



DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS  
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System of  
Environmental  
Economic  
Accounting

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## **SEEA EEA Revision**

# **Technical Meeting on Valuation and Accounting for the revised SEEA EEA**

**Progress and key questions for discussion**

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# Technical Meeting on Valuation and Accounting for the Revised SEEA EEA

## Progress and key questions for discussion

### 1. Background

The process to revise the SEEA EEA released in 2013 has been ongoing since early 2018. In mid 2018 a set of revision issues covering four research areas – spatial units, ecosystem condition, ecosystem services and valuation and accounting treatments – was finalised and a number of working groups were established to progress these revision issues. Working Group #5, chaired by Juha Siikamäki (IUCN) was formed in late 2018 to take forward issues on valuation and accounting treatments.

As for other working groups, the basic approach was to draft a series of discussion papers covering relevant topics, to send these for wider expert review and then to draft chapters for the revised SEEA EEA on the basis of the feedback. Through 2019 5 discussion papers were drafted progressively and all have been subject to a process of wider expert review. The following note summarises progress to date on a range of technical issues and describes the key questions requiring further clarification and discussion.

The document is intended to support discussion at a special meeting of experts on valuation and accounting to be held in New York on 16-17 March, 2020.

Next steps in the process are for chapters to be drafted that will be circulated for Global Consultation commencing at the end of April 2020. A range of questions will be posed at that time on topics for which the agreed solution is not yet determined or on which wider direction is required. Based on the feedback from the Global Consultation and further research and discussion, revised chapters will be circulated for a second round of Global Consultation commencing in October 2020 ahead of finalisation of the revised SEEA EEA in early 2021 for discussion at the March 2021 UN Statistical Commission.

### 2. Description of the ecosystem accounting framework

The logic of the core ecosystem accounting framework on which the work on valuation and accounting treatments is based has remained unchanged since the 2013 SEEA EEA. At the same time, across all of the key components there has been a substantial increase in clarity and consistency of language that is continuing to be refined through this revision process.

From the perspective of the work on valuation and accounting treatments the following are the key aspects to be understood:

- **Ecosystem accounting** involves accounting for stocks and flows associated with ecosystem assets
- **Ecosystem assets** (EA) are spatially delineated units classified by **ecosystem type** (e.g. forests, wetlands, agricultural areas). For accounting purposes, each unit can be considered an entity with associated stocks and flows.
- A set of ecosystem accounts will be compiled for a group of entities, usually covering a range of ecosystem types, with the boundary or scope of the accounts defined in biophysical terms by the **ecosystem accounting area (EAA)**

- Ecosystem accounting incorporates recording the **extent** (size) of ecosystem assets and the **condition** of ecosystem assets in a structured way to give a comprehensive assessment of the stock of ecosystem assets and how it is changing over time.
- Ecosystem assets supply **ecosystem services** which are the contributions of ecosystems to benefits used in economic and other human activity. Ecosystem services may contribute to production activity currently recorded within the SNA production boundary (**SNA benefits**) or contribute to activities and benefits outside the current SNA production boundary (**non-SNA benefits**).
- Recording ecosystem services implies
  - The SNA production boundary is extended by the supply of ecosystem services
  - All ecosystem services supplied must have a matching use – i.e. in accounting terms there is a **transaction** between the ecosystem asset and a user – e.g. household, business, government.
  - Transactions for different ecosystem services recorded in **supply and use accounts**
- Flows of ecosystem services are generally measured in physical/quantitative terms and then priced since there are no direct monetary payments to ecosystems – i.e. they are **non-market** transactions.
- The conceptual basis for the pricing of ecosystem services is **exchange values** and is aligned to the conceptual basis used in national and corporate accounting. (Further discussion of this below)
- Ecosystem assets are valued at a point in time (usually opening and closing of the accounting period providing balance sheet values) as the **present value** of the **future flow of ecosystem services**. (Further discussion on this below)
- **Change in ecosystem assets** reflected in **asset account** incorporating **ecosystem degradation, ecosystem enhancement, ecosystem conversions**, reappraisals, revaluations. (Further discussion on this below)
- The core ecosystem accounts (extent, condition, ecosystem services supply and use and ecosystem asset account) provides a comprehensive and coherent set of accounts for ecosystem assets. Because of the chosen measurement boundaries and conceptual principles, the information from these accounts can be integrated with the standard sequence of accounts from the SNA to provide extended production and income account, extended supply and use accounts, and extended asset accounts and balance sheets.

