SEEA Experimental Ecosystem Accounting

Proposed next steps and approach to finalizing the SEEA EEA Technical Recommendations and establishing a research agenda

Paper for UNCEEA meeting, June 2016

Revision history:

- Version 1.0 (Draft): Drafted by Carl Obst, 4 May 2016
- V1.1 (Draft): Revised by Carl Obst, 25 May, 2016
- V1.2 (Draft): Revised by UNSD, 27 May 2016

1. Introduction

This paper has been prepared for discussion at the 2016 meeting of the UN Committee of Experts on Environmental-Economic Accounting (UNCEEA). It has been drafted in the context of two streams of work. The first stream is the finalization of the SEEA EEA Technical Recommendations that is being developed as an output from the ANCA project (UNSD/UNEP/SCBD). A Draft of the Technical Recommendations was completed for consultation in December 2015 and the consultation with leading experts has revealed a range of areas in which further consideration of the direction and explanation of ecosystem accounting is required. This paper outlines some proposals in this regard. A summary of the feedback is provided in Annex 1.

The second stream is the ongoing work to progress the SEEA EEA endorsed by the UNSC in 2013. While the Technical Recommendations reflect part of this work, there is a more general need to continue the set the direction for ongoing and future work in this area. A particular aspect of this is determining an appropriate research agenda. This paper proposes a research agenda, utilizing the findings from the development of the Technical Recommendations.

An Editorial Board has been formed to take forward work on finalizing the SEEA Experimental Ecosystem Accounting Technical Recommendations (EEA TR). The proposals in this paper have been considered by that board.

The paper is structured in the following way. Section 2 describes the relevant context and processes that surround the development of ecosystem accounting. Section 3 makes proposals concerning the direction that work on ecosystem accounting should pursue, taking into account the feedback that has been received through consultation on the Technical Recommendations.

Section 4 describes a range of conceptual and technical issues that have emerged, or remain. It further proposes which of these issues may be answered in the short term (i.e. during 2016) and which issues should be established on a SEEA EEA research agenda for progression in the medium to longer term.

Section 5 outlines some options for testing and implementation of ecosystem accounting. Its focus is on describing the types of measurement issues which are relatively settled in conceptual terms but for which testing is required both to describe possible measurement approaches and to assess the conceptual model.

Section 6 concludes and proposes some next steps.

2. Context and processes concerning ecosystem accounting (UNSD)

Process of finalizing the SEEA-EEA Technical Recommendation

An Editorial Board[1] has been established for the finalization process of the SEEA-EEA Technical Recommendation. The Editorial Board will assist the editor in providing technical inputs on various versions of the draft chapters and take decisions on how to resolve technical issues and strengthen the recommendations. It is not anticipated that every issue can be resolved, but clearer recommendations will be drafted for technical issues that can be resolved conceptually in the short-term and strengthened recommendations will be articulated for testing and implementation for other technical issues in order to improve the clarity and usefulness of the Technical Recommendations for the SEEA EEA implementation in countries. It is envisaged the revised Technical Recommendation will be circulated for a second round of consultation in Mid-October 2016 and finalized by December 2016.

Process of advancing the SEEA-EEA

A timeline of revising the SEEA EEA by 2020 is proposed in the SEEA implementation strategy that was agreed in principle by the Statistical Commission at its 47th Session in March 2016. The revision process will need to be put in place in 2016 with the development of an agreed list of issues to be addressed in the next two to three years. For the purpose of the revision process, a Technical Committee on the SEEA-EEA will be established. In the interim, the aforementioned Editorial Board of the SEEA-EEA Technical Recommendation will serve as the Technical Committee on SEEA-EEA to finalize the Technical Recommendations by December 2016.

3. Advancing ecosystem accounting: Proposals for setting the direction

As described in the Summary of responses (Annex 1), feedback from experts on the SEEA EEA Technical Recommendations indicated a spread of views on how ecosystem accounting might be best taken forward. To some extent it would appear that a considerable, and perhaps underestimated, challenge in taking ecosystem accounting forward is obtaining a common understanding of what ecosystem accounting is and, importantly, what it is not. To finalise the EEA TR the following proposals are made. However, it is also noted, that these proposals are likely equally relevant in the broader discussion of advancing ecosystem accounting. It is particularly important that there is a shared understanding of the direction of ecosystem accounting, including the role of official statisticians, such that appropriate linkages can be made to other, related initiatives, and that the range of measurement projects can be working towards a relatively common goal.

The proposals in this section do not focus on specific conceptual or technical matters, these are discussed in Section 4. The intent here is outline a possible way forward among the different framings of ecosystem accounting that are emerging. Overall, it is proposed that Chapters 1 and 2 of the EEA TR be re-cast to take on board the following proposals for explaining the purpose and intent of SEEA EEA ecosystem accounting.

3.1. *Distinguishing between concepts and measurement*: The current draft of the EEA TR was intended to build directly on the conceptual model described in the original SEEA EEA and to discuss the various measurement considerations that would be relevant for a testing or implementation project. Unfortunately, this approach failed

[1] The Editorial Board members are as follows: Carl Obst (Editor), François Soulard (Statistics Canada), Rocky Harris (Department for Environment, Food & Rural Affairs, United Kingdom of Great Britain and Northern Ireland), Anton Steurer (Eurostat), Jan-Erik Petersen (European Environment Agency), Michael Bordt (United Nations Economic and Social Commission for Asia and the Pacific), Daniel Juhn (Conservation International), Lars Hein (Wageningen University), the World Bank and the United Nations Statistics Division. Statistics Netherlands, UNEP and World Conservation Monitoring Centre will be invited to join the Editorial Board.

to sufficiently differentiate between a discussion of clarifications or modifications to the original SEEA EEA concepts and the relevant practical considerations. This failure was reflected in the types of comments received which often mixed concerns about concepts and concerns about their application. It is therefore proposed that the next draft of the Technical Recommendations make this distinction between concepts and practice by amending the mid-level structure of the chapters. This proposal also encompasses bringing forward the annex that described the clarifications to the original SEEA EEA reflected in the EEA TR.

3.2. *Defining measurement pathways*: It is now evident that there are two distinct mind-sets around the application of the ecosystem accounting model described in the SEEA EEA. One is best termed a "top-down" approach and the other a "bottom up approach". Conceptually both approaches are consistent with the ecosystem accounting model but they are fundamentally different perspectives and will likely be suited to answering different types of policy questions. Depending on which approach is used, the required resources, the measurement approaches, the measurement assumptions and the statistical outputs will be different. It is therefore fundamental that the EEA TR is able to clearly distinguish both pathways. Combined with proposal 3.1 (above) this should help to better focus understanding of ecosystem accounting and its potential application.

