Developing ecosystem service classification(s) for ecosystem accounting – taking stock & moving forward

Expert Workshop organised by EEA and US-EPA, with support from UNSD, University of Wageningen and Nottingham University

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Executive summary

The Wageningen Expert Workshop on ecosystem service classifications (WEW in short) was organized as part of a process guided by UNSD to develop a multi-purpose international classification of ecosystem services (or a modular system of connected classifications) to support implementation of ecosystem accounting as described in the SEEA Experimental Ecosystem Accounting (SEEA-EEA).

It reviewed current experience in developing and applying ES classifications to assess how well current approaches support the needs of ecosystem accounting. This exercise compared CICES, FEGS-CS, and NESCS, as each aims to support ecosystem accounting.

Section 2 presents key concepts and comparative material for the three discussed ecosystem services classification systems. Please see paper for detail.

Section 3 discussed objectives, principles and criteria for classifying ES for ecosystem accounting, based on a variety of sources, incl. previous UNSD publications and the outcomes of previous discussions in SEEA fora. Based on that the authors propose a set of nine key principles to be considered in building ecosystem service classification(s) for ecosystem accounting:

- Enable focus on final ecosystem services, recognizing that comprehensive classification must include all potentially final ES, where "final" is determined by the use context
- Expect that different component accounts of SEEA EEA will be underpinned by their own specific classifications, especially for example, the ecosystem extent accounts
- Devise structure and guidance to users in a way that dissuades double counting, e.g., categories should be mutually exclusive
- Provide clear and precise definitions of categories and where not obvious, the types of elements that may be included in those categories
- Ensure that the classification allows all possible units of the items classified
- Facilitate aggregation to higher-level categories in the set-up of the classification (via embedded functional hierarchical structure)
- Ensure compatibility with, and links to, related statistical classifications (e.g., ISIC)
- Ensure time-series comparability between different versions over time
- Consider ease of use and ease of maintenance in the design of the classification

Putting together background material as well as the exchange at the workshop itself enabled a lot of shared understanding to be developed and resulted in the proposal of 9 key principles above. Other technical agreements were also identified that are listed in section 5 of this paper. Despite the differences identified it may be possible to derive a crosswalk between elements of FEGS-CS, NESCS and CICES – this needs to be further tested.

However, there are also a number of outstanding issues to be resolved. There are differences between the systems in terms of how ecosystem services are framed. FEGS-CS and NESCS frame each ES as a conjunction of an ecological end-product from an ecological asset with a specific use by a specific user (/beneficiary). CICES posits that services can be identified for the purpose of establishing an ES classification independently of specific ecosystems or beneficiary groups.

NESCS and FEGS-CS authors consider that ecological structures and processes that precede final ES can be appreciated in "ecological production functions" (EPFs), so that every ES in theory would have an EPF – although there is no claim to the uniqueness across the set of elements of an EPF relative to the EPFs for other ES associated with an ecosystem asset. Whereas the developers of CICES consider that many of the elements underpinning EPFs are best and more efficiently described via the SEEA EEA component accounts for ecosystem condition.

The question of the use and utility of EPFs is also closely tied to the definition /interpretation of the environment–economy boundary, where there seem to be different understandings.

Next Steps

As a way of taking the work forward one possibility discussed was to identify case study areas and logistical and methodological preparation of comparative analysis of the three respective systems. The following key components for review were initially flagged:

- Ecosystem units (~ecosystem types within a spatial grid) to be covered– there will be a great mixture of those in most case studies and it would be important to focus on the ones that are most common or most comparable.
- Categories of potentially final ES [Core Set] to be covered as a minimum set – for CICES this would mean selecting ES classes from all three main sections (provisioning, regulation & maintenance, cultural).
- Comparing definitions or metrics that are used for describing / quantifying these ES; and identifying what their functional characteristics would be w.r.t condition
- Compare approaches for identifying beneficiaries / users to support comparability of results between the three ES classifications.

This exercise needs to be embedded in the SEEA EEA accounts structure. So one additional question for comparison could be whether one can build ecosystem services supply and use accounts using the different systems – and whether the components and approach of each ES-CS is compatible with the SEEA EEA structure and logic.

The workshop in Wageningen was very useful for clarifying some key conceptual issues and to create a better understanding between the proponents of the different ES-CS. It also helped to identify key open issues and proposed a possible approach to tackling many of them (see next steps above).

At the same time, it also needs to be recognised that a lot of effort has gone into the development of CICES V5.1, which benefited from this and previous discussions and the example of a better connection to end user(s) provided in the NESCS approach. There is also nearly-completed work on the convergence of FEGS-CS and NESCS which aims to create more user support. The developers of both ES classification systems find it important, therefore, that space is given to each system's application in practical ecosystem accounting contexts to gather further experience on their fit with ecosystem accounting needs.

Section 1 – Introduction

The Wageningen Expert Workshop on ecosystem service classifications (WEW in short) was organized as part of a process guided by UNSD to develop a multi-purpose international classification of ecosystem services (or a modular system of connected classifications) to support implementation of ecosystem accounting as described in the SEEA Experimental Ecosystem Accounting (SEEA-EEA).

Starting from the three classification systems potentially useful in a SEEA context – CICES, FEGS-CS, and NESCS – participants discussed the principles and definitions underlying these three classification systems and shared conceptual understanding of how to classify ecosystem services (ES) for ecosystem accounting. The work also reviewed other purposes for ES classification(s) and other possible structures for classifying ES for ecosystem accounting purposes. The workshop explored whether there was sufficient convergence in thinking to develop a shared multi-purpose classification of ecosystem services or a modular system of explicitly connected classifications.

The objectives for the Wageningen Expert Workshop were:

i. Review current experience in developing and applying ES classifications to assess how well current approaches support the needs of ecosystem accounting. This exercise compared CICES, FEGS-CS, and NESCS as they share an explicit aim to support ecosystem accounting.

ii. Based on previous discussions and comparisons of CICES, FEGS-CS, and NESCS, develop a common understanding of the conceptual foundation for ecosystem services classification, to be used in the compilation of SEEA Experimental Ecosystem Accounts (including key objectives, definitions, and principles or criteria).

iii. Discuss a possible structure, or at least the necessary elements, of a classification of ecosystem services for ecosystem accounting, what a modular system (involving a set of linked classifications covering, for example ecosystems, services, benefits etc.) might look like, and identify any practical design and implementation requirements and measurement issues.

iv. Agree on the next steps and required research for developing and/or applying international ES classification(s) (or modular systems of connected classifications) in the context of SEEA Experimental Ecosystem Accounting.

