



DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS  
STATISTICS DIVISION  
UNITED NATIONS



System of  
Environmental  
Economic  
Accounting

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## System of Environmental-Economic Accounting— Ecosystem Accounting

### *Global Consultation on the complete document: Comments Form*

**Deadline for responses: 30 November 2020**

Send responses to: [seea@un.org](mailto:seea@un.org)

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The comments form has been designed to facilitate the analysis of comments. There are six guiding questions in the form, please respond to the questions in the indicated boxes below. To submit responses please save this document and send it as an attachment to: [seea@un.org](mailto:seea@un.org).

All documents can be found on our website at: <https://seea.un.org/content/global-consultation-complete-draft>

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## General comments

### Question 1: Do you have comments on the overall draft of the SEEA Ecosystem Accounting?

#### **1. Overall comments regarding valuation and the manual as an accounting standard:**

The chapters on valuation contain fundamental flaws that, at least in their current incarnation, do not meet the basic requirements of what would be expected of a statistical standard. The manual lays out an inconsistent, and at times contradictory, approach to valuation that violates the core objectives of an international accounting standard, as it leaves open an overly broad menu of valuation methods and invokes welfare-based value concepts (some of which are labeled as “complementary”) that would prevent these accounts from being comparable to other accounts national statistical offices produce.

One of the primary stated objectives of the accounts (or accounting more generally) is to facilitate useful and meaningful comparisons. Whether they are comparisons of ecosystem services accounts to other SEEA CF or SNA accounts, or international comparisons of the same accounts to their counterparts around the world, the comparisons hinge on commonly agreed upon valuation principles and methods. Chapter 9 opens the floodgates to numerous valuation approaches and the flexibility to produce accounts with whatever data is available. Chapter 12 further opens the door to welfare-based valuation in these accounts, albeit with certain qualifiers like “complementary approaches.” These chapters tacitly permit some countries to develop a set of accounts pursuing one valuation technique and other countries to develop a set of accounts using another technique that yield wildly different results (potentially for the same asset). Despite very different estimates for the same ecosystem service, both would be able to cite the SEEA EA as the impetus for their methods. This is antithetical to the idea of “standardization” and undercuts the purpose of a statistical manual.

The objective of the flexibility in the manual seems to be to allow more countries to produce these accounts more easily (§1.18), as it has been consistently stated in numerous forums by advocates for this manual that wider production of these accounts, however rudimentary or incomparable, will facilitate further development of these accounts in the coming years. Yet, our task here in evaluating and commenting on this manual is not to determine what version of the manual is the most strategic for the short-term and medium-term adoption and development of the accounts. Our broader task here, as we understand it, is to evaluate whether this manual’s principles are sound, implementable, and can produce accounts that satisfy the most basic, fundamental purposes of accounting standards: comparability and consistency. If the intent is to encourage countries to experiment and develop these accounts further by ‘casting a wide net’ on methods and offering a flexible set of approaches, then ‘experimental’ or ‘provisional’ seems entirely appropriate for this version of the manual and perhaps flexibility has some merit.

We recognize there are different valuation techniques for the same asset set forth in the SNA, for example, but in practice they are at least intended to measure a similar underlying construct or should arrive at a comparable estimate within reasonably well-defined parameters. In the proposed SEEA EEA manual this is not the case. For instance,

Ch. 9 states: “where directly observed prices are considered not economically significant, (such cases may arise in the context of fees paid to enter a national park, for example), the observed price should not be used and alternative valuation methods should be applied” (§9.26). The chapter proceeds to outline numerous alternative valuation methods that would produce greatly different estimates, as the chapter leaves little guidance regarding which methods are preferred. Nor is there guidance of disclosing the quality of the method chosen, which would likely result in a foreseeable disaster of countries producing seemingly arbitrary, incomparable estimates for ecosystem services accounts.

This issue is not unique to ecosystem accounting, and other international accounting standards have taken steps to mitigate this type of problem by issuing specific guidance on a hierarchy of valuation methods along with a clear disclosure mechanism to provide users of the data transparency regarding the quality of the method being used. Specifically, many aspects of accounting for business activity in the private sector involve estimates of fair value for assets that do not always have active markets (or quoted market prices) and similarly have complex challenges in valuing idiosyncratic assets. To be able to provide more comparable and useful information to the market on fair values in these circumstances, in 2006, the Financial Accounting Standards Board (FASB) and the International Accounting Standards Board (IASB) published a memorandum for a joint effort to create a common set of high quality global accounting standards. As a result of this work, FASB had created multiple updates to its fair value accounting (ASC 820), just as the IASB has developed with its IFRS 13 framework. With ASC 820, FASB outlined a “fair value hierarchy” of fair value inputs to be used where Level 1 (those with quoted prices in active markets for identical assets) are given highest priority down to Level 3 where unobservable inputs are used with the least priority. In addition to putting forward the hierarchy for this approach, these accounting frameworks also require disclosure about the level of inputs used with reported fair value accounting and the sensitivity of fair value measurements categorized with Level 3 inputs. For additional information regarding these business accounting standards and how they approach standardization of difficult valuation methods, see (section 4.5): <https://www.pwc.com/us/en/cfodirect/assets/pdf/accounting-guides/fair-value-measurements-global-guide.pdf>

While there are too many differences between national accounting and firm-level accounting to count, the core idea that is shared among them is that the accounts are rendered essentially meaningless to users if there is not sufficient comparability and consistency across accounts. And, when intangible capital, for example, is very challenging to value for a firm, international accounting standards require firms to provide adequate transparency about what method they are using for valuation and where it lies in the hierarchy set forth by the standard. There is not analogous guidance in this manual for national statistical offices, despite the need for one being stated in earlier comments. Nor is this something that can be easily remedied at this point, as it is unclear how a meaningful hierarchy could be developed for SEEA EEA without sufficient experimentation and the prerequisite experience of a broad set of countries implementing full sets of these accounts. Unfortunately, this is simply not the case at this point in time.

Further, Chapter 12 and its annex have a seemingly tacit endorsement of consumer surplus and welfare valuation methods, although it is framed as providing a “bridge” or a “complementary” application. There is nothing to prevent one NSO from publishing a welfare-based value of ecosystem assets, claiming they are following SEEA EA, while another NSO publishes an SNA-based value, also claiming they are following the SEEA EA manual. In this case, the two NSOs could even be using a similar valuation method, but they are measuring different things, yielding drastically different values for potentially the same asset type. This is not characteristic of an accounting standard. Indeed, Chapter 8 states explicitly that one of the goals of national accounts is to create consistent comparisons (§8.2). By not limiting valuation to only SNA-based valuation exclusively (without consumer surplus and welfare valuation), it is difficult to imagine that consistent comparisons across countries can be made under the guidelines set out by this manual. This is a fundamental violation of the goals of national economic accounts and would make these numbers not only incomparable across countries, but potentially incomparable within countries across types of economic accounts.

Given that valuation and monetary accounts are absolutely critical to this manual, particularly if its aspirations are for ecosystem services accounting to be part of a suite of national economic accounts, without such clear guidance and transparency, it is not clear that the SEEA EEA can transcend its experimental phase into becoming a standard at this point in time. There are portions of the valuation chapter that are consistent with the SNA and SEEA CF, on one hand, suggesting that we are merely extending the boundary without radically extending the valuation methods; but, throughout the valuation chapters, the methodological limits are stretched far beyond what would be recognized as a standard.

