Minutes of the Expert Group Meeting on Modelling Approaches and Tools for the Testing of the SEEA Experimental Ecosystem Accounting[1]

18- 20 November 2013
United Nations, New York

Agenda

Session I: Opening, National and International Ecosystem-Related Initiatives
Session II: Models and Platforms for Use in SEEA Experimental Ecosystem Accounting Testing
Session III: Toolkits and Frameworks for Analyzing Ecosystem Services
Session IV: Next steps for Testing and Planning for Pilot Projects

Session I: Opening, National and International Ecosystem-Related Initiatives

Opening

Outcomes and Actions:

- **The SEEA EEA provides strong value proposition in its systems approach to ecosystem management. Its research agenda outlines key areas where investigation is needed. These include issues related to the delineation of spatial units and the link with economic units, measurement of ecosystem condition and services and related classifications.**

- **A Steering Committee reporting to the UN Committee of Experts on Environmental-Economic Accounting (UNCEEA) should be established to oversee the advancement of the research agenda and the testing of the SEEA EEA and coordinate activities with existing groups working on issues related to the research and testing of the SEEA EEA. The Steering Committee would be supported by a technical committee consisting of experts from the research community as well the geospatial (e.g. Group on Earth Observations) and statistical community in view of the multidisciplinary nature of the work and the systems approach at the core of the SEEA EEA. In addition forums on ecosystem accounting to present the progress of work and key issues for further testing and experimentation of the SEEA EEA will be organized on an annual basis with a view to advance SEEA EEA as a measurement framework for official statistics. A broader international conference bringing together experts from different communities could be organized every three years, possibly using existing mechanisms such as the Trondheim Conference on Biodiversity.**

[1] Presentations for each of the tools and modelling approaches presented as well as related background documents are available at:
http://unstats.un.org/unsd/envaccounting/seeaRev/meeting2013/lod.htm

- **Countries seeking to implement ecosystem accounts have diverse policy needs and capacities for testing and experimentation. The testing and experimentation of the SEEA EEA therefore needs to remain flexible and responsive to these differences.**

Summary of discussion:

1. Ivo Havinga, Chief of the Economic Statistics Branch of the United Nations Statistics Division (UNSD), opened the meeting with a review of the purpose of the meeting and introductions of participants.

2. In sharing their expectations for the meeting, participants noted the valuable role of the SEEA EEA in providing a system's approach for assessing the characteristics of ecosystem condition and ecosystem services.

3. Alessandra Alfieri, Chief of the Environmental-Economic Accounts Section of UNSD, followed with an overview of the SEEA Experimental Ecosystem Accounting (EEA) conceptual model, valuation challenges, and the research and testing agenda. The research and testing agenda covers issues related to classifications of ecosystems, ecosystem services, land cover and land use; delineation of spatial units and linkage to economic units; and methods for measuring ecosystem condition and ecosystem services. The presentation also highlighted the need for the establishment of a mechanism to advance the research and testing agenda and to develop collaboration with existing groups working on areas of relevance to the SEEA EEA research agenda.

4. Discussion following the presentation highlighted the need to accommodate the diverse policy needs and institutional and technical capacities of countries and the need for the SEEA to be flexible in that regard.

5. Given the current interest in ecosystem accounting and the need to capitalize on that attention, the proposed Steering Committee should be quickly established and a medium term programme of work formulated, including the timeline for international meetings where the outcome of the research can be presented. It was clarified that the Steering Committee could have a limited number of members and be composed of representatives of the various ecosystem-related networks to bring together the cumulative experiences in the testing and experimentation of SEEA EEA(like the UNCEEA, Ecosystem Services Partnership, IPBES, WAVES PTEC, UNEP TEEB/WCMC, CBD, UNDP Poverty and Environment Initiative, etc.). This Steering Committee could be supported by a technical committee with a broader representation with the task of advancing the agenda set by the Steering Committee. The medium term work programme will also include a series of annual forums of experts to present the outcomes of and key issues for further testing and experimentation of the SEEA EEA with a view to advance SEEA EEA as a measurement framework for official statistics. Existing established conferences that already bring together the scientific and policy communities (such as the Trondheim Conference) could potentially provide a setting for discussing issues related to the SEEA EEA with a wider audience (e.g., the statistical and other communities).

6. Also the coordination with work done through the Group on Earth Observations (GEO) on the Global Earth Observation System of Systems (GEOSS) was specifically mentioned in view of their monitoring capability of ecosystems and the human impacts on them, and the delivery of associated ecosystem services, including issues of aggregation and disaggregation over space.

National and international ecosystem-related initiatives

Outcome and Actions:

- **Countries have varied levels of experience in working on ecosystem accounting. Some have made significant progress toward developing selected accounts (e.g., Australia, Canada), others are in the early phases of work (e.g., Brazil, Mexico, South Africa) and others are in the planning phase (e.g., Indonesia, Samoa, Uganda). Countries with more experience in the implementation of ecosystem accounts may be able to provide lessons learned and guidance for countries starting to embark upon the development of ecosystem accounting.**

- **Development of land use and land cover maps has been an initial step in the work on the SEEA EEA in several countries. Countries that are in the early stages of development of the SEEA EEA should consider the development of land cover maps as an initial step towards ecosystem accounting.**

- **Communication of the concepts is important to broader uptake and implementation of the SEEA EEA. Concept of "green infrastructure" might be useful to integrate with accounting work as it resonates with those who develop policies in these areas.**

- **Stakeholder mapping is an important step in the process of SEEA EEA implementation. Building on the stakeholder mapping, coordination boards could then be established to undertake the SEEA EEA implementation.**

- **Environmental ministries are becoming increasingly familiar with the work of the SEEA EEA. They have a key role in cataloguing, reviewing, and coordinating the management of environmental datasets.**

- **Ministries of finance, planning, and treasury are important in the context of the policy use of the SEEA EEA, because of their role in budget allocation processes and environmental-economic policy decisions. Continued effort should be made in building bridges between statisticians who compile data and macroeconomists using the statistics in those ministries. International organizations should continue providing assistance and promoting the SEEA EEA in national and international initiatives like the Green Economy and Natural Capital initiatives.**

Summary of discussion:

National Initiatives

7. Countries provided an overview of their activities in the area of the SEEA EEA.

8. **Mark Lound** of the Australian Bureau of Statistics reviewed work that has been done or is planned in Australia. The national government is working closely with policy agencies to find uses and cases for the application of the SEEA EEA. Energy and water had historically been drivers for Australia but now there is interest in working in the areas of ecosystem services and carbon and biodiversity. Work has been completed in the areas of environmental expenditures and land accounts. With the land accounts, collecting the information over time is an important objective of the work. Work on the land accounts will inform the Reef Outlook Report, slated to be released in the middle of 2014. Regional trials of the Experimental Ecosystem Accounting are underway through the Wentworth Group.

