Convention on Biological Diversity

Fifth meeting of the Ad Hoc Open-ended Working Group on Review of Implementation of the Convention on Biological Diversity (WGRI 5)
16 to 20 June 2014 - Montreal, Canada

Towards a Quick Start Package for Implementing Aichi Biodiversity Target 2 on National Accounting Systems

Ecosystem Natural Capital Accounts

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Environment, Nature and the National Accounts

- Bertrand de Jouvenel, 1968: "Because National Accounts are based on financial transactions, they account nothing for Nature, to which we don't owe anything in terms of payments but to which we owe everything in terms of livelihood."
- Initial demand of deducting damages to the environment from the GDP (so-called "Green GDP") progressively replaced by request to account for ecosystem services and their lost, and more recently for the ecosystem capital and its degradation.
- Presently, two streams:
  - Accounting of benefits (from ES) in money (Economic Welfare theory, neo-classical model of the capital)
  - and accounting for the ecosystem capital in physical terms (extent, condition, health, resilience, capability...) and the costs of its maintenance and restoration
  - A consensus: better have accounts in physical units firstly
- Two main approaches to accounting:
  - Priority to case studies of specific ecosystems, services or regions, valuation in focus, cost-benefit analysis style
  - Priority to framing the broad picture (the context) with physical accounts and produce macro-aggregates at the level of GDP, then focus on priority issues

Recurrent demands for improved macro-economic indicators and aggregates

- Historical pioneer projects after Stockholm 1972 (Norway, Canada, France, The Netherlands, Philippines, Indonesia, WRI…)
- Rio 1992, Agenda 21
- UN SEEA1993 to "adjust" the UN SNA ('green GDP'), revised in 2003, then in 2012/2013
- Multiplication of initiatives:
  - Material Flows Analysis (Ayres, Wuppertal Institute, NIES-Japan, OECD, Eurostat…)
  - IPCC accounting to support UNFCCC
  - Water Footprint (Twente U. , UNESCO)
  - HANPP (Vitousek, Haberl…)
  - Ecological Footprint Accounting (Wakernagel, WWF…)
  - Beyond GDP Conference followed Stiglitz/ Sen/ Fitoussi report on the measurement of economic performance (EU, OECD…)
  - Potsdam 2008 G8+5 initiative and TEEB to value ecosystem services (now hosted by UNEP)
  - Initiatives in Europe: Eurostat (the economy side) and the European Environment Agency & Joint Research Centre (the ecosystem side)
  - Country initiatives all around the World
  - WAVES (World Bank)
  - **2010 Aichi-Nagoya CBD Strategy: demand for including biodiversity values into the national accounts**

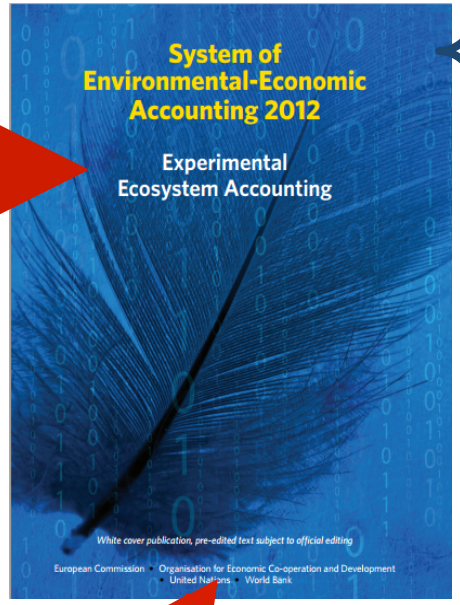
SNA and SEEA volumes 1 & 2

The System of Environmental-Economic Accounts adopted by the UN Statistical Commission in 2012 (SEEA 2012) has been supplemented in 2013 by a volume on “Experimental Ecosystem Accounting”. Several experimentations are ongoing.

SNA

SEEA volume 1 “Central Framework”

SEEA volume 2 “Experimental Ecosystem Accounting”