## **2. On the need for more detailed examples and practical guidance on implementation as a means to clarify the underlying principles:**

While some examples can be found throughout the manual, the SEEA EEA draft lacks sufficient guidance and detail to illustrate many of the principles and prescriptions it lays out. It is possible that much of the “general agreement” that the authors of this manual have received is mistaken, as one party views a vague principle as meaning they can do X, while another party views the same principle as meaning they can do Y. So, they both “agree” on the principle, but only because clearly constructed examples have not brought to the fore what precisely they may disagree about. Much of the manual is written this way, so as to invite consensus, waiving off the practical challenges of actually providing clear guidance on implementation. Many suggested revisions of prior chapter consultations highlighted where an example could call into question the principle or method, and the authors of the manual often elected to take out the controversial portion without actually using an example to clarify what the principle means in practice (e.g., deleting references to consumer surplus in the discussion of stated preference methods in Ch. 9 – specifically, deleting “A typical application of these methods yields values that include consumer surplus” – while keeping these methods in the most recent draft without explaining why these methods are still there and what it exactly it would measure if they are not used for their “typical application”). Hence, in some cases we are left with vague guidance that leaves a lot open for interpretation or overly flexible methodological options, thereby not really “standardizing” anything. Without well-defined concrete examples illustrating the underlying principles, it is difficult to determine whether there

actually is agreement about the principles or methods themselves. Thus, we do not agree that there is genuine broad agreement on the principles for this reason. The result of this will likely be ad hoc implementation by NSOs that follow the same “principles” but result in incomparable accounts, thereby failing to standardize these accounts. As a result, “experimental” or “provisional” are more fitting descriptors of this manual.

We should also note that, by comparison, the SEEA CF has better worked out examples that illustrate its principles along the lines we prescribe above. Indeed, not all of the SEEA CF examples are comprehensive or all-encompassing either, and there are instances of vague guidance in the SEEA CF, too. However, there is one notable difference with the SEEA EEA that requires a higher burden to carry by its examples. When they were being considered as a standard, both the SEEA CF and the SNA had been drawing on more extensive experience with these accounts in practice by numerous NSOs who were already producing full sets of accounts (not simply one account here or there). While there has been a lot of good academic work on ecosystem accounting, the experience with ES accounts among national statistical offices is far more limited. So, we think it is fair to ask to the manual, if it were to be considered a standard, to “show your work” particularly because this experience is more limited. The development of extensive guidance to accompany the manual, like the 100 plus page valuation guidance, does not compensate for this limitation of the manual—a manual should largely be self-contained. Or, the manual could continue to be “experimental” and allow countries to work out these (potential) examples in practice in the coming years, so that these examples will be better developed for the next revision to this manual (and thus be better positioned to be recognized as a standard on its merits).

### **3. On the consistency of the physical and monetary accounts:**

There is some discussion of linking and aligning monetary value to physical accounts, but it is often general and vague (e.g., §9.11 and 9.14). Indeed, paragraph 10.10 raises a related issue, as it states, “As required, and where data are available, asset accounts showing the same accounting entries can be compiled for individual ecosystem assets (e.g., a specific grassland), for all ecosystem assets of a single ecosystem type (e.g., all Trophic savannas (EFG T4.1)) or for various types of ecosystem accounting areas (e.g., a country, a large administrative area or a protected area) that includes multiple ecosystem assets of different ecosystem types.”

Without more concrete examples and practical guidance, it is easy to see how one can confuse a discussion about an “individual ecosystem asset” with a “single ecosystem type,” and how critical it is for valuation to be carefully aligned with the physical units actually being valued. Thus, while these chapters are seemingly siloed, they should be further developed in tandem and integrated to avoid, for example, a set of physical accounts by asset type and monetary accounts by individual assets in a way that is not precisely aligned. The SEEA CF had chapters on “Integrating and presenting the accounts” and many efforts to integrate the chapters throughout the manual in a way that the SEEA EEA does not.

Accordingly, compiling physical accounts without regard to monetary valuation makes the eventual development of monetary accounts more challenging. As mentioned, the

monetary valuation chapters are now too flawed to accompany the physical accounts in an integrated framework, but their continued development should be done in close consideration or in tandem with the physical accounts as much as possible.

### **Major\* Comments by sets of chapters**

**\*The comments in this section reflect serious conceptual issues or major considerations for revision. These are not merely expositional points that can be easily corrected, but mainly comments that will require substantial revision. Our more minor suggestions follow later, which are mostly expositional in nature and point to typos, word choices, and other fixable errors. While there is some overlap with our comments here and those on prior drafts, we should note that this set of comments is not exhaustive insofar as it does not include all issues we raised in prior chapter drafts (many of which remain unresolved).**

**Question 2. Do you have major comments on Chapters 1-2 of the draft SEEA Ecosystem Accounting?**

#### Chapter 1

1. Para 1.30: Accounting for ecosystem services, which does extend outside the SNA boundary, does not have to be synonymous with “green GDP” and revising measurement *within* the SNA boundary, nor should it be. Green GDP was not considered a good idea in the 1990s and was not widely adopted. Why is it a good idea now? We do not support expanding “the measurement of output, income and GDP” in the context of this manual. This crosses over to revising the SNA itself and it is inappropriate for one manual to speak for another. It is the SNA’s prerogative in its own revision to speak for measurement within the SNA boundary.

#### Chapter 2

2. Figure 2.1 and the associated text leave out a term defined in figure 2.1 in previous drafts, “ecosystem characteristics and processes” (ECPs; 6.10 has the CP without the E but the term is not pulled out or highlighted or acronymized, or in the Glossary). In conjunction with not including the phrase “ecological production function” (EPFs) there is no formally defined vocabulary in this text to use when contrasting the “qualified for inclusion in the ES list for SUTs” and what this excludes. There is more than a decade of confusion, and resistance to the specificity demanded for EA and for benefit-cost analysis in separating ECPs and EPF elements from final and inter-eco-asset intermediate ES, so that the former are not double counted. The accounting theory and the guidance proposed here to be a standard may be consistent with what EU members, for example, have used in some of their ES work, but the manual is not sufficiently clear on this point, which opens the door to serious double-counting issues if implemented more broadly.

Moreover, the problem of researchers calling ES final when they are not, and a need to relegate relevant non-final ES measures somewhere (including arguments within the writing team that if they had been resolved the other way would have misaligned that effort from correspondence with the SEEA EEA Tech Guidelines framework), was described in the US NCA work of Warnell, et al. 2020. Not offering a term or two to contrast SUT-appropriate measures with measures of ECP and EPF elements greatly risks inviting confusion, without an agreed vocabulary for untangling that confusion. In

this, the move to be elegant and simple and all-inclusive may undercut the ability of SEEA EA users to not make errors, and to understand, discuss through, and rectify errors when they occur. The simplification to arrive at this point from the figures and vocabulary in previous drafts may sacrifice a problem-correcting capacity at far greater long-term cost than the short-term benefits of the current simplification.

3. 2.30 defines Intermediate ES as flows between Eco-Assets. This definition is contravened in Ch 6, where also some ECPs are allowed to be Intermediate or Final ES in a very nebulous and porous way (with no explicitly defined vocabulary for how to distinguish ECP from intermediate or final ES, as noted above). Further, the Glossary definition of intermediate ES allows intra-Eco-Asset flows to count, as does 6.25 definition of intermediate ES, which includes intra- and inter-Eco-Asset. Separate from the problem of needing a framework and vocabulary to contrast SUT-appropriate from more upstream ecological variables, this contrast between definitions of the same thing in Chs 2, 6 & the Glossary is not up to the level of an international standard. If at that time, intermediate ES *are* allowed to be both inter-Eco-Asset and intra-Eco-Asset, then there needs to be new text added that explains how specifically to avoid double counting of physical quantities or value when putting both in the SUTs. Two specific examples in cultivation contexts, even if brief, might help. See related comments on intermediate and final ES in Ch 6 comments around Table 6.3.
4. Section 2.3.2 introduces ‘related accounts,’ which are not part of the main ecosystem accounts, have been exposed to minimal vetting (in some cases, introduced to be commented on for the first time in this draft) or are inconsistent with the principles set out in the core chapters. These ‘related accounts’ should be taken out of the main manual and presented as discussion papers or some other forum.
5. Para 2.93: we are still waiting to see the ‘stylised example’ – we want to see this! And be able to ask questions/give comments to how things are recorded since choices need to be made. As we discuss above in our overall comments, there are numerous areas throughout the manual where the principles are sufficiently unclear that clear examples would help clarify the principle itself.