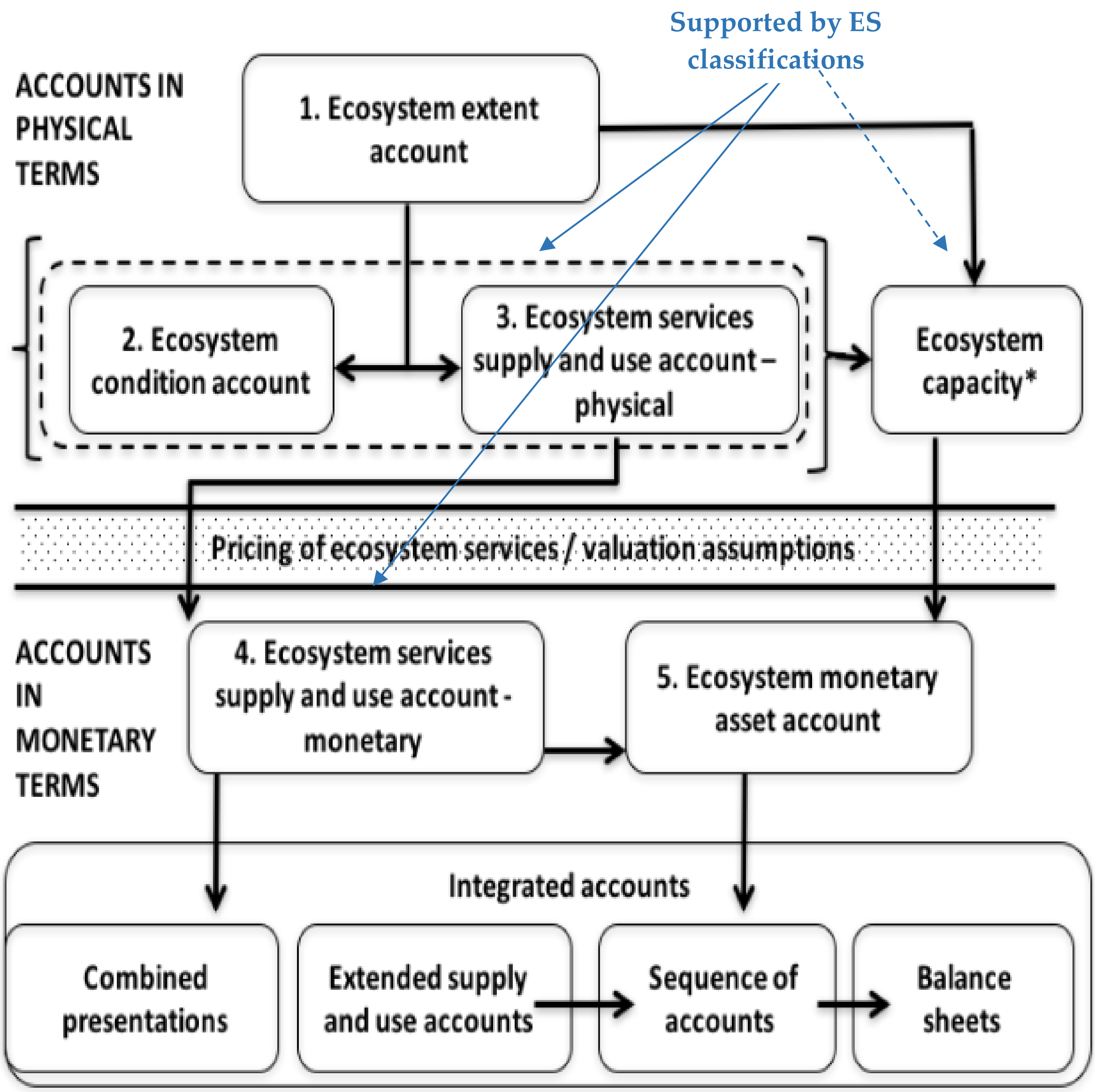
The following sections present key concepts and comparative material for the three discussed ecosystem services classification systems and review selected methodological questions that were meant to be discussed at the Expert Workshop. It should be noted that other ES typologies exist – these do not explicitly aim to support ecosystem accounting and are not directly reviewed here. This summary of the workshop discussions and background material aims to contribute to the ongoing technical review of SEEA EEA regarding ES classifications.

Section 2 – Brief review of SEEA EEA context and ES classifications covered

2.1 Context

The context for the review of these systems is the SEEA Experimental Ecosystem Accounting (SEEA EEA). Figure 1 below shows the conceptual structure of SEEA-EEA as described in the Technical Recommendations[1]. This figure makes clear that ecosystem service accounts are part of the overall system of ecosystem accounting. It also highlights the two components (Figure 1, elements 2b & 4, and possibly 3) that require a functioning ecosystem service classification for their implementation (see section 3 for criteria for functionality for ecosystem accounting).

Figure 1: Conceptual structure of ecosystem accounts as proposed by SEEA EEA



[1]https://seea.un.org/sites/seea.un.org/files/technical_recommendations_in...

2.2 Introduction to and comparison of CICES, FEGS-CS, & NESCS

This section sets out in an overview table key characteristics of the three ES classification systems compared at the WEW, and presents selected diagrams that describe the respective conceptual models of each system, for a conceptual comparison.

Table 1: Comparative overview of current ecosystem service classification systems

Characteristic	CICES	FEGS-CS	NESCS
Origin / custodian	EEA & University of Nottingham	US-EPA - ORD	US-EPA – ORD, OW, OAR
Purpose & use context	'Multi-purpose classification' of potential final ES for accounting, assessment etc.	Classification system focused on final ecosystem goods and services (FEGS) (for measuring) stocks	Classification system focused on final flows of ES by flexible "Use-User" combinations
Main conceptual model	Cascade model	Environment + Potential Beneficiary = FEGS	'Blue-green' diagram; Four-Part Structure
Structure / design	Hierarchical, developed on basis of 3 of 4 MA ES categories	Matching hierarchies of Environments and Beneficiaries yields a matrix of feasible types of FEGS	Nested hierarchies in each Part; linking across all four Parts to define final ES
Current use / users	Adopted for EU ecosystem accounting work; used by many research teams, mainly in Europe	EPA pursuing metrics and indicators for ecological measures using FEGS-CS; US NSF-funded Air Quality & ES work across many envts.	Developed for work by US-EPA, proposed / adopted by current working group on natural capital accounting, led by USGS
Links to other classifications	Inspired by work under MA & TEEB, a translation tool exists to those classifications as well as FEGS-CS	Embedded land and beneficiary classifications	Embedded and intentionally modular land and beneficiary sub-classifications (NAICS "plus")
Other information	Has been revised on extensive user survey; V5.1 released January 2018	Online user tool; FEGS-CS folding into NESCS, to be a product in 2018	'Guidelines for Use' forthcoming, with minor upgrades and a new name

Note: 'ORD' stands for Office of Research and Development, 'OW' for Office of Water, and 'OAR' for Office of Air and Radiation. 'NSF' stands for (The US's) National Science Foundation.