9. **Richard Mount** of the Australian Bureau of Meteorology presented on some of the policy drivers that have led to work in the area of environmental-economic accounting in Australia. These include the Environment Protection and Biodiversity Conservation Act, Commonwealth Marine Reserves, Water Act, and the Murray-Darling Basin Plan. Progress being made in the area of ecosystem accounting would also support arrangements for payments for ecosystem services and identification of green infrastructure. Meeting international responsibilities and reporting requirements (e.g., Convention on Biological Diversity, Intergovernmental Panel on Climate Change) is an additional driver for work in this area.

10. **Marco Neves** of the Brazilian National Water Agency (ANA) and Jose Antonio Sena do Nascimiento of the Brazilian Institute of Geography and Statistics (IBGE) followed with a discussion of current initiatives and policy drivers in Brazil. Statistical, environmental, and water management agencies are increasing their level of collaboration, and no experimental ecosystem accounts have yet been implemented in Brazil. Priority areas for ecosystem accounts in Brazil will likely be related to forests and water resources. The Forest Code 2012 calls for a significant restoration of forests across different biomes and a National Forest Inventory is currently being implemented. Priority biomes will likely be Amazon, Atlantic Forest, and cerrado/savanna. Systematic mapping of land cover and land use is underway, with a territorial grid that will be observed every 2 years using remote sensing and GIS. The classes used at present are an adaptation of those provided by Jean-Louis Weber with some changes to reflect on-the-ground realities in Brazil.

11. Following this presentation, there was some discussion of the requirements under the Forest Code. Restoring the forest area stipulated in the code will likely take many years, with the priority being restoration of Atlantic Forest and Amazonia.

12. **François Soulard** of Statistics Canada provided an overview of the Mainstreaming Ecosystem Goods and Services work being conducted in Canada. The project worked on developing data to apply concepts from the SEEA EEEA. An output of the project was the integration of the data collected for the project into a geodatabase; a report will be released at the end of November 2013. One of the findings related to spatial resolution was that the 250-meter resolution for basic spatial units was appropriate for some

locations, but not all. For the areas of the country where most people live (the south), 30-meter resolution was needed.

13. In the subsequent discussion, participants considered the issue of the denominator to use in biomass analyses, i.e., is it possible to continue extracting the same amount of biomass moving forward. The quality of biomass is important in determining sustainable extraction patterns. Australia has been doing work through the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in this area and a report is available. The European Environment Agency has investigated benefit transfer and scaling up methods, with a case study on wetlands; the report is available at http://www.eea.europa.eu/publications/scaling-up-ecosystem-benefits-a. Finally, the group considered the importance of the dynamic nature of demand for ecosystem services when modelling human impacts on the environment.

14. **Raúl Figueroa Díaz** of INEGI presented progress in the development of environmental-economic accounting in Mexico. Areas of work include air emissions, water accounts, green growth, green jobs, and trying to further understand the ecosystem service flows. This includes how consumers acquire ecosystem services and measurement in both physical and monetary terms. A task team with representatives from national accounting and geography are working to map not only the ecosystem assets and services, but also the final destination of the services, making the link between producers and recipients of services. Plans are to compile basic tables in physical terms and work on the level of detail in data (at present, it is quite aggregated).

15. **Aaron Israel Villar Mata** of INEGI described mapping work being conducted by INEGI related to climate, geology, vegetation, and land use. Of note, soils are mapped using the standard soils classification, and series 2 of the maps will use the international soils classification. Areas of investigation include soil erosion and soil properties, such as soil carbon. Vegetation type maps have shown that there are 16 vegetation types, and this information may be used as a basis for biodiversity and ecosystem accounting. Finally, INEGI also has a working group making GIS applications and will have a digital map of Mexico that compiles all of the information that INEGI collects.

16. **Øyvind Lone** of the Norwegian Ministry of Environment presented on the work in Norway in the area of ecosystems and ecosystem accounting. Key challenges for Norway have included problems with acid rain and pollution in the North and Baltic Seas. There are threats to reindeer and wild salmon and kelp forests have been decimated. There are also negative trends in seabird populations in coastal areas. Of interest, a lower percentage of protected areas are in lowland areas compared to mountain areas. The main policies driving work in the area of ecosystems are the Nature Diversity Act of 2009 as well as marine management plans (Barents, Norwegian, North, and Skagerrak Seas). Land use and land use change have been identified as the most important pressure factors on ecosystem services. Acidification of freshwater is still an issue in 10% of areas.

17. There was some discussion of a previously developed database for valuation studies in Nordic countries; that database has not been recently updated, but an updated compilation of valuation studies in Norway has been completed.

18. **Benjamin Sila** of Statistics Samoa shared the work underway in Samoa related to environmental-economic accounting. Samoa is working on implementing the 2012 SEEA. The key issue or Samoa is climate change and the associated rising sea level. An Environmental Unit was developed in 2013 and will work on integrating the environmental-economic accounting work into the Samoa Strategy for the Development of Statistics. The main challenges include limited coordination, data spread across multiple agencies, limited technical knowledge on environmental statistics and difficulties for researchers working in Samoa (e.g., insufficient data and limited technical expertise present).

19. **Amanda Driver** of the South African National Biodiversity Institute (SANBI) presented the activities conducted and planned in South Africa related to biodiversity. Two national biodiversity assessments have been conducted with a fair amount of work on mapping and classifying ecosystem types. There is a long history of mapping vegetation types and recent worked has focused on mapping marine ecosystems. A national ecosystem classification system is under development and various activities have sought to assess ecological condition of different habitat types. SANBI is currently working with Statistics South Africa on the development of national river ecosystem accounts, with an initial focus on physical accounts.

20. Meeting participants discussed the work being done in South Africa, in particular the rationale for developing ecosystem accounts, the plan for which ecosystem services to assess, and the use of green infrastructure as a mechanism to convey the value of the ecosystems. Ecosystem accounting was viewed as a way to reach a broader audience than what might be possible with biodiversity indicators alone. Communicating the importance of ecosystem assets was an important component of the work in South Africa. The green infrastructure concept was useful because it allowed them to tackle ecosystem services from the supply side of the equation—the assets that form the basis for providing a large range of ecosystem services. Future work should think through how to link such a concept to the accounting world to facilitate broader uptake of the SEEA EEA approach.

21. **Buyung Airlangga** from BPS Statistics Indonesia shared two presentations on work being done in Indonesia. One discussed the work on mainstreaming, including work on green economy in the areas of lowering greenhouse gas emissions, sustainable consumption and production, and development of financing for regional action plans in these areas. The other described pilot work being done by the Ministry of the Environment in the development of ecoregions.

