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***Discussion paper 3.1: Proposed concepts, definitions and
terminology for ecosystem services for the revised SEEA EEA***

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Disclaimer:

This paper has been prepared as part of the work on the SEEA EEA Revision coordinated by the United Nations Statistics Division. The views expressed in this paper do not necessarily represent the views of the United Nations.

Research area #3: Ecosystem services

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Background

The SEEA EEA revision process

In March 2013, the United Nations Statistical Commission endorsed the System of Environmental-Economic Accounting 2012 – Experimental Ecosystem Accounting (SEEA EEA) as an important step in the development of a statistical framework for ecosystem accounting for commencing testing and further development of this new field of statistics. The SEEA EEA offered an initial synthesis of the knowledge in ecosystem accounting and served as a platform for its development at national and sub-national levels. It also provided a common set of terms, concepts, classifications, and an integrated accounting structure for measuring ecosystem services and ecosystem condition in both physical and monetary terms. In December 2017, the SEEA EEA Technical Recommendations were released to provide an update of knowledge about ecosystem accounting and clarifying various aspects of the original SEEA EEA.

The SEEA EEA has now been recognized as the main statistical framework for ecosystem accounting in various other international and regional policy initiatives. These include, but are not limited to, the World Bank-led Wealth Accounting and the Valuation of Ecosystem Services (WAVES) partnership, the EU projects on Mapping and Assessment of Ecosystems and their Services (MAES) and Integrated Natural Capital Accounting (INCA), the UNDP Biodiversity Finance (BIOFIN) initiative, the Convention on Biodiversity Aichi Biodiversity Targets (in particular Aichi target 2), the UNCCD initiative on Land Degradation Neutrality and the UN Environment-led initiative on The Economics of Ecosystems and Biodiversity (TEEB).

Reflecting the rapid progress in the development and practice of ecosystem accounting since 2013, in March 2017 the United Nations Statistical Commission endorsed a revision process of the SEEA EEA with substantive work commencing in early 2018. The objectives of the revision process are to move towards a consensus on concepts and methods on ecosystem accounting building on the testing and experimentation that has been going on since the release of the SEEA EEA, as well as learning from the experience of various initiatives working on related projects and topics, including, for example, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and natural capital assessment projects, and taking advantage of the availability of new technologies and data sources.

Under the auspices of the UN Committee of Experts on Environmental-Economic Accounting (UNCEE), the United Nations Statistics Division (UNSD) supports the methodological development of the SEEA EEA and implementation of ecosystem accounting in countries through its regular work program and externally-funded projects including the recently-finished Norwegian-funded Advancing Natural Capital Accounting (ANCA) project and more recently the European Union-funded Natural Capital Accounting and the Valuation of Ecosystem Services (NCAVES) project. The latter project aims to assist five partner countries (Brazil, China, India, Mexico, South Africa) to establish an institutional mechanism in countries, compile selected ecosystem accounts based on countries priorities to measure ecosystem extent, condition and ecosystem services in physical and monetary terms. The project supports also global activities including this Forum, regional workshops and fosters sharing of experience among countries. There are currently around 40 countries undertaking piloting of ecosystem accounting at various scales.

Overview of the SEEA EEA revision process concerning ecosystem services

Technical work in the SEEA EEA revision process has been focused around four main research areas: (i) spatial areas; (ii) ecosystem condition; (iii) ecosystem services and (iv) valuation and accounting treatments. The work on ecosystem services builds on a series of pieces of research and discussion following on from the release of the first SEEA 2012 EEA (UN et al 2014). This work has included:

- a range of testing in the measurement and valuation of ecosystem services following accounting principles in a range of countries,
- research undertaken through the UNSD led ANCA project,
- discussions on the classification of ecosystem services for ecosystem accounting based on comparison of the Common International Classification of Ecosystem Services (CICES) and the National Ecosystem Services Classification System (NESCS) (encompassing also work on the classification of Final Ecosystem Goods and Services (FEGS)),
- the drafting of technical recommendations on SEEA EEA compilation (released in December 2017).