Further details on CICES can be found under: www.cices.eu

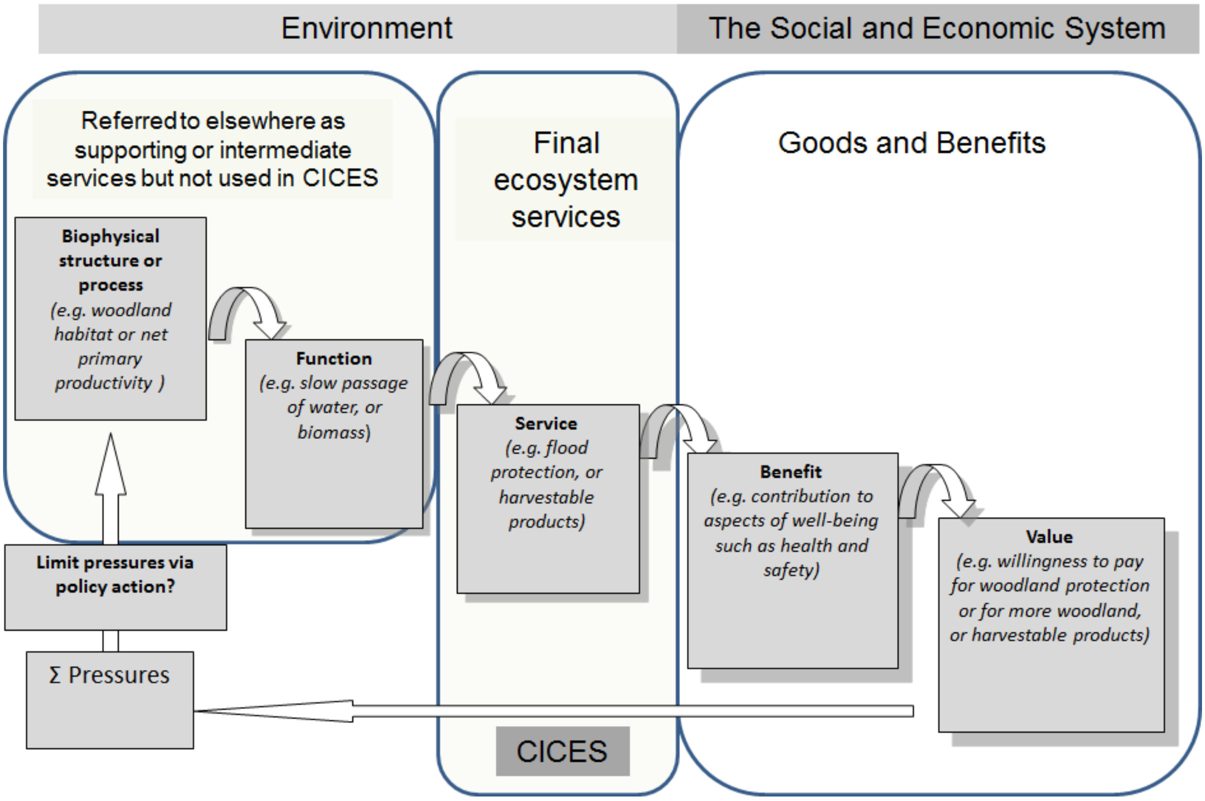
Information on FEGS-CS is provided under:
https://cfpub.epa.gov/si/si_public_record_report.cfm?dirEntryId=257922

Information on NESCS is available under: https://www.epa.gov/sites/production/files/2015-12/documents/110915_nescs_final_report_-_compliant_1.pdf

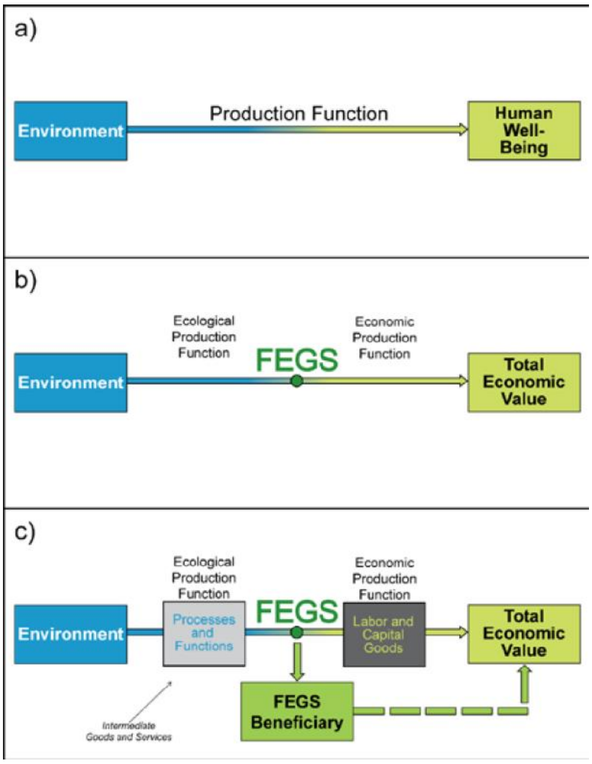
Key conceptual diagrams for each system:

The following diagrams show the main conceptual model(s) underpinning each of the three systems. These provide of course only a snapshot, further material is being prepared.

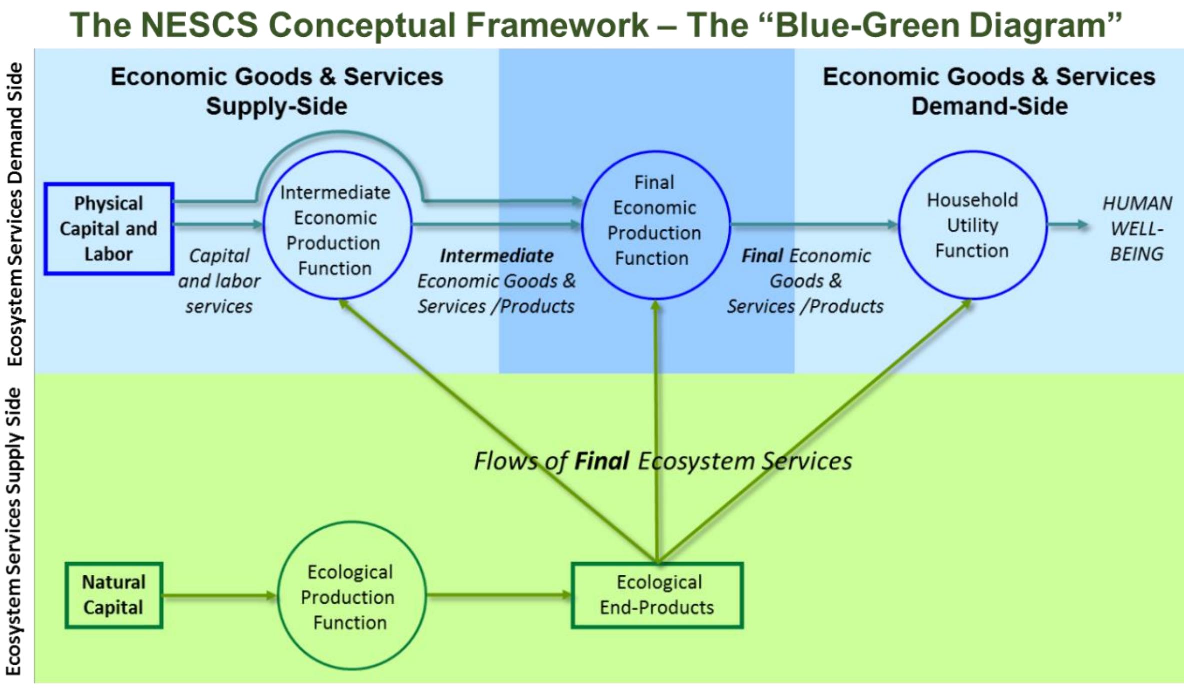
a) ***Figure 2: the CICES 'cascade model'*** – this aims to show the entire chain of processes from the underpinning ecosystem structures and processes to socio-economic goods and benefits, and values; it illustrates where the CICES ecosystem service classification is considered to sit in the cascade.



