Note on Valuation of Ecosystem Accounts

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Purpose

1. The main context and driving thrust for valuation is the belief among many economists that if we can determine monetary values for non-market goods and services, we could use the market mechanism to allocate them more efficiently or otherwise 'internalize' the values into a market-based scheme. This is the reason that calculation of 'prices' or monetary valuations has become one of the most active and promoted areas of research in environmental economics. It is important to be clear from the outset that the valuation task is not a simple one and that the premise for doing valuation at all remains somewhat controversial. Once it has been decided to undertake monetary valuation as part of an accounting system, it is important to not lose track of the original purpose for doing the valuation so that the results properly accommodate the users.

2. The brief, introductory discussion that follows aims to address specifically the scope of valuation within national ecosystem accounting and the UN System of Environmental-Economic Accounts (SEEA). A certain level of completeness of coverage is required for national accounting in order to have a coherent representation of balances between opening and closing stocks and so that macro-level indicators can be derived with policy relevance for the highest levels of government. Also, national accounts are designed to be compiled at regular intervals (in most cases annually) in order to produce a constant and coherent time-series for evaluating the overall state and health of the system over the long term and not only as a snapshot in time. Any valuation techniques or proposals that cannot be applied to these fundamentals of national accounting do not fall within the scope and context of this discussion.

Valuation in ecosystem accounts

3. There are basically two complementary types of monetary valuation discussed in the literature and proposed here for ecosystem accounts: (i) the valuation of degradation to ecosystem capital and (ii) valuation of ecosystem services flows.

4. Valuation of degradation should be comprehensive of all ecosystem units in the accounts and the focus is on changes for each period. Valuation of ecosystem services focuses on the flows within a given accounting period and, in practice, may not be

comprehensive of all services and systems.

5. Although over time an evaluation of degradation and the value of ecosystem services ought to be correlated, by the time that loss in value of services can be identified through a time series of historic compilations of accounts it is too late to prevent the loss and may be expensive and technically difficult to reverse the trend. An earlier warning is needed in terms of degradation, which is defined in terms of capacity for delivering services.

6. In reality, the relationship between degradation and loss of services is non-linear and highly complex. There are usually multiple factors that can affect multiple types of degradation and it is unrealistic to assume direct 1-to-1 relationships between drivers and impacts in terms of lost ecosystem services. This proposal, therefore, does not attempt to make or assume a complete and detailed model of these complex relationships. Instead a set of simple yet powerful rules are identified to indicate changes in the health of ecosystems in terms of general capacity for delivering a range of services to humanity, allowing that values of the flows of services can also be calculated in a complementary account.

Valuation of degradation

7. Degradation valuation consists of reviewing decline in vital health signals that impact the capacity of ecosystems to deliver services in the context of their economic costs. These measures are derived from the physical capital accounts of ecosystems compiled for the same period and scope of ecosystems. The idea is to evaluate the changes from the beginning to end of a period with negative changes recorded as degradation or losses in value. These losses in value may be recovered through restoration measures or may be left as is, i.e. not paid for in which case the lost value would be treated in the accounts as being equivalent to a debt.

8. The proposal is to treat degradation of ecosystems like consumption of fixed capital in the SNA. As with all valuations in the SNA, consumption of fixed capital is measured in terms of prices, where available. When there are no market prices the valuation needs to approximate what the prices would be if a market existed. This is different than determining the value to society - which could be defined in a number of different ways.

9. According to microeconomic theory, prices help create efficient allocations of scarce resources through the interactions of supply and demand, or marginal costs and benefits. They do not represent value in terms of, e.g., willingness to pay. Willingness to pay includes consumer surplus which, by definition, is not included in market prices. Therefore to be consistent with the SNA, the valuation of degradation in ecosystem accounts approximates prices rather than a holistic or social identity of value. This is important because consumer surplus for most ecosystems (and their services) could be practically infinite since they are necessary for life. Taking a holistic or social welfare

approach to valuation of ecosystem would provide, in many cases, astronomical and ultimately meaningless figures.

10. Restoration and maintenance costs incurred to maintain the beginning of period standard of health or state of an ecosystem reflects the actual market determination of the intersection between supply and demand for maintaining that given level of ecosystem function. The degradation to an ecosystem during a given time period may be completely mitigated for a cost well below what society would have actually been willing to pay. In principle, we propose that the costs of restoring an ecosystem from a state or level of health at period 1 to one that is equivalent to period 0 represents a reasonable approximation of the 'price' – i.e. the intersection of both the marginal benefit and marginal cost - of that specific amount of degradation to the ecosystem. Identifying this 'price' of degradation is useful in the accounts because this information can be used to aggregate across ecosystems to produce macro-level indicators of consumption of fixed capital, or debts, incurred for the case of natural capital.

11. One key problem with this approach is that the restoration and/or maintenance costs do not (directly) measure the value of opportunity costs in terms of lost ecosystem services – i.e. the complete opportunity cost from the perspective of society or the total present value of future streams of income (services) from lost rent. We submit that while there are a number of new methods are being tested to value flows of ecosystem services for a given time period, it remains uncertain whether these methods can also be used to calculated opportunity costs from degradation. As already mentioned above, the links between degradation and services are non-linear and prone to added complexity from the fact that ecosystems, when managed sustainably, are renewable.