All of this work has collectively progressed the understanding of the ecosystem services measurement requirements for accounting purposes. At the same time, at the start of the SEEA EEA revision process, there remained a number of aspects in the measurement of ecosystem services that required far greater alignment and consistency among practitioners to support statistical and accounting work. The relevant issues and topics are summarised in the list of SEEA EEA revision issues.¹

Initial work on ecosystem services in the context of the SEEA EEA revision process involved two main streams. First, there was work by a small working group led by Lars Hein (University of Wageningen) on a range of conceptual aspects in accounting for ecosystem services summarised in a paper presented to the June 2018 Forum of Experts.² Second, starting in September 2018, there was a focus on assessing definitions and measurement approaches for 10 selected ecosystem services led by Rocky Harris (UK DEFRA). This work was undertaken by around 35 experts in the measurement and valuation of ecosystem services and culminated in a workshop held in January 2019³ and an associated set of research papers.

In the lead up to the June 2019 Forum of Experts⁴, two further papers were drafted summarising the state of play and discussing a number of cross-cutting issues that had emerged from the earlier work. In June 2019, at the Forum of Experts and the Technical Expert Meeting that followed, discussion focused on selected key issues including the treatment of cultivated biomass and the treatment of mediated and unmediated flows. The key outcome from the discussions in June 2019 was that two discussion papers would be drafted on the relevant issues such that a wider engagement could be started that could give appropriate direction to the SEEA EEA revision process.

While there are a range of issues and treatments that require decision in the context of finalising the revised SEEA EEA, it is also clear that there is no disagreement on the general model being applied to incorporate ecosystem services into the wider ecosystem accounting model. Consequently, the core accounting principles for ecosystem services as outlined in the SEEA 2012 EEA and the SEEA EEA Technical Recommendations are not expected to change.

Thus, the focus remains on recording in the accounts the flows of final ecosystem services from ecosystems to people (including businesses) where these flows are considered as contributions to the benefits that people enjoy. The challenges lie in:

- applying this model consistently across all ecosystem services,
- finding alignment in the use of terms (such as services and benefits) and
- appropriately delineating the measurement scope and boundaries.

¹ <https://seea.un.org/content/seea-experimental-ecosystem-accounting-revision>

² <https://seea.un.org/events/forum-experts-seea-experimental-ecosystem-accounting>

³ <https://seea.un.org/events/expert-meeting-advancing-measurement-ecosystem-services-ecosystem-accounting>

⁴ <https://seea.un.org/events/2019-forum-experts-seea-experimental-ecosystem-accounting>

Summary of ecosystem services discussion papers

As noted, two discussion papers on ecosystem services are being prepared for expert review as part of the revision process of the SEEA EEA. Both papers summarise and reflect the existing state of discussions on the treatment of ecosystem services in the context of the SEEA EEA, building on much past conceptual work, ongoing measurement activities and recent discussions as described above.

This first paper - Discussion paper 3.1 (DP3.1) – has a focus on issues of concepts, definitions and terms. The second paper, Discussion paper 3.2 (DP3.2), has a focus on providing an initial list of services to support ecosystem accounting and summarising the treatment of selected ecosystem services and related flows for accounting purposes.

Many of the issues discussed in the two papers have been raised in other fora. The intent here is not to provide a literature review but to summarise the state of discussion within the SEEA EEA process and, with that in mind, provide an accounting perspective on the issues. It is hoped that the material provides a sufficient basis for experts in ecosystem services measurement to provide feedback, highlight concerns and offer alternative solutions that can be considered in working towards an agreed set of definitions, terms and treatments for the revised SEEA EEA.

While many of the issues that have been discussed concerning ecosystem services can be considered directly by experts in ecosystem services measurement, there are some specific issues in which a clear connection must be drawn to other research areas of the SEEA EEA revision. These issues concern:

- i. the valuation of ecosystem services which is being considered in depth in research area #4
- ii. the description and measurement of ecosystem capacity which is also being considered by research area #2 (in the context of ecosystem condition) and research area #4 (in the context of ecosystem degradation)
- iii. accounting for negative externalities and disservices which are also a consideration for research area #4 given the connection between valuation and environmental economics.

