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Status of revision issues

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SEEA EEA REVISION

STATUS OF REVISION ISSUES

1. Introduction

This paper summarises the progress made through the SEEA EEA Revision process with respect to advancing the set of revision issues finalized and endorsed by UNCEEA in June 2018. For reference, Annex 1 provides the text describing the final set of revision issues including a short summary of the process by which that set of issues was established.

Since June 2018, there has been an impressive range of research and discussion across all of the four research areas (see Table 1 below). For each research area in turn, this progress is summarized in the section immediately below together with description of the remaining research questions. A final section proposes six cross-cutting issues – i.e. those issues that will require collaboration by experts from across the research areas.

The proposed plans for taking this work forward are detailed in an updated SEEA EEA Revision planning document that has been prepared in parallel. The set of issues and the plans will be reviewed and updated following the discussion at UNCEEA and at the Forum of Experts on SEEA Experimental Ecosystem Accounting, both meetings to be held at the end of June 2019.

Table 1: Summary of issues for SEEA EEA Revision issues

Research area	EEA Revision Issue
1. Spatial areas	1. Classification of ecosystem types
2. Ecosystem condition	2. Characteristics and indicators of ecosystem condition
3. Ecosystem services	3. The description and classification of ecosystem services
4. Accounting treatments and valuation	4. Valuation concepts for ecosystem services and ecosystem assets
	5. Valuation methods for key ecosystem services
	6. Accounting for ecosystem capacity, degradation and enhancement

2. Research area #1: Spatial units

Progress on revision issues

Very good progress has been made in this research area while recognizing that there remain some substantive decisions to be taken. The focus of this research area is on the development of a classification of ecosystem types. As a starting point, it has assumed that the underlying model of spatial units described in the SEEA EEA and refined in the EEA Technical Recommendations is appropriate; i.e. the use of ecosystem assets (EA) as the conceptual accounting unit each classified to an ecosystem type (ET) with the role of basic spatial units (BSU) to be a tool to support compilation of accounts and the scope of an account is defined by the ecosystem accounting area.

As reflected in three discussion papers, the working group for this research area (WG#1) has started with the objective of using an ecological approach to identify relevant classes. A range of possible classifications were examined with two leading candidates emerging – the IUCN Red List of Ecosystems (RLE) and the USGS/ESRI Globally Distinct Biophysical Settings (GDBS). Other classifications of habitat and land cover were considered but as they did not classify ecosystems they are not on the short list. Some refinements and clarifications on these options are being considered, especially in light of these being both new classifications. A round of expert review has been completed (at end May) with the feedback to be considered and summarized ahead of the Forum of Experts.

In addition to the issues of classification, WG#1 has examined issues of the boundary for the classification – in essence the boundary for ecosystem accounting. Relevant topics here concern the treatment of marine areas and the treatment of the atmosphere. The inclusion of marine areas in ecosystem accounting is widely accepted and relevant classes for these areas will be included in the classification. Note too that freshwater areas are also explicitly incorporated. The aim is to ensure that the past focus on terrestrial areas is broadened. For the atmosphere some options for treatment have been proposed, including treating the atmosphere as distinct units for accounting purposes.

Work has also progressed on the delineation of urban areas, with a discussion paper released for comments. There are options here in terms of treating urban areas as a single ecosystem type or as a “mosaic” of different ecosystem types.

Remaining research issues and future work

The key focus moving forward, after considering the feedback from the expert review process, is resolving and determining appropriate ways forward for the classification of ecosystem types. It is expected that testing of leading options will be a particular focus in the coming months and co-ordination with geo-spatial experts will be required. Direction will also need to be set on the appropriate treatment of marine, atmosphere and urban areas based on the proposals in the discussion papers and discussion at the Forum of Experts.

The remaining research issues concerns the treatment of linear features and subterranean ecosystems (e.g. caves and groundwater). In both cases the learning from the discussion on urban areas and the atmosphere should be able to be applied so that the revised SEEA EEA can provide appropriate advice.

3. Research area #2: Ecosystem condition

Progress on revision issues

Very good progress has been made in this research area. This was considered one of the more challenging areas since it is the most “ecological” of the research areas and it was generally considered that the SEEA EEA was relatively weak ecologically, i.e., that there was substantial ecological knowledge that needed to be incorporated.

The working group (WG#2) has worked steadily since mid 2018 to provide a strong framing for the measurement of ecosystem condition for the revised SEEA EEA. Three discussion papers were completed in February and reviewed by around 30 experts. They have been very positively received overall. Particular areas of the framing that have been the focus of WG#2 are: the definition of condition, the links to perspectives on environmental values, a common structure (and terms) for discussing key measurement components (characteristics, variables, indicators, indexes and reference levels), structures of alternative accounts and a typology of condition indicators. Aside from conceptual work that synthesized existing ecological approaches to measuring condition, WG#2 also reviewed over 20 examples of ecosystem condition accounts to compare and contrast current approaches.