22. **Ronald Kaggwa** of the National Environment Management Authority in Uganda followed with a discussion of current activities in Uganda. He pointed out that Uganda is undergoing a rapid economic transformation and depends on natural resources for GDP. Changes in environmental assets and ecosystem services affect the economy. The National Environment Management Policy of 1994 includes an objective on environmental accounting to account for environmental costs and benefits. Valuation studies on urban wetlands, forests, and biodiversity have been conducted to

demonstrate the contribution of these resources to GDP, but the studies have not been used by Uganda Bureau of Statistics to prepare national accounts. There have been some inventories of critical ecosystems, a biodiversity data bank, and work on ecosystem restoration programmes. Needs include improved conceptual understanding of environmental-economic accounting, development of partnerships at all levels, stakeholder mapping of priorities, and alleviation of capacity constraints.

23. There was some discussion from the group regarding the issue of stakeholder mapping and its role in the broader process of implementing the experimental ecosystem accounts. Australia set up an implementation board for the SEEA to assist in prioritizing the accounts for development. The mapping worked with both the production and use side of the accounts. Stakeholder mapping is an important step in the work on the SEEA EEA and provides information that would be of use in the development of implementation coordination boards.

International Initiatives

24. Following the country presentations, international organizations shared their activities in areas related to the SEEA EEA.

25. **Richard Mount** of the Australian Bureau of Meteorology provided an overview of the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), describing its transdisciplinary work and the proposed inclusion of work on environmental-economic accounting in its future work plan. **Nicolas Bertrand** of the United Nations Environment Programme (UNEP_ followed with a review of the progress of The Economics of Ecosystems and Biodiversity (TEEB) program, noting two of the recommendation focused on accounting and indicating that TEEB assessments may lead to country studies that include recommendations for work on natural capital accounting. **Pushpam Kumar** of UNEP presented ProEcoServ , describing application of ecosystem service mapping and modelling in Chile, South Africa, Trinidad and Tobago, and VietNam; ProEcoServ is part of the larger VANTAGE program, which aims to bring together studies (e.g., from TEEB, SEEA, etc), for national and global evaluations.

26. **Sofia Ahlroth** of the World Bank shared information on the current and planned activities of the WAVES program. Tim Scott of the United Nations Development Program (UNDP) followed with a discussion of their Target Scenario Analysis work, which looks at a specific productive sector and decision maker, as well as BioFIN, which will work toward meeting the financing needs for biodiversity work (i.e., what is needed to achieve the Aichi targets and how does that compare with current funding levels). **Markus Lehmann** of the Convention on Biological Diversity reviewed the policy demand for environmental-economic accounting from the CBD perspective, including the 2010 strategic plan for biodiversity. Concluding the session on international initiatives, **Jock Martin** of the European Environment Agency discussed their activities related to the SEEA EEA, including work on calculating a landscape-species index and under the Mapping and Assessment of Ecosystems and their Services (MAES)—different European Union countries are at different stages in their work on ecosystem accounting, assessment, and have completed a range of pilot valuation studies.

27. After the presentations on initiatives, the question of the appropriate entry point for mainstreaming of the SEEA was discussed. There was some concern that, while the SEEA linkages with environmental policy are clear, and the role for environmental ministries in the coordination of environmental datasets, the connections to economic policy discussions have been less established. Finance, planning and treasury ministries are important because of their role in economic policy decisions and budget allocation processes. Some felt that accounting may not be the best entry point for discussions with finance and treasury ministers, while others thought more work needed to be done on getting finance and other economic ministries to better understand the source of the data (i.e., from accounting activities). One initiative mentioned to improve the understandings of the linkages in this area is the UNDP/DESA/DSD Green Economy program, which has been working to raise awareness of the environment-economy linkages. Additional work could be focused on providing macroeconomists and civil servants with a synthesis of what statisticians and those compiling accounts can do to assist in their decision making—the information on transactions that is critical to resource allocation decisions. The entry point question is an important one to consider in future discussions, as, at present, it is not clear how successful the approaches have been at a national level.

Session II: Models and Platforms for Use in SEEA Experimental Ecosystem Accounting Testing

Outcome and Actions:

- **Different models (e.g., GLOBIO, InVEST, ARIES, Nature Index, LUCI, MIMES) have different strengths and may be appropriate for different purposes. ARIES and InVEST have a focus on beneficiaries and mapping the linkage between sources of ecosystem services and the users of those services. Some models are quite complex (e.g., ARIES and MIMES) while others require a minimal number of datasets (e.g., LUCI); decisions need to be made regarding the tradeoffs between complexity, data requirements, and applicability at a national level. Rather than selecting one model, countries should determine the model most appropriate to their specific national context.**

- **Defining a set of standard metrics to use for characteristics of ecosystem condition remains a pressing question (e.g., what is the standard metric that should be used as a proxy for biodiversity). Work with appropriate experts should develop some initial consensus in this area.**

- **Reference condition is an important component of the conceptual approach outlined in the SEEA EEA. The ecosystem models presented each treat reference condition differently. Working closely with appropriate experts, a standard approach should be developed.**

- **Computational constraints are important to keep in mind when considering scaling up from site levels to the national or global levels; the different complexities of the various models would make this constraint more or less**

problematic. Those implementing ecosystem accounting at the national level should consider the potential computational burden when determining which model or models to select.

- **Stakeholder engagement and participation is important for groundtruthing model results. Countries should consider engaging stakeholders in the early stages of development and application of the ecosystem condition and service models.**

- **In one comparison of two different approaches, InVEST and ARIES produced similar results at the landscape level, but differing results at the site level. Experiences comparing multiple models at the same site are limited; more studies of this nature are needed. Development of standard datasets for input into the model would facilitate comparison of model outputs and should be a component of the program of work for the SEEA EEA.**

- **Standard spatial data layers for socio-economic characteristics would be valuable for those developing ecosystem accounts, in particular in establishing the direct links between ecosystem conditions, services and beneficiaries in an ecosystem accounting unit . Coordination with the UN-GGIM process may assist in development of selected standard data layers.**

- **The scale of analysis is important when selecting a modelling tool for ecosystem assessments. For instance, LUCI has been applied at the national level in Wales . Moreover, GLOBIO has been used to develop national estimates for impacts upon biodiversity in some countries, but additional work would be needed to strengthen the country-based assessments. Work on the SEEA research and testing agenda should continue to investigate the application of these models at differing scales.**

- **Comparison of models for biodiversity is important for the development of a global baseline. GLOBIO, for example, currently cannot provide a global baseline for biodiversity. More detailed land use maps and input from national biodiversity experts would be necessary to develop a global baseline. Work should explore the feasibility of this approach to arrive at an initial global biodiversity baseline based on national assessments.**