SEEA-EEA Experiment

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SEEA-EEA Experiment

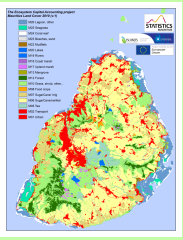
ENCA-EU

Ecosystem/ Natural Capital Accounts

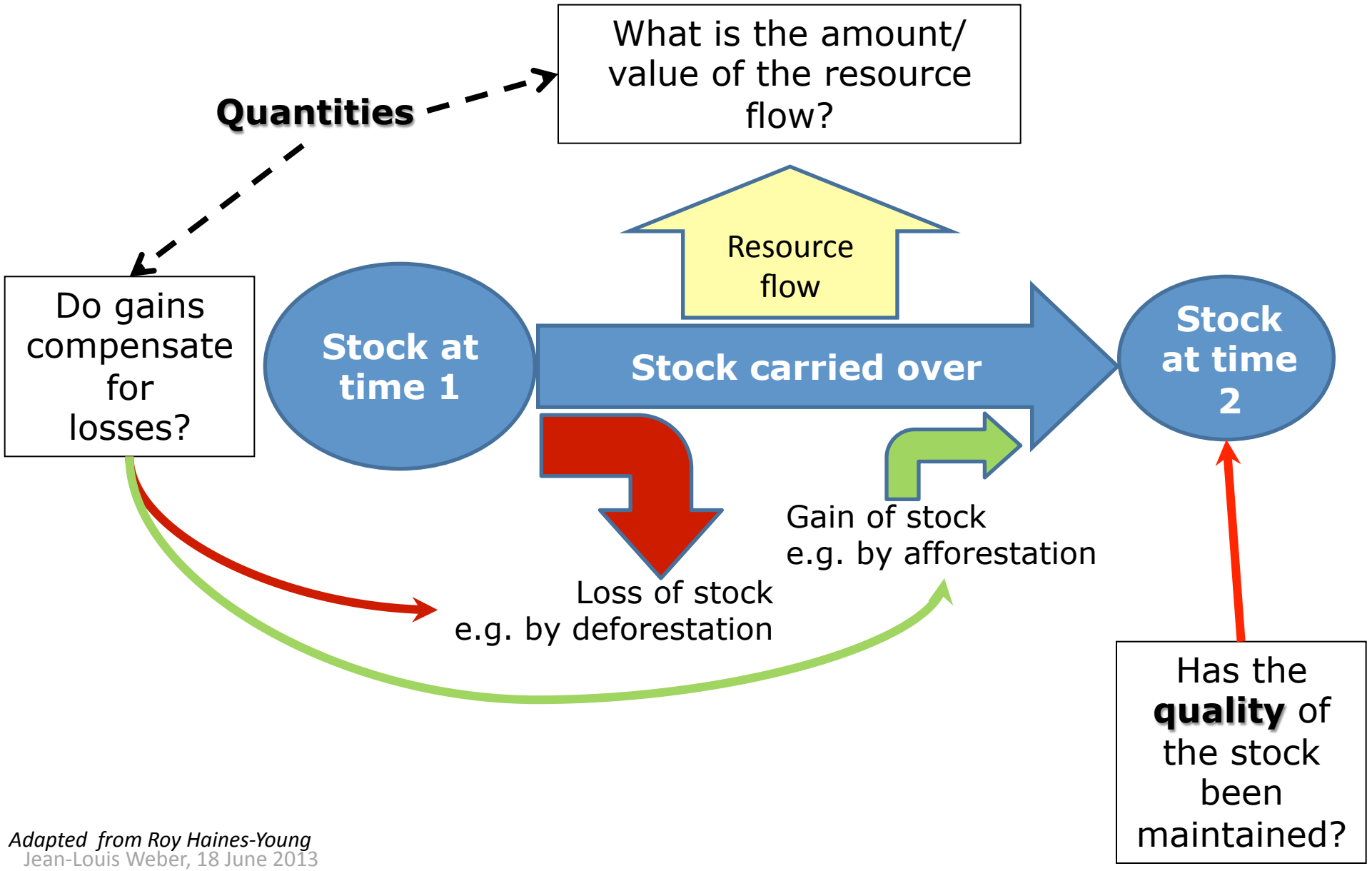
SEEA-EEA Experiment

ENCA-MU

Ecosystem/ Natural Capital Accounts

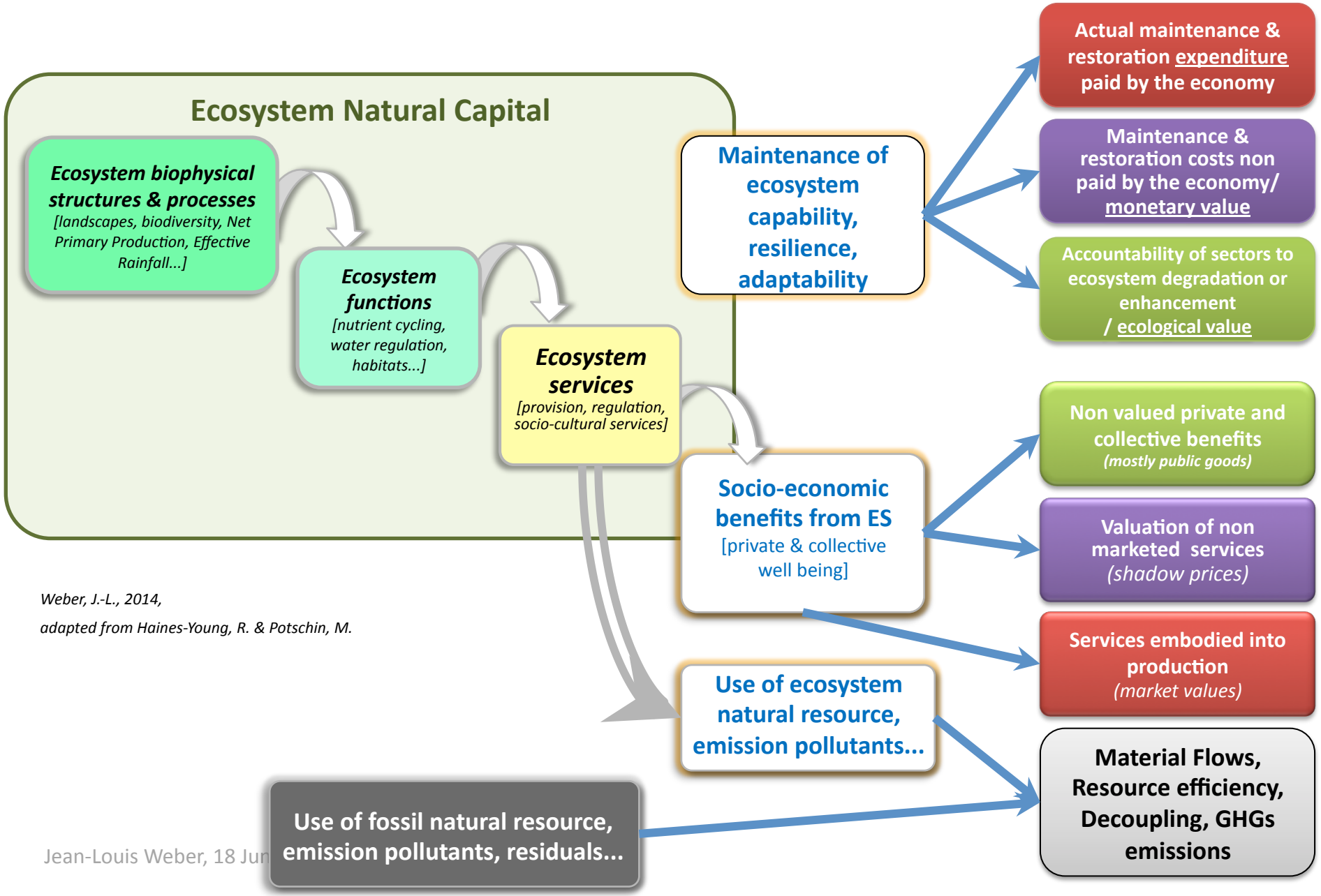


Ecosystem Capital Account: attempt to respond to basic questions



Adapted from Roy Haines-Young

Ecosystem capital & services: three main targets for accounting



Weber, J.-L., 2014,

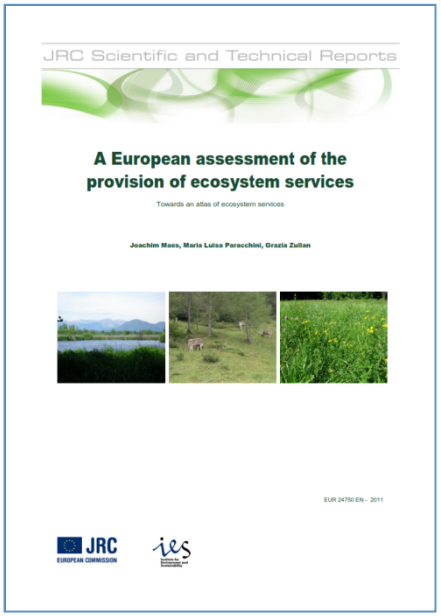
adapted from Haines-Young, R. & Potschin, M.

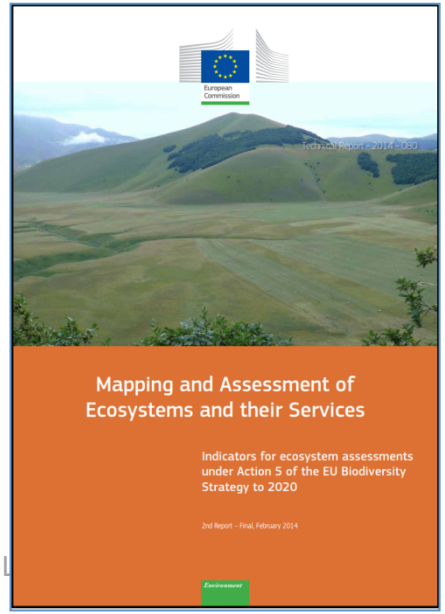
Remarks

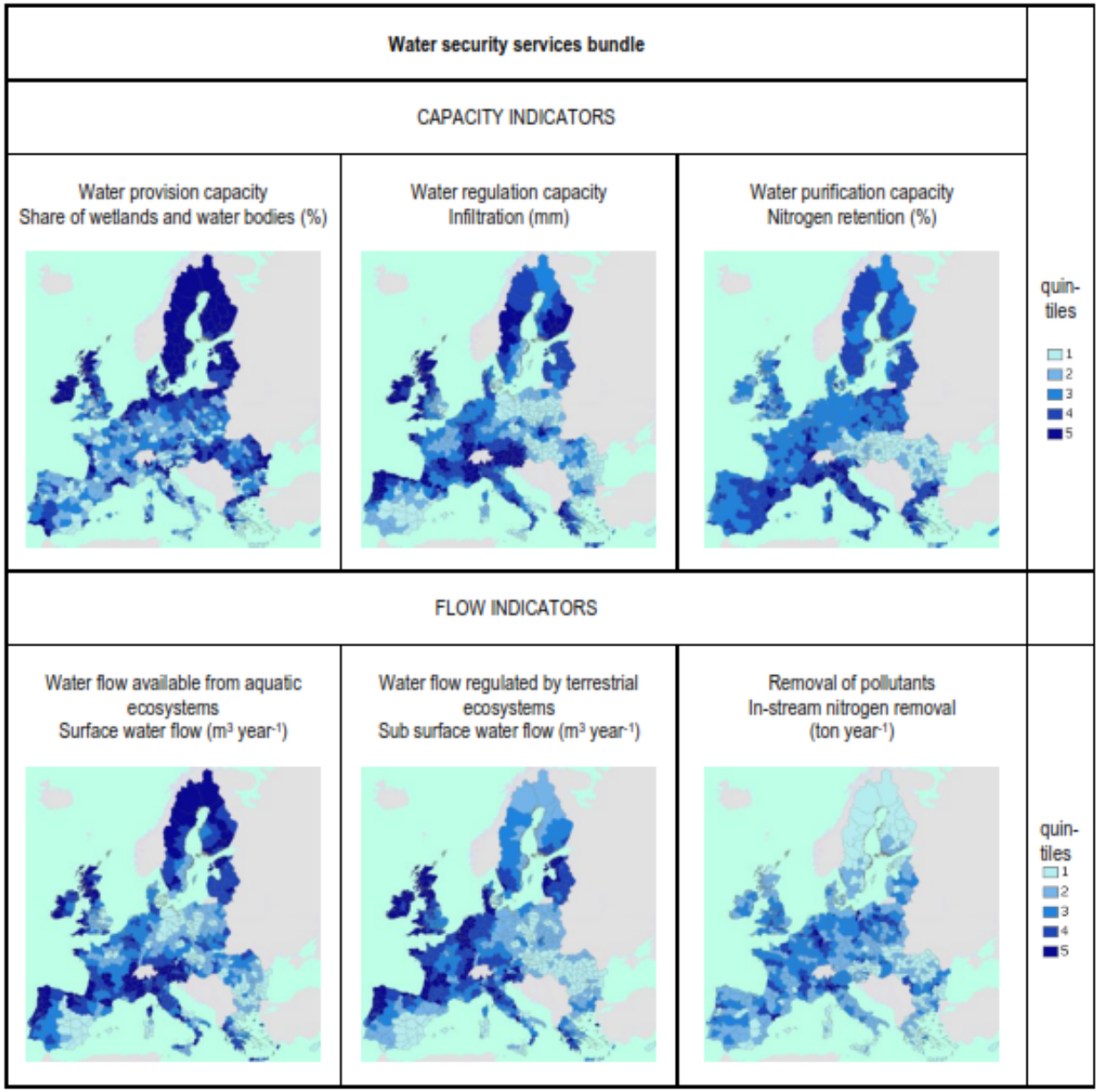
- Ecological value vs. Monetary valuation
  - **Ecological value**: Non-monetary assessment of ecosystem integrity, health, or resilience, all of which are important indicators to determine critical thresholds and minimum requirements for ecosystem service provision (TEEB, 2010).
  - **Economic valuation**: The process of expressing a value for a particular good or service in a certain context (e.g., of decision-making) in monetary terms (TEEB, 2010).

- Additivity of various ecosystem services expressed in physical units is limited

Ecosystem services assessment in EU natural capital accounting / MAES: limited addtivity of ES ➔ a “bundle” approach







Remarks

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- Additivity of various ecosystem services expressed in physical units is limited

- Additivity of ecosystem services expressed in money is disputed because of risks of double counting: e.g. Good quality fresh water (provisioning) and Water purification (regulating);

- Additivity of ecosystem services valued with shadow prices to market values based on actual transactions is disputed regarding national accounts (ex-post statistics, consumer surplus issue...)

Ecosystem Natural Capital Accounts:

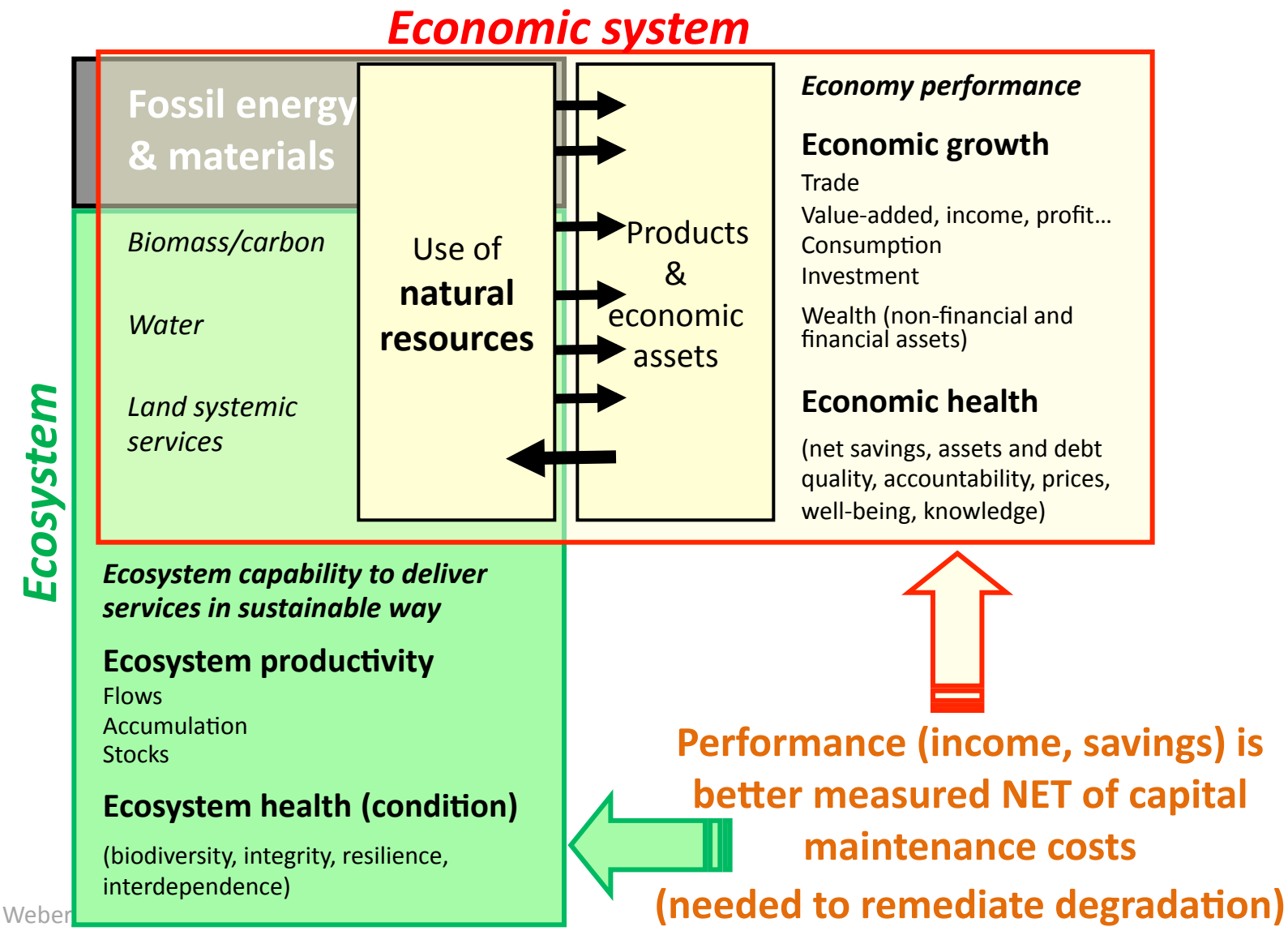
An accounting framework for measuring ecosystem sustainable capacity, resilience adaptability and economic sectors' accountability to the ecosystem

A "distribution" (in the sense used for open source software) to the SEEA, aimed at balancing the SNA

A Quick Start package for experimentations

The narrative behind Ecosystem Natural Capital Accounts:

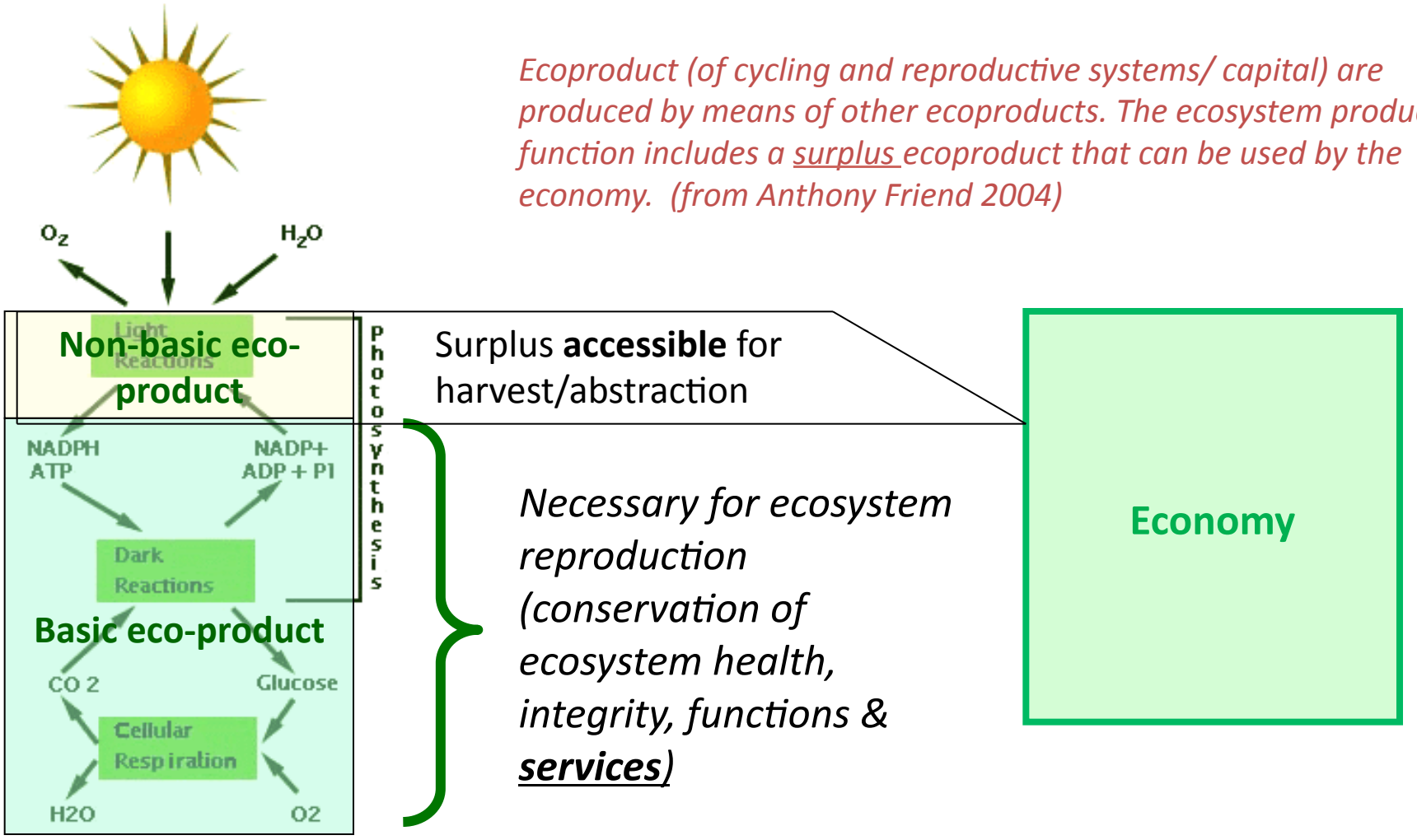
1 - Accounting for the performance(s) of 2 co-evolving systems: resources, productivity and health



The narrative behind Ecosystem Natural Capital Accounts:

2 - Only a **surplus** is **accessible** for human use

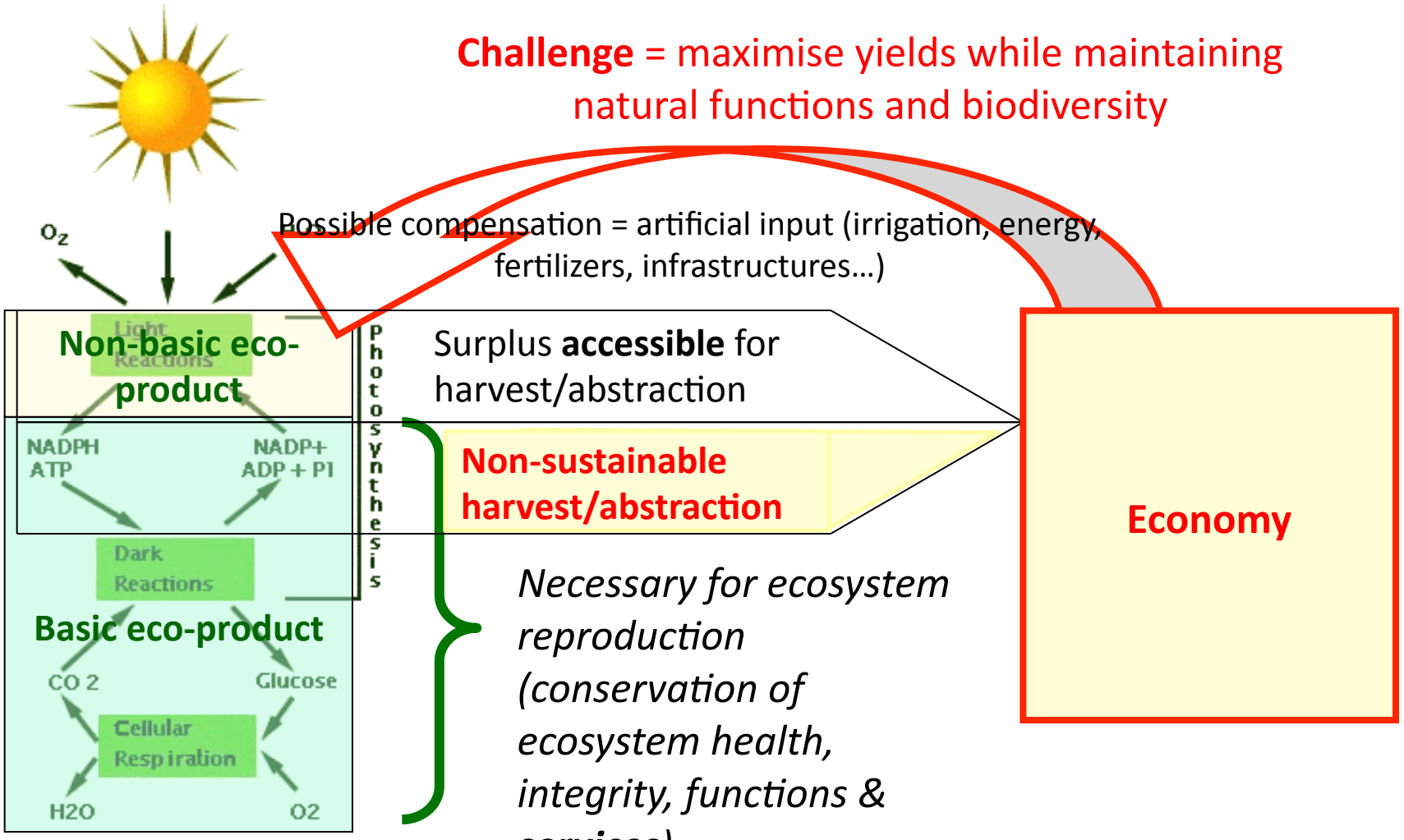
Ecoproduct (of cycling and reproductive systems/ capital) are produced by means of other ecoproducts. The ecosystem production function includes a surplus ecoproduct that can be used by the economy. (from Anthony Friend 2004)