Given the cross-cutting nature of these issues it is considered appropriate that they are advanced as distinct issues and experts on ecosystem services will be encouraged to be involved in the relevant work. Consequently, these issues are not considered in DP3.1 or DP3.2.

In addition, there has been some investigation into methodological issues such as concerning the appropriate reference level or baseline to be used for the quantification of ecosystem service flows for SEEA EEA purposes and also issues of aggregation and spatial attribution of ecosystem service flows. These topics are not discussed here but material on these topics will be distributed for feedback later in the SEEA EEA revision process.

Further work is also planned on providing more detailed descriptions of ecosystem services within the framings provided in these discussion papers and on describing the connections to existing work on ecosystem services classifications and typologies, especially CICES, NESCS and IPBES.

In drafting these two discussion papers on ecosystem services, is expected that:

- preferred definitions, treatments and measurement boundaries will emerge
- missing issues and concerns will be identified that can be the focus of further discussion and research
- it will be possible to draft relevant chapters of the revised SEEA EEA based on the feedback from ecosystem services experts.

Feedback on the papers and the associated questions should be sent to seea@un.org no later than Wednesday 31 March, 2020.

Discussion paper 3.1: Proposed concepts, definitions and terminology for ecosystem services for the revised SEEA EEA

1. General model for ecosystem services

Introduction

The key concepts of the ecosystem accounting framework related to ecosystem services concern:

- The supply of **ecosystem services** by ecosystem assets to users
- The contribution of ecosystem services to **benefits**
- The contribution of benefits to **individual and societal well-being**.

This core accounting framework has remained unchanged since the drafting of the SEEA EEA in 2012. Importantly, it reflects the general framing of the well-recognised cascade model (Haines-Young and Potschin (2012) and the framing provided by Boyd and Banzhaf (2007). Central to these framings is that ecosystem services are “contributions to benefits” rather than “equivalent to benefits” following the Millennium Ecosystem Assessment (MA, 2005). The treatment of ecosystem services as contributions can also be seen in work on classifications (CICES and NESCS), in the framework developed for the IPBES (Diaz et al, 2015) and in much of the ecosystem services literature. For the SEEA EEA, the focus on contributions also directly suits the accounting approach of the SEEA and the application of input-output and supply-use principles.

The challenge for ecosystem accounting lies in establishing, for accounting and statistical purposes, consistent descriptions and boundaries for all ecosystem services that, in turn, can support consistent choices in measurement and valuation. Most challenging in this task is defining the boundary between ecosystem services and benefits. This is problematic since, for the most part, the recognition of ecosystem services and their importance starts from the perspective of how the environment is being used by, or is useful to, people (including businesses). That is, the starting point for description, and especially for monetary valuation, is commonly the use or demand side.

Logic chains

To work through the issues in a consistent way, a tool referred to as a “logic chain” has been applied. The intent is to provide a standard framing for recording information relevant to the description and measurement of individual ecosystem services. A logic chain reflects a sequence in which an ecosystem asset supplies an ecosystem service to an economic unit who uses that ecosystem service as an input to a production or consumption activity which subsequently leads to a benefit (an SNA benefit for production activities or a non-SNA benefit for consumption activities). Logic chains can be shown graphically but may also be shown in a table as shown below.

Table 1: Generic logic chain

Ecosystem asset	Enabling factors and human inputs	Ecosystem service	Benefit
Forest	Atmospheric pollution Local population	Air filtration – reduction in tonnes of air pollutants	Reduced concentration of air-borne pollutants leading to reduced pollutant exposure

As shown in Table 1, each logic chain for a given ecosystem service has four key components:

- *Ecosystem assets*: All ecosystem services are treated as being supplied by ecosystem assets and hence it is relevant to describe the source of the ecosystem service. Importantly, the description should be of an ecosystem type, e.g. a forest, or combination of ecosystem types, as distinct from an individual component or resource within an ecosystem, e.g. timber/tree. Where relevant for descriptive and measurement purposes, it may be useful to highlight particular ecological characteristics of the ecosystem assets that are relevant to the supply of ecosystem services, for example the presence of particular species or ecosystem condition.
- *Enabling factors and human inputs*: In most cases, but particularly for regulating services, there are certain conditions, referred to as enabling factors, that are present which invoke the recognition of an ecosystem service. For many provisioning and cultural services the supply of benefits can be considered to reflect a joint production process involving contribution from the ecosystem but also from human inputs such as labour and produced assets. As appropriate, and to ensure a common understanding of the ecosystem service context, logic chains should include a listing of relevant enabling factors and human inputs.
- *Ecosystem service*: In the SEEA, ecosystem services are considered contributions to benefits, i.e. the ecosystem service reflects the role of the ecosystem in providing a benefit to people. In some cases, the contribution is straightforward to conceptualise, describe and measure. In other cases, it is more complex. DP3.2 focuses on issues concerning the description and measurement of ecosystem services and related flows.
- *Benefits*: Benefits are usually relatively straightforward to describe if they are known goods and services within the production boundary of the SNA (SNA benefits) such as food and fibre. Benefits are harder to describe for regulating and many cultural services, i.e. non-SNA benefits. The description of the benefit should provide a basis for understanding the importance placed on the ecosystem service

Building on this framing, work in late 2018 and early 2019 on logic chains for 10 individual ecosystem services highlighted notable differences in the application of the generic model for different services. A summary and analysis of these differences from drafted by Lars Hein ahead of the June 2019 Forum of Experts and Rocky Harris provided a summary of cross-cutting issues for that meeting ⁵.

To ensure the consistent application of logic chains for all ecosystem services, it has proved necessary to resolve a range of issues surrounding these concepts, including the choice of terms. In this section, summarises the key aspects of these issues based on feedback on draft discussion papers by selected experts. Where general agreement is evident, this is noted and proposals are made. Where outstanding issues remain, questions are posed.

The application of supply and use principles of recording

A general issue that emerges in considering appropriate treatments about ecosystem services and benefits is reaching a common understanding of recording the supply and use of ecosystem services following standard national accounting principles. A full supply and use recording can be a very useful tool for explaining appropriate treatments, especially for resolving concerns about double counting.

⁵ https://seea.un.org/sites/seea.un.org/files/towards_defining_ecosystem_services_for_seea_eea.pdf
https://seea.un.org/sites/seea.un.org/files/seea_eea_x-cutting_issues_summary_paper.pdf

The following points are noted as key features of the principles as applied in ecosystem accounting:

- Supply is attributed to an ecosystem asset. In cases where the service is jointly supplied by a combination of ecosystem assets, then it is assumed that the supply can be allocated/apportioned to individual assets if required using appropriate methods.
- Use of ecosystem services is attributed to an economic unit (business, government, household).
- For any single transaction in an ecosystem service (i.e. where there is a supply-use pair) the magnitude of the flow will be the same for supply and use in terms of either quantity and monetary value.
- Where the flow of ecosystem services is an input to the production of an SNA benefit (i.e. to a good or service currently recorded in the SNA production boundary), there should be a supply and use pair recorded for the ecosystem service and a supply and use pair recorded for the associated good or service. For example, the supply of biomass provision from a farmland may be recorded as a use by the farmer of that ecosystem service; and then there is a supply-use pair of the good, e.g. supply of wheat by a farmer and use by a baker. This recording allows the supply and use of ecosystem services to be seamlessly connected to entries for the supply and use of goods and services currently recorded in standard economic SU tables.
- The relevant entries for this stylized example are shown below in Table 2 alongside entries concerning air filtration.

Table 2: Basic Ecosystem services supply and use account

	Economic unit (selected)			Ecosystem asset (selected types)		
	Farmer	Government	Households	Forest	Farm land	River
SUPPLY						
ES #1: Biomass provision for wheat					100	
ES #2: Air filtration				50		
USE						
ES #1: Biomass provision for wheat	100					
ES #2: Air filtration			50			

The basic framing of supply and use entries is expanded on below in the context of explaining a number of conceptual aspects. Note there are some choices in the entries presented in Table 2 that are the subject of further discussion in section 2.