Summary of discussion:

Models and Platforms

28. **Adrian Vogl** of the Natural Capital Project[2] began the session on models and platforms for the SEEA EEA testing with a review of InVEST tools available. All of the

[2] The Natural Capital Project is a partnership between Stanford University, the University of Minnesota, the Nature Conservancy, and the World Wildlife Fund. InVEST (Integrated valuation of

models rely on a spatially explicit ecological production function and do not use the benefit transfer approach. The location and activity of beneficiaries is important and many, but not all, link to an estimate of economic value. Readily available data and limited technical capacity are required and the tools are downloadable on the internet at no cost and can be used with free or low-cost GIS. The user can adapt the model code to their particular needs and the carbon model includes an uncertainty assessment. The land use classification systems are defined by the user and the user also needs to derive the coefficient values that go into the model. For biodiversity, species/functional groups are not measured; instead, the model uses habitat quality and rarity and its relationship to threats to evaluate alternative management scenarios. Currently, there is an effort to take the GLOBIO model and improve its ability for downscaling using high-resolution data. For carbon storage, land use and land cover are the drivers and information on carbon pools is required. The carbon storage model intends to provide an approach to understanding relative change in sequestration without knowing details about all of the biophysical processes; better models are likely available for high-resolution evaluation of specific localized areas.

29. Following the presentation, the group discussed the relationship between habitat quality and biodiversity. InVEST makes the assumption that habitat quality is linked to biodiversity. Since ecosystem scientists might prefer an approach that allows them to evaluate changes in species composition, an approach such as GLOBIO may be more appropriate. Currently, the InVEST team is working on figuring out the best approach in this area. Further investigation of the appropriate indicator for biodiversity is needed. There was some question about how the InVEST work links to the SEEA EEA. The niche for InVEST is defining what the services are and who the beneficiaries for those services are—being able to track back from where the services are received to where the services were generated.

30. **Roel Boumans** of Accounting for Desirable Futures shared the MIMES[3] approach for modelling of ecosystem services. The MIMES approach is designed to play out over multiple scales and have several ecosystems integrated with each other. Through a process of mediated modelling, MIMES develops a dynamic GIS approach to simulating the biophysical functioning occurring in a given area. Depending on the needs of the user, MIMES can incorporate a range of existing models (e.g., InVEST, ARIES, others) and then develop a systems approach to exporting and importing between the different spheres (e.g., biosphere, hydrosphere, lithosphere, atmosphere, anthroposphere). The MIMES model has been applied in a range of areas and contexts, including the Manawatu watershed in New Zealand, work on human health outcomes with the Environmental Protection Agency and spatial marine modelling in Massachusetts (SeaPlan). Ontologies

---

Environmental Services and Tradeoffs) is a software suite that has been developed for quantifying natural capital.

[3] MIMES is a multi-scale, integrated set of models developed by Accounting for Desirable Futures that assess the value of ecosystem services.

are important in the model in terms of the ecosystems, economic sectors, and ecosystem services that are defined. Many of the MIMES models are agent-based or process-based so there are exchanges between locations and the temporal element allows for mapping of changes over time. Dynamic impacts can be modelled and provide more of a narrative than the sensitivity analyses available in other tools.

31. The attendees then discussed the time it would take to develop a MIMES model, the scalability of the MIMES approach to national and global levels, and the parameterization of the model. Many people who want to develop the models have familiarity with GIS, and the software used in MIMES is easier than ArcGIS, so that should not be a difficult hurdle to working with the platform. The systems modelling software used in MIMES, SIMILE, used to be fairly inexpensive, and a current focus is the potential use of open source software to avoid the current costs of SIMILE. Someone starting a project would be provided with a list of files to download, with the goal of developing a complex model that is also amenable to user manipulation. By engaging users in the model development from the beginning, the MIMES approach seeks to develop capacity in running the eventual model, rather than developing the model and then facing a steep learning curve from users. There was some concern that the model design process presupposes the items that need to be evaluated (i.e., the ontologies included may not turn out to be comprehensive). In terms of scalability, the initial MIMES work started with the GUMBO model, which was designed for a global application; however, as most funding for further development has come at the watershed level, the global-level GUMBO work still has several areas for future improvement (e.g., getting GUMBO to work at a lower scale with economic sectors defined by ISIC and calibration against GDP). It was also pointed out that the infrastructure limitations are also important to consider when scaling up from watersheds to regional or national scale—computational issues can arise with complex models. Determining the necessary level of complexity for the question at hand is a key issue that should be considered when developing national-level ecosystem accounts.

32. **Stefan Van der Esch** of PBL, Netherlands Environmental Assessment Agency, presented GLOBIO3[4] and its modelling of biodiversity. The approach begins with a 1 x 1 m to 50 X 50 km cell and then requires assignment of a quality measure to this cell. Mean species abundance (MSA) is used as an indicator of ecosystem quality, with assessment of that MSA in a disturbed state compared with an undisturbed state. The model looks at how pressures (e.g., land-use change, infrastructure, fragmentation, climate change, nitrogen deposition) impacts MSA and can translate many pressures into one indicator of ecosystem condition. Land use classes appear fairly comparable to those used within the SEEA EEA. GLOBIO usually works on global scale, but can work on national (e.g., examples from Zambia and VietNam) or subnational levels as well. The main challenge in application at a national level is projection into the future. IMAGE is currently used to predict future scenarios. Importantly, no weights are given based on species richness,

[4] GLOBIO3 is a modelling framework for assessing the impact of environmental drivers on biodiversity developed through a consortium consisting of PBL Netherlands Environmental Agency, UNEP-GRID Arendal, and UNEP-World Conservation Monitoring Centre (WCMC).

since that could muddle interpretation of what is changing over time. The accuracy of the MSA approach used in GLOBIO can be improved for national application by engaging local experts. More detailed national land use maps and work with national experts would also be necessary to develop a more rigorous global baseline based on national assessments.

33. Following the presentation, the participants discussed the MSA metric as used in GLOBIO and its application at different scales, and the aggregation of pressures. The "natural state" in GLOBIO is based on a comparison of a selected area with an area of the world that is deemed to be in the natural state. The intent of this approach is to avoid the use of an arbitrary cutoff date. Some indicated that they did not feel that GLOBIO output gives information on species themselves (or MSA), but is rather a relation of human impacts to biodiversity; it should be made clear that there are dose-response relationships drawn from the literature and it is not the MSA itself. There had also been consideration of whether to use MSA or species-area relationships as a measure in the model; the general impression was that MSA performed better in terms of completeness across the various pressures. To aggregate pressures, each is converted into a common metric and then they are multiplied; the largest pressure will dominate the result. Some of the pressures (e.g. agriculture) have some differentiation, but additional distinctions are possible, and invasive species are currently not included in the model. Further evaluation of the best approach for modelling biodiversity would be necessary for the development of a global baseline. There was also a question regarding the comparability of the GLOBIO output with the EEA condition scores; that comparison has not yet been conducted. On a technical presentation point, it was suggested that the histograms be labelled as normalized MSA (since it is a percentage compared to the natural state), rather than as MSA. Current policy applications have mainly been to see what changes are occurring at a global level.