Sources: Kling/U Michigan_2005 & Friend/ISEE_2004

The narrative behind Ecosystem Natural Capital Accounts:

3 - Only a **surplus** is **accessible** for human use

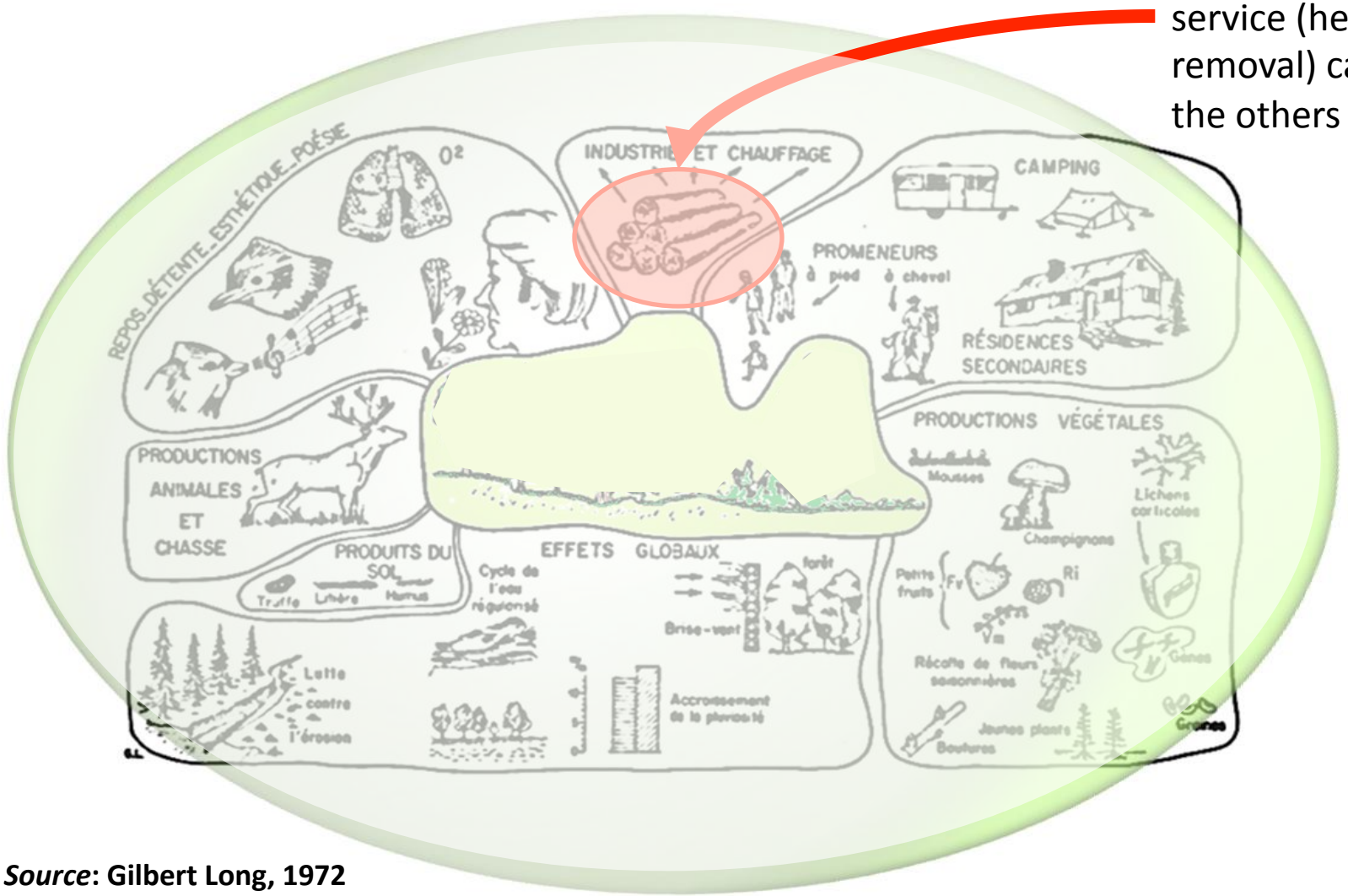


Sources: Kling/U Michigan_2005 & Friend/ISEE_2004

The narrative behind Ecosystem Natural Capital Accounts:

4 - Ecosystems deliver altogether **multiple services**

NOTE: Excessive extraction of 1 service (here wood removal) can ruin all the others