2. Issues for clarification

Final and intermediate services

The SEEA 2012 EEA defined ecosystem services as

“Ecosystem services are the contributions of ecosystems to benefits used in economic and other human activity” (SEEA 2012 EEA, 2.23)

It is intended to retain this definition in the revised SEEA EEA. This section highlights the need for supporting text to clarify the distinction between final and intermediate services.

Implicit in the SEEA 2012 EEA definition is that all ecosystem services are final ecosystem services. Indeed, SEEA 2012 EEA explicitly excluded flows between ecosystems that it notes “are commonly referred to as supporting services”. Discussion and investigation since 2012 suggest that, from an accounting perspective, recognizing flows of ecosystem services between ecosystem assets will be an important component of the accounting framework, at least from a conceptual perspective. The potential to recognize and record these flows in ecosystem accounting was therefore described in the SEEA EEA Technical Recommendations (section 5.3.3). Examples of ecosystem services that come within this scope include pollination services as inputs for growing crops nursery services as inputs to supporting fish biomass provision and water purification services that underpin recreation activity in rivers and lakes.

Given the discussion in the Technical Recommendations and recognizing also that not all flows between all ecosystem assets should become a focus of ecosystem accounting, it is proposed that the scope of ecosystem services be extended beyond final ecosystem services to include flows of ecosystem services which are part of an observable and material chain of flows to a final ecosystem service and associated benefits.

This proposed scoping allows the contribution of individual ecosystem assets to be recorded in the accounting system in a more complete way. Thus, where a final ecosystem service supplied from a single ecosystem asset is dependent on ecological interactions in other locations, it allows such dependencies to be recorded. This will include situations in which the interactions are between different ecosystem assets and situations in which the interactions are within ecosystem assets. Allowing for both flows between and within ecosystem assets supports consideration of a wider range of dependencies and also removes the effect of measurement scale on the scope of measurement. If only between ecosystem asset flows are included the coverage would vary depending on the size of the ecosystem assets that are delineated.

This scoping supports the development of ecological production functions that describe the linkages among ecosystems in the supply of ecosystem services. More generally, the approach serves to reinforce the key role of ecosystem processes from which ecosystem services emerge.

It is not proposed that all such interactions must be recorded. There are far too many potential ecological interactions for this to be considered for the revised SEEA EEA.

From an accounting perspective, this proposal does not increase the contribution of ecosystems as a whole, since flows between ecosystem assets will net out with respect to final ecosystem services. In effect total output of ecosystem services will increase but be offset by an increase in use of ecosystem services by ecosystem assets.

With respect to terminology, various terms have been used to refer to these flows of ecosystem services between and within ecosystem assets. The SEEA 2012 EEA applied the term *supporting services* (as per MA, 2005) but the SEEA EEA Technical Recommendations applied the term *intermediate services* since, in accounting terms, these flows are analogous to the intermediate consumption of products between businesses recorded in standard input-output tables. The term intermediate services has gained much negative attention although, as observed by Haines-Young & Potschin (2018) this reflects a wide variation in the underlying concept being associated with the term. Indeed, they accepted that the application of the term “intermediate” for accounting purposes was likely appropriate. Other possible terms include *indirect* and *non-final*. There is also a view that while these flows are important/relevant to recognize, it would be sufficient to refer to them as, for example, *ecological interactions* and hence distinguish them clearly from final ecosystem services.

On balance, it is proposed to apply the term *intermediate services* in the revised SEEA EEA to be clear on their role in the ecosystem accounting framework from an accounting perspective. To this end, the following description is proposed:

“intermediate services are ecological interactions between and within ecosystem assets that have a consequence for the flow of final ecosystem services”

Where there is a sequence of intermediate services and final ecosystem services (e.g. pollination and biomass provision), recording the supply and use of each service ensures that the appropriate net effect must flow through. In this example, the supply and use of pollination services from one ecosystem asset (e.g. forest) to another (e.g. farmland) should be recorded as well as the supply and use of biomass provision (in this case melons) from the farmland to the farmer. From the perspective of the farmland ecosystem asset there will be use of pollination (as an input to its supply) and supply of biomass provision. The relevant entries, building on Table 2 above, are shown below.