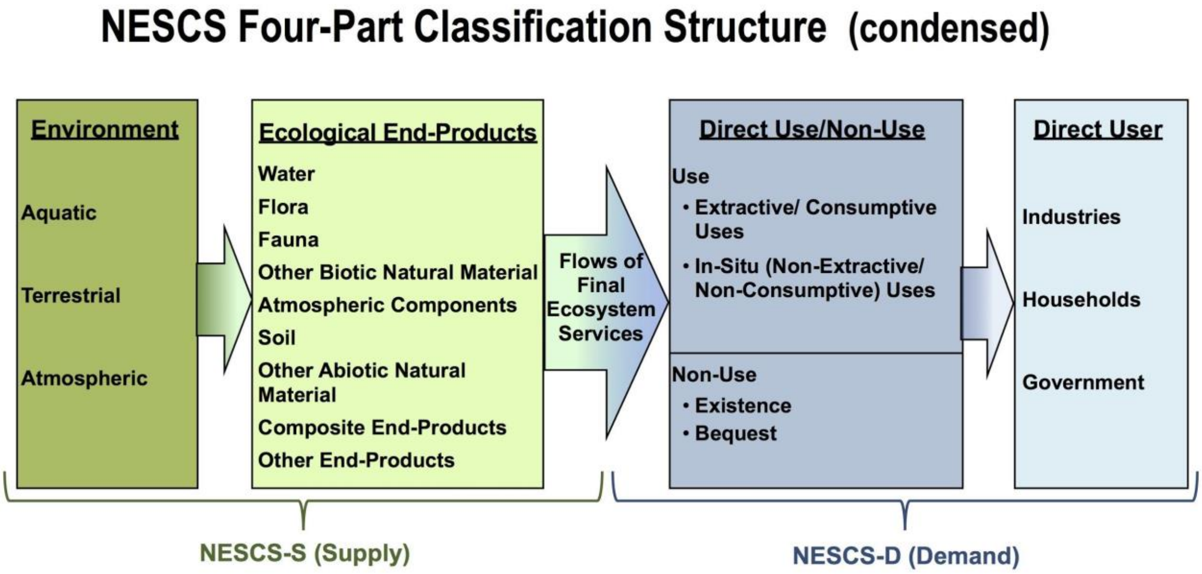
b) ***Figure 3: the FEGS-CS identification process*** – this shows the conceptual underpinning of the three operational steps used in FEGS-CS for identifying final ecosystem goods and services (i.e. 'FEGS').



c) ***Figure 4: the NESCS 'blue-green diagram'*** describes how economists would add "natural capital" to standard economic production thinking.

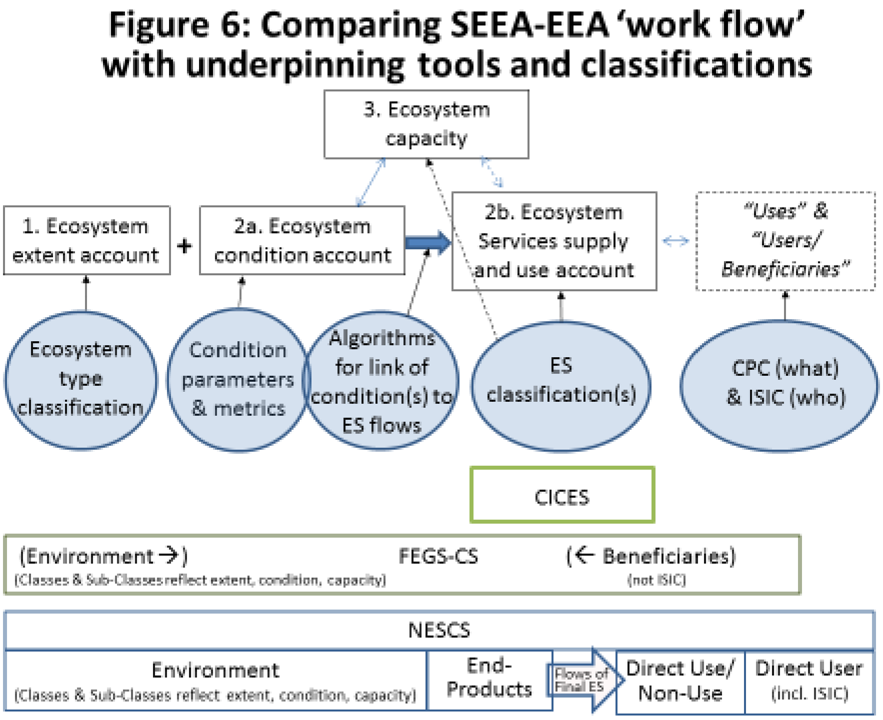


d) *Figure 5: the NESCS Four-Part Structure* illustrates the four components that the NESCS system is comprised of & that together are used to identify flows of final ES.



<u>Comparative diagrams that aim to show links and differences between the three systems:</u>

Figure 6 is an initial conceptual overview of the SEEA-EEA workflow that shows assumed analytical connections between components of SEEA-EEA (identified by their specific numbering in Fig. 1) and classifications and other tools that support the implementation of individual component accounts (blue bubbles & dashed box). Below that is a conceptualised representation of the range of classifications and other instruments that are covered or encompassed by the classification systems discussed.



Section 3 – Objectives, principles and criteria for classifying ES for ecosystem accounting

In order to develop a set of criteria for classifying ecosystem services within an accounting context we reviewed key sources such as:

- The SEEA EEA handbook and the related draft technical recommendations;
- The 'Best Practice Guidelines for Developing International Statistical Classifications', (A. Hancock, 2013) – see annex 2 for an extract;
- The draft summary paper of the UNSD expert meeting on ecosystem service classification in New York, June 2016[2];
- Reflections on essential issues for ecosystem service classification provided by Carl Obst in advance of the 2016 UNSD expert meeting in New York – see annex 1

The UNSD expert meeting on ecosystem services classification(s) on 20-21 June 2016 in New York, was a particularly valuable source of guidance; the key points that need to be considered were usefully summarised by Anton Steurer:

- ES = *final*, i.e., benefits humans, but classification can only name *potentially final* ES, because real use is context dependent
- '*Intermediate* ES' is a problematic term - different meanings are understood by different ES practitioners
- Classifications are intended to be modular (separate classifications for ES, ecosystem assets, users)
- Separate classification for abiotic (e.g., subsoil) elements is an issue, as these are arguably not ES
- Initial ideas to further improve CICES identified, timing should include testing *the future revised classification* and to align timing with SEEA EEA revision
- Next steps are testing existing classifications, clarifying terms, agreeing on principles for revised classification, developing and testing a revised classification

Some key issues have been further elaborated in a reflection paper by Carl Obst (see annex 1). He observed that in terms of core framing issues, while in much of the discussion the focus has been on the CICES, FEGS-CS and NESCS classifications, there seems to be a general lack of clarity on the role of classifications for ecosystem accounting exercises.