**Question 3. Do you have major comments on Chapters 3-5 of the draft SEEA Ecosystem Accounting?**

Chapter 3

6. Chapter 3 states that national classifications are recommended, but that if no national Ecosystem asset classification system exists, then the IUCN Global Ecosystem Typology (IUCN GET) can be used or a new classification can be established. But for international reporting and comparison, the SEEA Ecosystem type reference should be used – as shown in Table 3.3. While we had raised this issue in a previous draft of comments, we would like to reemphasize that, in essence, the adoption of the IUCN GET for the first 3 levels can be problematic for the official statistics world.

The finalized IUCN classification has only been published in Feb 2020 and has not been thoroughly tested for the purpose of creating environmental-economic accounts. The



IUCN website specifically states that this system will be revised: “Ensuring the divulgation of the typology among researchers will promote testing and refinements, which will be incorporated into subsequent versions and extension to local levels.” Source: <https://iucnrl.org/blog/tipolog%C3%ADa-global-de-ecosistemas/>.

Adapting a draft classification into a statistical manual is not recommended, especially since this is the core structure of the ecosystem accounts. This classification system is not under the auspices of the official statistical system and can be changed at any time to fit the needs of this private organization – without any consultation from the UNSD or UNCEEA. To not have control over the classification and to potentially have to pay to use it or to use data based on this system is against the principles of classification systems in official statistics. Please see The IUCN Red List Terms and Conditions of Use: <https://www.iucnredlist.org/terms/terms-of-use#3.%20No%20Commercial%20Use>

7. The IUCN scheme is not hierarchical – specifically, level 5 does not go into level 4, and both Level 5 and Level 4 go directly into Level 3. This is not how hierarchical classifications work in the official statistical system. The Eurostat definition specifically states that the categories are “mutually exclusive” – which is NOT the case in this classification system. There are also several Biome which are considered in 2 or 3 different realms.

“A statistical classification or nomenclature is an exhaustive and structured set of mutually exclusive and well-described categories, often presented in a hierarchy that is reflected by the numeric or alphabetical codes assigned to them, used to standardize concepts and compile statistical data.” Source: Eurostat (<https://ec.europa.eu/eurostat/data/classifications>)

In addition, there has been no guidance developed on how to use this IUCN classification system in the context of developing environmental-economic accounts for ecosystems. This classification has not been tested for the purpose of using it in for developing SEEA-EEA accounts. The plans of the UNCEEA work program clearly state that this is planned for 2020-2021. Until the IUCN GET has been thoroughly tested, it would be unwise to approve it for a statistical manual.

#### Chapter 5

8. Overall, the manual requires substantial clarification on basic concepts underlying ecosystem condition. Ecosystem condition should only enter ecosystem services accounts if a condition is directly related to the provision of an ecosystem service, and so each entry should reference the ecosystem service/s it relates to, thus providing a link to traditional economic accounts. In this way the condition accounts are meaningful additions to what exists in the Central Framework in that they portray functions or state variables that influence the level of service flow to specified users. Condition accounts that track conditions based just on biophysical components or states that cannot be easily linked to a measure of an ecosystem’s use by humans should not be included as they are easily misinterpreted and suffer from bias from indicator developers and index creation. The choice of reference conditions also presents further ambiguity if the benefit of that reference condition cannot be easily understood as having provided a certain flow of ecosystem services in the past. The key question for condition is “condition for what?” where what is related most directly to human use. This is a fundamental issue that this chapter has not sufficiently clarified.



9. Paragraph 5.34: what about the potential inclusion in this category of “near ecosystem services” metrics that cannot go into supply-use tables because a clear end-user (or ecosystem type, in the case of intermediate services) is lacking, or where it’s possible to generate index number or ratio metrics that are not suitable for supply-use tables nor capacity accounts? Examples are given in Warnell et al. 2020 (<https://www.sciencedirect.com/science/article/pii/S2212041620300413>), which may have been overlooked because it likely was not reviewed by Czucz et al. 2020’s paper since they likely overlapped in the publication process. If such metrics are not admissible as functional state characteristics, where do they belong in SEEA EEA accounts?
10. Paragraph 5.49: This paragraph covers spatial aggregation. What is not covered is temporal aggregation – and since many condition indicators are produced by aggregating remote sensing-derived data that come at subannual temporal resolution, the aggregation of such data into meaningful annual values should also be described. In this case annual mean values are not always the most meaningful: minimum or maximum values may be more appropriate than mean values, depending on the metric, and the analyst should be careful in correctly doing temporal aggregation to produce meaningful annual change estimates.
11. Paragraph 5.62 “An ecosystem at a natural reference condition exhibits an absence of major human modification. An ecosystem at its reference condition attains maximum ecological integrity” and Annex Table 5.1: “Sites with ecosystems with minimal human disturbance” – This reflects a dated view in ecology that “pristine” ecosystems are those with minimal human influence when in fact nearly all ecosystems were managed by indigenous people, and particularly in the case of fire-adapted ecosystems bringing back such human modification would improve ecosystem health (this is particularly true for example in North America and Australia). Further, while natural condition may be important, it says nothing about conditions value for ecosystem services or for humans in general. In fact, setting reference conditions as the most natural state possible is often directly in opposition of human use. By defining ecosystem reference condition in this way ALL human activities will be viewed as negative. Reference condition might alternatively be set as the state of an ecosystem at its maximal use by humans with no decrease in future usability. The slope of the relationship between increasing human use and ecosystem condition will thus be positive up until a threshold asymptotic level where further use will degrade the system’s integrity. At very least this could be properly caveated in Annex Table 5.1, but the authors of the manual should consider a major revision regarding ecosystem condition and how it is defined and used.
12. Para 5.69: Regarding, the changing capacity of ecosystems to supply ecosystem services, this is the critical requirement for condition accounts. They need to relate to the changing capacity of ecosystems to supply ecosystem services. Without the proposed setting of reference conditions and specific linkage of condition metrics to services this will be difficult at best. This issue needs further clarification.
13. Para 5.110: If the intent is to record stocks of assets and ecosystem services, and the concept of condition is encapsulated by capacity then what is the value of spending so much effort to separately account for condition? This is a foundational question that should be answered to justify a chapter (and account) for condition.

14. 5.117: It is expressed that, “the ability to connect the critical levels of ecosystem service capacity back to the ecosystem condition variables that have the highest influence on specific ecosystem services would be a valuable exercise to explore,” but should not this be one of the primary roles of a condition account? It is suggested here that it is an “exercise to explore,” but a focus on this, instead of condition for conditions sake would make a good starting point for condition accounts.
15. The title of the chapter reveals much about the way the chapter is written, but it raises a foundational question about for whom should the chapter be written? Much of this chapter implies that this work would need to be described and determined by ecologists and is not work for the national statistical office, or at least national statistical offices at this time. Our understanding of the role of the SEEA is that the EEA is supposed to be part of the SEEA suite to serve as complements to the SNA. This means that asset definitions, valuations, spatial units, and so on should be linkable to the SNA and the scope should be in some way connected. That is, Ecological Economics is not the same as National Income Accounting; and, to the extent that these can be bridged by environmental economic accounting seems to be the initial intent of this suite of accounts. The chapter would be well served to better bridge the economic relevance of the spatial unit discussion.

One way to do this would be to set out the spatial unit needed for Economic Ecosystem Accounting. Granted there should be some overlap, but, to the extent that this is economic accounting, the focus should be more on how a country might set up an economically meaningful spatial unit that could better complement the corresponding SNA accounts, rather than a pure standalone ecosystem accounting. Accordingly, much of the material in the body of the chapter does not advance this purpose and could be relegated as additions to the Annexes already there. Even so, a fundamental question is unanswered in Chapter 3: How should a spatial unit correspond to an economically meaningful unit? Some reference is made to the analogy with an establishment for EA. That is fine; but, then how does that translate into a spatial concept that serves as a helpful complement to spatial units within the SNA?

