically a goal, than there is a need

for indicators to monitor trends towards achievement of the goal. An analogy can be made to the concept of at least not depleting capital in the economic sense. If ecosystem health defines natural capital, than the goal is to maintain that capital – and given this analogy an accounting approach seems appropriate.

Issues 4-6 in this list relate to three of the possible core measures to monitor the state of ecosystems over time. Agreement is sought on a minimum set of measures, which may include carbon accounts, landscape accounts, and biodiversity, in addition to other measures related to water, soil, etc. An investigation is needed into the interactions between these potential measures and ultimately the ecosystem accounts should incorporate an assessment of which measures are most relevant for measuring overall ecosystem health and why. The objective should not be comprehensiveness of all possible indicators of health, but rather to aim for a simplified approach involving a small set of measures that sufficiently approximate the overall capacity of systems for providing a generic bundle of services.

Furthermore, agreement is sought on the methods for integrating the different sources and types of information on ecosystem health, reviewing the possibility for multi-criteria analysis and methods for deriving a single index or a "common currency" for ecosystem assessment. The proposed approach of ecosystem accounts is to identify some simple but powerful rules that guide or approximate key changes to the health of ecosystems. A useful analogy can be made to a regular health check-up with a doctor. The doctor checks the patient's vital signals, looking for symptoms or some general indicators of the state of the system. Ecosystem health is assessed in terms of observing changes in the vital signals or proxies of the general capacity of the systems for delivering the services; thus, the approach depends on acceptance of the general assumptions about the applicability of the adopted measures for predicting delivery of ecosystem services. The health checklist should be applicable at the global, national or local scales and support "preventive medicine" investigations as well as more thorough examinations when symptoms evidence a trend towards general health decline.

Tasks:

- Review and evaluate potential core measures from the ecosystem accounts and their applicability for assessing ecosystem health/potential/capacity measurement
- Propose, and provide justification for, a core set of symptoms or indicators for an ecosystem health check-list
- Review approaches to integrating different measures into a common index or 'common currency' for ecosystem accounts

References:

- David Rapport et al. (1998) Ecosystem Health, Blackwell Science, Maden, MA
- Wentworth Group of Concerned Scientists (2011) Draft Standards and Accreditation Manual for Australian Regional Environmental Accounts Trials 2011

- Cosier, Peter and Jane McDonald (2010) A Common Currency for Building Environmental (Ecosystem) Accounts, Wentworth Group of Concerned Scientists, Paper prepared for the London Group on Environmental Accounting, 25-28 October 2010, Santiago, Chile

8. Classification of ecosystem services

Ecosystem services can be defined broadly as the functions of ecosystems that provide benefits to human well-being and arise from the interaction of biotic and abiotic processes.

A Common International Classification for Ecosystem Services (CICES) is needed in order to integrate and compare across potential data sources for ecosystem service flows. A joint initiative on this topic by EEA, UNEP and UNSD resulted in 2 international workshops (Copenahagen, 2008 and 2009) and an electronic forum in 2009. CICES was developed on the basis of consistency with accepted typologies currently in use and compatibility with SEEA. CICES was presented for information to the UNCEEA meeting of June 2010. In the document, CICES is cross-tabulated with other international classifications, in particular the Central Products Classification (CPC V2), and the Classification of Individual Consumption by Purpose (COICOP).

Since these discussions, work has continued on ecosystem services and led to some developments. There is a proposal for a different type of classification for marine ecosystems by Anne Boehnke-Henrichs, Dolf deGroot and Salman Hussain for the purpose of economic value calculation. Other developments are taking place under the MA update process and ES applications (InVest, ARIES…). These works have to be reviewed and, where relevant cross-referenced, as part of finalization of CICES.

Tasks:

- Review recent developments related to the ecosystem services classification (CICES) and propose final version
- Identify deviations from other typologies in use (e.g. from TEEB) and explain the reasoning for deviations (if any)

References:

- Haines-Young, Roy and Marion Potschin (2010) Proposal for a Common International Classification of Ecosystem Goods and Services (CICES) for Integrated Environmental and Economic Accounting, Prepared for EEA for the UN Committee of Experts on Environmental-Economic Accounting, 23-25 June 2010, New York (http://unstats.un.org/unsd/envaccounting/ceea/meetings/UNCEEA-5-7-Bk1.pdf)

9. Prioritization of ecosystem services

It would be useful to distinguish between (i) services that increase overall production and welfare but are not currently captured in the SNA, and (ii) services that support economic activities already captured in the SNA, though not necessarily explicitly. There has been a general call within the context of the World Bank WAVES global partnership to examine which services should be regarded as priorities for ecosystem accounting, noting that some are more difficult than others from a measurement/valuation perspective. For the purposes of ecosystem accounts, prioritization can be made considering the following criteria: (i) economic importance; (ii) possibility to consistently include the service in SEEA; and (iii) availability of data. For these potential priority services, there is a need to analyse how available data (which will often be fragmented and/or spatially heterogeneous) can be used to construct meaningful national level physical and monetary statistics suitable for incorporation in SEEA. It will also be important to provide general clarifications in regards to avoid overlap or double-counting (or perceptions thereof) in national accounts by including different types of measures.

Tasks:

- Review criteria for prioritizing ecosystem services measurement for ecosystem accounts
- Analyze the interrelations between different service flow measures and determine which are most relevant and most feasible for ecosystem accounts
- Investigate availability of measures for capturing ecosystem service flows at different levels either in physical or monetary terms, or both

10. Principles of monetary valuation

There is a general consensus on the principle that monetary valuations in SEEA should be consistent with the SNA. However, there are a number of technical challenges to achieve this and also compile meaningful information for ecosystem accounts in monetary terms. In particular, there is a need to continue to take stock of existing practices and build a collective understanding on what is feasible or efficient and which approaches are appropriate for what purposes.

The scope of ecosystem accounts, in principle, may include valuations of services already included implicitly in the SNA and valuations of services not included in because they are flows outside of the SNA production boundary. Several general studies have been done to review current approaches to ecosystem services valuation, including the below analysis taken from EEA (2010).

Methodology	Approach	Applications
Change in productivity	Value impact on change on (market) products	Any impacts on products – need an observable change to production of valued product
Cost of illness, human capital	Value impact on morbidity and mortality and/or health problems	Any impacts on health (e.g. air & water quality)
Replacement cost	Cost of replacing the lost good or service	Any losses that can be replaced/restored
Travel cost method	Derive demand curve from actual costs of travel	Recreation, tourism
Hedonic prices	Disentangle effect of environmental factors on prices of goods and services	Air quality, scenic beauty, cultural benefits (e.g. of green spaces on property values)
Contingent valuation	Survey willingness-to-pay for a specific service	Any service
Choice modelling	Survey preferences for a set of options	Any service
Benefits transfer	Generalize results from comparable situations in different contexts	Any service for which suitable comparisons are available

Source: *Ecosystem Accounting and the Cost of Biodiversity Losses*, EEA Technical Report No 3/2010

Tasks:

- Review current proposals for valuation from the perspectives of policy-relevant uses, technical soundness, feasibility for regular and comprehensive accounting, and coherence with the general accounting framework
- Compile list of the key technical challenges for monetary valuation in the ecosystem accounts