Top-down approaches: These approaches commence from a more traditional national accounting perspective in working from a national level and aiming to provide broad context to discussions and decisions pertaining to the use of environmental assets and ecosystems. To this end, the starting point will commonly be delineating a country, or large administrative region, into a limited number of ecosystem types (e.g. forests, agricultural land) possibly following the land cover classification of the SEEA Central Framework but commonly based on national classifications. For each ecosystem type, a range of ecosystem services that are most considered most likely to be supplied can be measured and, if relevant for decision making, valued.

Top down approaches will generally be less resource intensive but equally will not be able to provide information to analyse detailed implications of policy options since the characterisations of ecosystems are generally very coarse. Thus the relative size of an ecosystem type will count heavily in any assessment as distinct from the ecosystems relative importance in overall ecosystem functioning (e.g. identifying the role of wetlands or linear features of the landscape may be difficult under a top down approach). Nonetheless, using top down approaches does provide an entry point for recognition of the potential for ecosystem accounting and provides a base for providing more detail over time.

Bottom-up approaches: Bottom-up approaches will generally commence from an ecological perspective where there is a desire to reflect, as a starting point, distinctions between ecosystem types at a relatively fine level. Using existing ecosystem type classifications, the aim is to delineate a relatively large number of ecosystem types with a particular focus on their configuration in the landscape. The mapping of ecosystems is a particularly relevant exercise in bottom up approaches. The measurement of ecosystem services will be more nuanced with some supply being directly linked to specific ecosystem types (mainly for provisioning services) but for regulating services in particular the general approach will recognize that these services may be jointly provided by multiple ecosystems.

Generally, bottom-up approaches will be more resource intensive and require more ecological expertise. Much higher levels of ecosystem specific information would be expected. This increases the potential for ecosystem accounting to provide information that is most relevant in assessing site specific trade-offs and policies and heightens the potential for the ecosystem accounting framework to assist in

organizing a large amount of ecological data. However, it raises challenges of aggregation that must be overcome if broader accounting stories are to be presented.

In addition to consideration of top-down and bottom-up approaches it will be relevant to convey how the implementation of ecosystem accounts may be completed in a staggered or tiered manner taking into account data availability and resources. Relevant in this regard is describing the steps necessary in order to achieve a full integration with the SNA. Overall, describing the different entry points into accounting is an important role of the EEA TR.

3.3. *Describing the linkages to other environmental-economic accounting.* The drafting of the SEEA EEA through 2011 and 2012 supported discussion of two measurement areas that we considered out of scope of the SEEA Central Framework – namely accounting for carbon and accounting for biodiversity. Together with accounting for land and accounting for water, information from these four areas of accounting have the potential to provide an underpinning information base for ecosystem accounting. In the Technical Recommendations these four areas are referred to as thematic accounts. Unfortunately, the links between the thematic accounts (including broader linkages to the SEEA Central Framework) and the testing of the ecosystem accounting model remain not well understood. In particular, the links between ecosystem accounting and accounting for biodiversity need to be better described. It is proposed to better articulate these linkages in the introduction to the Technical Recommendations, including discussion of how these sources of information may be relevant to either top-down or bottom–up measurement approaches.

3.4. *Articulating the measurement challenge*: The group of interested experts in ecosystem accounting is diverse. As a consequence there is not a common or shared understanding of the measurement challenge, i.e. the question that is to be addressed. To some extent, the Technical Recommendations are written from the perspective that ecosystem accounts can be used to support discussion of many issues. While this is likely true, the text can tend to be more generic in nature and hence imply assumptions that are likely incorrect depending on the analytical intent.

It is proposed to outline up-front, the central measurement challenge to be addressed via a SEEA based approach. This will link to the issue of top-down and bottom-up approaches and will also require, as far as possible, the definition of various concepts from a statistical perspective, e.g. for final ecosystem services. The description of a central measurement challenge does not invalidate other applications of the ecosystem accounting model, indeed from the perspective of information there are likely to be high levels of complementarity.

Central measurement challenge: It is proposed to define this challenge in the following way, recognizing the need for further discussion and elaboration. A country, or large region within a country consists of multiple ecosystem types (at a high level this will mean a combination including some of forests, lakes, desert, agricultural areas, wetlands, etc.). The composition of ecosystem types, in terms of their area, will likely change over time through natural changes and land use changes. Accounting should aim to record these compositional changes over time.

Each ecosystem (of a particular type) will also change in condition over time. For accounting purposes each of these ecosystems is considered a separable asset (where the delineation of assets is based on mapping mutually exclusive ecosystem boundaries) although it is recognised that there will be important interactions between each ecosystem. Nonetheless, it is envisaged that an asset account for each ecosystem can be described that records the changes in condition of each asset over time. These changes may be due to natural causes or human/economic intervention.

It is not a requirement that each asset remain of the same size (in hectares) and indeed, the change in condition may be a function of a change in size. Tracking the changes in condition of multiple ecosystem assets within a country (or large region) is a fundamental ambition of ecosystem accounting.

Either separately, or in conjunction, ecosystem assets will supply ecosystem services. Most focus at this time is on the supply of ecosystem services to economic units (incl. households), i.e., final ecosystem services. For accounting purposes, it is assumed that it is possible to attribute the supply of ecosystem services to an individual ecosystem asset (e.g. timber from a forest), or where the supply of services is more complex, to be able to attribute a contribution from different ecosystem assets. Generally, each ecosystem asset will supply a basket of different ecosystem services. The challenge in accounting is to record the supply of all final ecosystem services over an accounting period for each ecosystem asset. For each supply there must be a corresponding use of ecosystem services. The attribution of use to different economic units is an important aspect of accounting. Also, final ecosystem services are defined in such as way as to support data integration with the production of goods and services that is recorded in the standard national accounts.

This information set may be usefully extended by estimating prices and valuing each of the final ecosystem services. Based on these estimates, the valuation of ecosystem assets is also possible using net present value techniques. A range of approaches to the valuation of ecosystem services and assets is possible depending on the analytical or policy question. In a SEEA context, one ambition is integration of such valuations with the values recorded in the standard national accounts, for example, the recording of GDP adjusted for ecosystem degradation, or the estimation of extended measures of national wealth. For these purposes, a specific choice of valuation concepts is required, namely exchange values. Exchange values are related to, but different from, other concepts of value that are used in environmental valuation.