Table 3: Basic Ecosystem services supply and use account including intermediate services (physical units)

	Economic unit (selected)			Ecosystem asset (selected types)		
	Farmer	Government	Households	Forest	Farm land	River
SUPPLY						
ES #1: Biomass provision for melons (tonnes)					80	
ES #2: Air filtration (tonnes pollutants)				5		
IS: Pollination (pollinator visits)				2000		
USE						
ES #1: Biomass provision for melons (tonnes)	80					
ES #2: Air filtration (tonnes pollutants)			5			
IS: Pollination (pollinator visits)					2000	

Questions:

Do you agree with the principle of extending the ecosystem accounting framework to explicitly allow for the recording of flows of ecosystem services between and within ecosystem assets?

Do you have any comments on the proposed approach?

The measurement of well-being

The definition and measurement of the absolute level of well-being itself is outside the scope of the ecosystem accounting framework, as it is for the national accounts. At the same time, it may be possible, under various assumptions, to make inferences about changes in well-being using information about changes in flows of services and benefits. For example, using information from the accounts it may be reasonable to infer that a rise in water purification services will have a positive effect on well-being without making a statement on the magnitude of the effect (noting as well the need, in practice, to take into account how changes in ecosystem management affect multiple ecosystem services which will have varying connections to well-being). Thus, it would be expected that information about services and benefits (and other information for example on ecosystem condition) can support discussions about well-being.

A related discussion concerns the national accounts distinction between outputs and outcomes. In that discussion, it is generally agreed that the focus of measurement should be on outputs produced

by economic units (e.g. medical care) rather than on outcomes which reflect a particular state or condition to which people attach utility or value (e.g. health). It will generally be the case that the measurement of outcomes will reflect the measurement of well-being.

It is therefore proposed that in the ecosystem accounting, the focus be on measuring outputs, referred to as benefits, which in turn contribute to outcomes reflecting well-being. While this general principle may be adopted, in application there are additional issues to be considered concerning the measurement of cultural services (discussed in DP3.2) and the recording of benefits in the accounts as discussed immediately below.

Question:

Do you support this framing of the link to wellbeing and the proposed measurement focus for ecosystem accounting?

Accounting for benefits and recording the use of ecosystem services

The SEEA EEA recognizes two types of benefits – SNA benefits and non-SNA benefits. The intent in making this distinction is to recognize that some ecosystem services contribute to (are inputs to) the production of goods and services that are already recorded within the standard SNA production boundary. These goods and services are referred to as SNA benefits. This includes goods and services (outputs) from agricultural, forestry and fisheries activities, commercial tourism operations and similar situations in which there is a direct connection between business activity and the environment (including household subsistence production and consumption).

One result of this treatment is that, in a supply and use table, a transaction in an ecosystem service (e.g. timber provision) is recorded between ecosystem asset (e.g. forest) and an economic unit (e.g. forestry company). This transaction complements the SNA recording of a transaction in timber products (e.g. logs) between two economic units (e.g. forestry company and a paper mill). In this context, the recording of the ecosystem service makes visible the contribution of the ecosystem to current economic production. The relevant entries are shown in Table 4.

Table 4: Accounting entries for SNA benefits

	Supply by:	Use by:
Ecosystem service: Timber provision	Ecosystem asset: Forest	Economic unit: Forestry company
SNA benefit: Logs	Economic unit: Forestry company	Economic unit: Paper mill

It is important to note that in a standard ecosystem service supply and use table, the entries for the transaction in the SNA benefit would not appear as these are considered to be already recorded in the standard (SNA) supply and use table. Thus, Table 4 is designed to show how the treatment of ecosystem services and SNA benefits can be meaningfully aligned if a full integration of SEEA and SNA accounts is undertaken.

Further, it is noted that in this example there is no doubt as to the user of the ecosystem service and the supplier of the SNA benefit – it is clear that it is the Forestry company.

The original intent in recognizing non-SNA benefits was to facilitate the consistent recording of those ecosystem services that do not contribute to current, SNA-based production of goods and services. These services are mainly regulating and cultural services.