Thus we need to establish the relevant measurement concepts for ecosystem accounting and then use classifications to provide the detail to analyse these concepts. It may be that discussion of classifications helps to define the measurement boundaries for a given concept. However, in the final phase, the accounting concept and associated measurement boundary must be set before a classification can be finalized. In the situation here, we ultimately need an agreed definition/boundary for ecosystem services and then a classification can be established which, in effect, identifies different types of ecosystem services within the agreed boundary.

[2] http://unstats.un.org/unsd/envaccounting/workshops/ES_Classification_2016/Towards%20a%20Standard%20International%20Classification%20on%20Ecosystem%20Services%20-%20Final%20report%20for%20consultation.pdf

Building on the points outlined above and the Best Practice Guidelines for Developing International Statistical Classifications (Hancock, 2013; see annex 1 for full list), in the bullet list below the authors propose a set of nine key principles to be considered in building ecosystem service classification(s) for ecosystem accounting:

- Enable focus on final ecosystem services, recognizing that comprehensive classification must include all potentially final ES, where "final" is determined by the use context
- Expect that different component accounts of SEEA EEA will be underpinned by their own specific classifications, especially for example, the ecosystem extent accounts
- Devise structure and guidance to users in a way that dissuades double counting, e.g., categories should be mutually exclusive
- Provide clear and precise definitions of categories and where not obvious, the types of elements that may be included in those categories
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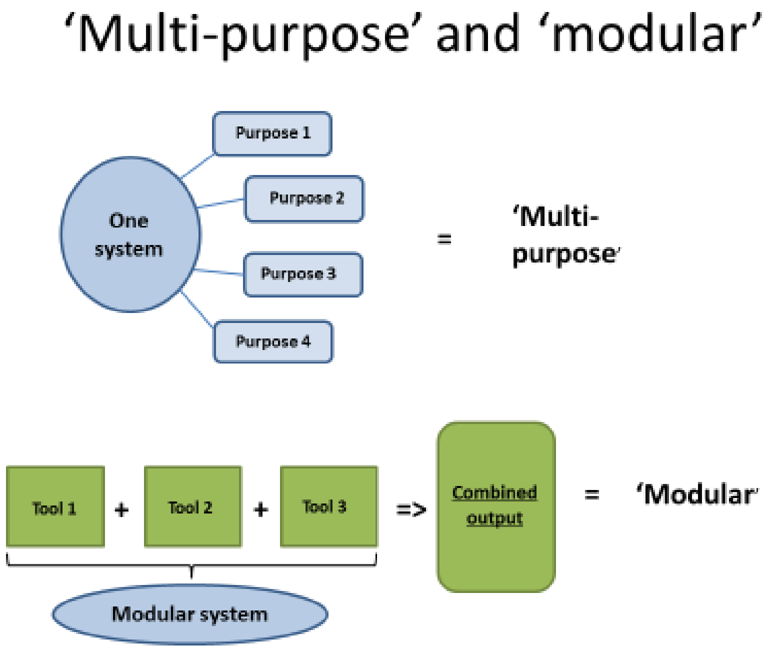
- Consider ease of use and ease of maintenance in the design of the classification

Section 4 – Key conceptual or methodological issues to be reviewed

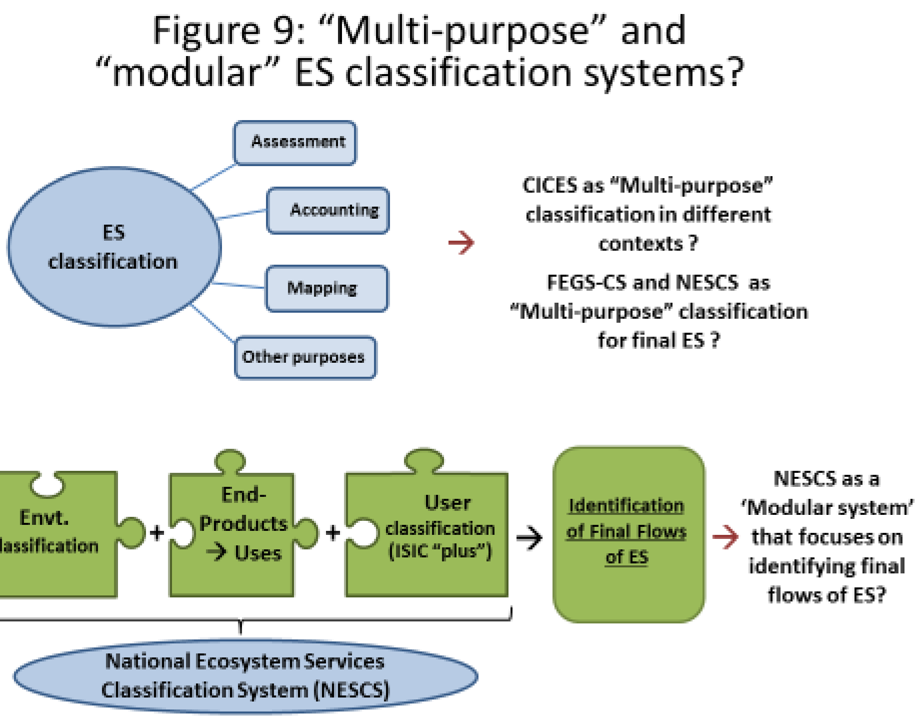
This section sets out key conceptual or methodological issues discussed in the WEW that merit further detailed review. The list of issues below is not meant to be exhaustive, but these issues have frequently been discussed at recent meetings on ecosystem accounting and related classifications.

a) Previous meetings talked about the need for a multi-purpose classification or a [modular] system of explicitly connected classifications. It was agreed that further clarification was needed about what a 'multi-purpose' classification actually entailed. Figure 8 aims to illustrate these concepts and Figure 9 applies them to two existing ES classification systems.

Figure 8: A conceptual representation of 'multipurpose and 'modular'



A multi-purpose system is one which accommodates several application functionalities within its classification approach, e.g. an ES classification that could be used for ecosystem accounting, as well as for ES mapping or other non-accounting purposes. A modular system on the other hand combines several classification tools that are connected in one overall analytical frame to achieve the targeted analytical output.



b) The concept and use of 'ecological production function(s)' (EPFs) appears central to understanding the long-term contribution of ecosystems to socio-economic benefits. EPFs have also been discussed as potentially useful for attributing the contribution of ecosystems to final socio-economic goods and benefits, for example to measure the contribution of nutrient cycling or photosynthesis to the production of agricultural crops. However, practical application of the EPF approach raises a number of questions:

- Does EPF refer to ecosystem functioning as a whole or does it refer to individual flows of services?
- What is the meaning of the term EPF in different contexts (e.g., only as part of bio-physical modelling or as a means to attribute a specific share of the value chain?
- Should we consider EPFs to be an expression of 'real' biophysical flows or should we consider them as a pragmatic way of dividing the contributions of nature from those of economic actors in the production of joint outputs (in a model of reality)?

c) Aggregation – this is an important function of any classification, in particular for statistical purposes. What are the potential solutions or approaches for implementing it in an ES classification context?