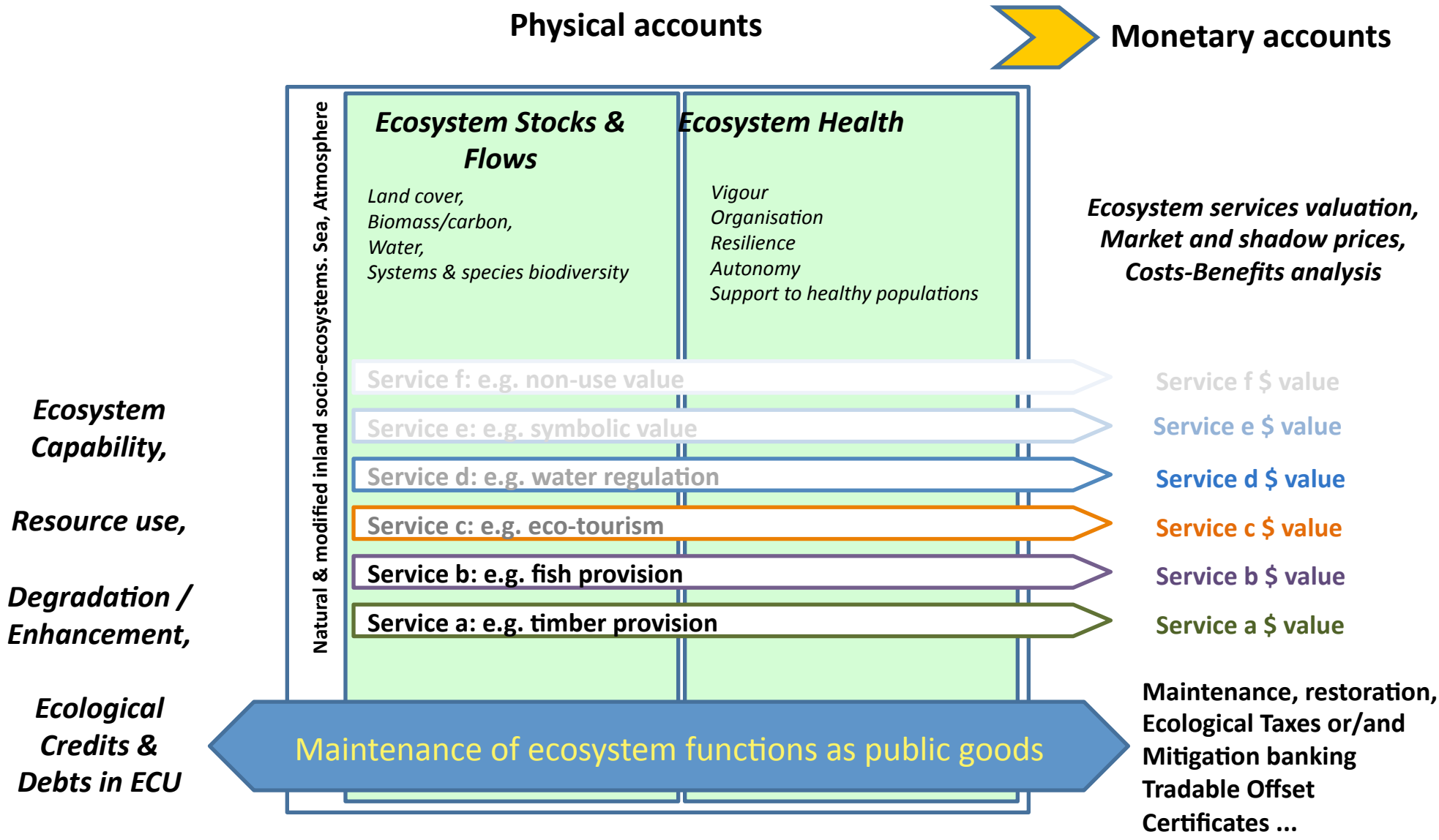


***Source*: Gilbert Long, 1972**

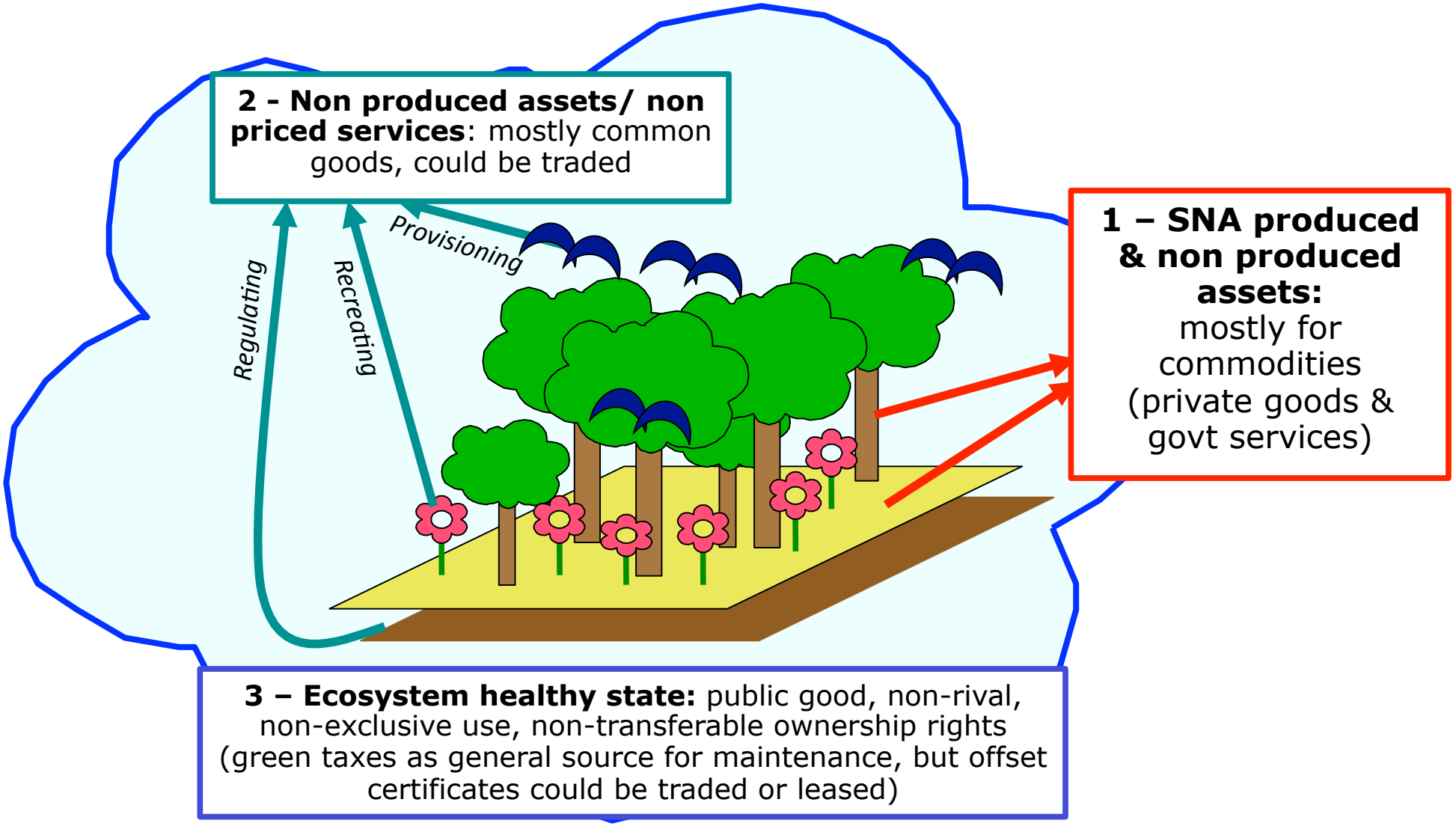
A propos du diagnostic écologique appliqué au milieu de vie de l'homme.
Options Méditerranéennes, 13 , CHIEAM, Montpellier, Juin 1972

The narrative behind Ecosystem Capital Accounts:

5. Physical vs. Monetary accounts



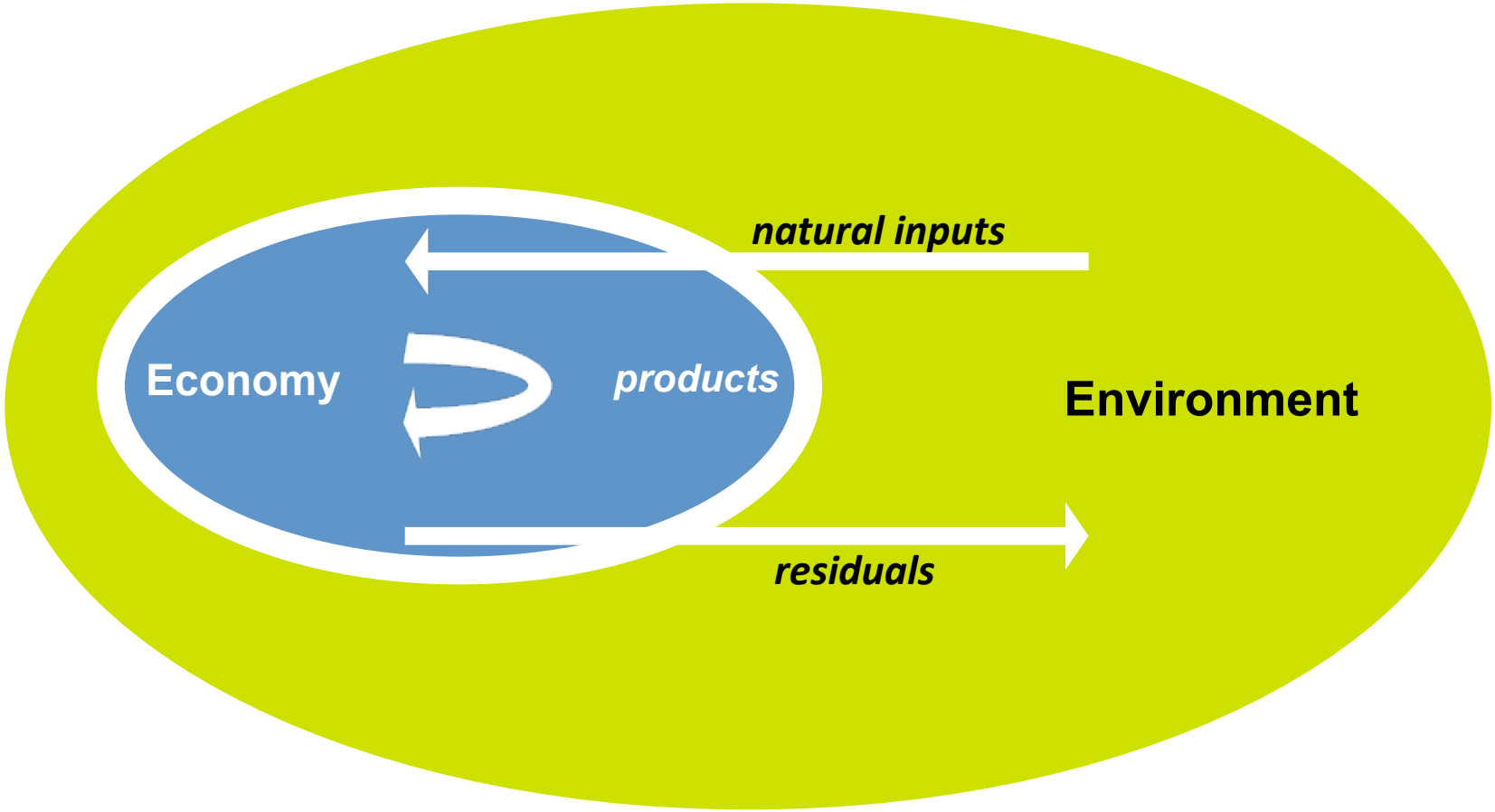
Ecosystems, economic assets, services and values: 3 dimensions



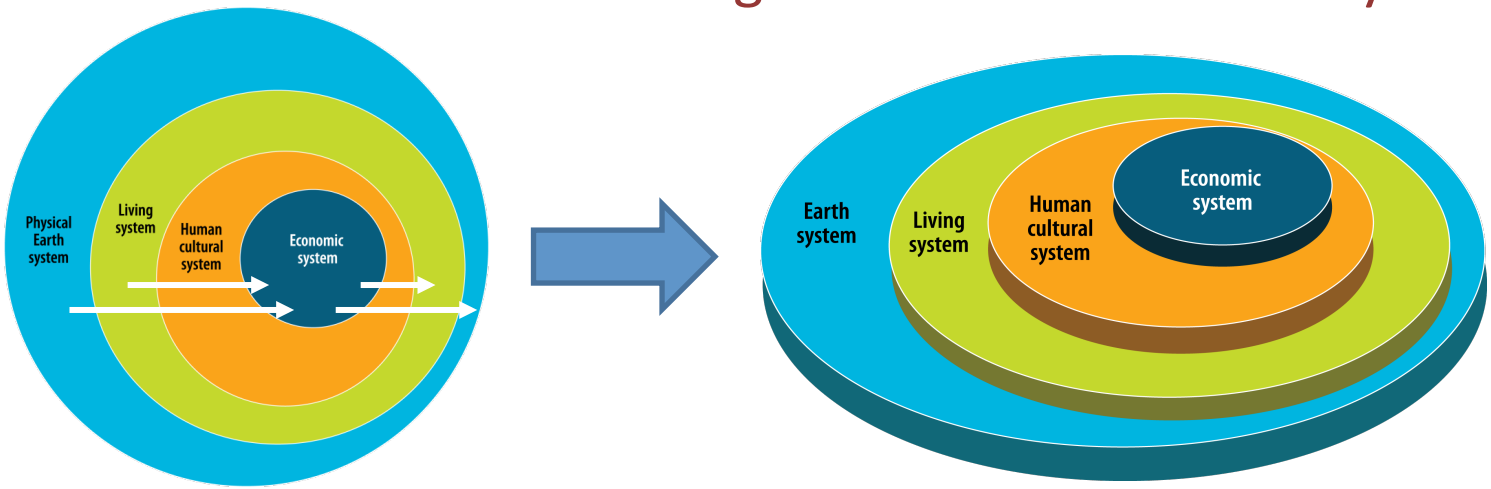
The narrative behind Ecosystem Capital Accounts:

6. Integration of economy and other systems

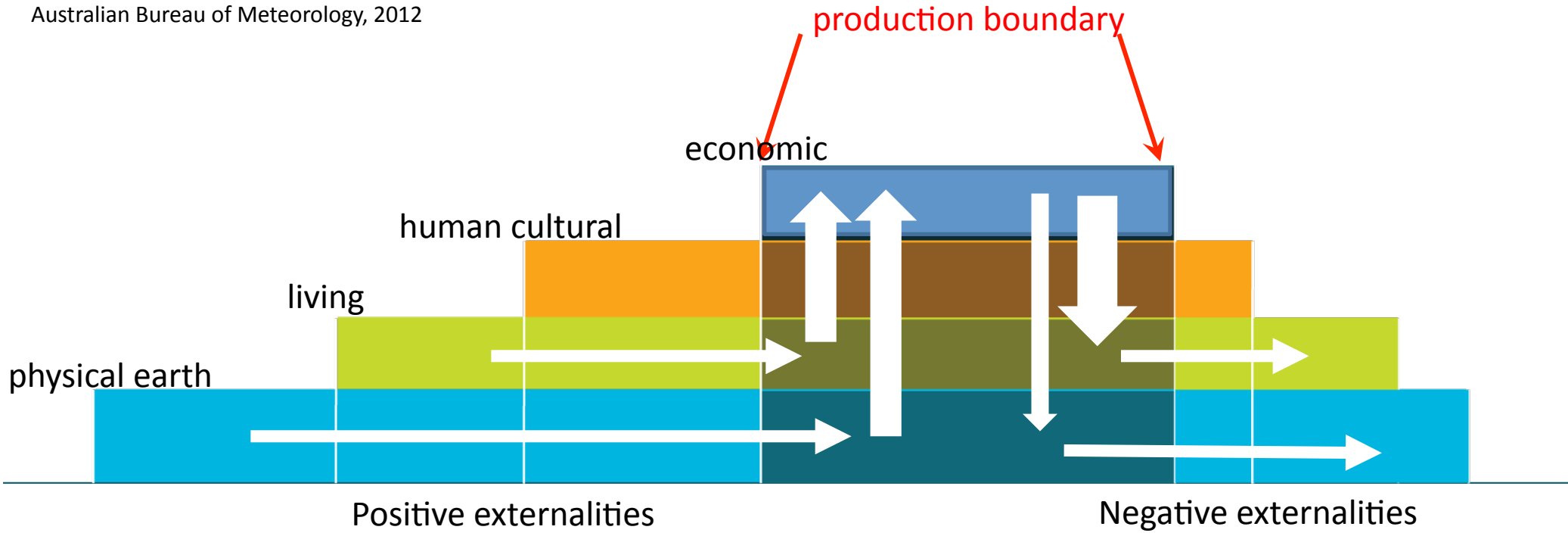
The current representation of the relation economy-nature in the SEEA bears possible misinterpretation that economy and ecosystem are mutually exclusive



ENCA: Integrated vision of economy and other systems



Source: Richard Mount,
Australian Bureau of Meteorology, 2012

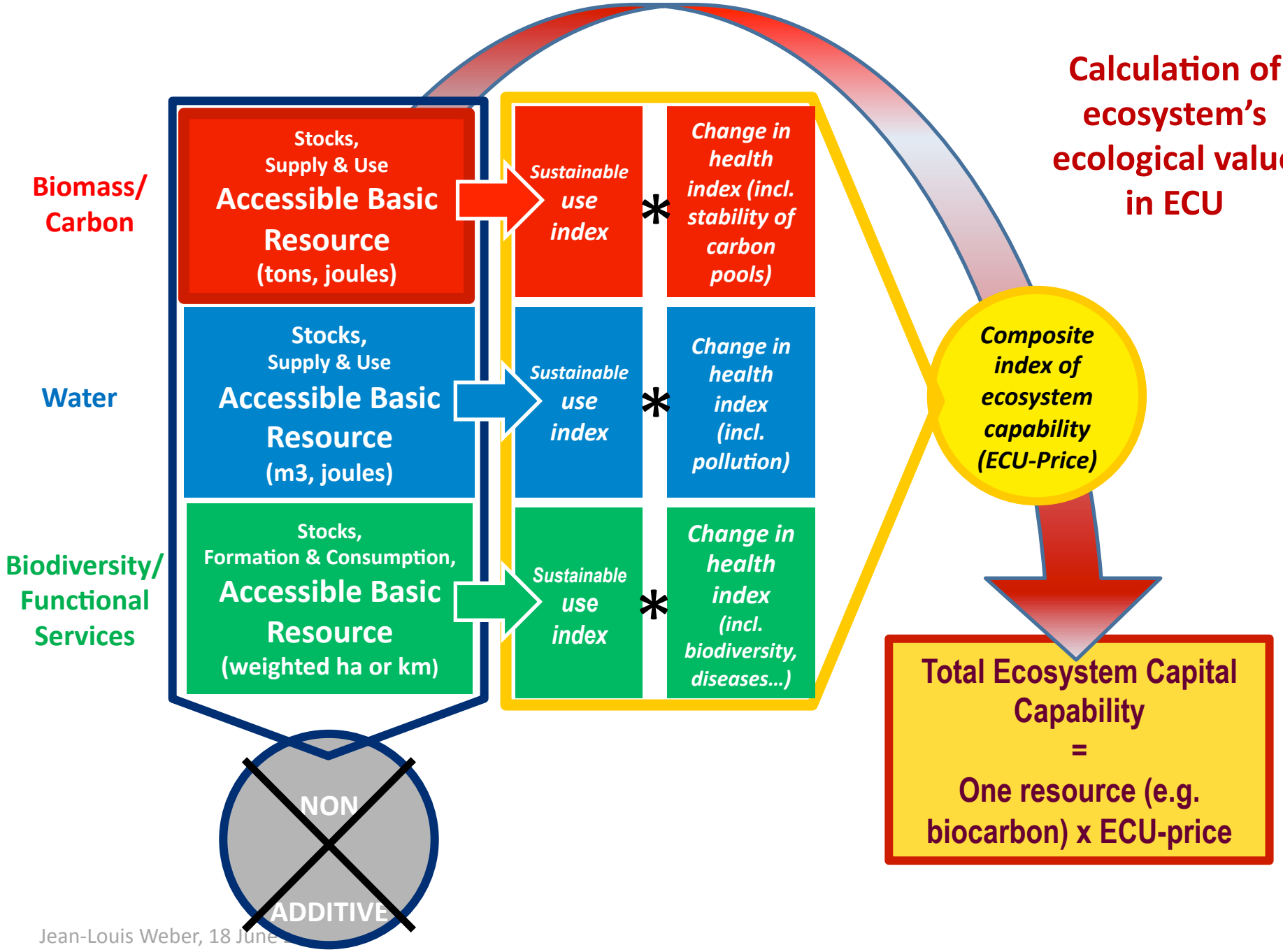


The narrative behind Ecosystem Capital Accounts:
6. Need of a unit of measurement of ecological value

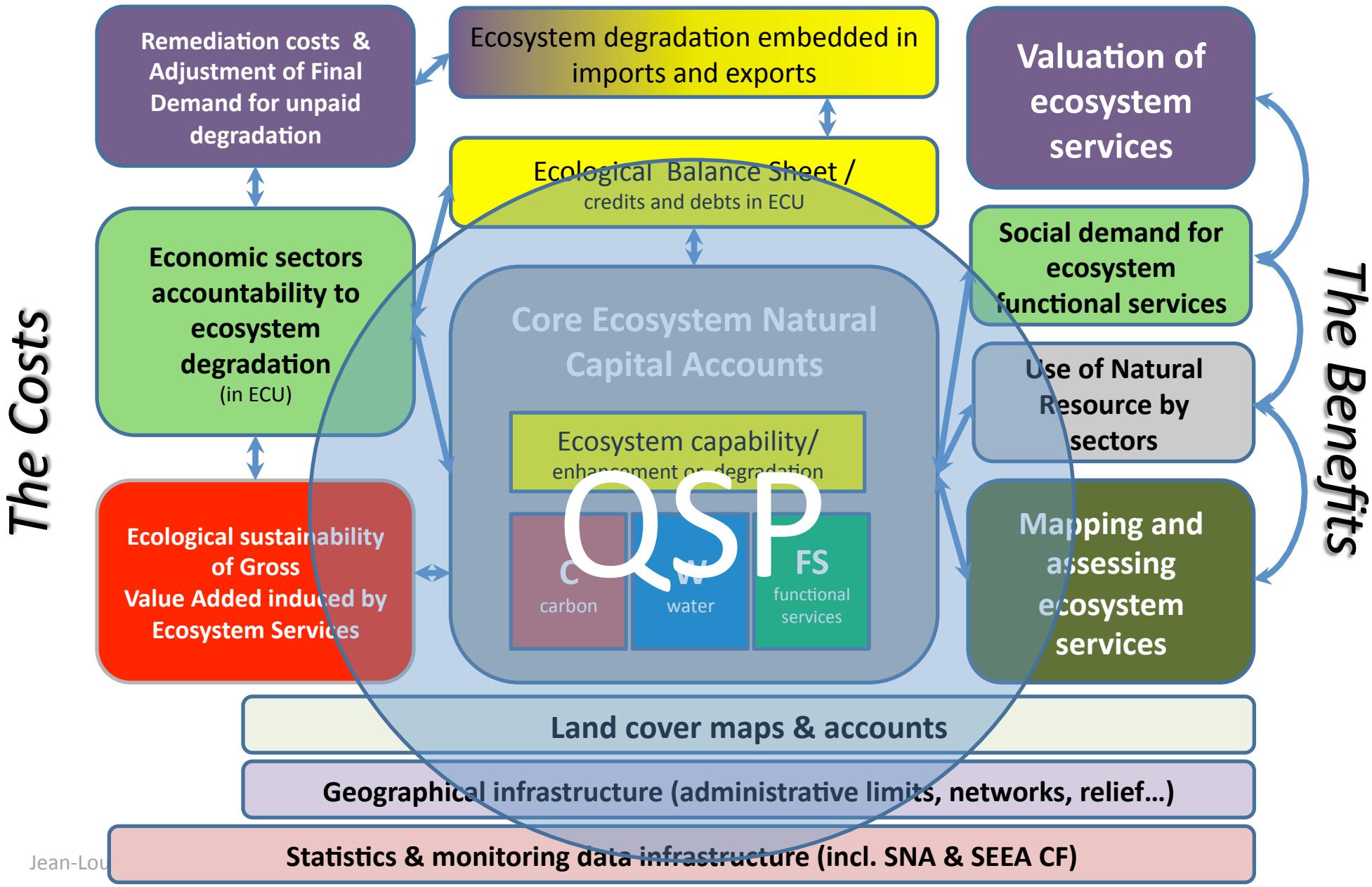
- Climate change: CO_2-equivalent to measure contributions to global warming
- Green Growth: tons (-equivalent) to measure resource efficiency
- Ecosystem/biodiversity: Ecosystem capability unit to measure total ecosystem performance in delivering ecosystem services now and in the future