34. In the next presentation, **Grégoire Certain** of the Norwegian Institute for Nature Research reviewed the process for compilation of the Nature Index (NI)[5] in Norway. He clarified that the NI is not a model for biodiversity, but rather a weighted index of scaled indicators. An expert panel of ecologists who provide the information that will be included in the NI are at the core of the NI development process. To develop an NI in another country, one would need to convene an expert group, which would, at a minimum, include a quantitative ecologist and informatician to sustain the database. In Norway 150 experts were involved with more than 300 indicators. The experts input reference information and document the reference condition (for a given indicator what would be the optimal state). The index is a weighted average, with the weights designed to assure equivalence between major ecosystems. The municipality is the basic spatial scale, and maps of ecosystem condition, trends of condition change, and local trends can be generated. Confidence intervals around trends based on lower an upper bounds for an indicator are also possible. If sociodemographic information is also available at the

[5] The Norwegian Nature Index provides information on the state of biodiversity in Norway's major ecosystems.

municipality level, it can be combined with the NI information. A thematic index can also be generated, depending on research/policy question of interest.

35. The meeting participants raised several points for discussion following the presentation. The central role of the expert group is consistent with work being done in Australia. A participant appreciated that the NI did not use natural reference condition, and prefers defining a sustainable reference condition. It was pointed out that a common date did not seem possible for reference condition in the NI—future work through the Steering Committee for the SEEA EEA and its associated expert group is needed to elaborate upon and seek consensus on the approach for determining reference condition. A participant noted that in looking through these models and platforms, one of the questions to consider would be whether there is a consistent set of indicators that emerge as appropriate for use in the SEEA EEA approach. There has been ongoing discussion at CBD regarding appropriate indicators to use, and groups of experts working to hone in on a set of indicators may be desirable. This could be an additional task for the Steering Committee and expert group to consider. Given the range of indicators in the NI, there was some concern about double counting (different indicators tracking the same thing); the weighting system in the NI is a strategy for tackling the potential double counting challenge—multiple indicators for the same species would result in each indicator getting lower weight.

36. **Bethanna Jackson** of Victoria University of Wellington presented the next model—LUCI/Polyscape[6]. LUCI is a second generation extension and software application of Polyscape. For carbon stock and emissions, it uses an approach that is fairly similar to InVEST, based on soil and vegetation. Water quality uses export coefficients. There are two simple approaches to considering biodiversity—habitat approach A (cost-distance approach) and habitat approach B (identification of priority habitat by biophysical requirements). LUCI requires three datasets—digital elevation data, land cover data, and soil data. The basic spatial unit varies depending on the area of analysis (50 X 50 m at global scale to 5m (UK) -15 m (New Zealand)). The LUCI approach focuses on biophysical where possible, but otherwise uses established, parameterized empirical approaches. The goal of the LUCI approach was to see what could be done using basic national datasets. It is modular, so the user can embed external models and also export aspects to other models. LUCI is currently being run on a national level in Wales, and aggregation and disaggregation is possible to allow for analyses on multiple levels. It uses ArcGIS software and standard Monte Carlo approach to uncertainty analysis. Economy is not explicitly linked in the current version, but there are plans to do an economic valuation of primary production. Flows to beneficiaries are not being done with LUCI—linkage with ARIES may be interesting in this regard. Stakeholder engagement is important for groundtruthing the model results and should be a component of the development and application of these models.

[6] Land Utilisation and Capability Indicator (LUCI) was first developed at Pontbren in Wales to investigate strategies for reducing environmental impact and improving the economics related to farming.

37. The meeting attendees raised several questions related to LUCI. It is available as a toolbox that can be put in ArcGIS, but a future version will have it as a separate interface. Many ecosystem services can likely be modelled using the basic layers required for the LUCI model. Regarding the scale of analysis, one of the unique attributes of LUCI is its ability to provide parameterization because it can be run at fine resolutions. Unlike LUCI, InVEST uses a lookup table, which may be difficult to translate across areas. The ability to run at fine resolutions is based on the way that the data is broken up in order to save computer processing time. One of the other reasons LUCI runs quickly is that it does not do coupling; this means that there is some sacrifice of the complexity of the interactions in the natural world. The full version of LUCI will likely not be available on the Web for another year.

38. **Brian Voigt** of the University of Vermont concluded the discussion of models and platforms with a presentation of ARIES[7]. ARIES is a modelling platform that uses open source data to generate a model customized to user goals. The models are developed through mediated modelling and application of local, global, and Bayesian belief networks, as appropriate. ARIES emphasized the connection between the ecosystem service provision and the location of demand (e.g., users). The output is quantitative, the unit depends on the service being considered, and uncertainty comes out of the Bayesian models. ARIES can incorporate existing biophysical models or other types of Bayesian models. Work is ongoing to scale up to global models, but matching up the users to providing area can become time consuming from a computational perspective. ARIES has a steep learning curve and 2-week training courses are provided. In terms of classification, one of the goals is building a crosswalk between different land use/land cover schemes.

39. Participants discussed several items related to ARIES following the presentation, including the terminology employed, the use of a Bayesian approach, the framework given to participants for model development, and the temporal aspect of ecosystem service flows. Some effort to create a crosswalk between the terminology used in ARIES and the terminology of the SEEA EEA could be helpful to allow users to understand how well the ARIES model covers concepts in the SEEA EEA. One participant asked if the use of Bayesian networks had been employed by national accountants. Statistics Netherlands has started using a modified optimization model, and it was suggested that national accounting may lend itself to these approaches since you often have more than one piece of information describing the same thing. The Bayesian approach is beneficial for ecosystems models since it can allow networks to be built from data in one location, with the transfer of those conditional probabilities to a comparable site. No strict rules are provided in the development of the ARIES model; the participatory framework primarily focuses on building a conceptual understanding of the system and then translating it into the source/sink/use/flow paradigm. The temporal aspect of ecosystem services (e.g.,

[7] Artificial Intelligence for Ecosystem Services (ARIES) is a federally funded project with support from the National Science Foundation. The ARIES consortium consists of the Basque Centre for Climate Change, University of Vermont, Earth Economics, Conservation International, INECOL, and UNEP-WCMC.

future beneficiaries for ecosystem service flows generated in the past) would be interesting to consider in future ARIES iterations.