Remaining research issues and future work

While substantive progress has been made in introducing an ecological framing to the measurement of ecosystem condition there remain a number of issues to be taken forward to satisfy the expectations of the initial set of revision issues and also to deal with issues that have emerged. A number of these seem best advanced in conjunction with other research areas.

The remaining issues are:

- Clarifying the role of the condition account within the broader ecosystem accounting system
- Determining appropriate advice with respect to reference levels and reference conditions
- Ensuring clear explanation of the place of biodiversity in measuring ecosystem condition
- Examining the link to ecosystem services via the concept of ecosystem capacity
- Considering issues of aggregation and scaling

The final three issues should be taken forward as cross-cutting issues and the first issue will be the focus of a separate context setting paper.

In addition, it is expected that an approach to testing the proposed structure of measurement components and the indicator typology will be developed to ensure that the proposed approach can be applied in a range of situations. This should also support development of proposals for a typical set of condition indicators for high-level ecosystem types.

4. Research area #3: Ecosystem services

Progress on revision issues

There has been ongoing and extensive discussion on the definition, measurement and valuation of ecosystem services since the release of SEEA EEA, and there has been much substantive research and discussion over the past 12 months on the various topics. In particular, following the drafting of an overall conceptual discussion paper in mid 2018, it was agreed that focus should turn to consideration of individual ecosystem services to assess how current measurement and valuation practice might inform the revised SEEA EEA. Using this focus, substantive research papers were drafted by over 30 leading experts for 10 selected ecosystem services. These papers were the focus of discussion at a workshop in January 2019. The findings from these discussions have now been drawn together in two papers for discussion at the Forum of Experts in June 2019.

Two key messages emerge from the past 12 months – first, that while ecosystem services measurement remains a developing field of research and there are differences in approach and terminology, there is a strong and commonly understood theoretical model; and second, that the measurement of ecosystem services aligned with the conceptual framing of the SEEA EEA is very possible based on available data and using well-established biophysical modelling approaches (e.g. for stocks and flows of carbon and water). The lack of firm agreement on terminology and treatments is thus not a barrier to implementation per se. In short, the SEEA EEA revision process provides an opportunity for statistical approaches to provide a degree of harmonization and to build on the existing body of knowledge.

As for other areas, finalisation is required concerning the set of revision issues described in Annex 1 - both conceptual and for individual ecosystem services - but for most issues it is now not a question of additional research but of making some choices/proposals that can then be the focus of wider consultation.

The focus on individual services has also revealed some additional issues that will need further consideration but commonly are also in the category of being well-described and hence choices needed. These additional issues concern:

- the treatment of abiotic services (e.g. solar energy)
- sink services and the mediation of pollutants
- use of space (e.g. for navigation)
- treatment of ecosystem services related to the atmosphere (e.g. GHG emissions)
- the role of the concepts of potential supply and ecological endpoints
- determining the measurement baseline (counterfactual) for regulating services
- the spatial allocation of ecosystem services
- describing the linkages between ecosystem services.

The final issue is perhaps the most challenging and the most intriguing topic to emerge from the discussion on individual ecosystem services.

Remaining research issues and future work

Material for discussion (both background papers and short notes) on all of the ecosystem services issues listed above and in Annex 1 has been prepared for discussion at the Forum of Experts. In terms of the future research agenda it is not expected that additional research is required on these topics but rather that there is ongoing discussion and conclusion with respect to the options on the table. It is anticipated that the Forum of Experts discussion in June will provide direction in many areas.

Based on the current understandings, and assuming some clear direction can be set for many of the issues on the table, the key remaining research areas are the following:

- Determining approaches to accounting for linkages between ecosystem services, potentially using supply-use frameworks
- Considering the development of a typology of ecosystem services for SEEA EEA
- Linking ecosystem services measurement to the measurement of ecosystem condition and capacity

The third issue will be the focus of investigation through the set of cross cutting issues.

5. Research area #4: Valuation and accounting treatments

Progress on revision issues

The final research area concerns valuation and accounting treatments. Work on the various issues in this area commenced in earnest in early 2019, noting however the contributions of many experts to the Expert Meeting on Ecosystem Valuation in the context of Natural Capital Accounting (Bonn, 24-26 April 2018) on valuation that brought the relevant perspectives together. Since early 2019, the working group (WG#5) has drafted three discussion papers covering all of the core research topics listed in Annex 1. There has been excellent engagement across the economics and accounting communities with around 15 people involved in the drafting and discussion of the papers. No broad review of the papers has taken place yet because of lack of time before the forum.

On a technical level substantive progress has been made in drafting text that describes much improved joint understanding of issues including:

- the wider valuation context (placing accounting values in context with other conceptions of value, including non-monetary values)
- the connection between exchange values and welfare values
- the potential to apply existing valuation techniques, including benefit transfer
- the framing of asset valuation for natural resources and ecosystems where the assets are renewable, ownership rights may be less clear and the services/benefits are not marketed
- the treatment of ecosystem degradation and enhancement in an accounting context
- the description of ecological liabilities

- the links to the SNA and the sequence of accounts

The three discussion papers have sought to integrate existing knowledge from environmental economics, capital accounting theory and national accounting. It is anticipated that discussion at the Forum of Experts will widen appreciation of the progress that has been made, consolidate as far as possible various treatments and concepts for the revised SEEA EEA and determine those areas in which further research and discussion is required.