1 ECU = the ecological value of 1 unit of accessible ecosystem resource

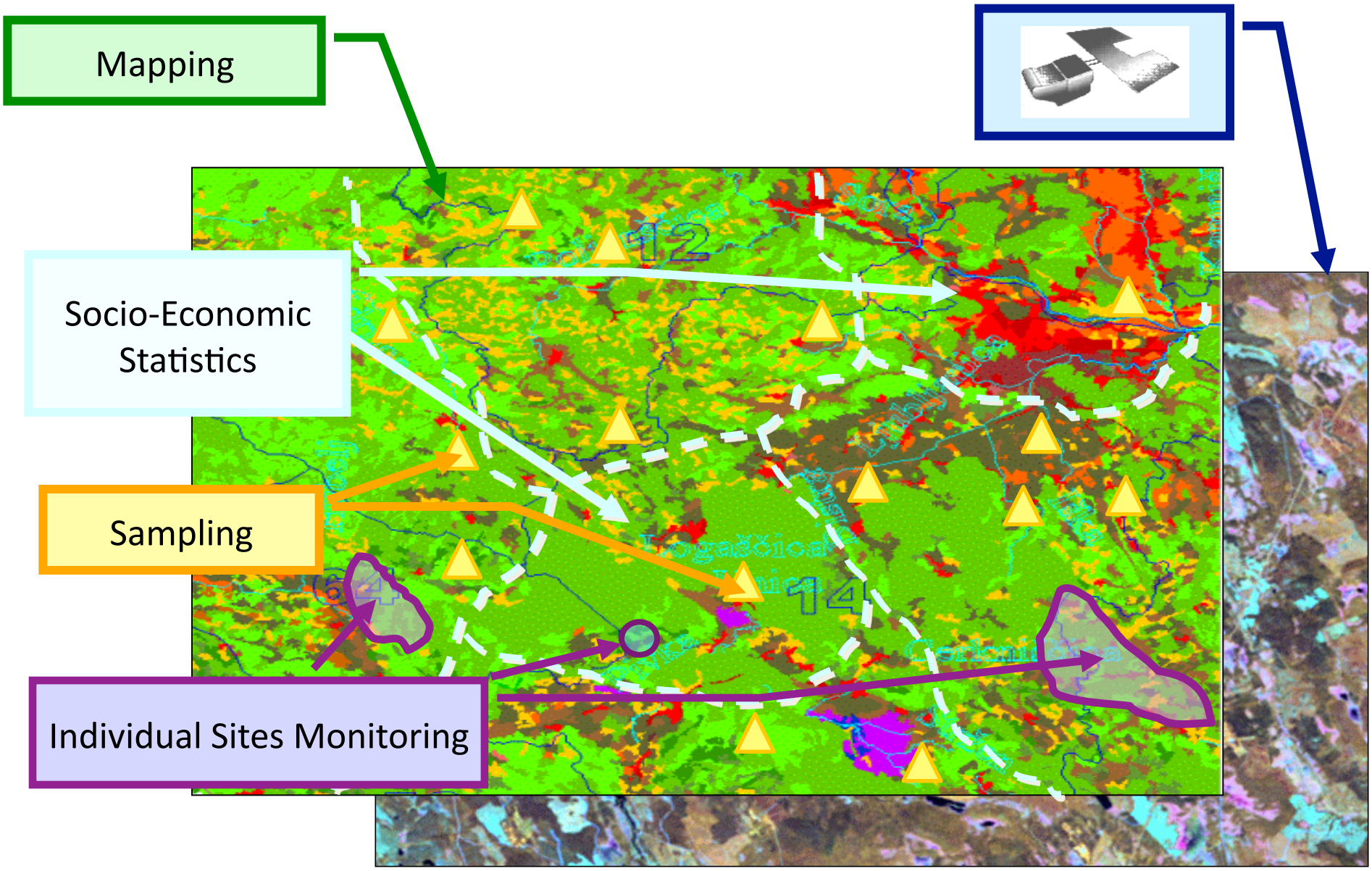
François 1st (1515-1547), Ecu d'or au soleil du Dauphiné, Source : Münzen & Medaillen GmbH (DE)


Calculation of ecosystem's ecological value in ECU
Biomass/ Carbon
Stocks, Supply & Use
Accessible Basic Resource
(tons, joules)
Water
Stocks, Supply & Use
Accessible Basic Resource
(m3, joules)
Biodiversity/ Functional Services
Stocks, Formation & Consumption,
Accessible Basic Resource
(weighted ha or km)
Sustainable use index
Change in health index (incl. stability of carbon pools)
Sustainable use index
Change in health index (incl. pollution)
Sustainable use index
Change in health index (incl. biodiversity, diseases…)
Composite index of ecosystem capability (ECU-Price)
Total Ecosystem Capital Capability
=
One resource (e.g. biocarbon) x ECU-price
NON
ADDITIVE

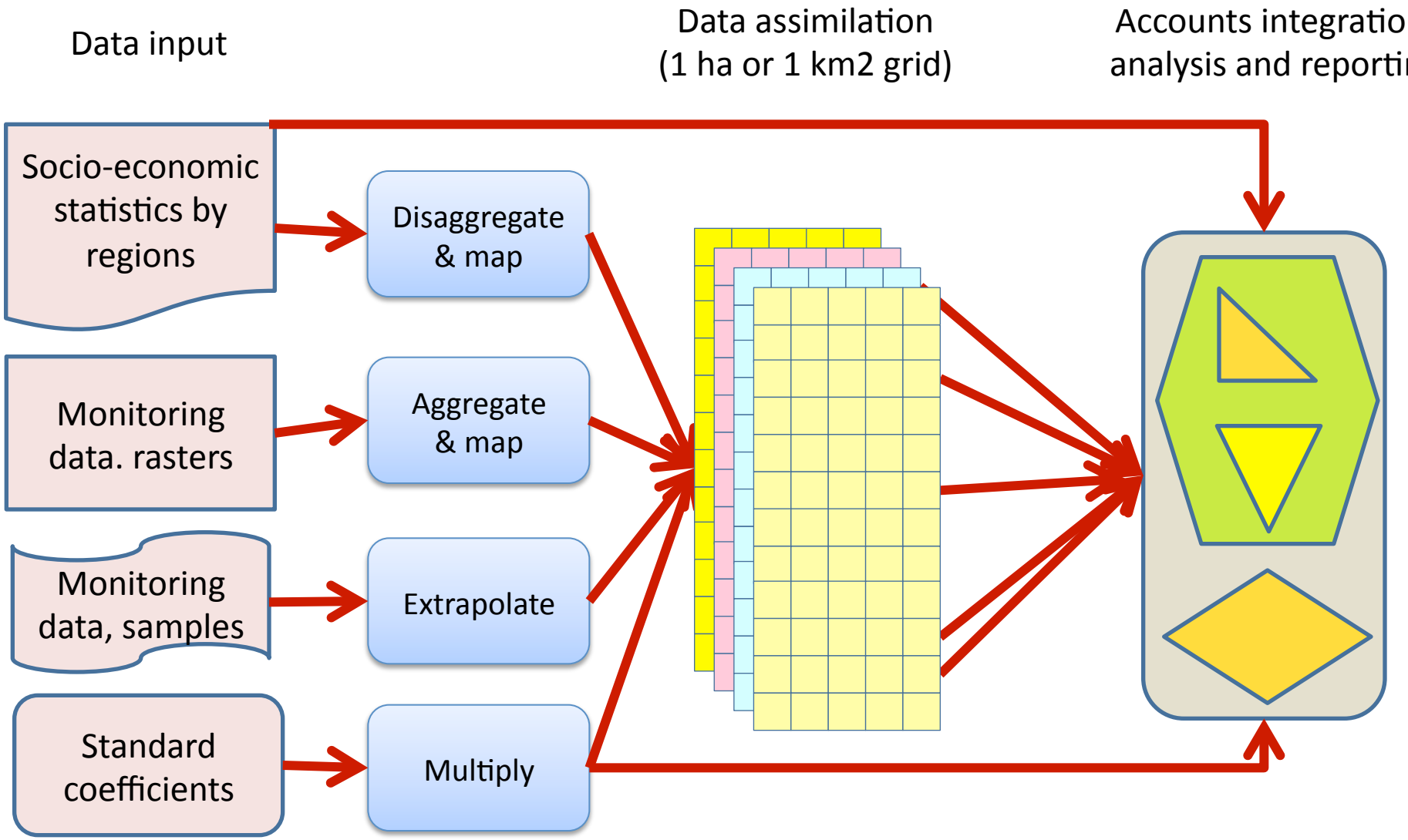
Structure of Ecosystem Natural Capital Accounts



Spatial Integration of Environmental & Socio-Economic Data



Main data flows to compile ecosystem capital accounts



From ecosystem physical degradation to capital consumption, ecological debts and sustainable benefits

Consumption of ecosystem capital (unpaid costs) & ecological debts (in $)