Spatial considerations

40. **Greg Scott** of UNSD provided participants with an overview of the UN Global Geospatial Information Management (GGIM) process. GGIM is working to bring professional communities together to a greater extent than in the past, so that spatial data can be applied in a range of contexts. For the SEEA the availability of persistent and appropriate spatial data is important, as well as considering approaches for aggregating and disaggregating the data. GGIM is working to determine how satellite data can be provided in a consistent way that can support national and international decisionmaking.

41. The participants discussed several spatial data challenges for the SEEA following the presentation. Differing levels of vertical accuracy can pose challenges when trying to combine different layers of microeconomic and environmental information; depending on the model that is being run, this can create significant issues when mapping features to their "real-world" location. GGIM could assist in the work on the SEEA EEA by facilitating dialogue with national geospatial experts related to problems of spatial analysis (e.g., boundary problem, modifiable areal units). Its work on integrating socioeconomic information with geospatial information would be an important contribution to the identification of beneficiaries of ecosystem services.

42. **Florencia Sangermano** of Clark Laboratories discussed the application of IDRISI software to ecosystem analyses. IDRISI is a mapping, analysis and display platform for geospatial monitoring and modelling where the user can bring in data in other formats and also export to other software systems. It can take images and classify them in an unsupervised (finds areas that are of similar reflectance and clusters them together) or supervised (user specifies an example of a particular classification and the algorithm than applies that classification to other similar areas). Hard classification assigns each pixel to a given category while soft classification provides a probability of a pixel being a certain land type. The land change modeller tool allows the user to look at future land cover changes and relate them to various drivers of change. There is a also a habitat and biodiversity modeller, an IUCN subset tool, which allows the user to extract species-specific data for a given area, and a climate change modeller tool, which takes the input used for the IPCC report scenarios and allows for consideration of uncertainties in sea level rise and elevation.

43. After the presentation, participants discussed the links between the models and the mapping in IDRISI. IDRISI can implement several types of modelling approaches—the current work with InVEST was based on funding from the Moore Foundation, but incorporation of other platforms (e.g., ARIES, GLOBIO) would be possible. One of the improvements in the IDRISI interface compared with the standalone InVEST tool is that the IDRISI interface is programmed to avoid the image size limitation of the standalone module. Models are updated as funding allows and use of a command line can streamline any necessary updating. The key role of data as an input into any of these models and maps was mentioned with a need for standard datasets that are updated on a regular

basis. By having standard datasets and stable classifications, all of the models would be working from a common source. Core vocabulary for ecosystems should also be established—for example, what is the metric for biodiversity, as all of the models approach it in a different way. Many of the models do not know what standard approach for classification, data, maps, and metrics to follow and a collective decision (e.g. use of the SEEA EEA or additional standards proposed by the United Nations) in this regard would be helpful. The GEO Biodiversity Observation Network is working on some of these issues.

44. **Louise Willemen** of EcoAgriculture Partners followed the discussion with a presentation on mapping tools developed through the Ecosystem Services Partnership. The project grew out of a desire to organize the maps that are available into an easily accessible online format. An alpha version of the site that compiles the various maps is available at http://esp-mapping.net/Home/. The goal is to have an interface for collaboration and sharing of maps and underlying data. Next steps include a beta version, use of CICES and linkage to other classification systems, and development of a clear linkage to work being done by the Marine Ecosystem Service Partnership.

45. Participants discussed the use of a standard color for the maps, the classification of biomes to create areas that are mutually exclusive, and the use of boundaries and ecotones (noting that the choice of the location of the boundaries is subjective). At present, they have not standardized the colors used in the online maps since they want the user to retain control over the maps provided. Biomes for selection by map providers are currently as classified by the Ecosystem Services Partnership, but there is some discomfort with this approach as it mixes different concepts; further work is needed in this area. There may be a need to look at the consistency of how people are assigning their mapping activities to different biomes. Regional boundaries and the use of ecotones are as determined by the user uploading the map. The group also indicated some desire not to reinvent the wheel in this kind of work, as national data centers are working to compile information. It was clarified that the platform only provides a link to the metadata and the map—no data beyond that. Listing of beneficiaries or beneficiary types may also be useful.

Experiences

46. Following the discussion of the specific models and platforms, several attendees presented on experiences applying the ecosystem service models.

47. **Kenneth Bagstad** of the U.S. Geological Survey presented on the use of ARIES and InVEST in the San Pedro River watershed. The use of both models enabled comparison of results. For landscape-scale change, the models aligned fairly well; however for the site-level scale, results were not as comparable. Additional studies applying multiple models at the same location are needed to evaluate the ability to replicate output from the different models. In terms of the use of the models, he pointed out that populating the lookup tables in InVEST can be a challenge. Both models took a significant amount of time to run and the final conclusion was that they were too resource intensive to use in regional land management offices. Even in "data-rich" areas, the team encountered data

limitation challenges. Ongoing work in Utah will consider tradeoffs between natural resource extraction and other benefits. Social values mapping is another area for future investigation.

48. Following the presentation, there was some discussion about the use of ensemble models, the scale of analysis, and the availability of the underlying datasets. Ensemble models similar to the approach used by IPCC were suggested as a possibility for ecosystems analysis that might help with statistical analysis and issues of spatial uncertainty. A challenge with an ensemble approach is that many of the ecosystem models currently operate at different scales and there is a lack of comparative studies. In terms of scale, many accounting transactions occur at what might be the equivalent of the site level, but it may still be informative to see what is happening at the larger scale as well. The underlying datasets used in this study are publicly available.

49. **Bridget Emmett** of the Centre for Ecology and Hydrology discussed the application of LUCI at the national scale in Wales. The Glastir Monitoring and Evaluation Programme (GMEP) aims to quantify the extent, condition, and change of natural capital assets and ecosystem services in Wales. For this assessment, there were multiple benefits derived from the use of LUCI, including the biophysical basis, the ability to run on 3 datasets, the scale, and the ease of the user interface. LUCI was used to model across a range of services (e.g., provisioning, regulating, and cultural) and outcomes (e.g., biodiversity, climate change mitigation (carbon), historic landscapes, water management) under the GMEP ensemble approach. Eventually they envision a key role for monitoring, but, in the mean time, models will help give early data and provide room for extrapolation. LUCI provided outputs appropriate as metrics of condition and extent (e.g., woodland biodiversity, water flow and quality, carbon) and as well as services (e.g., habitat, flood regulation, production, historical landscapes). Future work with LUCI in Wales will include development of information for cost-benefit analysis and a LUCI app for in-field assessment and self reporting by farmers. Additional activities will focus on comparing LUCI and InVEST in Wales, and Costing Nature, InVEST, and ARIES in sub-Saharan Africa.