Remaining research issues and future work

Notwithstanding the very positive progress over the past few months by the members of the working group, it is clear that a process of consolidation and wider discussion is required to advance in these areas. In that regard, it is considered that most of the research issues discussed above still remain as a focus of research, especially to take account of feedback from the Forum of Experts and also wider consultation.

In addition, considering the original description of research issues from June 2018 and other topics that have arisen in the course of the working group discussion the following issues are noted as requiring further consideration:

- The connection of ecosystem asset values to market values of land
- The treatment of multiple ecosystem services from a single ecosystem asset
- Valuation of cultural, health and non-use related ecosystem services
- The allocation of ecosystem degradation to economic units
- Accounting for ecosystem disservices and externalities in SEEA EEA
- Understanding the role of ecosystem capacity and condition measures in the valuation of ecosystem assets

Overall, there remains a some research and discussion to complete in this area. Some work will be taken forward in the context of the cross-cutting issues (see below). For other areas it will be necessary to take advantage of the significant steps forward that have been taken in the past 5 months. The organization of this research work will be a topic for discussion at the Forum of Experts meeting.

6. Cross-cutting issues

In the planning of the revision process, it was envisaged that following a first round of research on the four research areas, attention would turn to integration across the research areas, in part because of the inherent connections but also because the SEEA EEA is conceptualized as an integrated system and hence treatments proposed for different accounts must align.

Although some research issues remain for discussion within individual research areas (most notably for valuation and accounting treatments), it is considered appropriate to continue with the planned approach of moving to a focus on cross-cutting issues. The following issues are an initial list to commence discussion. Necessarily there will be connections among these issues as

well, and conversely each issue listed might be broken up into a range of topics. Nonetheless, this framing is proposed to provide both a reasonable coverage and a sensible number of discussion processes to manage.

It is also noted that to support the work towards an integrated SEEA EEA, the extended SEEA EEA Technical Committee to include also area leads and representatives of the agencies that are expected to put their logo on the publication, will now function (from June 2019) as an editorial board for the revised SEEA EEA and hence play a role as a technical focal point for work across all parts of the SEEA EEA.

The six proposed cross-cutting issues are:

1. **The framing of values** – The aim here is to ensure that there is a common understanding of accounting valuations in the broader landscape of values and the role of the whole ecosystem accounting framework in discussion of values (e.g. the role of condition measurement wrt intrinsic values). This topic has been considered already by research areas on ecosystem condition and valuation.
2. **Aggregation and scaling** – These issues have been noted in most research areas but not dealt with head on. The potential of accounting at larger scales (e.g. national), the associated data requirements and assumptions needs to be worked through. This topic has been considered to a small degree in relation to ecosystem condition, ecosystem services and valuation but a common understanding is required, which is likely to link directly to the approaches taken to delineating spatial units.
3. **Degradation and capacity** – Central to the intent of ecosystem accounting is to support understanding the impact of human activity on the environment. Degradation (and its accounting counterpart enhancement) can be defined and measured in different ways and will be linked directly to measurement of ecosystem condition and capacity. In addition to incremental/marginal changes, special consideration is needed of ecosystem conversions where the ecosystem type changes from one accounting period to the next.
4. **Biodiversity** – The SEEA EEA uses the widely endorsed definition of biodiversity from the Convention on Biological Diversity recognizing the variability among three levels of ecological organization – ecosystems, species and genes. It is now clear however, in discussion with biodiversity experts, that while some perspectives on biodiversity are well incorporated (specifically concerning variation in ecosystem types and local species populations), there are other important aspects of biodiversity that should be reflected, particularly global species diversity. Recent discussion has enabled better identification of these issues and one proposal is to complement the SEEA EEA framework to account for species. More broadly there remains a need to reach a stronger and common understanding of the connections between biodiversity and the ecosystem accounting system. This is needed so that the revised SEEA EEA can best incorporate the expertise of the biodiversity community and the data from the accounts can best support decision making on reversing global biodiversity loss.
5. **Application of ecosystem accounting principles to specific areas** – Here the intention is to ensure that the ecosystem accounting principles which have been largely developed from a terrestrial ecosystems perspective can be applied to specific areas/contexts. Four

contexts are proposed for discussion – marine/oceans; urban areas (and agricultural mosaics); protected areas; and the atmosphere.

6. **Connections between ecosystem accounts** - The SEEA EEA has a number of different accounts encompassing a wide range of information. There are also thematic accounts and connections to accounts of the SEEA Central Framework and the sequence of accounts of the SNA. For those not familiar with accounting systems, the understanding of the connections is much more limited than it needs to be. This can limit the potential to see opportunities for analysis and for integrated approaches to data collection. This discussion aims to clarify the accounting connections across the SEEA EEA system and beyond.

