DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS
STATISTICS DIVISION
UNITED NATIONS

System of Environmental Economic Accounting

System of Environmental-Economic Accounting 2012 - Experimental Ecosystem Accounting Revision

Chapter Draft prepared for Global Consultation

Chapter 4: Accounting for Ecosystem Extent

March 2020

Disclaimer:
This draft chapter has been prepared under the auspices of the SEEA Experimental Ecosystem Accounting Technical Committee as part of the work on the SEEA EEA Revision being coordinated by the United Nations Statistics Division. The views expressed in this paper do not necessarily represent the views of the United Nations.

Contents

SECTION B: Accounting for Ecosystem Extent and Condition

4 Accounting for ecosystem extent

4.1 Purpose in accounting for ecosystem extent

4.1 A common starting point for ecosystem accounting is the organization of information on the extent of different ecosystem assets (EAs) within a country or other ecosystem accounting area (EAA), and how that extent is changing over time. This information is summarised in an ecosystem extent account.

4.2 Accounting for ecosystem extent is relevant for four reasons. First, an ecosystem extent account provides a common basis for discussion among stakeholders of the composition of, and changes in, ecosystem types within a country. Thus, an extent account supports the derivation of coherent indicators of deforestation, desertification, agricultural conversion, urbanization and other forms of ecosystem change; they support the measurement of ecosystem diversity and the derivation of indicators of changes in biodiversity; and when information underpinning an extent account is mapped, it can support an understanding of the configuration of ecosystem types within an EAA and how this is changing over time (e.g. with respect to fragmentation of the landscape, or changes from an historical baseline).

4.3 Second, given a core intent of ecosystem accounting is to mainstream ecological data in economic planning and decision making, the organisation of data on ecosystem extent provides a straightforward but meaningful entry point to the discussion of ecosystems for those less familiar with ecological concepts and data. In particular, extent accounts provide a common framing through which other data about ecosystems can be presented.

4.4 Third, the structure of the ecosystem extent account, as set out below, demonstrates in an accessible and readily interpreted way the capability of accounting to provide a time series narrative, in this case through the estimation of opening and closing balances for an accounting period. Showing a time series of change is particularly important to reveal the degree to which the extent and configuration of ecosystems have changed, particularly through human activity.

4.5 Fourth, the spatial data required to compile an ecosystem extent account provides an underlying infrastructure for the measurement of ecosystem condition and for the modelling of many ecosystem services. In both cases the relevant indicators of condition and services will commonly vary by ecosystem type.

4.2 Ecosystem extent accounts

4.2.1 Scope of extent accounts

4.6 Following the principles described in Chapter 3, an ecosystem extent account is compiled for the total area of an EAA. Thus, an ecosystem extent account records the areas, and changes in areas, of all of the EAs within an EAA. Most commonly, in an extent account data on the area of individual EAs are presented using a classification of ecosystem types (ETs) such that the areas of all EAs of the same ET are aggregated.

4.7 In concept, at the national level, the EAA extends to cover all terrestrial, freshwater and marine ecosystems with a boundary set by the country's border with other countries and its exclusive economic zone (EEZ). Compilers may choose to use an EAA of smaller scope – for

example using a focus on the terrestrial or marine realm or a focus on a sub-national region. Nonetheless, given the use of the design principles for the delineation of spatial units described in Chapter 3, it will be possible to combine relevant EAA to provide a more complete set of accounts over time.

4.2.2 Structure of extent accounts and accounting entries

4.8 The structure of an ecosystem extent account is shown in table 4.1. The structure of the columns reflects the logic of asset accounts as described in the SEEA Central Framework, with an opening extent, closing extent, and additions and reductions in extent. Entries are in terms of area using measurement units appropriate for the scale of analysis e.g. hectares, square kilometres.

4.9 The row headings correspond to the classes of the selected ET classification. In table 4.1, the ETs reflect the biome level (level 2) of the SEEA ET reference classification based on the IUCN Global Ecosystem Typology (GET), as described in Chapter 3. This level has been applied here for ease of presentation noting that it is recommended that compilation of ecosystem accounts be undertaken at the ecosystem functional group (EFG) level (level 3). The full classification is presented in Annex 3.2.

4.10 At country level, it will be most appropriate to compile accounts using an existing ET classification and to make a correspondence to the SEEA ET reference classification for the purpose of international comparison.