12. Another problem with the restoration and maintenance costs approach is that in practice the realization of the costs is likely to happen only in a later period, implying that the valuation can only be made *ex post*. Moreover, as already mentioned, restoration or necessary maintenance may not happen at all. Or the expenditures might partially restore a damaged ecosystem but not recover all degradation incurred during a given accounting period. Therefore, valuations need to be made based on estimations using information from previous like situations where restoration did occur, or using estimations made for, e.g., insurance purposes. In fact, these kinds of estimates for major forms of environmental degradation are made regularly by government and industry for the purposes of cost-benefit analysis. The challenge in the ecosystem accounts valuation will be to identify these market rates and accurately attribute (generalize) them to the additional (marginal) level of degradation identified in the accounting period. It is essentially an exercise in identifying the market rate for a comparable service – a technique already familiar to national accountants. However, in practice, the links between physical measures of degradation to existing market information on restorations and maintenance need to be more clearly understood in order to achieve this.

13. An important advantage of accounting for degradation in accounts is the valuation of costs or debt incurred are attributed to the specific year or accounting period. Putting a value of all historical degradation and identifying it in an account as consumption of

fixed capital is clearly inconsistent with the SNA and not the measure we are looking for. In order for the accounts to be meaningful for producing macroeconomic indicators and adjusted economic aggregates, the figures need to represent the marginal changes for a given period and not try to put a value on all previous degradation. The proposal is to use variables to assess ecosystem capacity in terms of the change over a given accounting period; and hence historical degradation is taken as a given at the beginning of the period (in the same way that distribution of wealth is taken as a given at the beginning of the accounting period in economic accounts).

Valuation of ecosystem services

14. Experience with ecosystem services valuation thus far shows that a combination of methods is needed in order to incorporate the range of services and associated circumstances. EEA (2010) provided a summary of approaches in a table reproduced below:

Table 1: Approaches to ecosystem service valuation

Methodology	**Approach**	**Applications**
Change in productivity	Value impact on change on (market) products	Any impacts on products – need an observable change to production of valued product
Cost of illness, human capital	Value impact on morbidity and mortality and/or health problems	Any impacts on health (e.g. air & water quality)
Replacement cost	Cost of replacing the lost good or service	Any losses that can be replaced/restored
Travel cost method	Derive demand curve from actual costs of travel	Recreation, tourism
Hedonic prices	Disentangle effect of environmental factors on prices of goods and services	Air quality, scenic beauty, cultural benefits (e.g. of green spaces on property values)
Contingent valuation	Survey willingness-to-pay for a specific service	Any service
Choice modelling	Survey preferences for a set of options	Any service
Benefits transfer	Generalize results from comparable situations in different contexts	Any service for which suitable comparisons are available

Source: Adapted from table appearing in Haines-Young, Potschin, Kumar and Weber, eds. Ecosystem accounting and the cost of biodiversity losses: The case of coastal Mediterranean wetlands. EEA Technical report No 3/2010

15. Some of the methodologies listed above can be dismissed immediately for lack of coherence to the context of national accounting. Contingent valuation, or willingness to pay surveys, for example, is out. The travel cost method is relevant only for the case of recreational or tourism services.

16. One potential approach that has begun to emerge as an important possibility in the environmental accounting community and is not specifically described in the above table

is use of markets for conservation of land and ecosystems. Payment and/or trading schemes are increasingly being established by governments and other institutions for the purpose of preservation of natural systems on private land. In Australia, for example, the government has established a subsidy or payment scheme for private land owners for setting aside a certain area of land as a protected natural system.[1] These payments are distinct from the maintenance or restoration costs identified for valuation of degradation because they are made specifically to sustain a set of existing services and protect them from becoming eliminated by a competing interest for the land. In some cases, such as a bank scheme set up for wetlands in Washington State[2], private markets have even been developed for sustaining services with values determined by demand and a scientifically-determined supply of permits. Essentially, in a permit or conservation-orientated payment scheme, an institution, whether it be a private land owner or the Australian government, is purchasing something – and arguably that something is the set of ecosystem services provided by that space.

17. Again, the approach clearly does not capture the complete value of the services in terms of social welfare (or consumer surplus). But this is not our aim. Valuation from a social welfare, or consumer surplus, perspective may not be able to incorporate the dimension of scarcity. Payments for protecting services do reflect scarcities to the extent that they are embodied in the supply and demand relationship between the purchaser and the land owners (Because if the services were not scarce, why would an institution bother to make payments or establish a permit system to preserve them?).

18. One limitation of this approach is that it focuses only on certain ecosystems and does not separately identify individual ecosystem services. Identification of the services would rely on an *ex post* analysis of the functions of that particular area and documentation (where available) explaining the reasons that the payments or market was deemed necessary to begin with. Even in cases where a short list of ecosystem services 'purchased' through the payment scheme can be clearly identified, it may not be possible to disentangle the values for each individual service in ecosystem accounts. Also, while such types of schemes are growing, clearly most ecosystems and their services remain outside of the scope of any such program; thus the approach requires that the policy precede and inform the accounting. This is a serious limitation since ideally the information from the accounts would be useful to inform development of such policies, and not vice versa. This point also underlines the fact that this approach to valuation makes use of the *a priori* sustainability assessment made in order to design the payment or permit scheme to begin with. Therefore, using the valuations for any type of assessment or evaluation of the existing policy would be a form of circular reasoning. But such valuations would potentially be useful for other purposes, such as to aggregate across valuations of different types of systems or types of services and to provide a broad context integrated within the accounts of the relative scale of market-based expenditures

[1] M. Vardon, Presentation at World Bank WAVES Meeting (http://siteresources.worldbank.org/INTRANETENVIRONMENT/Resources/waves_australia_presentation.pdf)

[2] http://www.ecy.wa.gov/programs/sea/wetlands/mitigation/banking/index.html

for sustainable use of ecosystem services that otherwise would be allocated as public goods.