ANNEX 1: REVISION ISSUES NOTE - FINAL

July 2018

Background

In March 2013, the United Nations Statistical Commission endorsed the System of Environmental-Economic Accounting – Experimental Ecosystem Accounting (SEEA EEA) as the basis for commencing testing and further development of this new field of national accounting. The SEEA EEA was formally published in 2014 as a joint publication of the United Nations, European Commission, Food and Agriculture Organization of the United Nations, Organisation for Economic Co-operation and Development and the World Bank¹.

While the ecosystem accounting system described in SEEA EEA was novel, it reflected the integration of many existing strands of expertise including statistics and national accounting, ecology and natural science, geography and geo-spatial measurement. By providing a platform by which these disciplines could exchange and share ideas, there has been rapid growth in the development and testing of ecosystem accounting. From a zero base in 2012, there are currently over 40 countries with ecosystem accounting programs of some type underway and there are applications in, and participation from, all sectors – public, private, academia and civil society.

Given this level of interest, testing and experimentation, the body responsible for the development and advancement of the SEEA, the UN Committee of Experts on Environmental-Economic Accounting (UNCEEA), determined in June 2017 that a revision of the SEEA EEA drafted in 2012 was appropriate with the intention that as many aspects of ecosystem accounting as possible could be elevated to statistical standards by 2020. This revision process has now commenced. The revision process will be based on the SEEA EEA endorsed in 2013, the experiences of the many initiatives on ecosystem accounting in practice, and on the recently released Technical Recommendations in support of the SEEA EEA 2012².

As customary when launching a revision process, issues that remain unsolved and need to be addressed have been identified. A list of issues has been developed through discussions at the June 2016 and June 2017 UNCEEA meetings and the October 2017 London Group meeting of experts on environmental-economic accounting. The current list has been endorsed by the SEEA EEA Technical Committee, the working group under the auspices of the UNCEEA that will oversee the revision process.

In order to ensure a wide and inclusive revision process, the Committee of Experts on Environmental Economic Accounting sought input from experts working in organisations, initiatives or disciplines with a connection to ecosystem accounting. Feedback was welcomed on:

¹ https://seea.un.org/sites/seea.un.org/files/seea_eea_final_en_1.pdf

²

https://seea.un.org/sites/seea.un.org/files/technical_recommendations_in_support_of_the_seea_eea_final_white_cover.pdf

- The coverage and description of the revision issues described below
- The priority areas for research and discussion
- Your interest in participating in the revision process, noting the particular area/s to which you, your organisation or any groups that you participate in may wish to contribute
- Your suggestions as to other relevant organisations, groups or networks and associated events who should be connected to the revision process.

A total of 19 responses were received from a variety of organisations. These responses have informed the final version of this note on revision issues. Key findings from the feedback process were:

- The general set of topics identified in the note was agreed.
- Respondents had a range of proposals and inputs across the topics to provide additional technical precision in the coverage or description of the revision issue and to propose specific options and treatments for accounting. These latter types of proposals are not incorporated explicitly here but will be incorporated into the broader revision process.
- Three particular issues concerned the need to separately identify freshwater ecosystems from terrestrial ecosystems, to clarify the links to ecosystem condition metrics and to consider the scope of ecosystem services.
- In some instances, there was some confusion and/or lack of clarity on the description or intention in the SEEA EEA
- Some clarification in wording/expression of the revision issues was required
- Respondents provided a number of links to research and other work of relevance to ecosystem accounting which will be taken on board in the revision process

Since the conclusion of the feedback process in late March 2018, the revision process has built further momentum with a workshop on the valuation of ecosystem services and assets in Bonn in April 2018 and an Expert Forum on Ecosystem Accounting in New York in June 2018. The discussions during and around these events have led to further clarity and understanding of the revision issues documented here but these findings have not been incorporated here. This document thus represents the baseline for research during the SEEA EEA revision process.

Summary of issues

The list of issues considered here builds on the list of research topics identified and prioritised at the UNCEEA meeting in June 2016. That list reflected a blend of conceptual work and specific areas for testing and experimentation. The further discussion of the research agenda with respect to the SEEA EEA Revision at the UNCEEA meeting in June 2017 highlighted that the focus for the revision will be on resolving conceptual issues. At the same time, there are a few general connections that must be considered in working towards standardized concepts for ecosystem accounting:

- First, progress on conceptual aspects must take into account the findings and experience that continues to emerge from ongoing testing of the SEEA EEA framework and also from

the wide range of related projects on ecosystem measurement and valuation, including the EU funded project “Natural Capital Accounting and Valuation of Ecosystem Services.” Additional testing may be undertaken to test specific aspects of the research issues in an integrated approach possibly in collaboration with private cloud and data providers. This will be done through direct engagement with the various projects and also through involvement of the experts in the discussions of revision issues.

- Second, close connections must be maintained to progress on the implementation of the SEEA Central Framework and associated technical discussions. There should be a clear articulation of the links between the two components of the SEEA.
- Third, final description of concepts should take into account the potential for implementation. It is acknowledged that the development of additional compilation and guidance materials for ecosystem accounting is essential and, as work proceeds through the revision to clarify conceptual aspects, it is expected that work on guidance materials will occur in parallel.