### 3. Area of focus for Working group #5

Based on this core ecosystem accounting framework, WG#5 has focused on issues concerning:

- the valuation of ecosystem services, primarily on the conceptual basis for valuation and the techniques for non-market valuation of environmental stocks and flows
- the valuation of ecosystem assets
- the definition and recording of ecosystem degradation and related changes in ecosystem assets
- the integration of ecosystem accounts data with the SNA, in particular considering treatment of the ownership of ecosystem assets.

- The connection between the data and framing of ecosystem accounting and other economically framed approaches to organising/using environmental data, including the treatment of externalities and the link to wealth accounting.

Progress has been made in all of these areas, including significant clarification of concepts and terms. A range of options for treatment have been identified in a number of cases and in general it is agreed that all of the material “pieces” have been identified to support the discussion required to reach agreed treatments and an agreed measurement scope.

#### 4. Progress on valuation of ecosystem services

The SEEA EEA 2013 described the significant challenge in the valuation of ecosystem services for accounting purposes in which while accounting seeks to record exchange values for transactions, the vast body of work on environmental valuation has focus on what are referred to here as welfare values. It has taken much ongoing discussion between accountants and environmental economists to peel back layers of misconception and misunderstanding. While there remain some points requiring additional clarification a general understanding of the differences and connections between the valuation concepts has been obtained.

In summary:

- **Exchange values** reflect an observed price and quantity for a specific product. They can apply to:
  - An individual transaction at a point in time
  - An aggregate of a set of transactions for a period of time
- Exchange values for accounting purposes are recorded in nominal or current terms – i.e. at the observed prices and quantities for the time point in question.
- The change in exchange values between two points in time can be decomposed into a price component and a volume (quantity) component<sup>1</sup>. When aggregating across multiple products/assets it is usual to apply index number theory to undertake this decomposition – e.g. applying Laspeyres, Paasche or Fisher indexes.
- Given assumptions underlying index number theory, volume indexes will approximate the change in welfare for the set of products/assets within scope of the index. Volume indexes may also be referred to as measures in constant prices and will be related to measures of real income (depending on the measurement scope and underlying assumptions).
- The **welfare value** for an individual transaction, or set of transactions, in a specific product for a given period of time is equal to the **total surplus** for that product – i.e. the producer surplus plus the consumer surplus.
- The estimation of the total surplus relies on (i) determination of a price reflecting the intersection of associated supply and demand curves and (ii) the shape of the supply and demand curves. Assuming upward sloping supply curves and downward sloping demand curves,

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<sup>1</sup> The term volume is used in national accounts to make clear that the measurement concept should capture both changes in quantity and changes in quality.

the total surplus will be the area between the two curves to the left of the intersection of the curves.