This set of information (whether only biophysical or extended to estimate values) about multiple ecosystem assets within a country (or large region) – i.e. the changing extent, condition, and supply and use of ecosystem services – should provide the basis for, at least, a high level assessment of (i) the potential for the current stock of ecosystems to continue to supply ecosystem services, (ii) the effects of increasing or decreasing the condition of ecosystem assets; and (iii) the trade-offs between different land use scenarios. Within this same broad logic, using more detailed data, it should be possible to consider more specific questions in relation to individual ecosystems or ecosystem types. It is proposed that examples of the different policy/analytical questions be provided in the Technical Recommendations.

3.5. *Summary of ecosystem accounts:* In the context of this central measurement challenge, it is proposed that the current discussion of the different ecosystem accounts in Chapter 4 is summarized and brought forward in the document, e.g. to Chapter 2, with the detail concerning the individual accounts distributed to relevant chapters.

3.6. *Linking ecosystem accounting with national accounting:* The ecosystem accounting model emerged from the application of national accounts concepts and principles to the broad set of ecosystem information, including measures of extent, condition and services. The recognition of ecosystems as assets and the treatment of ecosystem services as being supplied by these assets are at the heart of the national accounting approach. Both elements are fundamental. On the whole however, there is little appreciation of the role of national accounting in the design of ecosystem accounting by those experts from other disciplines who are heavily engaged with the new material. This has created somewhat of a barrier in language/communication that must continue to be broken down. One proposal is to make clear upfront the key

concepts and definitions to better focus non-national accounts readers. In addition, it is proposed to incorporate a section to better explain and promote the role of many varied disciplines in advancing ecosystem accounting.

3.7. *Describing the potential role of national statistical offices.* The introduction to the SEEA EEA describes a number of potential roles for the involvement of NSOs in advancing ecosystem accounting, including their capacities around working with multiple national data sets and their experience in developing and maintaining statistical definitions and classifications. It will be relevant in the EEA TR to highlight and reinforce the potential benefits from the involvement of NSOs, in particular concerning the development of robust statistical production processes that will be relevant in establishing ecosystem accounting in the longer term.

4. Short term technical issues and establishing the research agenda

This section outlines the main technical issues facing the compilers of ecosystem accounts. The first sub-section outlines topics about which decisions and direction are needed from the Editorial Board as part of the process of finalizing the EEA TR. A short description of the issue to be resolved is provided below. It is proposed that, where possible, decisions on these issues should be taken by the Editorial Board by mid-2016, recognizing that this may be a challenging timeframe.

The second sub-section provides a list of topics that could be placed on a future research agenda and hence have more limited discussion in the EEA TR. It is envisaged that a decision on the SEEA EEA research agenda will be made by the UNCEEA at its June 2016 meeting.

4.1 Short term topics

a. *Use of a national coverage, in principle, i.e. not applying natural/modified ecosystem distinction, but at the same time explaining links to sub-national work*

   In general, the focus of the SEEA EEA has been intended as being at the national level in line with its genesis in national accounting. However, due to its spatially explicit approach there is conceptual possibility to focus instead on smaller areas within a country. Feedback suggested that a smaller focus, either in terms of specific areas/regions or in terms of focusing on only natural ecosystems (as distinct from modified ecosystems) would be more appropriate.

   It is proposed to here to specify clearly the national level intent of the SEEA EEA approach but at the same time to recognize that initiating work for large sub-national administrative areas, may be most appropriate for testing. A distinction to exclude modified ecosystems is not supported since this may be difficult to delineate and may lead to the organization of information that does not reflect broader changes land use.

b. *The role of composite condition indicators*

   The SEEA EEA presented the general proposition that the overall condition of an ecosystem might be measured by combining measures of individual characteristics. Subsequent discussion of this proposition has revealed that the measurement challenge is far more complex and the formation of composition indicators of condition for individual ecosystems may prove not possible from an ecological perspective, let alone any further aggregation to provide higher level perspective.

   It would be good for the Editorial Board to consider the text in the EEA TR which has been extended relative to the SEEA EEA to take into account the ecological measurement challenge. The Board's view on what advice might provided to countries in this area would be welcome.

c. *The role of the different ecosystem services classifications*

   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 another classification system developed by the US EPA, FEGS (Final Ecosystem Goods and Services) and NESCS (National Ecosystem Services Classification System) became known to the SEEA project. These two approaches to ecosystem services classification are distinct but there is an ongoing discussion on the

potential overlaps, differences and complementarities. It would be very opportune to be able to provide some clear advice to compilers and users about the options in this space in the EEA TR.

d. *Determining a reference condition*

Establishing a reference condition is an important part of ecosystem accounting since it supports comparison over time and across different types of ecosystems. While the theory is fine, the selection of a reference condition is not straightforward and there are many choices available. The EEA TR proposed using a common reference point for a country as being around 30 years ago, but this suggestion was not accepted at all by the reviewers. To support implementation some clearer guidance and advice is needed for compilers.

e. *The connection between biodiversity and ecosystem services (for accounting purposes)*

There is a long standing discussion on the connections between biodiversity and ecosystem services, well outside the SEEA discussions. From an ecosystem accounting point of view, because it is possible to account for both ecosystem assets and ecosystem services, it is quite straightforward to place these two areas of measurement in context. The following key points are relevant:

- Ecosystem diversity can be assessed via ecosystem extent accounts through measurement of the changing composition of ecosystem types within a landscape or country.
- Species diversity should be considered as a characteristic of ecosystem assets with declines in diversity usually reflected in declines in the condition of ecosystem assets. (Declines in ecosystem diversity may also lead to declines in condition of individual ecosystem assets.) This connection to assets is important as it implies, in accounting terms, that biodiversity can be considered to degrade or improve – a feature that cannot apply to services.
- The value of biodiversity should be captured via the value of the ecosystem services that each ecosystem asset produces. Except in very specific circumstances, the value of biodiversity is not evidenced directly, or if valued directly, this is not a value that is in addition to, ecosystem values measured via ecosystem services.
- There may be an ecosystem service where individuals find direct cultural services as a result of biodiversity. This may be evidenced by people supporting the conservation of particular species or habitats. This however, will be a relatively small sub-set of the contribution that biodiversity makes to the supply of ecosystem services.
- Genetic biodiversity is likely highly relevant to the production of ecosystem services but this has not yet been considered in the ecosystem accounting framework.

Currently, these points are made in various places across the EEA TR. The advice of the Editorial Board would be welcome in terms of the points themselves and on how best to communicate the points.

f. The potential to use restoration costs in the valuation of ecosystem services

Restoration costs are the estimated costs (i.e. outlays including costs of produced capital) of restoring a particular ecosystem to a given condition. The estimation of these costs has been proposed as a means of valuing ecosystem services, ecosystem assets and ecosystem degradation. The potential to use cost based measures in environmental valuation has long been debated. Generally speaking, accountants are relatively happy but environmental-economists are not.