In addition, a number of the issues pertain to the development of classifications. It is therefore expected that as the measurement boundaries and concepts are further clarified it will be appropriate and necessary to enlist experts in classification to participate in the revision process.

With this background, this paper identifies four research areas and six primary issues for the SEEA EEA Revision as listed in table 1. In the remainder of the paper, for each proposed revision issue within the four main research areas, there is (i) a description of the issue and the key research questions, (ii) a discussion of connections between issues, (iii) suggestions for the proposed timing of work and approach and (iv) initial thoughts on the likely communities of interest in advancing the research work. Particularly in relation to points (iii) and (iv), it is expected that the descriptions in this note will be subject to considerable change as additional planning takes place and various stakeholders and experts are identified. The descriptions in this note on these points should therefore be considered indicative only.

Table 1: Summary of issues for SEEA EEA Revision issues

Research area	EEA Revision Issue
1. Spatial areas	1. Classification of ecosystem types
2. Ecosystem condition	2. Characteristics and indicators of ecosystem condition
3. Ecosystem services	3. The description and classification of ecosystem services
4. Accounting treatments and valuation	4. Valuation concepts for ecosystem services and ecosystem assets
	5. Valuation methods for key ecosystem services
	6. Accounting for ecosystem capacity, degradation and enhancement

Research area 1: Spatial areas

Spatial units are at the heart of ecosystem accounting. The focus to date has been the development of a measurement approach that enables relatively broad scale terrestrial ecosystems to be accounted for. The general approach for delineating ecosystems using spatial areas has become relatively well established although there are still important matters requiring resolution.

Issue 1: Classification of ecosystem types (ET)

Description

The key focus in this research area is establishing statistically and accounting relevant classifications for land use, land cover and ecosystem types (ET) with careful review and application where possible of existing classifications of this type. The land use and land cover classifications of the SEEA Central Framework retain a status of “interim” and given the importance of ET in underpinning ecosystem accounting, it is essential that substantial, and integrated, progress is made in this area. Work for the revision must establish clear principles for defining ET classes, in particular concerning links to land use, management and ownership, as well as determining an appropriate set of classes for use at international level. Work should also ensure alignment in the advancement of the SEEA Central Framework land use and land cover classifications.

In establishing the principles, discussion will be needed on the treatment of coastal areas, linear features (e.g. rivers, roads, railways, hedgerows), connective phenomena (e.g. hydrological networks), and subterranean ecosystems (e.g. caves, groundwater systems). The discussion may also consider whether ecosystems may be delineated in other ways, i.e. not using spatial areas, for ecosystem accounting purposes.

Distinct focus should be placed on the description and classification of marine and freshwater areas given the strong interest in applying ecosystem accounting for these areas. Also, consideration should be given to articulating the connection to atmospheric units in order to complete a spatial delineation of the environment. Defining atmospheric units is relevant, for example, in advancing carbon accounting but also in supporting the connection of flows such as GHG emissions to the ecosystem accounting framework.

A final area of emerging interest concerns ecosystem accounting for urban areas. These should be distinguished from areas defined in terms of land cover or use as built-up areas and instead will be combinations of multiple ET. In this sense, urban areas may be considered a specific form of ecosystem accounting area (EAA) but one requiring specific definition to support policy and decision making. Other similar types of area types of policy focus might also be considered.

The research will involve significant engagement with a variety of stakeholders since the range of approaches and applications of land and ecosystem classifications is large and has been developed for a wide range of purposes at national, regional and global level. A key issue will be the extent to which a set of ET can be defined for SEEA EEA purposes to which other (national and international) land related classifications can be linked and which can be used to support international reporting and comparison (e.g. SDGs), and how accounting for change in a set of ET can best be recorded.

In addition to considering the classifications themselves, it will be necessary to agree on standard national boundaries for statistical purposes such that country areas underpinning the accounts are consistently defined and harmonised.

Finally, while the focus of the research work will be more conceptual, it will need to ensure good connections are made to the users of accounting information and to the sources of information on land cover, land use and other spatial information that underpins mapping and classification of ecosystem types, especially the remote sensing communities and those looking to establish national spatial data infrastructures (NSDI). This will be co-ordinated with work already underway on user engagement under the auspices of the UNCEEA, and other relevant groups, including the United Nations Global Working Group on Big Data (in particular the Task Teams on Earth Observation) and the GEO Earth Observation for Ecosystem Accounting (EO4EA) project.

Related ecosystem accounting issues

Establishing a classification of ET is fundamental to ecosystem accounting since these are the building blocks of the ecosystem accounting system. With respect to other issues there are important links to the development of indicators of ecosystem condition and the description and classification of ecosystem services. In both cases, clarity on the range of ET will support discussion.