- Where a monetary transaction is observed, the price used to estimate total surplus will be the same as the price underlying the exchange value described above.
- The exchange value will be different from the total surplus because (i) consumer surplus is excluded and (ii) costs (the area under the supply curve to the left of the intersection of the curves) are included. The difference between exchange value and total surplus will therefore be dependent on the shape of the demand and supply curves.
- The change in welfare between two points in time will be equal to the change in total surplus between those points in time.
- For accounting purposes, where exchange values are not observed non-market valuation techniques are required to estimate prices that can underpin the derivation of exchange values and measures of total surplus. (See next section).
- The observed prices within exchange values are assumed to be marginal prices reflecting the willingness to pay, and to supply, an additional unit of the product.
- Where there are no market imperfections, this observed marginal price will equal the marginal social benefit (value) of the product and the observed total surplus will reflect the total social welfare value. In the presence of market imperfections a difference will arise between the observed marginal price and the marginal social benefit, reflected in a gap between the observed total surplus and estimated social welfare value.
- For accounting purposes, there is generally no focus on measuring the difference in level between exchange values and social welfare values, putting aside in this instant the important differences in scope that are agreed to exist between a more complete measure of social welfare and the production boundary of the SNA. However, assuming steady institutional arrangements and behaviours (i.e. the market imperfections remain the same) then a change in exchange values measured using a volume index will approximate a change in social welfare values.
- This description assumes that all price and quantity combinations are plausible and hence that the demand and supply curves can be defined at both  $p=0$  and  $q=0$ . This applies for marketed products but for many ecosystem services this will not apply (the “zero” problem). This implies that total surplus and social welfare values cannot, strictly be estimated or are meaningful. However the changes in these totals are relevant.

#### Questions for discussion:

- 4.1 Does this short overview and associated materials on the relationship between welfare and exchange values suggest that we have a common understanding of valuation concepts and terms?
- 4.2 What changes, refinements or additional points should be incorporated?
- 4.3 What are the implications of the zero problem for the measurement of exchange values?

## 5. Progress on framing of values

Another area of conceptual discussion has concerned the focus of valuation for ecosystem accounting. In broad terms, but subject to drafting the appropriate text, it is agreed that the data from across the suite of ecosystem accounts can support discussion of multiple/plural perspectives on value, i.e. beyond economic and monetary valuation. Thus, for example information on changes in ecosystem extent and condition can be used to inform a discussion on intrinsic values. The topic of framing values has been discussed in both working group #5 and in the working group on ecosystem condition and hence this general topic will be included in the introductory chapters to make clear the overall intent and potential of the SEEA EEA in this regard.

While supporting this broad discussion, it has also been established that the discussion of valuation in the SEEA EEA will primarily focus on economic values expressed in monetary terms. Within this scope, there has been a discussion on the role of the Total Economic Value (TEV) framework in supporting an understanding of the relevant economic values to be included in the SEEA EEA.

In broad terms the TEV distinguishes between use and non-use values. There seems little doubt that use values (involving both extraction and non-consumptive / unperceived / indirect use) can be readily seen within an ecosystem services framing proposed for ecosystem accounting – i.e. as transactions between ecosystems and people. There is however, less clarity on the extent to which, and if so how, TEV non-use values covering option, bequest and existence values, can be best reflected in an ecosystem accounting/transactional framing. In some cases links seem apparent among cultural services, and in other cases the values (particularly option and bequest values) may be considered to concern securing transactions in ecosystems in the future (or for future generations) which may then be translated into a time of recording type issue.

Discussion on the way in which these non-use values may be captured in an ecosystem accounting framing is underway in the working group on ecosystem services but the perspectives from working group #5 would also be welcome. In particular, it would be of interest to consider whether values relating to non-use will reflect only consumer surplus or whether there is also an exchange value component that could be estimated.

### Question for discussion:

- 5.1 What is the appropriate framing of non-use values in an accounting context and to what extent might exchange values be estimated?
- 5.2 which variant of the TEV do we use?