50. Following the presentation, participants raised questions regarding the planned Ecosystem Services for Poverty Alleviation (ESPA) project. At the moment, the project is in its exploratory phase and three countries may be selected for the work. It was suggested that Uganda be considered for this project.

51. **Miroslav Honzak** of Conservation International followed with a presentation of the Ecosystem Values Assessment and Accounting (EVA) project being conducted in Peru. The accounting approach (based on the SEEA EEA) will require biophysical information on condition, capacity, and flow. He shared the preliminary biophysical approach being considered by Conservation International, which consists of the use of a Comunidad Andina map for ecosystems in combination with precipitation and water balance data from WaterWorld. The rate of water yield is used as a measure of ecosystem condition, the beneficiaries are rice growers, and the service is the flow of water to these growers. For the Ecosystem Accounting Unit (EAU) they may consider using hydrologic units or

district boundaries. The project is in its early phase and input to ensure its consistency with the SEEA EEA is welcome.

52. Questions from the group focused on the condition measure proposed for the model and the alignment of the conceptual framework of EVA with the SEEA EEA. Within the model, there are 128 parameters characterizing water provision, suggesting that the metric used goes beyond what is included for water in the SEEA Central Framework. In terms of the conceptual framework, care was suggested in the definition of *capacity* as it needs to incorporate some judgment on potential future uses of the ecosystems; ecosystem condition is needed before an assessment of potential future uses can be completed. It was also pointed out that it will be necessary to carefully think through the plans for valuation, as approaches acceptable to national accountants may not meet the information needs of other stakeholders.

53. **Richard Mount** of the Australian Bureau of Meteorology presented on experiences applying ecosystem accounts in Australia. There is a cooperative atmosphere related to the ecosystem accounting work in Australia, with the Australian Bureau of Statistics and the Department of Environment and Primary Industries in Victoria being key players. Land accounts are a central core account for ecosystem accounting, and have been completed for various areas in Australia. A building block approach is being employed in Australia, starting with building the asset accounts, getting at condition, and later working on beneficiaries and ecosystem services. Work is ongoing on experimental biodiversity accounting, using a moving window approach and application of a species area curve. Vegetation connectivity is also an area of research with one approach combining habitat amount, core amount and habitat separation to arrive at a connectivity index; the index can be tracked over nearly 40 years through the use of Landsat imagery. Development of net ecosystem productivity accounts (based on fluxes of carbon) in collaboration with the Commonwealth Scientific and Industrial Research Organisation has been informative in demonstrating the interannual and intraanual variability in net ecosystem productivity. Water quality accounting work is underway on the Great Barrier reef, using secchi depth as a measure of condition.

54. The group discussion following the presentation focused on the biodiversity and carbon accounting work as well as the challenge of defining ecosystem boundaries. There was the suggestion to determine a small group of metrics to move forward with and evaluate for use in biodiversity and carbon accounting. In discussion of the bird species richness measure, it was clarified that the index used a species area curve approach, with the curves developed over many years by vegetation types—the model does not assume that birds will stay in one given grid cell. Related to the carbon work, there was some question about N and P limitation and how the model addresses that when looking at CO2 fertilization. It was noted that the main driver in Australia was rainfall with a carbon fertilization signature. Boundaries for ecosystems will always be fuzzy and at some point a line will need to be drawn; the way space is divided may depend on the purpose of the account being constructed.

Session III: National and International Ecosystem-Related Initiatives

Outcome and Actions:

- **Ecosystem service classification schemes are critical to the SEEA EEA. The FEGS-CS developed by the US EPA appears mostly consistent with the SEEA EEA and brings the important additional perspective of classifying beneficiaries. Additional work on CICES is needed to clarify the distinction between intermediate and final ecosystem goods and services. Moving forward, the SEEA EEA research and testing agenda should review the FEGS-CS and CICES, in the context of any conceptual differences with the SEEA, and provide recommendations on a classification scheme combining ecosystem services and beneficiaries.**

- **The beneficiary perspective is an important element of the SEEA EEA work. International and national institutions should work to develop a database of ecosystem service beneficiaries. This database could be established through survey and census methods, such as adding additional questions to a national census.**

Summary of discussion:

55. **Dixon Landers** of the U.S. Environmental Protection Agency presented on the Final Ecosystem Goods and Services Classification System (FEGS-CS). The vision was to develop a classification system for ecosystem services that can be used nationally, regionally, and at the state and community level. The FEGS-CS perspective links the beneficiary to the resource used and looks at the relationship (and boundary) between the ecological and economic production functions. Environmental classes are drawn using Landsat and final ecosystem goods and services received are the combination of environmental class and beneficiary. The classification links an environmental resource class (e.g., lakes and ponds) and sub-class (e.g., saline lakes) and a beneficiary category (e.g., agricultural) and sub-category (e.g., farmers). Current work is looking at identifying metrics and indicators for each of the FEGS; for example the National Aquatic Resources Survey will look at metrics for 4 types of water resources.

56. Following the presentation, several questions and topics were discussed, with a significant focus on the compatibility of the FEGS-CS with the SEEA EEA structure. Participants were in general agreement that the FEGS was mostly consistent (aside from some semantics) with the intent of the SEEA EEA and the CICES classification system proposed for use. There may be additional effort needed in seeing how specific examples and applications would be treated under each approach, noting any areas of conflict. FEGS aims to focus as much as possible on what the environment provides and separating the ecological from the economic component. Several participants noted the usefulness of this approach for looking at classification from the beneficiary perspective. There was also some discussion of how one would populate the beneficiary database and locate the required information on what people need and where they get it from, including transboundary services. There was the suggestion that additional questions in a National Census may be useful in this regard and assist in educating the public about their dependence on the environment; Canada has a document of what people care

about related to the environment that may be informative in this regard. A workshop of social scientists and economists would also be useful to get a better sense of what people care about. There was some discussion of CICES and additional work needed there on making the distinction between intermediate and final ecosystem services. Some participants mentioned the ongoing challenges in dealing with ecosystem "disservices" and the classification of conservation (different types of beneficiaries that change over time). A focused evaluation of the classification schemes available, and their similarities and differences would be an important task in moving forward with the SEEA EEA research agenda.

57. **Mark Eigenraam** of the Department of Environment and Primary Industries in Victoria, Australia, followed with a presentation of the EnSym platform. EnSym integrates different models so that users can access all of them at the same time. When Victoria embarked on developing a Payment for Ecosystem Services plan, there was the need for a system that could "plug and play" and that was consistent across the landscape. Multiple published, referenced models (e.g., PERFECT, EPIC, SWAT) are used on the biophysical side, and the platform produces a quantitative output. EnSym is built in Matlab and the executable file is free and downloadable and can be run in a PC environment. Labor required will depend on the underlying models selected. Minimum data needs include maps on land use and management, DEM, climate (daily), and soil. Uncertainty can be incorporated at all stages. Changes in indices can allow for evaluation of changes in the level of function.