In the case of restoration costs the draft EEA TR, is not overly supportive, particularly when it concerns using restoration costs as a measure of degradation. At the same time, comments on the draft indicated that the rationale made for the EEA TR position is not strong (see paragraphs 9.47-9.50). The views of the Editorial Board on the use of restoration costs would be appreciated.

g. The estimation of social values in the SEEA context

In valuation of ecosystem assets, an important consideration is the choice of discount rate. The advice in the SEEA Central Framework is that for integration with the values on the balance sheet of the SNA, it is necessary to use market or private discount rates in the application of NPV approaches. However, for many environmental assets, particularly when being valued by governments, the use of social discount rates is considered most appropriate.

The current EEA TR is consistent with the SEEA Central Framework on this point although accepting that social valuation may be of interest in different situations. The views of the Editorial Board would be appreciated in terms of what type of direction might be provided to compilers and users.

h. The label to be applied for "ecosystem degradation"

In SEEA EEA, ecosystem degradation is the term applied for the entry to reflect the decline in condition of ecosystem assets due to human/economic use. It is analogous in concept to the consumption of fixed capital and depletion as defined in the SNA and SEEA Central Framework albeit with respect to a different class of assets, namely ecosystems. The EEA TR provides stronger explanation of the accounting logic underpinning ecosystem degradation. Nonetheless, there has been feedback to change the term because the ecological notion of degradation is distinctly different (relating to the complete loss of an ecosystem or transition to another ecosystem type). The views of the Editorial Board would be welcome on the appropriate term to be used.

4.2 Research agenda topics

The following is a draft list of topics for inclusion in the SEEA EEA Research agenda. This list should be considered a "first cut" and will be the subject of further consultation. It will be important that there is a alignment with the research agenda being finalized for the SEEA Central Framework and with topics being identified in other SEEA documents such as the SEEA for Agriculture, Forestry and Fisheries. This alignment is important in ensuring co-ordination of the limited resources available for research and for recognizing linkages between research topics.

With regard to finalizing the EEA TR, it is not anticipated that the issues arising under each of these topics will be resolved in 2016 although progress may be made on better describing the issues from a SEEA EEA perspective. Thus, in the EEA TR itself it is not anticipated that there will be any extensive discussion of the following topics.

a. *Delineation of "special" spatial units*

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. While the broad approach is largely bedded down there are still important matters requiring testing as described in Section 5 (below)

At the same time, it is recognised that measurement in relation to a range of other spatial areas and features needs to be elaborated. A particular focus must be on freshwater, coastal and marine areas – which will require consideration of area and depth. In addition, research should be extended to consider linear features (e.g. roads, railways, hedgerows), connective phenomena (e.g. airsheds, hydrological networks), and subterranean ecosystems (e.g. caves, groundwater systems).

b. *Treatment of the atmosphere, the connection to global systems and residual flows*

The scope of the SEEA EEA asset boundary has been limited to the biosphere, and largely terrestrial ecosystems. This is in line with the coverage of all large projects in this area of work, including the foundational Millennium Ecosystem Assessment (2005). At the same time, the reality is that the biosphere is one component of the Earth's systems. A particularly important system in the context of climate change is the atmosphere and, outside of ecosystem accounting, much work in the space of natural capital accounting has been devoted to accounting for carbon and related GHG emissions.

Ecosystem accounting in the SEEA EEA does not explicitly take residual flows, including GHG emissions, into account. This is, on face value, a limitation of the approach. Although ecosystem accounting does report on changes in condition due to residual flows, this does not extend to the atmosphere and, more generally, the concept of ecosystem services does not reference residual flows directly.

A topic of interest therefore is how residual flows should be considered within ecosystem accounting and, in this context, how to incorporate human interactions beyond the biosphere.

c. *Ecosystem disservices*

The production boundary in accounting deals explicitly with flows of mutual benefit between units. This assumption underpins the notion of a transaction. In cases where something "bad" or "unwanted" is transferred between units accounting is less able to recognize the flows directly. This issue affects the incorporation of flows of so-called ecosystem disservices.

It would be good to discuss relevant treatment options fully, particularly the role that information on changes in ecosystem condition might play in assessing the extent of ecosystem disservices. It is noted that one piece of feedback through the EEA TR consultation process concerned ecosystem disservices noting that the concept that has developed through the past 15 years may not be appropriate and proposing an alternative way forward (See Villa et al, Letter to *Ecosystem Services* 10 (2014)). The alternative may well be more amenable to measurement in accounting terms.

d. *Articulation of the links between ecosystem assets (and their condition) and the supply of ecosystem services (ecological production functions)*

The development of ecosystem accounting has been dependent on ongoing engagement between economists, accountants and ecologists. This discussion continues to grow and must continue such that the most appropriate insights from each discipline can be brought to bear on the measurement challenge. In this space, of particular interest for accounting is understanding the nature of the linkages between different ecosystem services and hence between different ecosystem types. For accountants these are similar to the representations of production functions that sit within an input-output table. Ongoing research to document these linkages will be important to ensure that the ecological underpinning of ecosystem accounting is as relevant as possible.

e. *Intermediate services and dependencies between ecosystems*

In assessing ecosystem services, the focus of ecosystem accounting has been on final ecosystem services – i.e. those services where there is a direct connection between the ecosystem and economic units (including households). In assessing ecosystem condition, the coverage of the accounts is all ecosystems but, generally speaking, each ecosystem asset is considered a distinct asset.

This framing works to cover many situations, particularly those relating to the use of ecosystems as inputs to economic activities such as agriculture and forestry. However, it leaves untouched the measurement of dependencies between ecosystems that may be of particular interest. These dependencies may be reflected in measures of condition (e.g. in terms of measures of fragmentation and connectivity) but, in an accounting setting, could be more directly measured as intermediate services – essentially the exchange of services between ecosystems. Further work is required to develop the relevant concepts and to articulate measurement approaches.

f. *Relating market land values to ecosystem asset values*

The SEEA EEA provides a conceptual model for the valuation of ecosystem assets through the NPV of ecosystem services. Putting aside the associated measurement challenges of this, an important issue that arises is the comparison of these ecosystem asset values with existing values for areas of land that might present in standard national accounts balance sheets. It is not simply a case of adding together ecosystem service based valuations and market based land valuations.