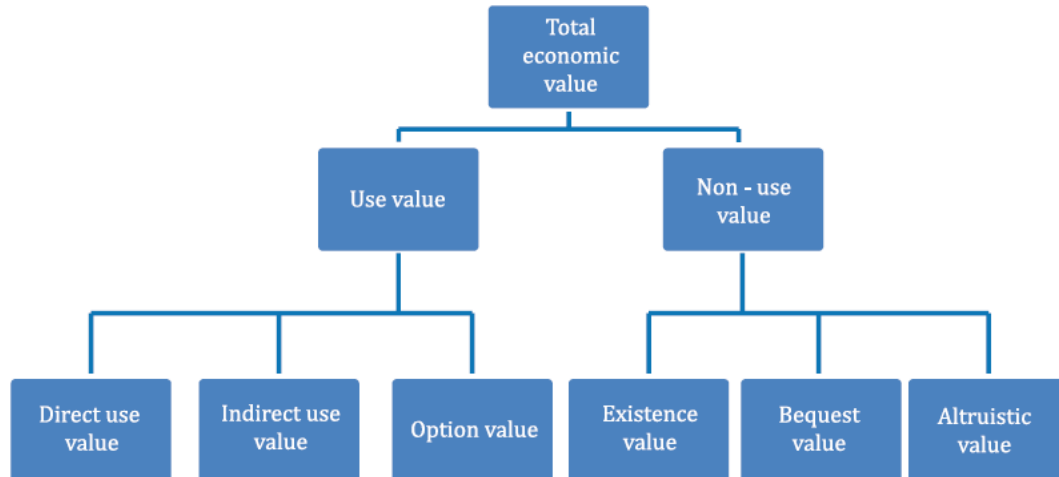


Figure 1 — Elements of the total economic value

ISO 14008

## 6. Progress on determining valuation techniques

The SNA concept of ‘exchange value’ refers to the price at which goods and services *are or could be exchanged*. While there is broad agreement of the need for consistency with SNA valuation principles there are various interpretations of what this implies:

- A. the majority view seems to be that application of SNA valuation principles gives flexibility to choose valuation methods, as long as they capture exchange values and hence exclude consumer surplus. The interpretation is that “could be exchanged” allows to impute transactions that have not actually taken place. The argument being, that this is also part of the regular practices of the SNA (well-known examples are imputations for owner occupied dwellings, FISIM, or kitchen gardens).
- B. some argue that consistency implies that since, for ES valuation, we are dealing with non-market production, exchange based valuation in principle should be ‘at cost’, similar to the way the SNA values non-market education and health output. This would imply essentially using the correct expenditures on say conservation, or park maintenance as an estimate for the value of services provided;
- C. some argue that we should explore the fact that SEEA as satellite account allows for flexibility to define a different type of production (in addition to market production, non-market production, and production for own consumption traditionally recognized), especially when it comes to valuing ecosystem services, which is arguable something very different from the usual bread and butter of the SNA. As most of the empirical work has been on welfare values, they argue that using total surplus would be a proper approach;
- D. some argue that the SNA is not prescriptive as to the institutional mechanism that it prescribes for valuing transactions (e.g. Brett Day: “any value function between 0 and the demand curve would suffice”), and hence assuming perfect price discrimination (which would make the consumer surplus go away) would not be inconsistent and may be a practical assumption to make, as it would by construction eliminate consumer surplus.

**Questions for discussion:**

6.1:

- A disadvantage of option A is that the resulting values will depend on the valuation technique that we apply (e.g. using an expected damage approach for valuing coastal protection of mangroves, will give a different value than a replacement cost technique).
- A disadvantage of B is that SEEA EEA would not allow to assess “return on investment” e.g, by conserving this forest (which costs X), you are able to obtain a bundle of ES (Worth B). But this would be similar to the case of health care where the search for proper independent output measures has been ongoing for many years.
- A disadvantage of C is that this is considered a “bridge too far” for most accountants and may limit integration with the standard economic accounts.
- A disadvantage of D is that this can be perceived as unrealistic. (although price discrimination e.g. charging foreigners more when visiting tourist attractions is common in many countries).
- Which of the above 4 argumentations should form the starting point for SEEA EEA?
- Should different framings be applied for different ES?