In the development of CICES it was assumed that aggregation is an important function for an accounting approach (it also makes great sense in many other analytical contexts). Hence CICES is built on a hierarchical structure that is meant to allow horizontal aggregation from lower level categories to groups and sections. NESCS also enables aggregation in the sense that each of its four major parts (see Figure 5 above) employs a nested hierarchy, so aggregation seems possible, although perhaps more for certain modular elements (i.e., within a part), rather than across the full 4-Group identification of a final ES. A similar approach was taken in FEGS-CS.

d) Application of the environment-economy boundary in different contexts

This is a key issue to be addressed as ecosystem accounting in many cases will cover, and hence needs to be applicable to, human managed systems and not just 'natural ones'. All ecosystems are potentially covered by ecosystem accounting – the issue of 'joint production' then needs to be resolved if we want to disaggregate nature's contribution.

In the SEEA-EEA, the critical point for accounting purposes in the chain of flows between ecosystems and human well-being is the point where the ecosystem ends and benefits begin. The definition of 'benefits' is an essential concept in the process of identifying final ecosystem services, but remains subject to divergent interpretations.

In the SEEA-EEA, 'benefits' refer to goods and services that are ultimately used and enjoyed by people and which contribute to individual and societal well-being. Benefits are distinguished from ecosystem services (which contribute, usually along with economic inputs, to the generation of economic benefits) and from well-being (to which benefits contribute).

Two broad types of benefits are described in the SEEA-EEA:

- SNA benefits encompass the products (i.e., goods and services) produced by economic units within the production boundary defined by the SNA. SNA benefits include goods produced by households for their own consumption.
- Non-SNA benefits are not generated solely by economic production processes as defined by SNA. Rather, they encompass ecosystem services that may or may not contribute to the production of SNA goods and services.

While all parties present at the Wageningen workshop agreed with the general definitions set out above, it is clear that further work needs to go into an operational definition of the 'ecosystem endpoint'. Different interpretations exist with their own internal logic, but a standardized understanding of the environment-economy boundary is an important tool for identifying only final ecosystem services in different application contexts, which is an important objective in ecosystem accounting.

Section 5 – Next steps toward a shared (system of) ecosystem service classification(s)

This section aims to address what the next steps toward building a shared (system of) ecosystem service classification(s). It thus serves to document points of agreement and outstanding conceptual differences, and is divided into four sub-sections.

a) What are the points of agreement?

1. ES-CS developers accept the premises of the SEEA as these may affect ES classification, insofar as these developers currently understand them. These premises include that:
    i. The current goal is to help deliver, develop, or at least largely inform, a theoretically consistent classification for ES that respects rules of classification, and meets principles of national accounts within the proposed accounts structure as part of the revision of SEEA EEA;
    ii. ES are flows (and cannot be stocks) between ecosystem assets and those who benefit from economic, ecological, and joint-ecological-and-economic products – but these flows are tied to natural elements that can in principle be counted or physically measured;
    iii. only final ES need to be formally classified (in the first order, for the ES Supply and Use tables), so "ES" means "final ES" in the sense that classified ES are those that may be used or appreciated by humans (and not background or formative ecological structures processes or functions that do not directly connect to human use or appreciation);
    iv. useful ES classification structure must structurally accommodate any appropriate final ES, where finality depends on supply and on use context. This means while ES supply and use table cell entries will be actual ES, ES classification structures intrinsically name potential final ES; "

v. ES Supply and Use tables will exist within a wider set of tables, recognizing that all contextual elements associated with ES are not themselves ES, and the call for data useful in SEEA, and even in EEA, is wider than named ES can be.

2. While developers of the SEEA EEA account design consider that ES are defined as outside the boundary of SNA goods and benefits, ES-CS developers see that ES have been bundled into some products in the SNA, so find respect for the "boundary" to be less than straightforward at a number of points. The contributions of natural processes to the production of timber and crops represent high-visibility examples.

   Nonetheless, there is agreement that the "scope" of final ES for ES-CS classification (in ES Supply and Use tables) include *all* flows that contribute to human benefits that are traced specifically to a living evolving environment, and not purely to minerals, to abiotic elements, or to elements dominantly of human production.

3. ES-CS developers agree that choices of category, and hierarchical aggregation or breakout of these categories, should be based on theory and logic, and not on measurement constraints. The latter may sometimes become an over-riding concern to ensure early applicability. Close attention should be paid to this potential risk throughout the field.

4. ES-CS developers at WEW agree that ES classification proves useful for four types of application, and that SEEA applications are one of four types of application within the ES paradigm: mapping, assay/simple assessment, policy scenarios (ES profiles over an area under contrasting conditions), and recording/accounting. This split recognizes that most ES publications necessarily mix a few of these application domains. This understanding arose as ES developers slowly came to agree that ES of interest in one application may be different than those preferable or even allowable in another application.

   i. Example 1: "mapping ES" need not be restricted to strictly "final" ES, as for accounting;

   ii. Example 2: economic valuation based on Total Economic Valuation approaches will include, for example, "existence" values, that are excluded from accounting because they are not transaction-based (whether transactions physically occur or not).

   This understanding means that the span of ES allowable under SEEA EEA is a restricted set of ES appropriate for some assessment and policy scenario research – and that both of these may be restricted sets of what a research team may wish to "map" as "ES" or ES relevant. WEW organizers agree that there is a need and incentive to work across these four application domains with the highest agreement of categorization and vocabulary possible.

   Because of the fundamentally different approaches, a single monolithic and unmodified ES-CS may not meet the needs of all four application types. However, ES-CS developers envision their (respective) ES-CS to be centralizing, starting-point frameworks appropriate for any application. ES-CS developers are committed to supporting SEEA EEA with the best tool or guidelines and formats for an ES-CS tool (or modular system of classifications) that meet SEEA EEA needs.

5. ES-CS developers agree that efforts to harmonize vocabulary and definitions of ES across application domains could move the field closer to establishing a common database of results from ES research. They further anticipate that building SEEA EEA accounting tables could also move the field closer to establishing a common database of ES research results.
6. Representatives of the CICES, FEGS-CS, and NESCS systems agree that the ability to classify *all* final ES within a nested hierarchical structure(s) and that following rules of classification are both fundamental to their tools, and to efforts on behalf of SEEA EEA.
7. Developing cross-walks between different ES-CS would be very useful. Comparing the key systems in the same application context through practical comparative case studies would be very useful.

b) What are the outstanding conceptual differences?