In addition, recognizing non-SNA benefits facilitates a clearer discussion of the contribution of the ecosystem which in turn can support understanding approaches to measurement and valuation. By way of example, a distinction is made in the SEEA between the ecosystem service of air filtration and the related non-SNA benefit of reduced exposure to pollution. Indeed, understanding and describing the non-SNA benefits is essential since it is this benefit (and its link to well-being) that describes the demand for the ecosystem service. In doing so, the description of non-SNA benefits also provides the entry point for the valuation of these ecosystem services. The concept of non-SNA benefits is thus of direct relevance.

However, from an accounting perspective, discussion has identified that the appropriate treatment of non-SNA benefits must be aligned with the appropriate treatment of the use of ecosystem services and this topic has not been considered in depth.

The main reason this issue has not been discussed to date is that, for economic analysis purposes, it is sufficient to state that ecosystem services of air filtration supplied by a forest are an input to non-SNA benefits of reduced exposure to pollution received by households. Indeed, this would be a reasonable interpretation of the logic chain in Table 1. However, as shown in Table 4 – an aligned treatment of ecosystem services and benefits requires two transactions to be identified with a supplier and a user in both cases. That is, what is required in this simple example is a user of ecosystem services and a supplier of non-SNA-benefits. This “gap” is shown in Table 5.

Table 5: Accounting entries for non-SNA benefits

	Supply by:	Use by:
Ecosystem service: Air filtration	Ecosystem asset: Forest	Economic unit: ??
Non-SNA benefit: Reduced exposure to pollution	Economic unit: ??	Economic unit: Households

For the ecosystem services supply and use accounts, the critical choice concerns the user of the ecosystem service, i.e. the transaction shown in the first row of Table 5. Determining the appropriate unit to be the user in this transaction will be sufficient to complete the ecosystem service supply and use accounts.

Three options appear possible:

- (i) Treat by convention the economic unit using the ecosystem service and supplying the non-SNA benefit as the same as the unit that receives the non-SNA benefit; in this example households.
- (ii) Consider that a prime motivation for the accounts is to support ecosystem managers make trade-offs in the landscape and hence record the user of ecosystem services to be

the relevant ecosystem manager (assume in this case the forest manager). This economic unit would also be the supplier of the non-SNA benefit to households.

- (iii) Consider that, by convention, all non-SNA benefits are public goods and hence record the associated ecosystem services as being used collectively by general government. This treatment might be most appropriate in cases where the ecosystem services are non-rival, e.g. water regulation mitigating extreme events. The general government would then be shown as the supplier of the non-SNA benefit to households (or other beneficiaries).

In accounting terms all are possible. Option (i) aligns with a commonly applied idea of own-account production and consumption but, at the same time, appears overly complex. Option (ii) seems relevant in terms of decision support but may be seen as complicated and requiring additional information. Option (iii) seems appropriate for a range of contexts.

Each of these options provides a means by which to complete the recording required for the two transactions shown in Table 5. However, it is also clear that for the purposes of completing an ecosystem services supply and use account only the first transaction needs to be recorded. That is, it is important to consider whether the transaction in non-SNA benefits should be recorded at all.

From an accounting perspective, recording non-SNA benefits would require a further extension to the production boundary of the SNA beyond the addition of ecosystem services. This may not be considered appropriate and may open the door to the need to account for other means by which the non-SNA benefits could be produced (e.g. through additional investment or household consumption). Also, since the transaction in non-SNA benefits relates to a different output, it will require additional measurement and valuation work – i.e. in addition to the measurement and valuation of the ecosystem service. To some extent, this additional work will be required, at least for valuation, since the value of the ecosystem service is likely to be linked to quantification of the non-SNA benefits.

To date in the development of the SEEA EEA, it has not been expected that the transaction in non-SNA benefits would be recorded in a set of accounts. At the same, there is likely significant interest in the values of non-SNA benefits, especially where these benefits can be linked to health outcomes. Thus, if additional measurement and valuation work is undertaken to estimate the flows of non-SNA benefits, these flows could be analysed separately and it would be possible to design complementary tables showing the links between ecosystem services and non-SNA benefits. Indeed, such tables are likely essential in the compilation process in any event since collating data on the non-SNA benefits, including for example regarding the location and characteristics of using populations, will be important in measuring and valuing the ecosystem services.