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 asset might be used to estimate the prices of ecosystem services.

g. *Defining and measuring degradation*

The challenges in the measurement of degradation are many. The SEEA EEA makes a good step in taking the discussion further than in previous SEEA based approaches but a range of aspects require further discussion. Two are mentioned here. 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. These developments have been reflected in the EEA TR but, although introductory in nature, they raised a range of concerns. Clearly further discussion and research is required.

The 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. Also, the accounting entries related to allocating degradation estimates to multiple economic units need to be considered.

h. Valuation of ecosystem services and assets

The valuation of ecosystem services and 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 accounts on the appropriate and relevant methods, assumptions and applications of valuation for accounting purposes. Some particular aspects that will require focus include 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.

i. Recording activity that maintains or restores ecosystem condition

One of the key drivers for ecosystem accounting has been the general trend of ecosystem degradation across most of the world. The ecosystem accounting focus on ecosystem asset condition and flows of ecosystem services supports a fairly comprehensive recording of ecosystem degradation in line with accounting concepts of depreciation and depletion of natural resources.

However, there is less clarity on the treatment of activity that maintains or restores 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 treatment for any expenditure would be a very useful development.

5. Key matters for testing and implementation

The concepts for ecosystem accounting have developed progressively over the past 5 years and can now be considered quite well established. There remain a number of areas for further research but this should be expected in any field, including long-established measurement areas such as national accounts. In short, there is a sufficient framing of the conceptual model to support testing in practice.

At the same time, while there are many ecosystem related measurement projects and initiatives, there are relatively few examples of direct testing of the ecosystem accounting

concepts. However, the number of projects has grown rapidly in the past 18 months, although the number is growing. Specific SEEA based ecosystem accounting projects are underway in a range of countries including Australia, Canada, South Africa, the Philippines, the Netherlands, Colombia, Peru, and the UK, and there are a number of countries preparing to start work including the United States. Broader scale work for the EU and also the GEOSS proposed project – Earth Observations for Ecosystem Accounting, are other examples of the potential to harness findings from around the world as tests of the EEA model.

The EEA TR is intended to directly support the application of the ecosystem accounting concepts of the SEEA EEA. To that end it is important that appropriate direction and guidance can be provided particularly in areas where there is less clarity on precisely what measurement approaches may be most relevant and appropriate. This section covers six areas of ecosystem accounting for which testing of the concepts and the development of methods is most needed.

5.1 Spatial units

The delineation of spatial units is an essential feature of ecosystem accounting. The spatial units delineate the different ecosystem assets and hence form the basis for accounting of ecosystem extent and condition and the supply of ecosystem services. The general model of small basic spatial units (BSU), ecosystem units that reflect a distinct ecosystem asset and broader areas, geographical aggregations, reflecting landscape scale and administrative areas is broadly in place. However, different measurement approaches will tend to utilize the model in different ways.

To take things forward it is suggested that clearer guidance for testing is provided in respect of two different measurement approaches – top-down and bottom-up. For top-down approaches the focus is on delineation of spatial units using broad land cover classes in the first instance. Advice on the linkages between these areas and the size of BSUs is then relevant.

For bottom-up approaches, consideration of a wider range of environmental characteristics is relevant. Guidance should be provided on the specific characteristics, for example types of plant communities, land use characteristics, etc., that might be used to delineate ecosystem assets. A further question for testing is whether the size of BSUs required for bottom-up measurement are the same as those recommended for top-down measurement.

As part of the both approaches, an important area of testing will be the required level of classification of land cover and ecosystem type. The proposed starting point is the interim SEEA Central Framework Classification of land cover. Alignment to national classifications and consistency with existing ecological classifications will be important considerations. It will also be relevant to test both hierarchical and layered approaches to delineating spatial units.

Also, it will be relevant to consider the merits of different sources of spatial information. In particular, the potential of remote sensing information is of high interest given the expanding range of this data (e.g. covering both optical and radar data, and increased frequency, detail and coverage). The potential for this information to be harnessed for ongoing monitoring of SDG is also relevant and the SEEA EEA can provide a central framework for considering the use of this information.

An initial set of recommendations covering these types of issues was provided in the draft EEA TR but there were a range of concerns that will need to be addressed in later drafts. It is likely that the Editorial Board will need to engage with experts in this area to ensure the technical rigour of the EEA TR recommendations.

5.2 Indicators of ecosystem condition

The second area of testing concerns the measurement of ecosystem condition. This is a fundamental aspect of ecosystem accounting since it is the regular monitoring of asset condition that lies at the heart of assessing both the potential loss of natural capital and the capacity of ecosystems to supply ecosystem services.

The SEEA EEA outlines the conceptual basis for measuring condition but a range of areas require further testing. There are four main areas to note:

- First, developing examples of the indicators of condition that are relevant for different ecosystem types. It is generally considered that different ecosystem assets (eg. forests and wetlands) will require the use of different condition indicators. Which indicators are of most relevance in tracking condition is an important area for testing and exchange of experiences.
- Second, an aspect in the measurement of condition that has emerged since the drafting of SEEA EEA is the need to ensure that the indicators selected take into account the use of the ecosystem, particularly in the supply of provisioning services. Testing how this is best consider is required.
- Third, although the use of different indicators for different ecosystem types is the starting advice in the EEA TR, it would be interesting to test whether there are some indicators that might be relevant across a number of different ecosystem types – for example measures of NPP. To the extent that some more generic indicators can be found these may be of considerable use in the application of top-down approach to ecosystem accounting.
- Fourth, with respect to reference conditions some general advice is required for the EEA TR in the short term but an ongoing area of testing should be the selection and application of reference conditions as part of ecosystem condition measurement. The implications for comparisons over time, across ecosystems and among countries should all be examined.

5.3 Selection and measurement of ecosystem services

Alongside ecosystem condition, measuring the flow of ecosystem services is the second key plank of ecosystem accounting. Measurement of the flows in physical is relevant directly to enable a broad mapping of the role of ecosystem assets and the relevant beneficiaries; and also to facilitate the valuation of ecosystem services.

As part of the testing of ecosystem accounting the following areas in the measurement of ecosystem services are of most interest:

- First, clarifying the different types of ecosystem services following classifications such as CICES or the FEGS-CS. Testing the relevance and application of each of these classification will be important and build on the discussions that are currently underway to refine this aspect of accounting. An additional aspect here is building a picture of the types of ecosystem services that are most likely to be supplied by different ecosystem types.
- Second, describing and exchanging views on the methods used for measuring different ecosystem services. It is likely that information on provisioning services may be available from national level sources while flows of regulating services may require the use of environmental models. The potential of remote sensing information to be used to estimate ecosystem services flows may of particular relevance. While some methodological suggestions are provided in the EEA TR and the relevant literature, further testing of different methods is important.