Part of the problem is that there is too much of a technical ecological discussion and the focus on economics and the needs of national accounts is lost. For example, it is imperative for there to be mutual exclusivity between spatial units—both for the asset and the attending service flow. This is alluded to and assumed to be feasible, which is a strong assumption; but, numerical examples (or instances where an NSO has implemented this at a national level) would help clarify how mutual exclusivity could work to avoid double-counting problems that the SNA focuses on.

**Question 4. Do you have major comments on Chapters 6-7 of the draft SEEA Ecosystem Accounting?**

Chapter 6

16. Para 6.14: Regarding indirect benefits, while it is understandable to want to include some key processes/characteristics/flows that lead *indirectly* to the direct contributions to benefits since we have been used to thinking of these as ecosystem services, it would be cleaner to include these in the condition account. These indirect services are perfect candidates for the condition accounts as they can easily be linked to “Final” ecosystem services and so are directly relevant and understandable for policy decisions. This would leave a shorter list of ecosystem services, *limited to final services* and would allow services with no available direct measure to be added to the list and then linked to a condition metric that then can be used as a proxy measure.
17. Para 6.24: Regarding “a range of connections among ecosystem assets involving a range of ecosystem structures,” how is this different from condition account? We need to clearly separate intermediate services from condition or drop the differentiation and focus on just condition and final services where condition metrics would be equivalent to what is in the intermediate services group now. This would then push any non-intermediate type services condition metrics back out of the condition accounts and firmly back in the science of ecological stocks, processes and functions.
18. Para 6.27: Regarding the concept of intermediate services not being equivalent to the wide array of biophysical flows, the explanation of how these are not equivalent is incomplete. There seems to be no discernible differentiation between intermediate services and intra-and inter ecosystem flows. This is another reason to get rid of the term intermediate services.
19. Table 6.3 soil quality regulation is Intermediate ES only in the table, but there are important conceptual questions that are not clear in Ch. 6. For example, this means that of the two tracks for describing agriculture-based ES in previous drafts, where the first is “all ecosystem contribution to biomass provisioning”, and the second lists out “final” ES including rain and condensation, pollination, soil quality, etc., from the current text, the second track cannot exist, because in that track, soil quality appears that it would be final. Then, everything that NESCS, for example, would list as final ES must now be intermediate (with an intra-Eco-Asset option). Removing the choice is one problem, but the other is consistency and lack of double counting within the one remaining agriculture-based final ES path. It is not clear even now, how “all ecosystem contribution to biomass provisioning” does not cover elements then double counted in at least Rainfall pattern regulation, local climate regulation, soil quality regulation, soil erosion regulation, and pollination services where any of those in their agricultural context are separately deemed final, and must therefore be additive. There is some text (physical SUT, 7.10, at least) indicating that rows cannot be totalled. But rows will be totalled in many contexts, and once valuation is done, and totalled by ET (agric. ET). What nation does not have the incentive to attempt that?
20. There needs to be new text explaining how there is not double counting or how it can and should be avoided in all potential cases introduced by the “all ecosystem contribution to biomass provisioning” method, versus the multiple ES method where final ES are rainfall, genetics, pollination, etc. in cultivation contexts. The field already

debated this issue and there is continued confusion on these points. This document should clearly define boundaries, methods, and ways for respecting the measurement options within the boundaries. That is not the case for cultivation contexts, crop or livestock, where total ES values for these may be higher than for all other ES combined (because people tend to eat every day, even if they don't hike or dive, or are protected from flooding every day, and many people will value not being hungry over amenity values outside their window). If the first row of the ES list for the SUTs is suspect or wobbly, where does the entire SUT creation effort stand?

21. More clarity is needed by ES-list line, and in main text for these specific rows which cannot also be final under the only remaining final ES path for agriculture: genetic, rainfall, soil quality, soil erosion control, pollination. Since these all must and must always be intermediate in cultivation contexts according to the current restrictive path built on a measurement compromise, this should be noted in the description for each and every one of these, as with language under soil erosion: "It is generally an intermediate service (contributing to biomass provisioning services) but it can also be a final ecosystem service ([where]...". Indeed, all rows with "Interm/Final" or "Final/Interm" need to have some description of when it is either. It is not clear that adding the text can solve the problem of inviting confusion, double counting, or underappreciation of key ES such as soil quality.
22. Para 6.42: Regarding "for provisioning services, the mutual exclusivity will be connected with using a classification of biomass outputs such as of agricultural products," if this is the case, why are livestock not considered the biomass output when row crops are?
23. Para 6.125: The definition begins with definition of capacity, then extends to and attempts to enmesh a definition of sustainability. Capacity is current productive condition, and sustainability is maintenance of a production condition over time – two different concepts. Each concept may be applied, but sustainability is not a necessary part of capacity. It confuses the definition to paste the latter on unnecessarily. The fourth bullet in 6.130 seems adequate to address the concept of sustainability, given a stoppage/truncation of the definition in 6.125 at "uses." The truncation avoids compromising a key definition, and the fourth bullet allows the welcome additional concept to be applied. The manual should clarify these concepts and be consistent how they are used and applied.
24. Para 6.132: The apparent logic will be better condition means lower capacity since in the condition section reference condition is proposed to be state of naturalness or with no-use and capacity is all about use. Fixing the reference condition issue will help fix this problem here.

#### Chapter 7

25. Table 7.1: The table lists all of the services in the reference list and without someone having just studied that list for what is intermediate or final and an understanding of the overlaps between services that are present in the reference table this presentation promotes double counting in the accounts. We suggest removing anything that is not mutually exclusive and possibly removing strictly intermediate services. Further, the conceptualization of intermediate services is not consistent here. Why can't an ecosystem provide food or water provisioning for plants and animals in another ecosystem just as one ecosystem might regulate soil erosion, temperature, rainfall,

pollination for another ecosystem? The grayed out boxes suggest only regulating services can be intermediate, although this is unclear.

**Question 5. Do you have major comments on Chapters 8-11 of the draft SEEA Ecosystem Accounting?**

Chapter 8

26. Para 8.2: It states that, “In ecosystem accounting, the primary motivation for monetary valuation using a common monetary unit or numeraire is to be able to make comparisons of different ecosystem services and ecosystem assets that are consistent with standard measures of products and assets from the national accounts. The availability of national accounts aligned monetary valuations can support: comparing the values of environmental assets (including ecosystems) with other asset types (e.g., produced assets) as part of extended measures of national wealth...”. Comparisons are indeed essential in accounting, and we fully agree with this sentiment. However, this clashes with the idea that such latitude can be given over the choice of valuation methods outlined in Ch. 9 and the discussion of “complementary” approaches in Ch. 12, both of which render comparability to other asset types meaningless, more or less.
27. Para 8.5: Environmental economics and national accounts/statistics are two very different things. Stating that ‘The valuation of ecosystem services is a well-established field’ does not make this true. There is very little consensus in this field, in part due to the fact that just not that many countries have produced a full set of monetary ecosystem services accounts. And in a statistics manual, there is no “careful matching of different methods to the accounting context” – there needs to be agreement on what to do, otherwise it is ad hoc and not a standard.
28. Para 8.9: It states that “...valuation concept that is applied is exchange values. This is the same as applied in the SNA and hence is a concept that supports comparison and integration with national accounts estimates and a range of analytical and indicator applications as described above.” The manual asserts in Ch. 8 that for valuation, it follows the same exchange value concept as the SNA, yet in Ch. 9 and especially Ch. 12, the methods depart from standard SNA conception of value. Moreover, as we have stated in numerous comments on prior drafts or related discussion papers, the distinction between exchange value as “price” or “price\*quantity” is an important point to clarify in this manual. Instead, the manual skirts this issue by assuming a unit (1) quantity to abstract away from this issue (in paragraph 8.15, for example). There is neither consensus on this issue nor consensus on the methods outlined in the valuation chapters.
29. Para 8.11: Ch. 8 states up front that these SNA-based valuations are not particularly comparable to many environmental economics studies that employ many of the methods described in Ch. 9 (“monetary valuation undertaken for the purpose of

accounting will regularly differ from estimates of monetary values obtained in environmental economic studies”). This is correct. Yet, it is recommended that these methods are valid for valuation of ecosystem services in subsequent chapters. This is fundamentally inconsistent and contradictory, unless we torture the definitions of some of these methods in Ch. 9 to assert that they will be doing SNA-based valuation when it is highly uncommon to employ a method toward this end (e.g., contingent valuation or WTP methods that almost exclusively are used to measure consumer surplus or are part of some welfare-based valuation in the vast majority (all?) studies where they are employed). These contradictions come off as an attempt to please everyone by advocating SNA-based valuation in Ch. 8, while leaving the door open to “alternative methods” in Ch. 9 and “complementary approaches” in Ch. 12 and its Annex. But, taken together, it is incoherent and fails the basic objectives of what a standard is supposed to achieve: standardization for comparability and consistency.

