<u>**Expert Meeting on Ecosystem Accounts**</u>

5 - 7 December 2011, London, UK

ISSUE 5: Landscape accounts and landscape ecological potential

Issue paper on Landscape accounts and landscape ecological potential

Jean Louis Weber, European Environmental Agency,

1. Introduction

The ecosystem potential to deliver services relates to their size, productivity and health. Ecosystem health can be assessed via a diagnosis based on the observation of change in productivity, integrity, robustness, resilience, autonomy, capacity to support healthy populations… the theory of ecosystem heath has been developed by David J. Rapport and experienced in case studies at various scales since the end of the 1970s.

Total ecosystem potential is a composite indicator which summarizes ecosystem capability to deliver ecosystem services which are accessible to people and contribute therefore to production/consumption as well as to non-market benefits of private or collective nature.

Accessibility corresponds to the amount of resource which available under the constraint of use sustainability. This constraint relates to the resource itself as well as to the other services potentially delivered by the ecosystem. Accessible biomass/carbon can be measured in tons of carbon or in joules starting from observed stocks and flows and adjusting them in relation to ecological sustainability constraints. The same can be done for accessible fresh water resource, measured in cubic meters or in joules.

Coming to **systemic services**, regulation and socio-cultural services, which cannot be directly measured, the approach is to record the area of the ecosystems which can deliver them (or length in the case of rivers) and postulate that their amount is correlated to ecosystem good health. Instead of measuring them, accounts will record the potential of ecosystems to supply them – and change in potential. In the case of simplified ecosystem accounts, the approach is to start with one single service and detail it in a second step according to priority ecosystem services.

The ecosystem potential for delivering systemic services will combine quantitative measurement of surfaces (land covered by various ecosystems) and lengths (for linear elements, in particular by rivers) and qualitative rating regarding landscape integrity and biodiversity.

2. Land cover stocks and change accounts

Land cover stocks and change accounts have been implemented by the EEA since 2006 (EEA, 2006) and updated. The issue paper on land cover classification addresses the issue and proposes three linked classifications for stocks (types and functional units) and flows of land cover.

Table 2 Land Cover Types (all levels)

Code	Title
01	**Artificial surfaces (including urban and associated areas)**
01.a	Artificial surfaces from 10 to 50 %
01.b	Artificial surfaces from 51 to 100 %
02	**Herbaceous crops**
02.a	Small size fields of herbaceous crops rainfed
02.b	Small size fields of herbaceous crops irrigated or aquatic (rice)
02.c	Medium to large fields of herbaceous crops rainfed
02.d	Medium to large fields of herbaceous crops irrigated or aquatic (rice)
03	**Woody crops**
03.a	Small size fields of woody crops
03.b	Medium to large fields of woody crops
04	**Multiple or layered crops**
05	**Grassland**
05.a	Natural grassland
05.b	Improved grassland
06	**Tree covered area**
06.a	Tree covered area from 10 to 30-40 %
06.b	Tree covered area from 30-40 to 70 %
06.c	Tree covered area from 70 to 100 %
07	**Mangroves**
08	**Shrub covered area**
08.a	Shrub covered area from 10 to 60 % (open)
08.b	Shrub covered area from 60 to 100 % (closed)
09	**Shrubs and/or herbaceous vegetation aquatic or regularly flooded**
09.a	From 2 to 4 months
09.b	More than 4 months
10	**Sparsely natural vegetated areas**
11	**Terrestrial barren land**
11.a	Loose and shifting sand and/or dunes
11.b	Bare soil, gravels and rocks
12	**Permanent snow and glaciers**
13	**Inland water bodies**
14	**Coastal water bodies and inter-tidal areas**
14.a	Coastal water bodies (lagoons and/or estuaries)
14.b	Inter-tidal areas (coastal flats and coral reefs)

Table 2 First sketch of aggregated LCFU classification

01	Urban and associated developed areas
02	Medium to large fields rainfed herbaceous cropland
03	Medium to large fields irrigated herbaceous cropland
04	Permanent crops, agriculture plantations
05	Agriculture associations and mosaics
06	Pastures and natural grassland
07	Forest tree cover
08	Shrubland, bushland, heathland
09	Sparsely vegetated areas
10	Natural vegetation associations and mosaics
11	Barren land
12	Permanent snow and glaciers
13	Open wetlands
14	Inland water bodies
15	Coastal water bodies
16	Sea (per memory)

Table 4 Provisional Land-cover Flow classification

lf1 Land development processes, urban sprawl, expansion of intensive land	
lf11	Artificial development over agriculture
lf12	Artificial development over forests
lf13	Artificial development of other natural land cover
lf14	Conversion from small field agriculture and pasture to broad pattern
lf15	Conversion from forest to agriculture
lf16	Conversion from marginal land to agriculture
lf17	Water body creation and management
lf2 Land restoration processes	
lf21	Conversion from crops to set aside, fallow land and pasture
lf22	Withdrawal of farming
lf23	Forest creation, afforestation of agriculture land
lf3 Rotations, natural processes and steady state	
lf31	Internal conversion of artificial surfaces
lf32	Internal conversion between agriculture crop types
lf33	Recent tree clearing and forest transition
lf34	Forest conversions and recruitment
lf35	Changes of land-cover due to natural and multiple causes
lf4 No observed land-cover change	