Research area 2: Ecosystem condition

The measurement of ecosystem asset condition is a fundamental aspect of ecosystem accounting since it is the regular monitoring of asset condition that is central to assessing the changing capacity of ecosystems to supply ecosystem services.

Issue 2: Characteristics and indicators of ecosystem condition

Description

The SEEA EEA outlines the conceptual basis for measuring condition. This research issue concerns developing a generalised model/structure of characteristics and indicators of condition for different ecosystem types. As reflected in the Technical Recommendations in support of the SEEA EEA, discussion on the measurement of ecosystem condition has advanced somewhat since 2012 but there remains a lack of clarity on precisely which characteristics are relevant in the monitoring of condition. A key issue is the extent to which non-ecological characteristics, including data on land use and management practices and indicators of pressures, threats and stresses on ecosystems, are appropriate for inclusion within an overall condition assessment.

Further, it has been proposed that SEEA EEA should provide a broad structure for the key or core types of ecological and non-ecological characteristics which should be the focus of measurement in different ET, noting that ideally the same broad structure should be used in measuring condition across different ecosystem types. Of particular interest in this respect is the way in which

biodiversity (of ecosystems, species and genes) is best understood and integrated in an ecosystem condition context.

Associated with the definition of characteristics, this research issue should investigate types of indicators that would be most relevant for different characteristics, in particular considering the potential to utilise summary or holistic indicators for specific ET.

This issue also encompasses developing more definitive advice with respect to reference conditions. While there has been general support for the concept of using reference conditions, there has been no clear agreement on how such reference conditions should be established with views ranging from the application of pristine/natural conditions to the condition of the ecosystem asset at the beginning of the accounting period.

The requirement is to determine the conceptual approach that is most appropriate for ecosystem accounting, with due consideration of whether the use of different reference conditions is problematic for ecosystem accounting and comparison within and across countries. It is noted that there should be close connections to defining the key/core characteristics for the measurement of condition since (i) a priori it would appear that the characteristics selected for monitoring condition of a given ET should also be taken into consideration in determining the reference condition; and (ii) the reference condition is likely to be relevant in determining approaches to the aggregation of condition measures.

The discussion should also consider the potential to aggregate across EA and ET or otherwise provide summary perspectives on ecosystem condition across an ecosystem accounting area (EAA). This will likely link directly to the issue of defining reference conditions.

Finally, a link should be made to the measurement of ecosystem capacity. This concept was introduced in the SEEA EEA but not developed to the point of a definition amenable to measurement. This reflected a lack of consensus on the basket of goods and services that would underpin the measurement of capacity in practice. Since the drafting of the SEEA EEA, the concept of ecosystem capacity has been further discussed and some measurement has been undertaken, but more work is needed. Under this research area, the focus should be on biophysical aspects of the measurement of condition. This work should complement the focus in research area 6 which is on conceptualising ecosystem capacity in the system of ecosystem accounts.

Related ecosystem accounting issues

There will be close connections to a number of research issues, including

- Classification of ecosystem type: The types of ecological and non-ecological characteristics applied in the measurement of condition will likely also be relevant in considering the delineation of ecosystem assets.
- Description and classification of ecosystem services: The choices of characteristics for the measurement of ecosystem condition are generally accepted to be linked to the basket of ecosystem services provided by an ecosystem asset. Consequently, the discussion of ecosystem condition will be usefully informed by progress on the description of ecosystem services.

- Accounting for ecosystem capacity and ecosystem degradation: Changes in ecosystem condition underpin the measurement of ecosystem capacity and degradation and it will be necessary to ensure that the progress of research in these areas is aligned.

Research area 3: Ecosystem services

Measuring ecosystem service flows in physical terms is important to enable a broad mapping of the role of ecosystem assets and the relevant beneficiaries; and to facilitate the valuation of ecosystem services.

Issue 3: The description and classification of ecosystem services

Description

The broad conceptual place of ecosystem services in ecosystem accounting is well understood and in particular the recognition that ecosystem services are outputs generated by ecosystem assets and consequently provide the link between the measurement of ecosystem extent and condition on the one hand and the benefits people obtain from ecosystems on the other.

However, while this general framing is well accepted there are a range of measurement boundary challenges that remain the subject of ongoing discussion. These include:

- the boundary between final ecosystem services and benefits, especially with respect to provisioning services in relation to crops
- the definition and treatment of intermediate services, and hence the issue of measuring dependencies between ecosystem assets
- the distinction between SNA and non-SNA benefits
- the relationship between the definition of ecosystem services, benefits and the SNA production boundary
- the differences, if any, in the time of recording and other accounting treatments between ecosystem services and related flows of natural inputs in the SEEA Central Framework
- the treatment of users and beneficiaries with respect to the consumption of ecosystem services
- the extent to which accounting systems can record the contributions of ecosystem services to broader well-being, reflect for example in health outcomes.

A key aspect of the work required in this research area is therefore to work through these various conceptual issues and finalise treatments that are appropriate from an accounting perspective.