30. Para 8.12: It is stated here that Ch. 12 is to “build a common language among accountants and environmental economists.” But it is difficult to see how Ch. 12’s actual purpose is to build a common language in a way that is appropriate for this manual. If it were, its focus would be explaining the SNA’s relevance to welfare, not the other way around. The way it is set up in the current draft, Ch. 12’s purpose is to show how welfare valuation is appropriate (as a “complement”) for these accounts, whereas the bridge it *should* build is simply showing how these *SNA-based valuations are complementary to the welfare-based valuations* found in the academic literature (and not produced by NSOs). We can support an Annex as described by the latter (and close to what is described in Ch. 8), but the Annex in Ch. 12 did not turn out like this and should be removed from the manual.
31. Para 8.27: This paragraph is correct in theory, but stands as a good example where the key assumption (“approach thus assumes the separability of ecosystem services”) is absolutely critical to the practical implementation of these accounts, but there is little direction what principles guide decisions when compilers of these accounts face challenges of separability and aggregation of particular ecosystem services and assets.

### Chapter 9

32. Section 9.3 provides a list of different valuation methods and Table 9.2 provides some mapping of valuation techniques to ecosystem services to help guide which method to use with each type of ecosystem service. Table 9.2 shows that there can be several valuation methods for each type of ecosystem service. As discussed above, this seems antithetical to the idea of a “standard.”
33. The scaling up discussion – called ‘value transfer’ – is not a very convincing or thorough as a way to estimate ecosystem services and their valuation. Going from small scale studies as a basis for grossing up to a larger area or to a whole country is fraught with issues, and there seems to be more problems that arise than are solved. A robust methodology for grossing up seems insufficiently developed in this manual.
34. Para 9.28: Is the social cost of carbon consistent with the exchange value concept?
35. Para 9.29 and 9.30: This seems to be inconsistent with 9.26 and goes back and forth on this idea that recorded values can be “too low” or “not significant.” There should be wiggle room here. It is not the role for NSOs to say whether some value is “low” or not and then proceed to record “complementary accounts” that are compared side-by-side with these ES accounts and SNA accounts. The practical problem with this is

that it introduces an adverse-selection problem with the development of “complementary” accounts or alternative valuations, essentially recommending that NSOs primarily (exclusively?) develop alternative statistics for valuations that are “too low.” Further, it pushes the accounts in a more political direction for NSOs, because what numbers are “too low” is inherently subjective, inviting political pressure to produce alternative valuations whenever a particular group is unsatisfied with the relative value of a particular ecosystem asset, for instance. Moreover, this subjectivity further makes cross-country comparisons even more difficult, as some countries produce complementary or alternative values for accounts they see as “too low” while other NSOs choose something else. This is simply not what a standard looks like.

36. 9.42-9.44: This seems to be double-counting SNA expenditures by counting travel costs for valuation, while we do not typically value travel costs for corresponding SNA assets or services. And, “estimates of a demand function” is very close to consumer surplus, despite this section saying that CS should not be measured here. This could probably be deleted, or it should clearly be explained why the consumer expenditure approach makes sense in this context.
37. Para 9.72: This discusses using meta-analysis in the context of value transfers but does not include the qualification that these studies are unlikely to be using an SNA-based value. This is also problematic as the methods underlying the study are opaque to the user of these statistics.

#### Chapter 10

38. Para 10.70: bullet 2: We do not support the use of social discount rates unless they are derived from long-term government bond rates.
39. There are some major inconsistencies between the physical asset accounts and monetary asset accounts, and the valuation actually has to come from the ecosystem services flows. See some of the minor comments below for examples (mismatched categories, etc.).
40. Paragraph 10.16 states that, “Since measures of ecosystem enhancement are linked to activities undertaken in the landscape, the changes in extent, condition and value can be directly related to estimates of expenditure and other measures of human input (e.g. volunteer hours) associated with that activity.” The chapter needs to be careful here, as expenditure in many cases does not coincide with the SNA conception of exchange value. Consider a non-ES example. As an asset, a bad film or television show produced with highly valued labor (famous actors, etc.) is not valued based on its inputs, but its potential output. So, in this case, adding another expensive star to the project does not necessarily enhance the value of the asset, which could analogously be true for some ES asset enhancements. A qualification here would be helpful, because this point is not necessarily obvious.
41. Para 10.28: The terms could be formulated a bit more clearly, given that costs are not explicitly a term in the equation, but implicitly in the value of the asset. At first glance, it looks like a present value (PV) calculation that simply discounts a stream of benefits, but it is only later that costs are discussed to make this a NET present value (NPV). Further, the discussion of the costs is very short, and exactly what costs are included receive little attention here.

#### Chapter 11



42. This chapter is not consistent with the other portions of the manual – it is not well thought through and should be deleted. Combining the SUT from the SNA and ecosystems SUT is like putting pieces together from different puzzles – the system boundaries are different, so they do not fit together (nor are they really meant to)! But this is acknowledged in para 11.17. It is not clear what these are used for. Just because you can put two things together does not mean you should do this.

Table 11.3 shows an extended balance sheet. Here the environmental assets have very different categories than those in Table 10.1 (which is the IUCN ecosystem typology, which has its own issues that we have commented on before in prior drafts). Where are we supposed to get the asset values of the categories in Table 11.3? Why are these categories different than the ones used in Table 10.1? Terrestrial ecosystem is IUCN, but not ‘Land’ and not ‘Renewable energy resources’ – so the monetary asset accounts cannot be used for an extended balance sheet? This section does not seem to be very well thought out and the coherence of the manual would benefit from its omission. Instead, a chapter that resembled something closer to the spirit of SEEA CF’s Ch. 6 would suit the manual much better and add coherence to it (rather than detract from it).

**Question 6. Do you have major comments on Chapters 12-14 of the draft SEEA Ecosystem Accounting?**

Overall, Chapter 12 through 14 should be removed from the manual, as they are much better suited as discussion papers (not affiliated with any specific endorsement). There is interesting and even provocative, thought-provoking content here, but for the reasons stated below and the lack of consensus around its content, it is not clear that these chapters belong in a statistical manual.

Chapter 12

43. Overall, Chapter 12 and its annex create more problems than they solve, and this section of the manual would be better suited as a paper outside the manual itself. Chapter 8 sufficiently motivates why these should be completely separate, noting that: “since values recorded in the accounts exclude consumer surplus and the coverage of ecosystem services in ecosystem accounting excludes non-use values, monetary valuation undertaken for the purpose of accounting will regularly differ from estimates of monetary values obtained in environmental economic studies” (8.11). A portion of Chapter 9 effectively makes the case that these accounts do not have to ‘be everything to everyone’ and a constrained scope is sufficient as long as the accounts are qualified as such. Specifically, the manual states that, “Thus, it is important that compilers document the scope of the ecosystem services included in the accounts and highlight ecosystem services that have been excluded from the scope of measurement and valuation. This is required so that users of the accounts can readily understand and interpret the aggregate measures of the monetary value of ecosystem services. Further, it highlights that data about non-priced ecosystem services will remain relevant for decision making” (9.7).