58. Participants raised questions related to how the model deals with connectivity of tenures and also the links of the EnSym terminology with the SEEA EEA terminology. Connectivity is an ongoing challenge, given the computational time requirements for more complex systems, but water connectivity may be one strategy for addressing this issue. There are differences in terminology when compared with the SEEA EEA—for example, the Ecosystem Benefit Index is not ecosystem service benefits, but a measure of ecosystem condition. Services to other ecosystems are in this metric, compared with the anthropocentric view of beneficiaries in the SEEA EEA. Further work on developing global models is needed in general; there needs to be a larger scale model that is linked to a finer grained model for local analysis. The importance of engagement of the various user groups when designing the platforms and interfaces was reiterated; however, trying to make an interface that will work for a range of users can be challenging .

59. **Eugenie Regan** of UNEP-WCMC provided an overview of the TESSA toolkit, which is designed for work on the site level. The tool is designed for use by non-experts by groups with limited technical capacity. The tool can be used to get data on the ground, which can then be fed into models—it assists in guiding non-specialists through low-cost methods. There is no GIS component and the software required is Excel. Primarily it is a scoping exercise that does not yet quantify all the services that might be coming from a site. The tool uses CICES and is adaptable with minimal labor and infrastructure requirements. Linking ecosystem services to beneficiaries is an important component of the process outlined through TESSA.

60. Following the presentation, participants noted that the TESSA toolkit appeared useful for stakeholder engagement. One participant asked about how the assessment incorporates vulnerability to extreme events; that is one of the areas the TESSA group would like to look at moving forward. A challenge that comes up in performing this type of assessment is that some services may be difficult to measure, such as several under the rubric of cultural ecosystem services.

Session IV: Next Steps for Testing and Planning of Pilot Projects

Outcome and Actions:

- **A medium-term programme of work that includes a communication and funding strategy is needed. The programme of work will assist in communicating the objective of the SEEA EEA research and testing, namely the development of an internationally agreed measurement framework for ecosystems for official statistics, and securing funding. In the short term, a Steering Committee, related Terms of Reference and 3-year programme of work need to be established.**

- **Experimentation of SEEA EEA concepts and comparison of potential models in "data rich" and "data poor" countries will assist in advancing the research and testing agenda and should begin as soon as possible. There are a broad range of policy needs and objectives for the ecosystem accounting and data availability at country level. The model selection process in the pilot trials should therefore be related to specific country policy priorities and national data availability.**

- **For the purposes of the pilot testing, standardization of datasets (where feasible) and approaches is important to allow comparison of model outputs. This includes standardizing datasets for inputs into the models (e.g., land use/land cover) as well as standardization of ecosystem classification schemes and approaches for classifying objects from remote sensing data. The proposed Steering Committee and technical committee should include working on the development of standards in these areas for application in national pilot trials as part of its programme of work. Development of a virtual platform for the community of practitioners of the SEEA EEA may be useful in advancing the standardization and facilitating communication of lessons learned as pilot projects begin.**

- **The technical committee will need to address the standardization issue described above, as well as to explore the underlying datasets themselves. For this purpose, the technical committee should meet on regular basis by teleconference and, when possible, face-to-face to discuss issues related to the statistical production process of specific national SEEA ecosystem accounts, taking into account the processing of basic biophysical data from land cover and land use maps to the SEEA EEA accounting tables.**

Summary of discussion:

61. The meeting participants engaged in a general discussion of the plans for moving forward with the research and testing of the SEEA EEA.

62. There is the need to work on providing a gradient between low resolution and high resolution analysis and finding the appropriate "zone" for different user groups. The "zone" that is appropriate will change significantly depending on who is going to be using a given model. A starting point may be thinking of the user group and moving forward from that point. Part of this would include determining the needs of different countries.

63. The establishment of mechanisms to advance the SEEA EEA need to be addressed in the very near term, with the development of a concrete plan for action that links to the SEEA EEA research agenda, which provides the legitimacy for this undertaking. This may take the form of a 3-year programme of work to be developed within the next 2 months. In order to prepare the programme of work, a Steering Committee is to be established, assisted by technical committee to advance the programme of work. The overarching objective of developing an internationally agreed measurement framework for ecosystems for official statistics should guide the activities undertaken for the SEEA EEA.

64. The steering committee and technical committee described above may coordinate with a broader annual forum of experts. Coordination with existing ecosystem-related networks and conferences (e.g. the IPBES, CBD processes) should also be pursued to advance the SEEA EEA towards an internationally agreed accounting framework.

65. Funding issues will also be important for the steering committee to consider. Development of programme of work will assist in communicating the objectives and purpose of the SEEA EEA project and securing funding. There is likely a wide network of philanthropy that is not yet being reached. Funding should not be limited to developing countries, but is required to support advancement of this work in all countries.

66. Other technical meetings would be valuable where the participants choose an account and work from basic data to the population of the SEEA EEA tables to policy applications. Several participants indicated the need to clarify how to move from the basic biophysical data and geospatial maps through to the accounts and tables of the SEEA EEA and through to policy application. This clarification should also include the use of the models in generating the accounts and tables. The preparation of guidance material on linking models to tables and then to policy would be an important output in the near term of the work programme.

67. Standard databases, layers and units (land use/land cover, biomes, vegetation types, metric on what to measure, etc.) are important for allowing for comparisons across models and for advancing work in this area. A consensus regarding ecosystem service and ecosystem condition classification schemes could be an important output of the work programme. A platform for sharing this information among a community of environmental-economic accounting practitioners could facilitate this standardization and comparison of models.

68. Experimentation and testing in pilot countries of the SEEA EEA led by national steering committees is critical to making progress on the research and testing agenda. Applying the models in several different countries will help in the development of the

SEEA EEA. Countries that are not data rich should be included as well as countries that are data rich.

69. In the context of the country trials, several participants indicated that it may be beneficial to force the country trials to be at a national level; this would encourage a focus on balancing complexity with obtaining initial broad national results.

70. In the selection of models for piloting at country level the countries should consider issues of technical complexity, data intensity and availability, and policy use. Choosing one model may be difficult. The choice of the models may be affected by the specific services of interest at the national level.

71. The availability of high quality datasets at country level is an important aspect of the experimentation and testing of the SEEA EEA and needs to be addressed in the near term. GEOSS should be contacted to explore whether and how globally available data can be applied at the national level.