To make this conceptual discussion most relevant, an essential requirement of this research is that the most commonly discussed and measured ecosystem services (perhaps around key 15-20 services) are described in a consistent way with agreed terms for each service, recognising that the agreed underlying definitions and concepts will need to apply to all ecosystem services. At present, different experts will use different descriptions and varying terms for what might be similar ecosystem services. This variation is considerably limiting the potential for the measurement community to make clear progress through exchanges of experience, and

conveying knowledge to new participants. The conceptual treatments must be able to be consistently applied to all ecosystem services.

Among the potential types of key ecosystem services, particular note is made of the need for agreed descriptions of:

- carbon sequestration and carbon storage
- ecosystem services in the context of cultivated assets including agriculture and forestry
- water related services such as water regulation, sediment retention, water yield, water purification
- habitat and nursery related services
- marine ecosystem services
- the potential for services to be recorded in relation to the use of space – e.g. use of land for landfill/solid waste, use of waters for navigation.

Complementing the development of conceptual treatments and agreed descriptions of key ecosystem services is the development of an agreed ecosystem services classification for ecosystem accounting purposes. At the time of drafting the SEEA EEA, the ecosystem service classification known to the drafters was the CICES (Common International Classification of Ecosystem Services). Immediately following its public release, the existence of other classification systems developed by the US EPA, FEGS (Final Ecosystem Goods and Services) and NESCS (National Ecosystem Services Classification System) became known to the SEEA project. Finally, alternative typologies for grouping different ecosystem services might also be considered. For example, by degree of connection to human well-being or linkage to ecosystem processes. A recent example is the work from the Inter-governmental Platform on Biodiversity and Ecosystem Services (IPBES) and their concept of ecosystem services as nature's contribution to people.

These various approaches to ecosystem services description and classification are distinct but through the revision process the aim is to find a suitable pathway to support implementation and comparison between ecosystem accounting projects.

Related ecosystem accounting issues

Clarifying the descriptions of key ecosystem services will be important in advancing the valuation of ecosystem services since valuation requires a clear and common understanding of the nature of the service being valued.

Research area 4: Accounting treatments and valuation

Determining appropriate application of national accounting principles to the measurement of ecosystems and undertaking valuation are challenging areas. There have been some important advances in both areas, including improved understanding of the use of non-market valuation techniques from environmental economics for ecosystem accounting purposes, but a range of issues remain. It is noted that monetary valuation is not mandatory within the SEEA EEA, but where such values are required, including for example for full integration with the SNA, the aim

of research must be to ensure that the SEEA EEA treatment of monetary valuation is as clear as possible and that proposals for the integration of ecosystem services and assets with standard economic accounts are fully articulated.

Issue 4: Valuation concepts for ecosystem services and ecosystem assets

Description

The development of valuation concepts for ecosystem services and ecosystem assets is an ongoing field of research and investigation. While it will be important to test methods in practice and gain experience from their application, it is also important to continue the dialogue between economists and accountants on the appropriate and relevant methods, assumptions and applications of valuation for accounting purposes.

The recently release Technical Recommendations provide a substantive update to the thinking on valuation for ecosystem accounting taking advantage of a range of discussions and incorporating research work through the World Bank WAVES program. There is now an improved foundation for discussion and a number of issues have been clarified relating to the estimation of non-market values for ecosystem accounting purposes. Of importance is establishing a clear understanding of the appropriate assumptions concerning institutional arrangements that should underpin the estimation of the exchange values needed for national accounting (i.e. should exchange values be estimated with an assumption of perfect markets, monopoly markets, or some other institutional arrangement). While the technical material has advanced, much wider discussion is needed of the current line of thinking.

Beyond the valuation of ecosystem services, the SEEA EEA provides a conceptual model for the valuation of ecosystem assets through estimating the net present value (NPV) of ecosystem services. Assuming that methods are in place for the valuation of ecosystem services themselves, applying NPV approaches requires the selection of discount rates and the estimation of the pattern of future flows of ecosystem services relative to the capacity of an ecosystem asset. These are not trivial choices and further advice is required on how such choices should be made in an ecosystem accounting context taking into consideration the potentially infinite asset lives of ecosystem assets, the reality that most ecosystem assets will generate a basket of ecosystem services, and how SEEA EEA based valuation relates to the valuation of ecosystem assets as public goods.

In addition, an important issue that arises is the comparison of these NPV based ecosystem asset values with existing values for areas of land that might be present in standard national accounts and balance sheets. Two related research issues emerge. The first is to understand further the extent to which there is an overlap in the valuations of these assets from different perspectives. The second is to consider how market values of land assets might be used to estimate the prices of ecosystem services.

Finally, in advancing and establishing the relevant valuation concepts for accounting purposes, it will be necessary to place these values within a broader framing of potential environmental values. This should include connecting with the work of sociologists and others involved in well-being research. In setting this broader context for valuation, it will be necessary to recognise the alternative policy and analytical uses of values and to clarify the role of exchange values. A

particular aspect of this research should be on the relationship between valuation for ecosystem accounting and the measurement of negative externalities.