Chapter 13

44. Thematic accounts have been redefined from the old land-water-carbon-biodiversity to address biodiversity, climate change, oceans, and urban areas. This resolves the old tension where land and water accounts were both SEEA CF and SEEA EEA thematic accounts. One question might be: why does the guidance not mention the “demotion” of land and water accounts from the thematic accounts? And was it adequately vetted given that this is the first we’re seeing of it? In our opinion these seem developed conceptually but more lacking in worked examples than mainstream SEEA EEA accounts. Given that this is the first that we are seeing this chapter, it seems unusual to include it without sufficient vetting.

#### Chapter 14

45. This discussion is not guidance and is not specific, although specific possible indicators associate with “potential” exist in many tables. It seems like a very positive general discussion of the role of indicators and their types and matching to different clearly defined and lesser defined needs. However, this reads more like a suggestive or persuasive appendix than a chapter in a standard or a guidance intended to function as a manual.

46. Table 14.1: It remains unclear from Table 3.2, or the promise of paragraph 13.90 (*outside* of the accounts in a loose “thematic” strategy), if there will be delineation between heavily urban areas, through a spectrum thinning to suburbs and on to exurban streets in mostly rural settings. This indicates a continued risk with the GET typology that having only T7.4 for all “urban” is far too coarse for great swaths of EA valuation work. An eco-function-based typology has an Achilles heel precisely where ES value commonly and quickly aggregates – where lots of people that use ES are. It may lock in a peculiarly ecological perspective, limiting the capacity of economists and accountants to apply their tools fully (lacking articulated ecosystem assets), short of extending the main account to include an urban thematic account that emerged only in this global consultation draft, after years of drafts without it. Is this a sufficient promise of a sufficient patch to rectify the hobbling of value assessments explicitly tied to spatial grids of ecosystem assets? Will an indicator of % urban area be useful, if it is not clear whether this includes only the densest part of cities, or out to wherever there are 2 houses/km<sup>2</sup>? At this pinch point the GET Tier 3 may represent a continuing threat to the ability to assess ES values at a useful and tractable level of articulation. This could have serious implications for valuation (\$US billions).

47. Table 14.4 opens the door for “Gross Ecosystem Product (GEP)” and other nebulous concepts that have very little consensus, which we do not support at this time.

#### **Minor\* Comments by sets of chapters**

**\*The comments in this section reflect relatively minor suggestions, many of which are expositional in nature and point to typos, word choices, and other fixable errors. While relatively easy to fix, many of these errors were overlooked in correcting previous versions of this document.**

**Question 2. Do you have **minor** comments on Chapters 1-2 of the draft SEEA Ecosystem Accounting?**

## Chapter 1

Para 1.1: Should not start the manual with a statement that primarily motivates the accounts more narrowly to be about a couple policy issues. This distracts from environmental-economic accounting by implying that these accounts are primarily about climate change and biodiversity loss. These accounts have numerous potential uses and the introduction should not narrow the scope to only these. Consider deleting most of paragraph or reframing it; start with the final sentence only, “Establishing agreed and ongoing measurement of changes...”

Para 1.1: second sentence, remove “towards”; last sentence remove last incidence of “the”

Para 1.3: from Para 1.16 it appears that a full dash should be preceded and followed by a space; space before dash is missing here

Para 1.6: it is not clear why a statistical manual needs to pitch itself as ‘primarily intended to support national level policy decision making...’. Granted, this is one of many potential purposes, but at the end of the day it is an *accounting system* with a purpose of organizing information in a way that is systematic and meaningful to a wide array of potential users. The USES of that information is for someone else to determine, which is not necessarily the role of the statistical system to rank order its uses.

Para 1.8: ENVIRONMENTAL accounting... NOT ecosystem accounting in the 1980s

Para 1.8: last sentence, “on” is missing in Conference title

Para 1.9: first sentence, not “city” but perhaps consider “several groups”? Second to last sentence end with “.” In that sentence “Because of this,” implies an exclusive causality which the facts may not support. Dropping that introductory phrase leaves a true sentence, but one that makes no claim regarding causality.

Para 1.10: last sentence, consider adding “certain” before “physical flows” if the sentence refers to specific accounts rather than to a comprehensive theory, as the CF could not have included all of them in specific accounts, or EA would not have physical flows (as it does at least in the provisioning services). Perhaps make clearer that the approach is a framework, and not the resulting accounts?

Para 1.11: last sentence, remove last incidence of “to”

Para 1.12: last sentence, should experimental be in parentheses because it is referred to as a label?

Para 1.16: “(statistical standard)” is clearly a placeholder, not the intended language, and the placeholder needs to be replaced to make a true statement. Perhaps “SEEA EA is proposed to be the statistical standard for...[EA]”?

Para 1.18: This reads like an advertisement. Consider deleting.

Para 1.18: second sentence, remove “,”

Para 1.23: consider that subjunctive in English may demand “if a market for the services were present.”

Para 1.26: remove “s” from “complements” and “extends” to grammatically match verb form.

Para 1.26, iii: There is no consensus to “the mainstreaming of ecosystem information in standard measures of income, production and wealth” and implies some revision to the SNA in a way that is vague and not specified in the manual. Consider deleting the last sentence of 1.26 iii.

Para 1.26, iv: This is inconsistent with para 1.6 – solution is to delete para 1.6 see above

Para 1.31: It is overly presumptuous to say that there is some consensus about a “longstanding ambition in environmental-economic accounting” to derive “adjusted measures of GDP.” The SEEA-CF went as far as depletion of natural resources, for example, but NOT degradation of ecosystems. Consider removing.

Para 1.32: We do not support the ‘derivation of degradation-adjusted measures,’ nor the integration of ecosystem accounting data into the SNA’s sequence of institutional sector accounts and balance sheets. There is no consensus that this is something that the statistical offices should do.

Para 1.35: first bullet, full dash, as in 2nd-6th bullets

Para 1.42: Has the UNSC adopted the view that NSOs are “data stewards”?

Para 1.43: “...almost always involves the active...”?

Para 1.45: NOT “SEEA” change to ‘SEEA EEA’

### Ch. 1 Annex

Para A1.2: “...broader *than* that provided...”

Para A1.7: “...therefore concerns the range...”

Para A1.11: “...forests, timber *and* fisheries (SEEA...”?

Para A1.16: bullet 1, “...inputs *of* energy from...”?; bullet 4, “Natural resource residuals ~~are~~ defined in the SEEA Central Framework represent...” OR “Natural resource residuals are defined in the SEEA Central Framework *to* represent...”?

Para A1.18: as in A.16, “...accumulation” (SEEA...3.73).” where sentence punctuation at end, not in quote, leaving freestanding citation.

Para A.19 “...*in* Chapter 12.”

Para A1.22: “...stocks and flows assets” reads as awkward for the double noun “flows assets”. Is this a mistake, or are ‘stocks-and-flows assets’ a unique subset of assets discriminated from assets that do not have stocks and flows?

### Chapter 2

Para 2.5: again, integration with GDP keeps appearing, there is no consensus that this is a goal and explicit references to changing the SNA should be reserved for the SNA revision.

Para 2.7: 4<sup>th</sup> bullet – How do ecosystems have ‘social demands’?

Para 2.8: second dependent clause needs a verb

Para 2.20: ‘food web’ is not defined or used in the manual – delete and use a different example or define the term.

Para 2.28: what is the difference between ‘labour’ and ‘individual’s time’ in this context?

Proposal in para 2.35 that complementary valuations are provided is not acceptable (see our “overall comments” above).

Delete section 2.4 on the ‘value perspective’ – it is self-contradictory. SEEA EEA uses a perspective that “the environment is a supplier of benefits for human use.” And this section is making this a confusing mess. This section reads more like a philosophy text, which raises more questions than it answers/clarifies.