1. Open discussion continues about elements particular to any subset of the three ES-CS, including nuances in definitions of ES, benefits, and other core terms, owing to starting assumptions, academic background, and path-dependence within the development arc of an existing ES-CS. There is not yet agreement on what the first order of hierarchy should be in an ES-CS well suited for EEA needs, because the three systems each began hierarchical organization at different points, and with different sub-classifications.
2. There is a fundamental difference between the systems in terms of how ecosystem services are framed. FEGS-CS and NESCS frame each ES as a conjunction of an ecological end-product from an ecological asset, with a specific use by a specific user (/beneficiary). CICES posits that services can be identified for the purpose of establishing an ES classification independently of specific ecosystems or beneficiary groups.
3. Despite the differences identified in 1 and 2, however, it seems possible to derive a crosswalk between FEGS-CS and CICES (as well as for elements of NESCS and CICES) which throws light onto the similarities and differences in scope of the respective systems. A first proposal that compares CICES 5.1 and FEGS-CS has been developed but requires further methodological checking.
4. There is an open discussion about which approach to ES classification will best meet the widest core of needs across the four application domains.
5. There is a contrast between the approach to classification of final ES between the CICES and the FEGS-CS and NESCS (where the last two are of one type), in the way that “final” is distinguished as a definitional strategy. The FEGS-CS and NESCS approach actively pushes intra- and inter-ecosystem characteristics and processes away from the classification candidate space.

Developers of the FEGS-CS and NESCS systems have consistently maintained that ecological structures and processes that precede final ES can be appreciated in "ecological production functions" (EPFs), so that every ES in theory would have an EPF – although there is no claim to the uniqueness across the set of elements of an EPF relative to the EPFs for other ES associated with an ecosystem asset. These developers further claim that EPFs, and the modelled relationships and contributing elements that they represent, can sufficiently characterize the production dynamics of final ES, such that intra- and inter-ecosystem characteristics and processes generally need not be categorized (but could be), but that these contributing elements and processes must be strictly excluded from classification for ES Supply and Use tables.

CICES 5.1 also contains elements that provide guidance to users for avoiding an erroneous classification of intermediate services as final services, which in the design of CICES relies on additional evidence and can only partly be addressed via the definition of individual ES classes. In addition, the developers of CICES consider that many of the elements underpinning EPFs are best and more efficiently described via the SEEA EEA component accounts for ecosystem condition.

The potential role of EPFs in the implementation of SEEA EEA accounts is not settled, nor is the potential role of any EEA accounts that quantify elements relevant to EPFs for non-accounting uses clear. This is conceptually difficult, and occurs at one of the most complex interfaces between the fields that intersect within the ES paradigm. Significant progress on communicating issues, and finding common terms for how to proceed in this exploration was made at the WEW and discussions after.

c) What are the next steps in shared testing and comparison of existing ecosystem service classifications?

As a way of taking the work forward one possibility discussed was to identify case study areas and logistical and methodological preparation of comparative analysis of the three respective systems. The following key components for review were initially flagged:

- Ecosystem units (~ecosystem types within a spatial grid) to be covered– there will be a great mixture of those in most case studies and we would like to focus on the ones that are most common or most comparable.
- Categories of potentially final ES [Core Set] to be covered as a minimum set – for CICES this would mean to select ES classes from all three main sections (provisioning, regulation & maintenance, cultural).
- Comparing definitions or metrics that are used for describing / quantifying these ES; and identifying what their functional characteristics would be w.r.t condition
- Compare approaches for identifying beneficiaries / users to support comparability of results between the three ES classifications.

This exercise needs to be embedded in the SEEA EEA accounts structure. So one additional question for comparison could be whether one can build a full set of accounts using the different systems – and whether the components and approach of each ES-CS is compatible with the SEEA EEA structure and logic.

The workshop in Wageningen was very useful for clarifying some key conceptual issues and to create a better understanding between the proponents of the different ES-CS. It also helped to identify key open issues (see subsection b) above and proposed a possible approach to tackling many of them (see subsection c) above).

At the same time, it also needs to be recognised that a lot of effort has gone into the development of CICES V5.1, which benefitted from this and previous discussions and the example of a better connection to end user(s) provided in the NESCS approach. There is also nearly-completed work on the convergence of FEGS-CS and NESCS which aims to create an even more user-friendly system. The developers of both remaining ES classification systems find it important, therefore, that space is given to their application in practical ecosystem accounting contexts to gather further experience on their fit with ecosystem accounting needs.

Annex 1:

1.1 Extract from paper on UNSD principles for statistical classifications

Note: this material has been extracted from a comparative paper on ecosystem service classifications developed by Michael Bordt (version of 7 July 2016)

According to the United Nations Statistical Commission (Hancock, 2013):

> *"A statistical classification is a classification having a set of discrete categories, which may be assigned to a specific variable registered in a statistical survey or in an administrative file, and used in the production and presentation of statistics."*

The purpose of an international statistical classification is to provide a standardized and consistent approach to classifying statistical data, with the objective of (a) supporting the compilation of statistics that are reasonably comparable between countries and (b) providing linkages to national (or existing) classifications for the same characteristics (adapted from Hancock, 2013).

Hancock (2013) further outlines ten "Principles to consider when developing an international statistical classification". The following is an interpretation of these principles in the current context (direct quotes are from Hancock):

1. **Custodians**: Custodianship generally resides with the United Nations Statistics Division (UNSD). UNSD is required to present the proposed classification to the Expert Group on International Statistical Classifications to ensure best practices have been observed and that it is coherent with related classifications.

2. **Conceptual Basis**: The conceptual basis is a description of definitions, concepts and principles that guide categorization, structuring and interpretation. In terms of ecosystem services, this would also require a definition of the scope of classification. That is, a sufficiently detailed definition and description that would allow users to decide if (a) a candidate unit was indeed an ecosystem service and (b) where to assign it in the classification structure.

3. **Classification structures**: This refers to whether a classification is flat or hierarchic. In a hierarchic classification, statistics assigned to more detailed levels can be aggregated to higher levels. In terms of ecosystem services, this requires consideration of the "kinds" of services, units of measure and whether measures (monetary or physical) can and should be aggregated.

4. **Classification types**: This distinguishes between international and country-specific classifications. An international classification provides a common framework for collecting and organizing information. That is, it should accommodate country-specific requirements even though all requirements may not be applicable to all countries.

5. **Mutual exclusivity**: Categories in a classification must be mutually exclusive. That is, any unit should only be classified to one category. "A classification with categories which are not mutually exclusive will confuse users and not enable the statistical classification to be accurately and consistently used." In terms of classifying ecosystem services, this suggests that sufficient detail is required to ensure a common interpretation of the service,(its origin and its user) thus avoiding different interpretations in different contexts.

6. **Exhaustiveness**: A classification should be exhaustive for all possible units that the classification represents. That is, within the scope defined in the conceptual basis, all types of ecosystem services should be accommodated.

7. **Statistical balance**: This refers to the balance between the size and homogeneity of categories. To support aggregations (i.e., tabulation), it is best to have homogenous categories of similar size.

8. **Statistical feasibility**: It should be "possible to effectively, accurately and consistently distinguish between the categories in the classification on the basis of the information available". Detailed coding tools (definitions, classification flow charts) are required to support effective classification.

9. **Classification units/statistical units**: The classification unit is the basic unit to be classified. Statistical units are the units of observation for which data are collected or derived. For ecosystem services, the classification unit and statistical unit are both an ecosystem service. Further specifying the unit of measure, which for ecosystem services vary greatly, would facilitate data collection and classification.

10. **Time-series comparability**: Comparability over time can be managed using correspondences that link versions over time.