Table 4.1: Ecosystem extent account (Units of area)

	Selected ecosystem types (based on Level 3 - EFG of the IUCN Global Ecosystem Typology)																					
Realm	Terrestrial							Freshwater			Marine				Transitional							
Selected Ecosystem Functional Group (EFG)	Tropical-subtropical lowland rainforests	Boreal and temperate montane forests and woodlands	Seasonally dry tropical shrublands	Trophic savannas	Semi-desert steppes	Ice sheets, glaciers and perennial snowfields	Croplands	Permanent upland streams	Large permanent freshwater lakes	Large reservoirs	Seagrass meadows	Epipelagic ocean waters	Continental and island slopes	Submerged artificial structures	Tropical flooded forests and peat forests	Deepwater coastal inlets	Rocky shores	Coastal shrublands and grasslands	Artificial shores	Coastal river deltas	TOTAL
	T1.1	T2.1	T3.1	T4.1	T5.1	T6.1	T7.1	F1.1	F2.1	F3.1	M1.1	M2.1	M3.1	M4.1	TF1.1	FM1.1	MT1.1	MT2.1	MT3.1	MFT1.1		
Opening extent																						
Additions to extent																						
Expansions																						
Managed expansion																						
Natural expansion																						
Upward reappraisals																						
Reductions in extent																						
Regressions																						
Managed regression																						
Natural regression																						
Downward reappraisals																						
Net change in extent																						
Closing extent																						

*<<**Note to reviewers**: The selection of ET in the ecosystem extent account (and in the ET change matrix, Table 4.2) is intended to give an illustration of the structure of the accounts and should not be considered a definitive list of EFG to compilation or comparison. The selection is based simply on using the first EFG listed in each of the IUCN GET biomes.>>*

4.11 From an accounting perspective, there is no specific limit on the number of classes that are included. The choice made should be dependent on relevance of different ecosystem types and data availability. The overall constraint is that the sum of the areas of different ETs must be equal to the total area of the EAA.

4.12 The accounting entries encompass opening and closing extents, additions and reductions in extent and reappraisals. The following treatments should be applied noting that depending on data availability, it may not be possible to complete all accounting entries that distinguish the different types of additions and reductions. In this case, it is sufficient to record the opening and closing extents and the net change in different ETs. This level of detail can still provide important information on trends in ecosystem extent.

4.13 Relevant accounting entries are:

- Opening and closing extents represent the total area of EAs for a given ET at the beginning and end of an accounting period, generally one year.
- Additions to extent represent increases in the area of an ET. Where possible, additions to extent should be separated into managed expansion and natural expansion.
    - Managed expansion represents an increase in the area of an ET due to direct human activity. Examples include the conversion of forests into agricultural land or land reclamation work in coastal areas. Human activity may also create new areas of more natural ecosystem types, for example by the reforestation of agricultural areas.
    - Natural expansion represents an increase in area of an ET resulting from natural processes, including seeding, sprouting, suckering or layering. Natural expansion can be influenced by human activity, for example, the expansion of deserts due to the effects of climate change.
- Reductions to extent represent decreases in the area of an ET. Where possible reductions in extent should be separated into managed regression and natural regression.
    - Managed regression represents a decrease in the area of an ET due to direct human activity. Examples exclude deforestation and increases in urban areas.
    - Natural regression represents a decrease in area of an ET associated with natural processes, including for example extreme events such as hurricanes and bushfires. Natural regression can be influenced by human activity for example the loss of coral reefs due to the effects of climate change.
- Reappraisals can be upward or downward. They represent changes due to the use of updated information that permits a reassessment of the size of the area of different ETs, for example, from new or re-interpreted satellite imagery. The use of updated information may require the revision of previous estimates to ensure a continuity of time series.

4.14 Generally, additions to one ET will be matched by an entry for reduction in another ET, for example an increase in agricultural land may be matched by a reduction in forest land. If there is an addition or reduction in the total area of the EAA a matching entry is not recorded.

4.15 Changes in total area due to political factors (e.g. changes following a realignment of borders) should be recorded as upward or downward reappraisals for the relevant ETs. These changes do not require revisions to past accounts although it may be of analytical interest to compile historical information pertaining to new ET within an expanded EAA.

4.16 The area of an EAA for a national jurisdiction including marine, terrestrial and freshwater realms is unlikely to change significantly from the opening to the closing stock. Hence, the

total area recorded in the right-hand column of Table 4.1 will generally be the same for the opening and closing extent and hence the total additions will equal the total reductions.

4.17 However, changes at the margins of the realms, particularly between the marine and terrestrial realms are likely to occur, for example through coastal erosion and aggradation and sea level rise, or through land reclamation work. The associated changes in ET will need to be accounted for.

4.18 For the ecosystem extent account presented in table 4.1 there is no requirement that the areas recorded for each ET be contiguous. That is, the total area of, for example, savannas and grasslands, is likely to be spread out across an EAA in distinct EAs. Consequently, the data in tables 4.1 reflect an aggregation of individual EAs of the same ET.

4.19 Significant analytical benefits are likely to arise from developing maps of ecosystem extent which show the configuration of EAs by different ET across an EAA. Analysis of a time series of extent maps will also enable analysis of the location of changes in ET. Mapping ecosystem extent can also reveal patterns of changing fragmentation of EAs which will not be evident in an ecosystem extent account presented for ET.