6.2 The following table provides an overview of the various valuation techniques and their suitability to estimate exchange and welfare values. While there is a range of techniques to estimate exchange values, it would be important to get further clarity on the table itself (e.g. the distinction between production and consumption), as well further discussion on some of the techniques:

- Cost of illness (e.g. DALY/QALYs)/ human capital; are these approaches consistent with exchange values or do they include some welfare values (see footnote 1)?
- Opportunity costs; is the use of opportunity cost (e.g. to value an acre of forest based on the opportunity cost of alternative land-use) consistent with SNA principles?:
- Travel cost method; the TCM includes also opportunity cost of traveling to and time spent on-site; is using the opportunity cost of time consistent with SNA principles?
- The Simulated Exchange Value (Caparos et al); should this be seen a separate approach ? can it be applied also beyond nature-based recreation?

Table 3.4. Summary of Valuation Methods and their Links to Exchange and Welfare Values.

Approach	Method	Exchange Values			Welfare Values
		Exchange Values Incorporated in GDP of SNA by Contribution to		Exchange Values not Incorporated in GDP of SNA	
		Production Activities	Consumption Activities		
Market Data Available	Productivity Change	√			
	Replacement Cost			√	
	Opportunity Cost			√	
	Defensive Expenditure	√	√		
	Cost of Illness			√	√
	Human Capital (1)			√	
	Shadow Project (2)	√			
	Residual Value	√			



Revealed Preference Methods	Travel Cost (3)		√		√
	Hedonic Price	√			
Stated Preference	Contingent Valuation				√
	Discrete Choice				√

Source: Adapted from Stats Netherlands, 2019)

*Ad 1: ) Human capital values are considered in the SEEA as exchange values but this is debatable.*

6.3 A different point for discussion is that some of these valuation techniques lie arguably more in the realm of modelling and require various assumptions, that would have implications for the whole economy (e.g. charging entrance fees to Central Park NY would not only change actual visitor numbers but also housing prices in New York etc.) Does this violate somehow SNA principles or are they just what it takes to get to a reasonable price estimate?

6.4 The need for bridge tables, showing the differences between exchange and welfare values has been emphasized by many commentators, and DP 5.1 has an example table. Should such a table be included in SEEA EEA (not as core table), if so, how should this table look?

A possibility could be to show not just 2 values (welfare and exchange) but several values that one would obtain based on institutional assumptions one makes. For instance, looking at supply and demand curves for a forest (for recreation), one could estimate:

-  $P*Q$ ; the maximum societal revenue under demand curve; the trapezium; the welfare value / perfect price value etc.

## 7. Progress on the valuation of ecosystem assets

The discussion on the valuation of ecosystem assets has built on the original framing provided in the SEEA EEA 2013 but has been extended to incorporate a range of economic research on valuing natural capital. The starting point for the discussion is that following standard national accounts principles, the exchange values for assets reflect the value at which they would have been transacted at a specific point in time – usually valued at a balance sheet date.

Where transactions in the relevant assets are not observed or observable, which is commonly the case for natural resources and ecosystem assets, then a standard valuation method is to use the present value of the future stream of benefits attributable to a given asset. In this framing, the price of an asset is the change in the present value of holding one additional unit of stock.

As applied to ecosystem assets, the asset value will therefore be dependent on:

- The scope of ecosystem services attributed to an asset, noting that generally an ecosystem asset will supply a basket of services
- The predicted flow of ecosystem services and their distribution over time
- The predicted prices for ecosystem services
- The discount rate applied

The choice of the scope of ecosystem services is critical as different asset values will be obtained for different scopes. There are also many patterns that may be assumed with respect to the future flow of benefits. For accounting purposes, the central approach is to use the pattern of flows that is most

expected/likely based on current and expected institutional arrangements (also referred to as the resource allocation mechanism or economic program and which encompass property rights). Ideally, estimation of the flows should take into consideration ecological and other impacts that affect the stock as a result of the expected pattern of use (e.g. expected patterns of degradation of the stock through extraction should be factored in).