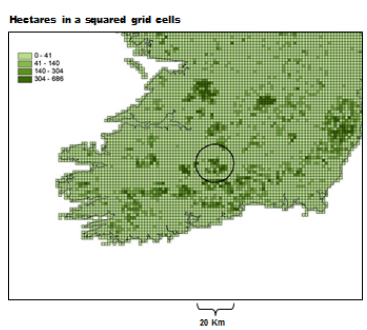
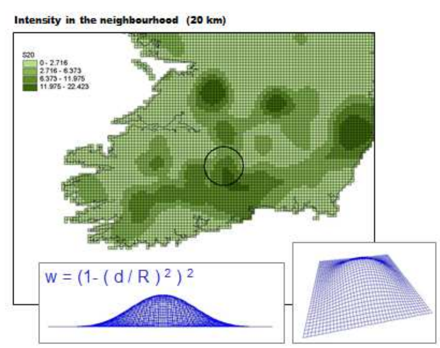
3. From land cover to landscape accounting

Landscape is a concept referring to the combination of multiple objects in a given place and to their value. Values can be diverse regarding the purpose of landscape analysis: aesthetic, economic, political, ecological... However observation of landscapes shows some features which are generally considered in every case. Also, landscapes composite nature is essential dimension which needs to be reflected in indicators.

In LEAC, landscape accounting is approached firstly from land cover.

The spatial interaction of land cover classes is assessed by transforming each individual layers into fuzzy data sets measuring their importance within a conventional cell (1 km^2) and in their neighbourhood (5, 10, 20 km). The methodology used is called smoothing and the data sets CORILIS.

Figure 1 Illustration of land cover smoothing methodology used at the EEA

Input data:% of forest by grid cell…	And smoothed data (values in the neighbourhood)
	

The smoothed value of each land cover class is expressed as %; the mathematical property of the method used makes that the sum total of each cell is 100. Then a first layer is produced by simple grouping of classes according to their “green” (natural classes, forests, pastures…) or less green character (“arable land, urban areas). The index produced is called Green Background Landscape Index. It has been tested by comparison with other ecological maps using the possibility to define threshold values. E.g. GBLI > 65% matches fairly well maps of ecological corridors produced independently. GBLI is not the ultimate landscape measurement but it presents the advantage to be simple and to change in proportion to land cover flows. As long as the methodology is transparent and the map reproducible, it is possible to modify weighting factors according to purposes.

On the basis of GBLI, the EEA has started to produce a more elaborated landscape index. Not all “green” grid cell have the same nature value. Not only surface matters: fragmentation has to be taken into consideration. On that line has been defined the Landscape Ecosystem Potential which can be illustrated by figure 2:

Figure 2 LEP

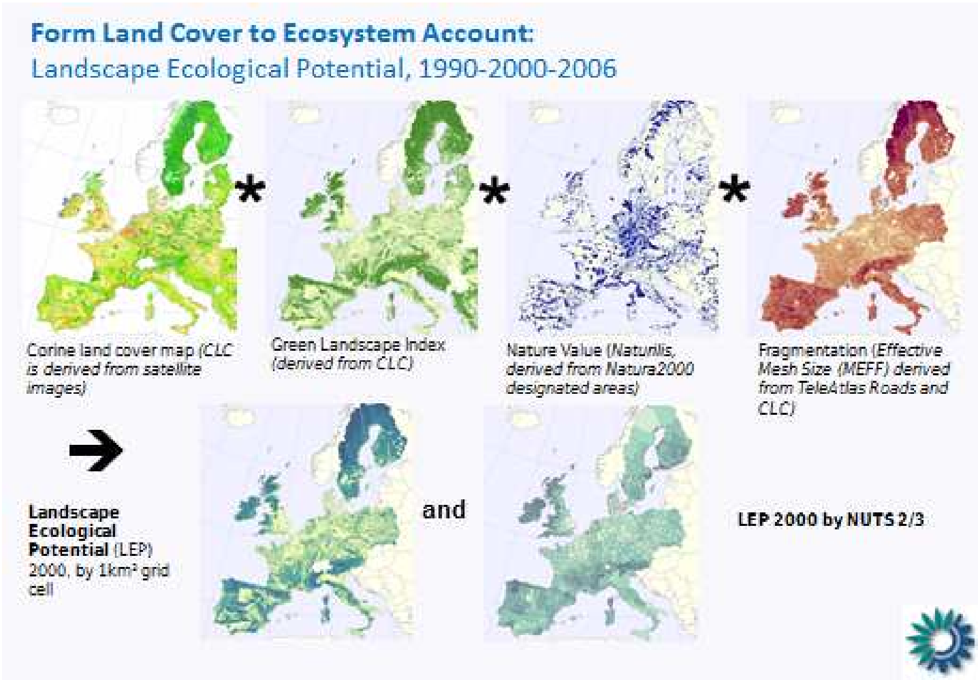
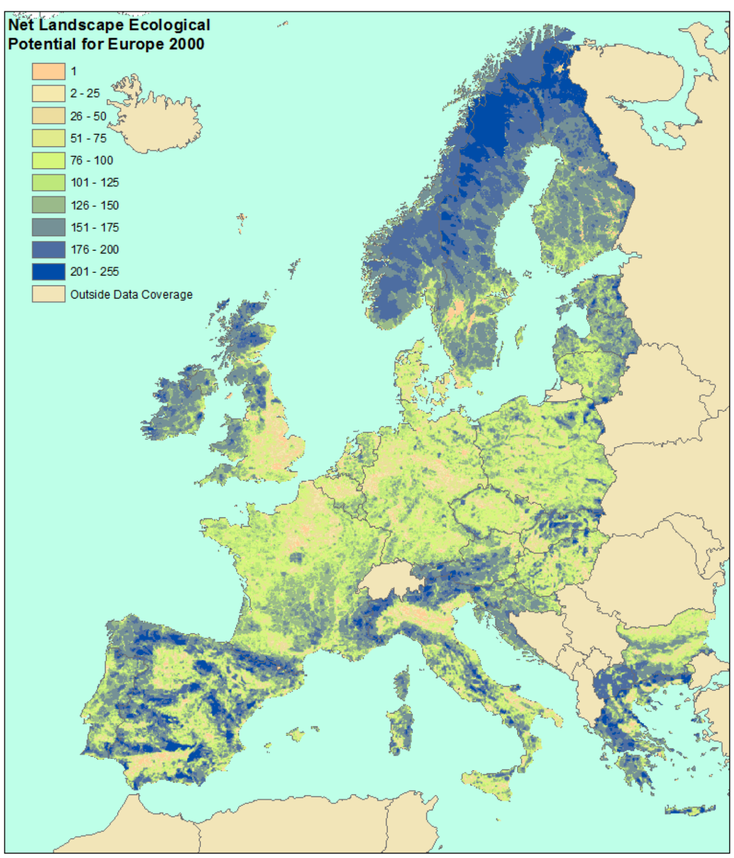


Figure 3 The Landscape Ecological Potential of Europe, 2000



The current LEP methodology is described in "Net landscape ecological potential of Europe and change: 1990-2000" (EEA, 2008), http://unstats.un.org/unsd/envaccounting/seeaLES/egm/EEA_bk2.pdf.

By experience, LEP in its current format delivers a fair picture; it is anyway not the ultimate formula. Another layer has been recently produced at the EEA: the ecotones. Ecotones are interfaces between different biotopes. They are particularly rich in terms of animal and plant species. A coarse but useful dataset of ecotones has been produced from Corine land cover and will be integrated into/ combined with LEP.

Another element currently developed relates to micro linear landscape features like lanes, field hedges, hedgerows… which is are as many components of landscape richness and niches for biodiversity. Once available, micro linear features will improve the quality of LEP

4. **River ecosystem potential (REP)**

Rivers don't only provide fresh water but systemic services as well: habitats for fish, amenities for angler and many others, value for tourism, wastewater assimilation etc… River ecosystem potential has therefore to be calculated and added up to LEP.

Calculation of REP starts from river infrastructure in measured in km. As long as km it relate to large (even very large) as well as small rivers (even very small), km must be weighted in order to have a common metric of river potential. This can be done in Standard-River-Kilometer (1 srkm = 1 km*1m^3/second), the method proposed in SEEA-Water for river quality accounts. The river infrastructure potential can then be subdivided into large rivers, medium rivers, small rivers, brooks and streams. For each group, a river integrity composite index can be computing, weighting srkm with water quality, rivers fragmentation and river green ecotones (the riparian vegetation…).

From landscape/river integrity to species biodiversity:

LEP measures ecosystem integrity using spatial data and analysis tools. It has to be completed with data on species biodiversity, plants, animal and if possible, soil micro-fauna/flora. It is acceptable to consider that landscape integrity and species diversity are two aspects of the same issue. They are separated at this stage because in differences in methodologies and scientific background – differences which are vanishing with time.

QUESTIONS

Questions 1: is LEP an acceptable surrogate to assess systemic ecosystem services?

Question 2: is the LEP format presented above acceptable for experimental accounts. If not, which minimal improvements should be considered?

Question 3: what are other solutions to calculate a LEP type index? Similarities/differences with the EEA methodology ?