- Third, beyond measuring the supply of ecosystem services, approaches to determining the relevant consumers and beneficiaries of the ecosystem services is also needed.
- Fourth, when working on regional level and national level accounting measures, it is likely to be necessary to use modeling results from studied ecosystems to estimate flows in other, similar ecosystems. The step of transferring results from one location to another requires specific consideration of similarities and differences between ecosystem assets and testing of techniques that are appropriate for accounting would be useful.

5.4 Role of thematic accounts

The EEA TR develops a distinction between ecosystem accounts - pertaining to ecosystem assets and ecosystem services - and thematic accounts – pertaining to individual stocks and flows, such as carbon, water, land and biodiversity. Often these accounts may be presented as all being ecosystem accounts but they have different roles to play. On the one hand thematic accounts will organize information of direct relevance for the compilation of ecosystem accounts; and on the other, thematic accounts will have much information of value in their own right for tracking important policy issues – GHG emissions, biodiversity loss, water scarcity, deforestation, etc.

Through testing it would be positive to demonstrate the relationship between these types of accounts and the best ways in which information may be integrated among them. Of particular interest are the different spatial scales at which different accounts might be compiled, both from the perspective of users of accounts and from the perspective of compilers.

5.5 Approaches to valuation

The SEEA EEA takes an open position on valuation. It does not advocate strongly for valuation noting that much relevant information is available in physical terms, but at the same time it recognizes the specific role that valuation can play in decision making and highlighting the importance of natural capital, notwithstanding the various measurement and interpretation caveats.

For testing purposes, the focus should be on (i) clearly identifying the target of valuation (ecosystem services distinct from benefits; and exchange values as distinct from welfare based valuations); (ii) documenting the choice of valuation technique with the type of ecosystem service and (iii) documenting the assumptions used, particularly if values have been estimated using benefit transfer techniques. Collection of this type of information and exchange of experiences on these points would be valuable for progressing an informed discussion on valuation.

5.6 Presentation of accounts – tables and maps

The focus of the SEEA EEA is on the description of a conceptual model. The EEA TR uses this conceptual model and further refines the structure of relevant accounts. Neither document however, is able to provide practical guidance on the best ways in which data compiled in ecosystem accounting project might be best presented. Presentations may include tables, accounts and maps and should take into account the required level of detail (of asset and service type), the relevant scale and the extent to which information is integrated with relevant economic and financial data. All of the important presentational issues should be subject of testing and ongoing discussion with users and analysts.

6. Conclusions and next steps

This paper provides a broad overview of the range of issues at play in taking the SEEA EEA forward. There are some short term issues on which technical guidance from the proposed Editorial Board would be welcome to finalize the EEA TR. There is a range of issues that should form the basis for a SEEA EEA research agenda. Finally, there are various topics that should be the focus of testing and implementation of ecosystem accounting in practice.

In taking this work forward the guidance of UNCEEA is sought. Ultimately, the direction set at this point should form the basis for a common understanding of how a revision of the SEEA EEA might be scoped and timed and what the relevant processes would be. At this point, finalizing the EEA TR and supporting ongoing testing and implementation of ecosystem accounting is undoubtedly the key focus but keeping an eye on a longer term agenda would be beneficial in ensuring that co-ordination with other initiatives can be placed in a suitable medium to longer term context.

Annex 1: SEEA EEA Technical Recommendations - Summary of responses to the Consultation Draft

7 April, 2016

Introduction

In December 2015, a draft of the SEEA EEA Technical Recommendations was circulated for comment to various experts. Comments were received from 21 experts/agencies (a list is provided at the end of this annex). Many were extensive in nature – i.e. providing more than 10 pages of comments. This high level of engagement is to be very welcomed. At the same time, given the volume of feedback there are a significant range of suggestions and proposals – and in a number of cases the proposals would imply taking the document in different directions.

Given this situation this note presents a first summary of the feedback selecting key issues and themes that emerged and making some initial proposals on possible ways of taking the document forward. A final section proposes six next steps.

Beyond the general observations in the next section, the feedback has been summarized into three main themes: Style and presentation; Technical content; Application and implementation. Particularly in relation to technical content there are many sub-themes and the discussion here groups these sub-themes as best as possible.

General observations

The bulk of the feedback is substantive – i.e. it is not editorial or suggesting errors in the text (although some of these are identified). As a consequence, it would be expected that considerable effort, and further rounds of consultation, would be required to effectively take on the feedback. Further, to the extent that there are clear differences of opinion in the direction that the Technical Recommendations might proceed, it will be necessary to determine the appropriate decision making mechanism such that the text can be finalized.

There are some instances where the feedback highlights either a general misunderstanding of the intent of the SEEA EEA approach or a difference of view as to what a SEEA approach should entail. This highlights a general need to be more explicit about the purpose and role of

SEEA EEA as well as the role of the Technical Recommendations themselves. While this is a reasonable response, it is far from clear that this will be easy to describe. Since the development of ecosystem accounting has, rightly, brought many disciplines and perspectives to the table, it has also implied that the motivations for utilising the ecosystem accounting framework are many and varied. An open question is the extent to which a more narrow framing of the purpose and role of SEEA EEA would fragment the growing group of people and initiatives who are keen to pursue activity in this area.

Related to this last point on purpose and role, there were a few comments raising concerns about the approach to ecosystem accounting that they inferred from the draft. On the one hand, some people are concerned that the approach to ecosystem accounting described in the Technical Recommendations was overly complex and would not be amenable to measurement at a national level or in countries with limited statistical resources. These people were encouraging a clearer description of "top-down" type approaches that would be based around broader scale considerations of ecosystem types. On the other hand, some people were clearly of the view that unless a detailed "bottom up" type approach was recommended then the usefulness of the exercise would be limited.

It is certainly possible that the ecosystem accounting model can be implemented in a top-down or in a bottom up fashion – much as GDP can be compiled in more aggregate fashion or using a detailed input-output tables. Thus there can be conceptual alignment but the resulting information sets (and related applications) and the compilation requirements are quite different. To date, the SEEA EEA has been able to sit on the fence on this issue through a focus on the conceptual model. The way forward may be to better articulate the concept versus implementation aspects thus leaving open the way in which testing might be undertaken at country level which would be come a function of available resources and a choice as to whether a more detailed or a more general information set is required.