Based on:

Hancock, A. (2013). Best Practice Guidelines for Developing International Statistical Classifications (No. ESA/STAT/AC.267/5). New York, NY: United Nations Statistics Division. Retrieved from http://unstats.un.org/unsd/class/intercop/expertgroup/2013/AC267-5.PDF

1.2 Reflections paper by Carl Obst on essential issues for ecosystem service classification in advance of the UNSD expert meeting in New York

Developing an international classification for ecosystem services for environmental-economic accounting

Comments – Carl Obst

16 June, 2016

The following comments and observations are intended to support discussion at the upcoming meeting on a classification for ecosystem services to be held in New York on 20-21 June. I'm sorry I won't be able to attend but wish you well in the discussions.

Core framing issues

1. While in much of the discussion the focus has been on the CICES, FEGS-CS and NESCS classifications, there seems to be a general lack of clarity on the role of classifications for SEEA type / national accounting exercises. The following are my thoughts on this issue.

a. We need to establish the relevant measurement concepts and then use classifications to provide the detail to analyse these concepts. It may be that discussion of classifications helps to define the measurement boundaries for a given concept but, in the final phase, the concept and associated measurement boundary must be set first before a classification can be finalized. In the situation here, we ultimately need an agreed definition/boundary for ecosystem services and then a classification can be established which, in effect, identifies different types of ecosystem services within the agreed boundary.

b. Three distinct classifications are relevant for ecosystem accounting

i. Classification of ecosystem types – recognizing that ecosystem assets are quasi-producing units in the ecosystem accounting framework then a classification of different types of producing units is needed.

ii. Classification of ecosystem services – here the accounting logic is that the ecosystem services are the production of ecosystem assets – in effect sales by a producer. We could lump all types of ecosystem services together without distinction in the same way as all products (goods and services) from production by economic units could be grouped together. But it is meaningful to record different types of ecosystem services and this is the role of the classification.

iii. Classification of user/recipient - The production of ecosystem services reflects a transaction between a producing ecosystem asset on the one hand and a recipient or user on the other. For "final ecosystem services" the user is an economic unit, household/individual or society generally. It would be useful for these users to be classified following the classifications used in the SNA – either by institutional sector or by economic activities (ISIC). A convention to treat use by society as use by general government would be consistent with the SNA. For intermediate ecosystem services the transaction is between a producing ecosystem asset and another ecosystem asset (the convention suggested/implied here is to ignore transactions internal to a single ecosystem asset which is also the starting convention for national accounts). The relevant classification of these ecosystem asset "users" is the classification of ecosystem types as above.

c. Some notes on these points
i. These three classifications are distinct in accounting terms. That is, while there may be relationships between them that emerge – i.e. there are combinations (or “triplets”) that happen more often than others (e.g. forest/timber/forestry unit), national accounting does not require that the triplets be known before the classification is established. One might argue that to establish the relevant classes you need to map out the combinations but that is a question of how you delineate the classes not a question of the role/nature of the classification itself.

ii. The scope of the classification of ecosystem services need not be, and indeed, should not be, necessarily limited to final ecosystem services. Whether a given type of ecosystem services is final or intermediate – any single transaction must be one or the other – depends on the type of recipient not on the type of service. This is exactly the way in which the Central Product Classification (CPC) is used in the national accounts. A single product type (e.g. bread) may be final (if purchased by a household) or intermediate (if purchased by a restaurant).

iii. Further on this point, it may be the that scope of the classification at this stage is limited to the types of ecosystem services that are final, but this should be taken as implying the classification itself is only relevant for classifying final ecosystem services.

iv. The set of economic units (including households and individuals) who receive ecosystem services may be collectively termed beneficiaries. As a corollary, the ecosystem accounting model considers that these (final) ecosystem services are inputs to the supply of benefits – SNA and non-SNA. SNA benefits are those goods and services already recorded in the SNA, i.e. they are within the SNA production boundary (and as a result can be classified using the CPC). Non-SNA benefits are new (wrt SNA) but even still, final ecosystem services are contributions to these benefits.

v. For each final ecosystem service there must be an associated (and distinct) benefit and a corresponding beneficiary. This is particularly important to reinforce when considering the description of services and benefits and when considering valuation.

Other issues
d. Determining the treatment of specific flows can be difficult. Six examples come through in the discussion that has been held – crops, carbon sequestration, biodiversity, cultural services, open space and abiotic services. The treatment in each case might be determined in response to two questions:
i. What is the nature of the contribution of the ecosystem – i.e. what did the ecosystem do to produce the services that is reflected in the transaction between the ecosystem asset and the recipient?

ii. To what extent is the ecosystem service already captured in the existing production recorded in the SNA?
e. The second question is important if the objective is integration with the national accounts. Since ecosystem accounting implies an expansion of the production boundary, then treating something that is already included in the production boundary (e.g. crops) as ecosystem services could be considered double counting. If no integration is anticipated then this question is less relevant.

f. There is some consideration of the extent of human inputs as being a criteria to consider. I think this is a red herring – the issue is whether things like cultivated biological resources are already in the scope of the CPC and the production boundary of the SNA. To the extent that they are, then the scope of ecosystem services needs to exclude these products.

g. There has been some discussion on ecological production functions and I think an issue here is that the accountants (me at least) have used the term too loosely. The intent for me was to suggest that the ecosystem accounting framework provides a means by which a more complete set of inputs to the production of outputs can be recorded. Thus for example, pollination by wild pollinators can be recorded as an input to the production of crops, in addition to fertilizer, fuel, etc.

h. A key objective of a classification of ecosystem services should be establishing a more common language around types of ecosystem services. I suspect there is a considerable variability in what is meant/interpreted when someone says they are measuring water regulation services, for example.

i. A transaction in ecosystem services need not imply physical flows between supplier (ecosystem asset) and the recipient (beneficiary). The classification of ecosystem services should therefore focus on describing what is being transacted rather than trying to make connections to physical movement or lack thereof.

j. I can't see a reason why a classification of ecosystem services that is used for accounting would not equally be used for mapping, valuation, cost benefit analysis and testing of scenarios. I'd note that I think the same classification would apply irrespective of the variables or measures being considered. Perhaps the issue here is more around scope of the classification.

k. I have no particular preferences concerning the structure of the classifications I would just like there to be distinct classifications for different concepts. We should recognize that to a far greater extent than in economic statistics there will be secondary and other production from individual ecosystem assets. Consequently, imagining there would be a nice diagonal through a supply table is not realistic. Indeed, a number of ecosystem services will be produced through more than one ecosystem type working together.

l. Provisioning, regulating and cultural services is quite useful for conveying the scope of final ecosystem services. My concern is not these high level classes but that what is placed under these categories can vary considerably. Indeed, I suspect that many cultural services are in fact benefits. Of course, since these broad categories emerged from the MA in which ecosystem services equalled benefits this wasn't a problem.

m. In the notes for Session 5, point g asks about double counting. It would be useful to be clear what is meant by double counting. Is it the distinction between final and intermediate, is it the difference between ecosystem services and benefits, or something else. In concept, there is no reason for double counting to emerge as an issue for accounting purposes providing the measurement boundaries and definitions are clearly established.

n. I would like to suggest that it would be beneficial to include sink services explicitly in the discussion. This would include the service that the atmosphere provides as the recipient of GHG emissions for example.