This central approach will differ from patterns of future flows based on alternative institutional arrangements such as those that are considered sustainable in terms of maintaining the underlying physical stock of the asset or optimal in terms of maximising social welfare values. Using alternative institutional arrangements can be assumed to derive alternative asset values. In Glen Cove there was support to name these alternative arrangements, “unrealized values”.

When comparing between different asset values, the use of a different set of institutional arrangements should be seen as distinct matter from the use of a different scope of benefits. It should be possible for all of the different institutional arrangements to be applied for different scopes of benefits and comparison among different asset valuations should consider both aspects.

While this core framing is generally accepted, there are a number of issues of detail and of application that remain for clarification and decision.

#### **Questions for discussion:**

7.1 In accounting, the future flow of benefits and the associated prices will result in the value of the future stream of income reflecting exchange values. This future stream may be applied in nominal terms ( $p \times q$ ) or in volume terms (constant prices). The choice will impact on the selection of the discount rate. How does this logic play out in other contexts?

- Does the future stream of income under an optimal institutional arrangement reflect a time series of social welfare values - quantities multiplied by appropriate marginal social benefits?
- Will this future income stream necessarily be in volume/real terms?
- What is the relationship between the future stream of income and the selection of discount rate in these circumstances?

7.2 A common term that is applied in the context of valuing natural capital is shadow price. There seems a variety of ways in which that term can be interpreted which relate to comparison among the scope of the benefits included and the assumptions concerning institutional arrangements. Can we reach an agreement, for the purposes of discussion of ecosystem accounting, about what is intended when the term shadow prices is used?

7.3 Within the core ecosystem accounting framing it is intended that the entity to be accounted for/asset to be valued is an ecosystem reflecting an ecological unit which supplies ecosystem services but has no direct input costs. A common alternative framing is that the focus of valuation is a spatial area incorporating all activities and associated incomes and costs within that area. The second framing can lead to quite different valuation results if the costs to maintain the ecosystem assets (incurred by, for example, the ecosystem manager) are deducted to estimate the future stream of income of the asset. Is there agreement that the entity that is to be the focus of valuation for ecosystem accounting is the ecologically defined unit?

7.4 The treatment of capital gains is a common area of confusion. From an accounting perspective, capital gains are excluded from measures of production and income as recorded in the relevant flow accounts. However, for the purposes of valuing assets based on future flows, it seems plausible that expected capital gains should be considered. What is the appropriate treatment for accounting purposes and how does this align with the approaches in the economics literature?

7.5 Generally, present value approaches are applied to individual benefit or income streams which in effect suggests that a single ecosystem service can be given an asset value. However, in the ecosystem accounting framing, it is intended that an ecosystem asset would be regarded as supplying a basket of ecosystem services such that the value of the ecosystem asset would reflect multiple future income streams. A compromise approach might be to estimate the present value of each individual ecosystem service and then aggregate. However, it is accepted that in reality, for any given ecosystem asset, there will be strong connections among the supply of different ecosystem services – some competing and some complementary – thus the future patterns of flows for individual ecosystem services will be connected. Given this reality, what are the options and implications for measuring the overall value of an ecosystem asset (for example with respect to measurement of degradation)? What assumptions and approaches are appropriate for ecosystem accounting?

## 8. Progress in describing accounting treatments and entries, including degradation

As noted in description of the core ecosystem accounting framework, the design of accounts in the SEEA EEA supports compilation of

- i. a set of/system of accounts for ecosystem assets and flows of ecosystem services
- ii. a set of integrated accounts linking ecosystem assets and services to the standard SNA sequence of accounts

The potential to make this clear distinction reflects in part that the definition of ecosystem assets does not derive directly from the definition of economic assets in the SNA that is dependent on establishing ownership and a stream of benefits but instead derives from the definition of environmental assets from the SEEA Central Framework. In this definition, ecosystem assets are defined in the first instance by their biophysical characteristics and their potential to provide benefits, in the same way that the asset boundary for land in the SEEA Central Framework is defined.