Para 2.80: states that there can be “balancing of supply and use and related reconciliation” but this is NOT done in the same way as standard SUTs since the ecosystem SUTs are not additive over rows. And it is only in para 2.79 that this is named. This is a major difference in the way SUTs are balanced so the statement in the last sentence is not adequate.

Para 2.2: not “focus are” but “focus *is*”?

Para 2.8: *are* all of the same

Para 2.17: *flow* not flows

Figure 2.1: tighten arrow head from FES to Benefits hexagon to match the shorter arrow.

Para 2.35: accounting values ~~will~~ *with* those

Table 2.1: not “account– physical” but “account – physical”

Para 2.38: “physical and monetary terms, with...”?

Para 2.40: “country. Compilation”

Figure 2.3: why “Source: own elaboration” under the figure? There is no such citation on earlier newly designed or re-designed figures.

Para 2.46: “...are *a* number of...”

Para 2.48: clause missing as penultimate sentence ends with “or.”

Para 2.49: “are accounts that”; “expenditures”?; at end “described” *or* “introduced” “in chapter 13.”

Para 2.50: “can be designed”

Para 2.52: the last “in” is actually “it”

Para 2.55: “and reflect and integration”

Para 2.56: following form in this list, add “.” At end of first bullet.

Figure 2.4: It would help to “core out” or make a gap between the up and down arrows, because there is a very clear split between non-anthropocentric and anthropocentric, where TEV only applies to the latter. That is, it is not a continuity from lower to upper region, but a demarcation, and a slight break in continuity of the up and down arrows would better convey that. Both values may be held in some measure, but TEV *only can* apply to anthropocentric. The horizontal arrows depict a continuum. The left right arrow is more continuous, and can in some manner be additive.

Para 2.60: not cantered but *centered*

Para 2.70: footnote 18 incomplete citation name.

**Question 3. Do you have *minor* comments on Chapters 3-5 of the draft SEEA Ecosystem Accounting?**

Chapter 3

Paragraph 3.32: “in the delineation of an ecosystem asset the condition of that asset will be relatively homogenous following the approach to the measurement of ecosystem condition described in Chapter 5.” – This seems like a fairly misleading overgeneralization. Within a given ecosystem asset – particularly large contiguous ones, there can be quite a bit of variation in ecosystem condition. This may be true for small, isolated ecosystem assets but is an overly broad blanket statement.

Paragraph 3.60: I think this rewrite adequately addresses our previous concern about misrepresenting the heterogeneity present in anthropogenic biomes and especially cities.

Paragraph 3.76: a minor point, but polar regions and oceans are certainly managed – oil & gas exploration, marine spatial planning, proposed seabed mining are all examples of this. Saying “more or less intensively managed” would be more accurate.

Chapter 5

Para 5.64: Regarding cases where a natural state does not represent a meaningful reference for condition accounts, since this is possible, I would suggest that this be the rule not the exception for setting reference condition in condition accounts.

Footnote 32: Ecological integrity is different than reference condition in ecosystem condition accounts. Consider clarifying this.

**Question 4. Do you have *minor* comments on Chapters 6-7 of the draft SEEA Ecosystem Accounting?**

Chapter 6

Para 6.13: last sentence, verb matches “types” and should be are not “is”

Para 6.16: third sentence, is too broad, as there can be wild berries as food, or water drunk from a stream or shelter in a cave. Also ending on “services” may imply that all the list is services and not just commercial recreation services like jeep tours. Perhaps something like “...include all food...services available for purchase.” This would leave no doubt.

Para 6.6.18, i. users from its their use” to match noun and verb case

Section 6.2.3: final and interim ES, has no mention that interim ES cannot be totalled with final ES for value.

Table 6.1 Why is geothermal energy not under geophysical resources?

Para 6.37, bullet two, sentence two, “may be relevant”; for 6.37, having made clear that outputs and not outcomes are focus of accounting, the two can be contrasted in the Table 6.2 example, where the ES description or its physical metric is the output, and improved human appreciation or health is the outcome.

Para 6.42 last sentence, individuals (pl)

Table 6.3 biomass wild animals, close parentheses; local climate reg, close parentheses in description; soil erosion, if it is “generally an intermediate” then why in the last column is it “Final/Intermediate”?; water purification “mitigate” without “s” as verb pairs with plural noun; pollination, remove “other” as confusing?; species appreciation lacks a designation in the Use column, and by 6.3.4 is not interm or final, so perhaps a note in the Use column there, representing that or directing to 6.3.4?

Para 6.53 “operates” without “s” as verb pairs with plural noun;

Para 6.38: The language is subtle but clear that there are only two formal ES classifications, and MA TEEB and IPBES are not ES classifications. A welcome and important clarification.

Paragraph 6.41: The ones in the reference list are not mutually exclusive.

Paragraph 6.42: Please separate these into two tables and consider not calling intermediate services ecosystem services as it is confusing. Intermediate services, as used here, could be added to the condition tables as a subset of those processes and functions of ecosystems that closely but indirectly effect the supply of one or more specified ecosystem services. This leaves the reference list of ecosystem services containing only what we might refer to a “final” ecosystem services, although we wouldn’t need to name them that. Also, if we make the handling of biomass provisioning consistent across row crop and biomass production and separate out intermediate services from ecosystem services then figuring out the net contribution becomes less difficult

Para 6.79: “where *the* livestock production process” OR “where livestock production processes”. To say here, ‘if there is no grazing (animal indoors its whole life), then there’s no ES,’ is to ignore at least some portion of the evolved genetics that exist underneath what humans have manipulated by breeding. There would still be a genetic material service because the entire DNA sequence as nature evolved remains productive, un-substitutable, and was never engineered entirely by humans.

This exposes a flaw in the genetic material services description, which focuses only on “new” population, varieties, and synthesis. That is ok when all of the agricultural ES parts (by NESCS) are always folded into “biomass contribution”. But when they are not, the parts remain relevant. Having excluded grazing does not cover all of nature’s contribution to the production of the animal, even if it never sets foot on anything but cement and sunlight never touches it. Folding almost all production ES into biomass production is a measurement compromise that embeds precisely this risk of missing an ES that should be there by the theory. When the strict conditions of the compromise are dropped, ES that had been folded under in aggregation can drop out entirely. This makes it a method problem, with implications for descriptions in the ES List, and in the text in the 6.70s, and in the table in Annex 6.1 in the first box after Cropland.

Para 6.60: If it is not an ecosystem service then it should not be included in the reference table.

Para 6.74: It needs to be clearly stated in the reference table that biomass is a PROXY measure for the suite of ecosystem services that contribute to biomass production and so the agricultural product shouldn’t be considered a direct measure of an ecosystem service.

Paras 6.77-78: The inconsistency here is not good. They should be treated the same way. I recommend treating plants like livestock in that the focus would be on the extent of the connection between the plant and the relevant ecosystem asset. Genetic services would then fill in the added contribution, after nutrient, water, soil, pollination, feed, etc. that the actual agricultural product provides to the final product harvested.

Paragraph 6.81, “Links to recreation-related services” – what about links to other cultural ES, such as traditional harvests by indigenous groups? Could this be framed more broadly as biomass harvest with associated cultural ES benefits, rather than just “recreation-related services”?

Para 6.81 second bullet, Does the first sentence ignore that the #1 livestock crop by value in the US is beef, and that millions of head of cattle live a few of their 3-4 stages before slaughter in the US and a few of the stages in Canada (often grazing in both countries before finishing on corn)? While this represents billions of dollars in ES value (by grazing, in US, and in Canada), is this case so exceptional that the sentence here should be retained unaltered? This concern may not affect the third bullet text at all.

Para 6.90, How/Why are all aquifers treated as ecosystems since “glacial” aquifers are not replenished, as is true for part of the Ogallala Aquifer system from South Dakota to Texas (that supports \$US billions in agric value)?