Beyond discussion here on the selection of ecosystem service user, it will therefore be important to consider the accounting entries in the context of proposals for integrated accounting that are being considered in Working Group #5.

Question:

Which option, or combination of options, for the recording of the use of ecosystem services that contribute to non-SNA benefits is most appropriate in the revised SEEA EEA?

Beneficiaries and users

In addition to the definition of benefits there is a related discussion on the use of the term “beneficiaries”. The starting point for this discussion is that in the context of both SNA and non-SNA benefits there are economic units (including households and individuals) that receive the final

ecosystem service and subsequently receive an associated benefit. By choosing the word “benefits”, the SEEA EEA naturally introduces a connection to the word “beneficiary”. But, because of the way in which the transition from ecosystem services to benefits takes place, the distinction between “users of ecosystem services” and “beneficiaries of ecosystem services” becomes less clear.

To support discussion consider the following example concerning the production of wheat in which a farmer uses a combination of ecosystem services (e.g. biomass provision), produced capital (e.g. a tractor), labour, and intermediate goods and services (e.g. fertilizer, fuel) to produce wheat that is sold for subsequent use in the production of flour ultimately leading to bread consumed by households. Following the logic of SEEA EEA, the wheat is recorded to as a benefit supplied by the farmer and the farmer is considered a user of ecosystem service of biomass provision. The following entries are relevant (building on the discussion above).

Table 6: Entries for a supply chain

	Supply by:	Use by:
Ecosystem service: Biomass provision	Ecosystem asset: Farm land	Economic unit: Farm
SNA benefit: Wheat	Economic unit: Farm	Economic unit: Flour producer
(additional steps in the supply chain)		
Final good: Bread	Economic unit: Baker	Economic unit: Household

The language and descriptions of the SEEA 2012 EEA and the Technical Recommendations suggest that the economic unit of the farm is both the user of the ecosystem services and the beneficiary. An alternative formulation is that the term beneficiary should not apply to the use of ecosystem services but instead should refer to the economic unit that consumes (or uses) the benefit (in this case the flour producer using wheat and the subsequent goods). In this framing, the set of beneficiaries could then be extended to include other producers (e.g. bakers) and ultimately households as final consumers. A further complementary perspective, is that the set of beneficiaries might also be considered to include the supply chain of the farm, e.g. the people supplying labour in the production of wheat, the suppliers of intermediate goods and services, etc.

The situation is somewhat more complex with respect to non-SNA benefits as discussed in the previous section. Depending on the preferred treatment, the user of the ecosystem service and the receiver of the non-SNA benefit (the beneficiary) could be the same economic unit.

Given this background, it is proposed that a change in language is adopted in the revised SEEA EEA to specify that:

1. The term **user** relates to those economic units who directly receive the ecosystem service – i.e. they are at the other end of the transaction with the ecosystem asset.
2. The term **beneficiary** relates to those economic units who consume or receive benefits (both SNA and non-SNA benefits).

From an ecosystem accounting perspective, this proposal implies that the term user should be applied to a far greater extent in the explanation of the supply and use of ecosystem services.

Three other points are noted:

- In recognising that beneficiaries will potentially encompass a much broader set of economic units, it will be important for those using the term to clearly describe the set of beneficiaries being considered.
- In the description of both users and beneficiaries it will be relevant to consider their location, for example in terms of being at local, regional, national or global scale. This will extend to consideration of imports and exports of ecosystem services and associated benefits.
- The proposed application of the term beneficiary will likely align better with the conception of economic units applied in environmental economics with respect to assessing positive and negative externalities. In this regard it is noted that in environmental economics there is no pre-determined group of economic units that defines the set of beneficiaries and these will vary according to context. Thus, making a clear distinction between users and beneficiaries for ecosystem accounting purposes may be an important step forward in better understanding among experts.

Question:

Do you have any comments on the proposed application of the terms user and beneficiary for ecosystem accounting purposes?