Summary of comments: Style and presentation

While most comments did not raise concerns around the style and presentation, and further, a number found the material accessible and readable, the following key points emerged on the issue of the style and presentation of the material:

- The language was considered too technical and complex and not suited as introductory material.
- Additional diagrams and examples would be beneficial including policy examples
- The accounting focus/style was too strong and a "lighter" touch on the accounting side would be beneficial.
- A number of responses thought there was a range of duplication of material and that the document could be shorter.
- In terms of structure it was suggested that chapters 5 and 6 might be switched, and also chapters 3 and 4.
- Improved explanation of the links to the SEEA Central Framework were suggested
- It was suggested that Annex 1, which outlines the links to the SEEA EEA, could be brought upfront and text explaining the links to the SEEA EEA more generally would be useful to give better context.
- Regarding the recommendations various comments were made including the need for more practical solutions, greater clarity on what should be tested and relevant criteria and a better flagging/distinction between things for testing and research.

Responding to these issues the following thoughts come to mind:

- The SEEA EEA Technical Recommendations should not be considered introductory material but rather material that would be considered in depth and through the life of

a testing project – i.e. over a period of at least 3-6 months. Consequently, in general the accounting focus is appropriate and a separate, updated introductory/engagement type document may need to be drafted.

- Additional diagrams and examples are likely a good idea but it would be useful to have explicit suggestions and also noting the likely addition to the length of the document (all else being equal)
- The length and structure of the document is always a matter for discussion. It will be relevant to reassess both of these issues taking into account decisions made on the purpose and role of the document and decisions around technical content.
- Better links to the SEEA Central Framework and the SEEA EEA are good suggestions to be taken on board.
- Improvements in the description of recommendations should be possible following reflection on the technical content and document purpose.

Summary of comments: Technical content

Comments on spatial units

Although much time was devoted to drafting the updated description of spatial units in the Technical Recommendations, this area raised many comments. The main issues to emerge were:

- That the units approach seemed overly definitive/final and some alternative options need to be considered for testing
- Questioning whether it would be possible to undertake accounting without delineating BSU
- When using BSU, can more specific advice on the size of the BSU be provided
- Whether it is appropriate to assume homogeneity within a BSU
- How can cadastres be used in delineating BSU and what role should land ownership play in delineating EU
- The acronym for ecosystem units (EU) is too confusing (wrt European Union) and an alternative should be found.
- Clarify the relationship between land cover classes and EUs, in ecological terms, and consistently apply the concept of EU type
- Explain that the definition of an ecosystem asset is not solely the spatial area
- Explain whether EU are fixed spatially over time (in my view they can grow and reduce much as a company would in terms of turnover or employment)
- Clarify the role of the EU wrt the organizing framework for input data – i.e. do input data need to be attributed to EU level or data collected at this level?
- Clarify the role of EU in analysis and with respect to the measurement of ecosystem service flows.
- Consider how nested ecosystem types can be reflected in the units model
- Unclear how to deal with highly fragmented landscapes
- Concern about whether the GA (Geographic Aggregation) concept was needed for the spatial units description
- That the question of what scale should be adopted for ecosystem accounting such that the data are fit for purpose is unclear.
- Need to clarify the links to economic units
- Need to check further the technical references to pixels, rasters, vectors, etc and whether they are being used appropriately/correctly

Proposed response: There is clearly a widespread concern, albeit from multiple perspectives, about the current description of the spatial units relevant for ecosystem accounting. In part it seems that the initial focus on EU as the conceptual basis for accounting is causing concern and there is a lack of distinction being made between the conceptual basis for the units and the practical implementation. This links directly to the issue of top-down / bottom-up measurement. I suspect that in drafting the process got too much into the specifics and omitted to provide a broader rationale.

While providing additional context will assist, and needs to be aligned with the top-down / bottom-up considerations, there are other issues here that will need further discussion. In particular, the link to land ownership and cadastres needs better articulation and the role of the BSU needs to be more clearly understood and described.

Comments on the scope of the accounts

There were a few comments concerning how broadly the accounts might be defined. Key points were:

- Need to mention the connection to both marine environments and the atmosphere and their links to ecosystem units
- Proposing scope of the accounts be limited to natural ecosystems only – i.e. excluding modified ecosystems (agricultural & urban).
- Propose a focus on accounting for sub-national areas to heighten the policy relevance of the outputs
- Clarify how ecosystem accounting might deal with "global" systems as distinct with local ecosystems.

Proposed response: These are interesting boundary questions that should be clarified up front. Given the general intention to have national coverage then the limitation to natural ecosystems seems inappropriate and indeed the boundary between natural and modified would be problematic to define.

Comments related to measuring ecosystem condition

In general, it seems that this area of the text was well accepted and the following issues suggest that any improvements will be relatively minor in an overall context. The three key points were:

- The need to include a definition of reference condition from the SEEA EEA
- Clarify the role of composite condition indicators
- Introduce specific soil condition indicators – namely organic carbon, pH, and soil texture

Comments on ecosystem services

The measurement and definition of ecosystem services continues to raise issues, particularly around the issue of classification. The following were the key points made:

- Explain better the connections between CICES, FEGS and NESCS and the roles of ecosystem service classifications.
- Clarify the boundaries between ecosystem services and benefits and between final and intermediate services.
- Describe the assumption concerning the separability of ecosystem services
- Better define/describe cultural services
- How to determine the priority ecosystem services for measurement
- Better describe the link between biodiversity and ecosystem services
- Explain the expectations concerning the nature of the relationship between ecosystem assets and flows of ecosystem services
- Better describe the treatment of disservices

Proposed response: Nearly all of these issues would be potentially considered in the ongoing discussion around ecosystem services classifications. Without that discussion it is possible that some refinement of text can provide a better description of the state of play but actually taking a step forward will be somewhat difficult without a conclusion to that discussion.

The treatment of disservices may be a slightly different discussion. A note on disservices was specifically forwarded and it presents an alternative approach to the one normally considered. A third option that has a stronger accounting option might also be described.

Comments on valuation

There was a range of comments concerning valuation. Main issues arising were:

- Better explanation of the role of valuation in the context of the SEEA EEA
- More explanation of the best approach to valuation of ecosystem assets with regard to the application of NPV, choice of discount rates, links to SNA, shadow asset prices, and use and non-use values.
- Description of the treatment of transactions in land with respect to ecosystem asset valuation
- Question as to whether valuation always requires biophysical accounts
- The treatment of restoration costs
- The role of social values in a SEEA context

Proposed responses: The inclusion of additional text on these issues is possible although substantive recommendations in this area are difficult to determine. There is some substantive progress being made in current WAVES work that might be incorporated in due course depending on that work's review process and the timing of outputs. The most significant question for discussion in the short term concerns what might be said about social values in the valuation of ecosystem assets.