Para 6.106, second sentence, use full dashes, not hyphens for offsetting phrase, as in previous Paras. Language directly implies that the species appreciation row is not an ES in the SUT. This rather should be stated directly.

Para 6.113, periods at end of two of the three bullets

Para 6.123 “and in other cases the limits”

Para 6.124 “patterns of supply and use of ecosystem services supply and use and the”



Paragraph 6.106: “Amenity services” is listed here as one of the cultural ES but in Table 6.3 it’s called “Aesthetic enjoyment services”. Which is the correct label?  
Para 6.5: first sentence, missing “recording of”, but rewrite unclear based on preference. Perhaps: “The explicit recording of ecosystems’ contribution to...”?  
Para 6.6: Third sentence, again, missing preposition “with information” on/from/about?  
Para 6.133: dash not hyphen, and different, not difference with “assumptions”  
Annex 6.1 table: (continuing “genetic services” problem from 6.79 above) add genetic services to ecological factors determining supply?  
Annex 6.2: note, for them to

### Chapter 7

Para 7.3: last line, punctuation before “this” may need to be “;” or “.” or a word added to sentence. Flow not clear, or fragment.  
Table 7.5 Terminology and recording: The economic units used in this table are very confusing and are not well explained. What is meant by ‘electricity generator’? Is this a piece of equipment – a generator? Or an economic unit in ISIC 351 ‘Electric power generation’? Does the farmer own the wind masts and is responsible for the electric power generation or is it a utility company who has placed the masts on the farmland? This example needs to be re-written and the correct statistical and energy terminology used.  
Para 7.8: third sentence, to  
Para 7.55: *one-to-one* link  
Table 7.7: flood mitigation row, comments no such a thing as no flood  
Table 7.4: This table should include the biomass provisioning service for the pollinated melons as well as the supply for the wheat that corresponds to the use listed to better illustrate the point that *Pollinating services are Intermediate* and for which final ecosystem service they are linked to.  
In Table 7.5, “melons” need to be recorded on both the supply and use sides of the table (currently the use side has wheat, the example from the previous table).  
Para 7.13: It states that, “The recording of intermediate services by ecosystem type is not applicable for provisioning or cultural services; i.e., all of these services are final ecosystem services and hence cannot be used by an ecosystem type” yet the text in the reference table states: “Final in cultivated production contexts there may be many intermediate services that could be recorded.” So this sentence is not true? Needs clarification.  
Para 7.72: It would be better to recommend a baseline here of a completely impervious surface such as parking lot concrete as many ecosystem processes take place in the soil of bare ground which might be measured as a final service

**Question 5. Do you have minor comments on Chapters 8-11 of the draft SEEA Ecosystem Accounting?**

Chapter 10

One problem is that Table 10.1 suddenly appears without making clear connections to the physical ecosystem assets and how you go from the physical accounts to the ecosystem assets in monetary units. The steps to get the 'opening value' in Table 10.1 are not described clearly. For example, it may look something like:

1) From Table 4.1 'opening extent' which would be in some type of area unit, ex.

hectares, and a type of ecosystem type, ex. deciduous temperate forests (T2.2)

The value of this area of deciduous temperate forest (T2.2) is determined by the ecosystem services flowing from this area of forest.

These flows would be identified by the entries in the physical SUT in Table 7.1.

Each of the separate flows shown in Table 7.1 are then given a value using NPV, prices, etc.

2) It is the flow of these 'ecosystem services' that are given a value, and then all of these values are added up to give an asset value for the ecosystem area. This is confirmed in para 10.39.

3) The same procedure is then done for the closing extent value

4) and then the changes between the two are attempted to be placed into the various categories of 'change' - and if this is not possible then it is simply recorded as 'net change'

Table 4.1 only includes 'additions' and 'reductions' - by managed and natural – Why isn't there more of a one-to-one relationship between the categories shown in Tables 4.1 and 10.1?

In Table 10.1 there are several new categories and it is unclear that there would not be double counting between 'ecosystem conversions' and 'other changes in volume of ecosystem assets'. And there is no mention of Table 7.1 as the source of the data to be used as the 'supply' amount. They are not showing how to put the pieces together here – the processing logic is missing / unclear.

In the Annex to chapter 10, there is some type of decomposition analysis to figure out the types of changes. And their calculation example does not explain why there are 40 physical units of carbon at the start and only 30 at the end of the period. This analysis comes off as somewhat confusing, hand-waiving, and mystical.

Para 10.49: the following is unclear meaning: "In practice, the set of ecosystem services included for asset valuation should align with the set of services recorded in the monetary ecosystem services flow account for each ecosystem type." Does this mean Table 9.1?

Annex 10.1 The Stylized example needs better explanations for the entries in Table 10.2. For ex. why does the carbon start at 40 physical units (t0) and end at 30 (t1)?

**Question 6. Do you have minor comments on Chapters 12-14 of the draft SEEA Ecosystem Accounting?**

Chapter 13

There are some obvious incomplete sentences, missed punctuation, etc. The new material in the manual in particular would benefit from a full copy edit.

Table 13.1 is useful, but what about including Fig. 4 from this recent publication: <https://www.sciencedirect.com/science/article/pii/S1462901120313769>? This is a nice overview of the links between biodiversity and accounting.

Paragraph 13.53: I believe this is saying that CO2 equivalents are not calculated, i.e., for different types of greenhouse gases – but from the wording that’s not completely clear. Suggest rewording for full transparency.

Paragraph 13.78: given the amount of ABNJ ocean, compiling global ocean accounts does make a lot of sense. It could be worth mentioning as well that critical economically and nutritionally important fish and other aquatic species migrate beyond national EEZs, so informal imports/exports between nations matter more yet are worse understood than on land (see <https://science.sciencemag.org/content/364/6446/1192.abstract>, <https://www.researchgate.net/publication/344787424> *The transboundary nature of the world's exploited marine species*).

Paragraph 13.98: The challenge of spatial resolution the need for high spatial resolution data is mentioned in the context of change detection; it’s also needed to accurately quantify ecosystem extent, condition, and services period as moderate resolution data (e.g., 25-30 m) often can miss or misclassify small green spaces, trees, etc. Equity may be another aspect worth briefly mentioning in this paragraph, given the high socioeconomic and geographic heterogeneity of most of the world’s cities.

Chapter 14

Para 14.10, last sentence situations (pl.)

Para 14.21 “generation – thereby”

Para 14.24 “A/The majority of” ..... “They also contain...” ... “community”

Para 14.25, last line, not “respond” but “correspond”

Para 14.29, “monetary terms.” (pl.)

Para 14.30 “and the post-2020”

Para 14.32 “reporting of the sustainable...and the post-2020”

Para 14.33 “Under each goal and target” (sing.)

Para 14.34 not helps but “helping”; reporting “requirements” (pl.)

Table 14.5 Line B “natural ecosystems” (pl.); there is no line C., only A, B, D....; Line D protection of ecosystems (pl.)

Table 14.6 , line 1 “allowing restoration of [X%]”; line 7 “ecosystem (sing.) based approaches (not -ed)” and “services) by natural ecosystems.”, line 10 “and ecosystem approaches”, line 11 “green spaces within the built up areas (pl)”

Para 14.36 “and reduce inequality”

Para 14.38 “makes (pl) it an ideal framework”, “and providing supplemental”

Table 14.7 some numbers are missing the hyphen (not dash?) before the descriptive text

Para 14.39 sub-national levels (pl); compile (not -ed)

Para 14.40 ecosystems (pl)

Para 14.41 related to: ; 5<sup>th</sup> bullet expenditures (pl?) and instruments (pl); "." after text on last bullet?

Para 14.47 agreed "on" or "to" an initial?, dash not hyphen

Para 14.49 EESVs) that provides (pl)

Para 14.53 dash not hyphen; last sentence, ecosystem assets (l) derived; add "."

Para 14.58, 2<sup>nd</sup> bullet, no "."; 3<sup>rd</sup> bullet assesses...ecosystems (pl); last bullet allows users to determine (?)