4.2.3 Recording changes in extent over time

4.20 The ecosystem extent account shows changes in ET. These changes are collectively referred to as ecosystem conversions. Ecosystem conversions are of particular interest in understanding trends in ecosystem condition, biodiversity and flows of ecosystem services. Identification of ecosystem conversions relies on clearly determining the time point at which the opening extent is recorded, the length of the accounting period and identification of the differences between ET. These issues are discussed in this section.

4.21 Generally, the length of the accounting period is one year and this will be an appropriate reporting period to record ongoing managed expansions and regressions. Time frames for natural expansions and regressions may, however, vary considerably. Some changes, such as those caused by extreme events, may happen rapidly. In these cases, where it is expected that the ecosystem will recover from the effects of an extreme event, it is appropriate to record no change in ET, i.e. the change may be considered to be part of normal patterns of disturbance. In this case, changes in patterns of disturbance (e.g. more frequent bushfires) are likely to be better represented as changes in condition for the relevant EA.

4.22 Where changes are gradual and longer term, for example changes in coral reefs due to ocean acidification, it is also appropriate to record annual changes as changes in the condition of the EA. However, it is possible, at some point in time, that the ecosystem is considered to have changed sufficiently in terms of its ecological characteristics to be considered a different ET. This change of ET for a given ecosystem should be recorded in the accounting period in which the change took place. Even though determining the precise point of change between ET may be a matter of ecological uncertainty, by adopting an annual reporting approach, there will be a clear structure in place that ensures consideration of changes on a regular basis and provides a full range of options in terms of time of recording. These two paragraphs highlight the importance of considering both changes in ecosystem extent and ecosystem condition in understanding changes in ecosystem assets.

4.23 A common, and broader, ambition of ecosystem extent accounting is to record changes in the extent and configuration of EAs over long periods of time, often dating back to points in time associated with the industrial revolution and increases in human effects on the landscape. Conceptually, the compilation of extent accounts to compare two, or more, points in time that are considerably apart is straightforward. For instance, using the same structure as shown in

Table 4.1, the opening extent could be estimated for 1750 (or a similar baseline) and the closing extent estimated for 2015. Other points in time might also be chosen to provide a baseline for comparison, or a series of accounting periods might be defined from 1750 to 2015 such that the progressive changes in the composition of ecosystem extent are recorded. Overall, the ecosystem extent accounting approach does not limit the potential to record changes over long periods of time.

4.24 Additional detail on the nature of ecosystem conversions may be obtained from the compilation of an ecosystem type change matrix. The ET change matrix set out in table 4.2 shows the area of different ETs at the beginning of the accounting period (opening extent); the increases and decreases in this area according to the ET it was converted from (in the case of increases) or the ET it was converted to (in the case of decreases) and, finally, the area covered by different ETs at the end of the accounting period (closing extent). As just noted, the dates for the opening and closing extent could be recent or historical.

4.25 Presentation of this information requires detailed data that records the location of individual EAs and how they have changed. Spatially based approaches to delineating EAs as described in Chapter 3 are well placed to be able to provide such information.

Table 4.2: ET change matrix (Units of area)

Selected ecosystem types (based on Level 3 - EFG of the IUCN Global Ecosystem Typology) – Opening Extent		Closing Extent: T1.1 Tropical-subtropical lowland rainforests	T2.1 Boreal and temperate montane forests and woodlands	T3.1 Seasonally dry tropical shrublands	T4.1 Trophic savannas	T5.1 Semi-desert steppes	T6.1 Ice sheets, glaciers and perennial snowfields	T7.1 Croplands	F1.1 Permanent upland streams	F2.1 Large permanent freshwater lakes	F3.1 Large reservoirs	M1.1 Seagrass meadows	M2.1 Epipelagic ocean waters	M3.1 Continental and island slopes	M4.1 Submerged artificial structures	TF1.1 Tropical flooded forests and peat forests	FM1.1 Deepwater coastal inlets	MT1.1 Rocky shores	MT2.1 Coastal shrublands and grasslands	MT3.1 Artificial shores	MFT1.1 Coastal river deltas	Opening
Tropical-subtropical lowland rainforests	T1.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Boreal and temperate montane forests and woodlands	T2.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seasonally dry tropical shrublands	T3.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trophic savannas	T4.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Semi-desert steppes	T5.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ice sheets, glaciers and perennial snowfields	T6.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Croplands	T7.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Permanent upland streams	F1.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Large permanent freshwater lakes	F2.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Large reservoirs	F3.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seagrass meadows	M1.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Epipelagic ocean waters	M2.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Continental and island slopes	M3.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Submerged artificial structures	M4.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tropical flooded forests and peat forests	TF1.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Deepwater coastal inlets	FM1.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rocky shores	MT1.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coastal shrublands and grasslands	MT2.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Artificial shores	MT3.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coastal river deltas	MFT1.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Closing		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**