Related ecosystem accounting issues

There will be close connections to the other research issues on valuation, in particular issue #5 which aims to examine the issue of valuation by considering individual key ecosystem services. This is because the way in which ecosystem services are characterised can vary significantly and the approach to valuation will depend to a large extent on the characterisation that is set or assumed. Connection to work on issue #3 on the description of ecosystem services will also be of high relevance since reaching common ground on these descriptions will be of tremendous help in applying appropriate valuation techniques for ecosystem accounting.

Issue 5: Valuation methods for key ecosystem services

Description

Notwithstanding the need for further conceptual advances on valuation for accounting purposes, it is recommended that in parallel research investigate the estimation of exchange values for specific ecosystem services selected for their relevance from the categories of provisioning, regulating and cultural services. From this basis, more generic findings will be able to be conveyed and should be adapted within the concept focused research. Specific issues to be considered for the relevant ecosystem services include (i) appropriate valuation approaches in the situation of low or negative resource rents, (ii) the use of cost based approaches, especially the use of restoration cost approaches, (iii) approaches to the valuation of water, and (iv) the use of data from PES schemes.

In addition, it should be recognised that the conceptual discussion of accounting for ecosystem services has largely focused on provisioning and regulating services. While there remain important issues for resolution for these types of services, the conceptual basis for the inclusion of cultural services in an accounting system has not been articulated in the same detail. As well, in the testing of ecosystem accounting there has been less focus on cultural services.

Thus, while there is no doubt that cultural services should be within scope of the discussion in ecosystem accounting, there is less clarity on (i) exactly what the ecosystem contribution is to benefits in the case of cultural services (i.e. distinguishing services and benefits in the case of cultural services is much harder than for other services); (ii) the link to concepts of non-use of ecosystems; (iii) the implications for valuation in exchange value terms. Further work is required to develop the relevant concepts and connect cultural services more definitively to ecosystem accounting.

Related ecosystem accounting issues

There will be connections to research issue #4 on the valuation concepts for ecosystem services and ecosystem assets and to research issue #3 on the description of key ecosystem services. Indeed, there should be a close alignment between the ecosystem services that are the focus of research within issues #3 and #5.

Issue 6: Accounting for ecosystem capacity, degradation and enhancement

Description

When considering the integration of ecosystem accounting estimates with standard national accounting data the definition and treatment of ecosystem capacity, degradation and enhancement needs to be progressed to ensure a common basis for integrated accounting.

The challenges in the measurement of degradation are many as it touches on all of the aspects of ecosystem measurement. The SEEA EEA Technical Recommendations make a good initial step in taking the discussion further but a range of aspects require further discussion. The first concerns the concept of ecosystem capacity. This was introduced in the SEEA EEA but not developed to the point of a definition amenable to measurement. This reflected a lack of consensus on the basket of goods and services that would underpin the measurement of capacity in practice. Since the drafting of the SEEA EEA, the concept of ecosystem capacity has been further discussed and some measurement has been undertaken, but more work is needed. Under research area 2, the biophysical aspects of the measurement of condition are considered. In this research area, the focus is on conceptualising ecosystem capacity in the system of ecosystem accounts.

A second aspect is the means by which measures of ecosystem degradation can be attributed to economic units. This is not straightforward since unlike produced assets, ecosystem assets may have multiple users thus implying that the degradation will affect a range of income flows. There are a number of considerations, including ownership and regulatory requirements, that should feature in a discussion. The accounting entries related to allocating degradation estimates to multiple economic units need to be considered as well as the connection to the treatment of restoration costs.

Third, while there has been some progress on describing the issues on degradation, there is far less clarity on the treatment of activity that maintains, restores or enhances ecosystem condition. In particular, the accounting question is whether the expenditure on that activity represents a good measure of the level of investment in the ecosystem asset, or whether the more appropriate measure would be the increase in the NPV of the ecosystem service flows that arises as a result of the expenditure. A related challenge occurs in the standard SNA in the treatment of land improvement and the reconciliation of entries for capital formation and associated balance sheet entries. Given the extent of focus on developing policies to restore ecosystem condition, determining the appropriate accounting treatments for any expenditure would be a very useful development.

Finally, underpinning measurement of capacity is the connection between ecosystem condition and expected flows of ecosystem services. This is an ecological measurement challenge as much as an accounting one. While this topic will not be able to resolve this discussion, it should be possible to articulate in the SEEA EEA the type of ecological considerations that need to be considered in developing estimates of capacity and, also, it should be possible to describe how accounting approach can support the development of data sets to inform understanding of the connection between condition and service flows.

Related ecosystem accounting issues

There will be connections to many research issues. Most important will be connection to the discussion on ecosystem condition in issue #2 as this will frame the discussion of ecosystem characteristics to be considered in the assessment of capacity and hence the measurement of degradation and enhancement. However, also relevant will be discussion of ecosystem service flows and the links between final and intermediate services, these will be relevant in discussion of future ecosystem flows.

In terms of valuation, there will be direct links to the discussion of the valuation of ecosystem assets and NPV in issue #4 and also to the treatment of restoration costs in issue #5.