Comments related to accounting issues, including capacity and degradation

There was a range of comments that concerned ecosystem accounting concepts and model. Key points were:

- Concern about the use of the term ecosystem degradation. If it is to continue to be used, then the distinction from the common ecological understanding of the term needs to be conveyed.
- Explain that change in NPV does not equal degradation
- Range of concerns about the description of capacity as needing further discussion and highlighting the complexity of the concept. The challenge of defining the basket of ecosystem services to measure capacity was noted.
- Clarify the integration of the ecosystem accounting model with the SNA. Relate this discussion to the role of satellite accounts.
- Explain the recording of human activities that restore the environment
- Describe the extent to which bioeconomic models might be utilized in the account compilation process

Proposed response: These issues should be able to be covered through some further explanatory text and ensuring that the status of the discussion on capacity (as being the subject of ongoing research) is effectively conveyed. An important decision concerns the labeling of ecosystem degradation. Even while the accounting concept will be able to be better conveyed, it may be that the term itself has too much baggage to be retained. An alternative might be "consumption of ecosystem capital" linking to consumption of fixed capital from the SNA.

Other comments

Other key points included:

- Need for a discussion of the measurement of ecosystem diversity – current focus is very much on species diversity.
- Explanation of the challenges of/ approaches to aggregation
- Consider the ability of different models to produce results that are comparable over time

- Consider discussion of material on measurement of socio-economic drivers and pressures.
- Recognise the challenge of temporally adjusting data to fit the selected accounting period

Summary of comments: Application and implementation

A range of issues arose requesting a better explanation of how ecosystem accounting might "roll out". Key points were:

- Request for text on appropriate institutional arrangements and approaches to capacity building
- Discussion on the role of NSOs (NB text already in SEEA EEA Ch 1)
- Describe decision support tools (incl maps) that might emerge from the accounts
- Describe the role of ecosystem accounting in analysis, including links to the derivation of indicators and links to welfare analysis
- Clarify the appropriate scale for the compilation of accounts, especially in terms of what is possible at national scale
- Explain the level of flexibility that is appropriate in compilation
- Clarify the role of thematic accounts and especially the logic for biodiversity accounting
- Consider whether starting compilation from EU (as the ecosystem assets) might be difficult in practice and hence there is an increased role for thematic accounts
- Distinguish clearly between data inputs and data outputs
- Explain the data requirements (perhaps using a tiered approach) for the proposed recommendations
- Concern that the method/approach proposed will work better in relatively less disturbed countries and hence will not be relevant in Europe
- Recognise that there will be benefits beyond ecosystem accounting of a common spatial referencing of multiple data sets.
- Seek means to further involve the scientific community

Proposed response: In general, this aspect was not really put within scope of the drafting of the Technical Recommendations. It will be relevant in the next draft to pick up on these various points to ensure that the Technical Recommendations can be placed in context. At the same time, it is not proposed that a significant amount of text is devoted to these issues. Of course, this should be considered in the light of decisions taken on the overall purpose and role of the Technical Recommendations, and in light of other information/documentation that is available (e.g. the SEEA Implementation Guide and the SEEA Applications and Extensions)

Concluding remarks

Based on the summary of comments and general observations, the following practical steps seem appropriate:

1. Spend time on elaborating the primary purpose and role of ecosystem accounting and place the Technical Recommendations in this context. This will require a reworking of Chapters 1 and 2, and likely involve placing the key accounting logic from Chapter 4 in a more summarized form up front. The more detailed aspects of Chapter 4 would then be placed in relevant chapters. This text will also need to consider/explain
    a. The appropriate spatial and systems scope of the accounts

b. The issue of top down / and bottom-up approaches

c. The expectations with respect to the recommendations – how definitive are they, at what scale are they most relevant, what degree of flexibility is considered reasonable, etc

d. The role of thematic accounts

Also relevant in this re-working of the initial chapters is the reality that the very engaged response by experts to the draft, suggests that this document may provide an important milestone in the process of establishing the next edition of the SEEA EEA. Some thought about the process that might be followed towards this might be useful to incorporate so that, in cases where an issue remains outstanding, those involved have a sense of how further engagement might take place.

2. Work carefully through the issues of defining the spatial units. A special group might be convened for this purpose to reflect in detail on the specific comments and feedback. This issue needs to be resolved since, at its heart, ecosystem accounting is spatial in nature and, without a pathway on spatial units, testing and implementation will be difficult. Many of the concerns are likely to be resolveable via discussion and re-presentation of the logic and motivation for the current text – but this needs to be confirmed.

3. In the light of the feedback, revisit the recommendations for each chapter and consider what remains appropriate and what additional recommendations might be included. A clearer articulation of testing versus research would also be appropriate. As part of this exercise, we can consider again whether additional information on "how" accounts might be compiled – in particular the ecosystem condition accounts and ecosystem services accounts. An approach to consider here would be the inclusion of specific examples of methods that have been used.

4. Form decisions in the short term on the following topics

    a. Using a national coverage, in principle, i.e. not applying natural/modified ecosystem distinction, but at the same time explaining links to sub-national work

    b. The role of composite condition indicators

    c. The role of the different ecosystem services classifications

    d. The connection between biodiversity and ecosystem services (for accounting purposes)

    e. The potential to use restoration costs in the valuation of ecosystem services

    f. The estimation of social values in the SEEA context

    g. The label to be applied for "ecosystem degradation"

5. Place the following topics on the longer term research agenda

    a. Treatment of the atmosphere and the connection to global systems

    b. Disservices

    c. Articulation of the links between ecosystem assets and the supply of ecosystem services (ecological production functions)

    d. Relating market land values to ecosystem asset values

    e. Defining and measuring ecosystem capacity and degradation

    f. Recording activity that maintains or restores ecosystem condition

    g. Approaches to aggregation across spatial areas

6. Based on these steps then an updated draft can be prepared. That draft will also take into account more specific suggestions on improvements/corrections to the current text. Many of these are outlined above but a range of smaller points have also been provided.

Countries/Agencies responding to the draft SEEA EEA Technical Recommendations

PBL - Netherlands

University of Sofia

Statistics South Africa

SANBI

Statistics Norway

UK DEFRA

La Notte – EU JRC

Statistics Canada

CBD

Wildlife Conservation Society (Hedley Grantham)

David Robinson (CEH)

US EPA – Dixon Landers

INEGI – Mexico

World Bank – WAVES program

Statistics Netherlands

Eurostat

University of Twente – Louise Willeman

EU DG Environment

Conservation International

European Environment Agency

Kyrgyzstan