The consequence of this is that determining the ownership of ecosystem assets is not a requirement for compiling a system of accounts for ecosystem assets. However, this is essential for developing a set of integrated accounts.

In relation to the system of accounts for ecosystem assets, aside from issues concerning the measurement of ecosystem asset values and ecosystem service values as discussed above, the significant challenge is to account for the changes in ecosystem assets, especially ecosystem degradation.

As for the standard asset accounts of the SEEA Central Framework, the intent for ecosystem accounts is to record changes between balance sheet values due to additions, reductions and revaluations. To support integration with the standard economic accounts, it is also intended that the various additions and reductions are separated into those that are attributable to human activity and those due to natural causes.

With this context, a range of definitional issues arise in relation to ecosystem degradation that are noted below under “Questions for discussion”. Some aspects have been generally agreed. Thus, it is accepted that ecosystem degradation has both physical and monetary aspects but the proposal to apply separate terms to each aspect (e.g. deterioration and degradation) has not been supported with a clear preference to retain one term – degradation – with appropriate descriptions of the physical and monetary aspects.

Further, it has been generally agreed that while there may be the potential to link the definition of ecosystem degradation directly with the concept of ecosystem capacity, this should not be pursued in the short term due to the range of perspectives that exist on the definition of ecosystem capacity. At the same time it is agreed that the concept of ecosystem capacity is an important one that should be discussed in the revised SEEA EEA and, as appropriate measures of ecosystem capacity should be able to inform a discussion of ecosystem degradation.

Generally speaking the same issues concerning the definition of ecosystem degradation apply to the measurement of ecosystem enhancement.

To compile integrated accounts, three related issues have emerged beyond those pertaining to stand-alone ecosystem accounts, namely: the determination of economic ownership for ecosystem assets; the way in which ecosystem assets are presented within an extended sequence of economic accounts; and approaches to the allocation of degradation to economic units. These three issues are described below under questions for discussion.

#### **Questions for discussion:**

8.1 In the SEEA EEA 2013 and subsequent materials, ecosystem degradation has been associated with a loss in condition due to human activity. The proposal to make the link to human activity is associated with the intent to establish a cost of capital that can be attributed to a relevant economic unit. For that purpose, the starting assumption is that only those costs that can be reasonably attributed to human activity should be deducted. Feedback has suggested both conceptual and practical concerns in making this distinction between human and naturally induced changes, especially as the boundary may be very blurred in some cases. What is the appropriate approach for ecosystem accounting? (NB: the total change in asset value will still be recorded in the asset account, this is a question of whether and how far to isolate the changes)

8.2 As noted above, degradation has both physical and monetary aspects. The physical aspects are linked to declines in condition and the monetary aspects are linked to declines in expected ecosystem service flows. Discussion has observed that it may not always be the case that declines in condition (considered a pre-requisite for recording degradation) will lead to declines in expected ecosystem service flows. What is the appropriate treatment and what factors should be considered when this issue arises?

8.3 Generally, the accounting treatments presume that an ecosystem asset remains largely in place over an accounting period, perhaps changing slightly in size. In cases where an ecosystem asset changes to another ecosystem type during an accounting period (e.g. from forest to agricultural land) how should this ecosystem conversion be recorded in the accounts? Should ecosystem conversion be recorded distinctly from other additions and reductions and if so, what considerations are appropriate?

8.4 The framing of ecosystem degradation describe here suggests that, in general, ecosystem degradation will reflect a change in present value of ecosystem services. This approach therefore requires estimation of ecosystem asset values in the first instance. Alternative approaches based

on restoration costs and damage costs have been proposed in the accounting literature. How should these cost based approaches be considered within the ecosystem accounting framework as described?

8.5 Determining the economic ownership of environmental assets following SNA principles is challenging when the assets and the benefits they supply are public goods and not subject to clear property rights. A range of considerations have been examined, including consideration of the treatment of other “public” assets such as natural resources, resources on the high seas, research and development, intellectual property type assets; as well as the treatment of leases and joint ventures. Given the range of possibilities, what considerations and treatments are most appropriate for ecosystem assets and their integration into economic accounts?

8.6 Three models (listed below) for an extended sequence of economic accounts have been proposed each with various pros and cons. The consultation on DP 5.3 gave most support for either Model A or C. Which model is preferred/most appropriate for integrated accounting?

- Stewardship model (A) – economic units as custodians, ecosystems a distinct sector
- SNA model (B) – ecosystem assets owned by economic owner of the land, no ecosystem sector
- Split model (C) – ecosystem assets partitioned according to use of ecosystem services, ecosystem sector included.

8.7 Following standard national accounting principles, degradation should be allocated/attribution to the economic unit whose future flow of ecosystem services is reduced. This is considered a costs borne approach. While this approach does align with national accounting tradition, the fact that a loss of ecosystem condition can arise through no fault of the economic unit losing the services, suggests that an alternative approach is to attribute degradation to the economic unit that causes the loss of condition. This is known as a polluter pays approach and is a common framing from a policy and user perspective. Both treatments are possible in the accounts using various accounting entries. Which approach is most appropriate for ecosystem accounting purposes?

## 9. Progress in linking to other related economic and accounting approaches

Beyond these relatively standard accounting entries, a range of other approaches to reflecting the relationship between the environment and the national accounts have been considered over the past decades. The main alternatives have been described in Discussion Paper 5.5 (with respect to externalities and disservices) and Discussion paper 5.4 (with respect to environmental liabilities, in particular the possibility of recording unpaid ecological costs (following Vanoli 1995)).

In addition, there are a range of proposals that fall under a general category of estimates of the value of assets under alternative institutional arrangements – these might be referred to as unrealised ecosystem asset values.

With respect to environmental expenditures there is general interest in determining how such payments, which are recorded in the standard national accounts, and for which there are standard treatments in the SEEA Central Framework, might be best linked to the SEEA EEA. For example, through spatial allocation/attribution of expenditures.

Still on expenditures, and as raised in earlier topics, there is a general interest in determining a treatment of so-called defensive expenditures – payments made to recover from/adapt to events that are considered to have a negative effect on welfare. There is a long history of proposals in this area and many relate to how national accounting aggregates might be adjusted to recognise that the payments may not increase societal welfare.

Finally, there are other approaches in the literature to integrating ecosystem services, these include

- Work of Campos and Capparos in Andalusia who apply Model B (above) but also adopt different definitions of income and treatment of capital gains to derive a number of sustainability indicators.
- Wealth accounting, including comprehensive and inclusive wealth approaches. These cover more than ecosystem assets but clarifying the links to their treatment of these and other environmental assets would be relevant
- Proposals for a Complementary Accounts Network from Turner et al.

#### **Questions for discussion:**

9.1 Among this range of other related approaches, can clear linkages be made to some from the SEEA EEA and if so, should complementary or bridge tables be considered? If so, are some approaches considered of higher priority for connection from a SEEA EEA perspective?

9.2 Are there other related approaches that should be considered?

## **10. Other topics to be considered**

The following topics have either been identified originally but not yet been discussed or have emerged more recently. Feedback would be welcome on these issues, particularly their relative priority in terms of finalising the research agenda on valuation. Any other issues that have not been covered should also be raised.

- Integration with measures of ecosystem capacity, resilience, biodiversity, environmental thresholds and safe operating spaces. How are these concepts best considered in an accounting context?
- Land valuations – links to ecosystem enhancements, SNA land improvements and valuation of abiotic flows (use of space)
- Links to valuation and recording of individual natural resources in the SNA and SEEA Central Framework
- Potential combined presentations and indicators