Economic statistics & national accounts

Ecological sustainability of **Value Added supported by ecosystem services**

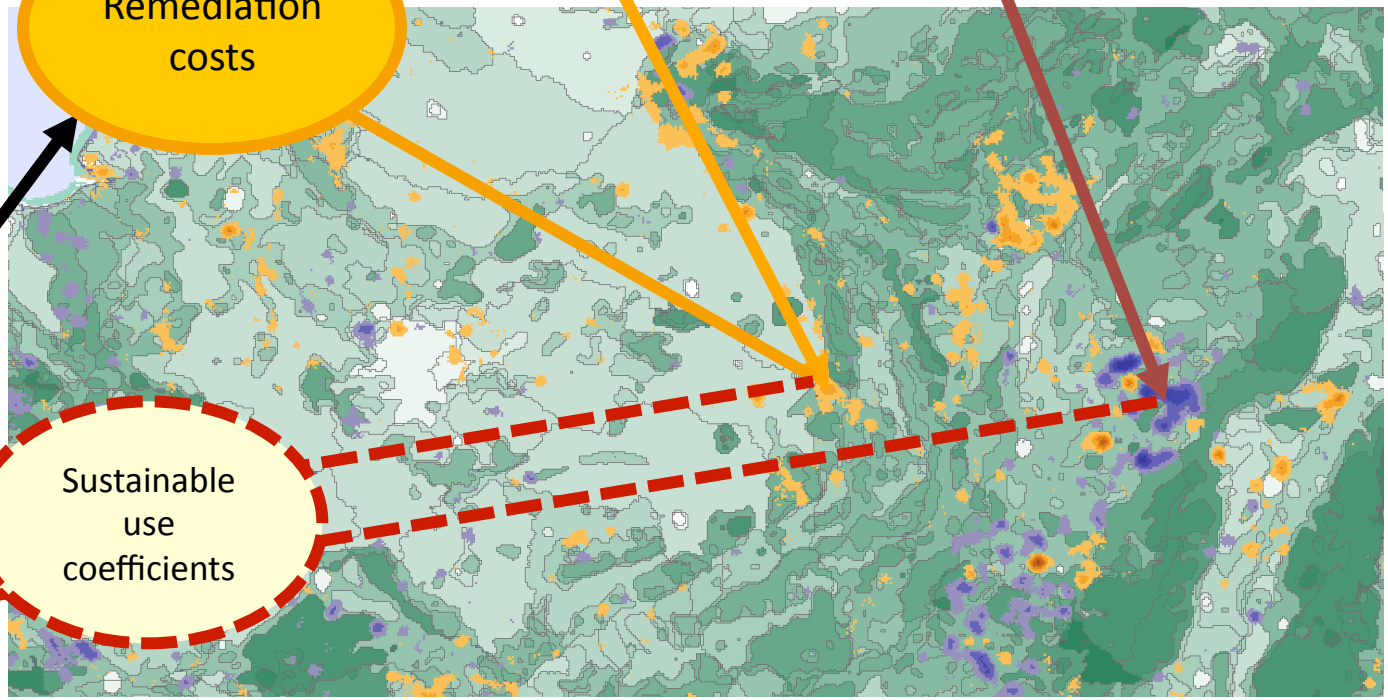
Remediation costs

Sustainable use coefficients

Degradation

Enhancement

Balance sheet of ecological debts & credits (ECU)



Landscape Ecological Potential change 1990-2006, by ecosystem landscape units

(J-L Weber and E. Ivanov, 2011)

Presentation of the ENCA core integrated accounting framework

- A “distribution” of the SEEA part 2 on experimental ecosystem accounting
- Based on experiences at the European Environment Agency and in Mauritius
- Examples are in line with the forthcoming SCBD Technical report on ENCA, A Quick Start Package

SEEA-ENCA land cover account structure

Land Cover Ecosystem Functional Classes (LCEF)		01	02	03	04	05	06	07	08	09	10	11	12	13	14	TOTAL	Sea (interface with land)
Land coverstocks and flows (lf)		Urban and associated developed areas	Homogeneous herbaceous cropland	Agriculture plantations, permanent crops	Agriculture associations and mosaics	Pastures and natural grassland	Forest tree cover	Shrubland, bushland, heathland	Sparsely vegetated areas	Natural vegetation associations and mosaics	Barren land	Permanent snow and glaciers	Open wetlands	Inland water bodies	Coastal water bodies and inter-tidal areas		
Opening Stock																	
Consumption of land cover																	
lf1	Artificial development																
lf2	Agriculture development																
lf3	Internal conversions, rotations																
lf4	Management and alteration of forested land																
lf5	Restoration and development of habitats																
lf6	Changes of land-cover due to natural and multiple causes																
lf7	Other land cover changes n.e.s.																
Total consumption of land cover																	
Formation of land cover																	
lf1	Artificial development																
lf2	Agriculture development																
lf3	Internal conversions, rotations																
lf4	Management and alteration of forested land																
lf5	Restoration and development of habitats																
lf6	Changes of land-cover due to natural and multiple causes																
lf7	Other land cover changes n.e.s.																
Total formation of land cover																	
Net change in land cover (formation - consumption)																	
No change																	
Closing Stock																	

Classifications used for land cover accounts

Ecosystem land cover classes

01	Urban and associated developed areas
02	Homogeneous herbaceous cropland
03	Agriculture plantations, permanent crops
04	Agriculture associations and mosaics
05	Pastures and natural grassland
06	Forest tree cover
07	Shrubland, bushland, heathland
08	Sparsely vegetated areas
09	Natural vegetation associations and mosaics
10	Barren land
11	Permanent snow and glaciers
12	Open wetlands
13	Inland water bodies
14	Coastal water bodies and inter-tidal areas
Sea (interface with land)	

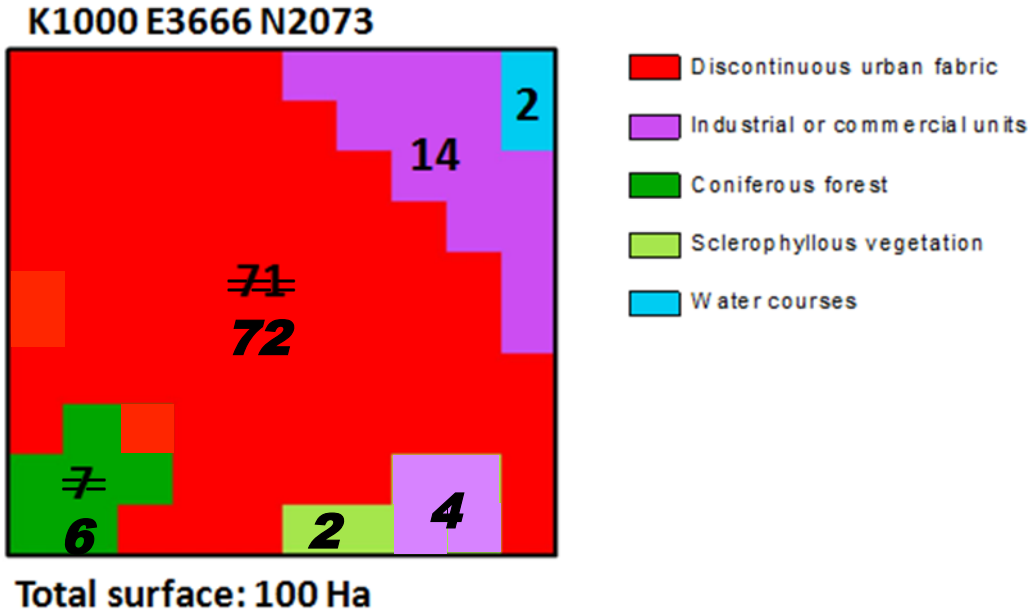
Land cover flows (formation and consumption of land cover)

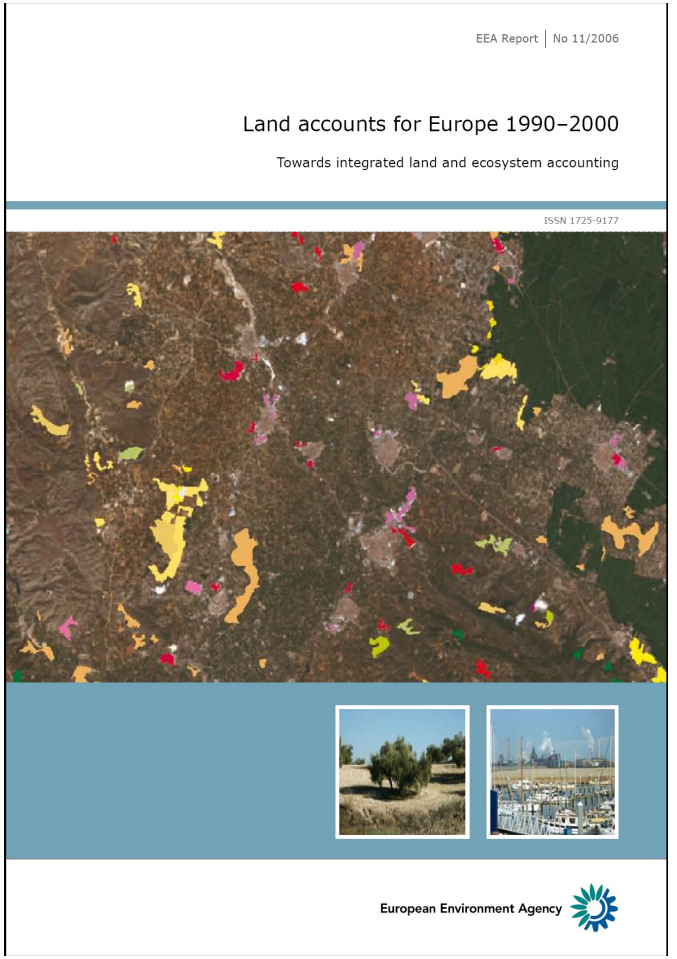
lf1	**Artificial development**
lf11	*Artificial development over agriculture*
lf12	*Artificial development over forests*
lf13	*Artificial development of other natural land cover*
lf14	*Water bodies creation*
lf19	*Other …*
lf2	**Agriculture development**
lf21	*Conversion from small scale/mosaic to large scale agriculture*
lf22	*Conversion from grassland to agriculture*
lf23	*Conversion from forest to agriculture*
lf24	*Conversion from marginal land to agriculture*
lf29	*Other …*
lf3	**Internal conversions, rotations**
lf31	*Internal conversion of artificial surfaces*
lf32	*Internal conversion between agriculture crop types*
lf33	*Internal conversion between forest types*
lf34	*Internal conversions of natural land*
lf39	*Other …*
lf4	**Management and alteration of forested land**
lf41	*Management, felling and replantation*
lf42	*Fires, epidemics and other*
lf49	*Other …*
lf5	**Restoration and development of habitats**
lf51	*Conversion from crops to set aside, fallow land and pasture*
lf52	*Withdrawal of farming/ Landscape restoration*
lf53	*Forest creation, afforestation of agriculture*
lf54	*Forest creation, afforestation of marginal land*
lf55	*Forest recruitment*
lf56	*Restoration of degraded land*
lf59	*Other …*
lf6	**Changes of land-cover due to natural and multiple causes**
lf61	*Climatic anomalies*
lf62	*Climatic and other hazards*
lf69	*Natural transitions n.e.s.*
lf7	**Other land cover changes n.e.s. and revaluation**
lf0	**No observed land-cover change**

Land cover accounting: statistics based on gridded data

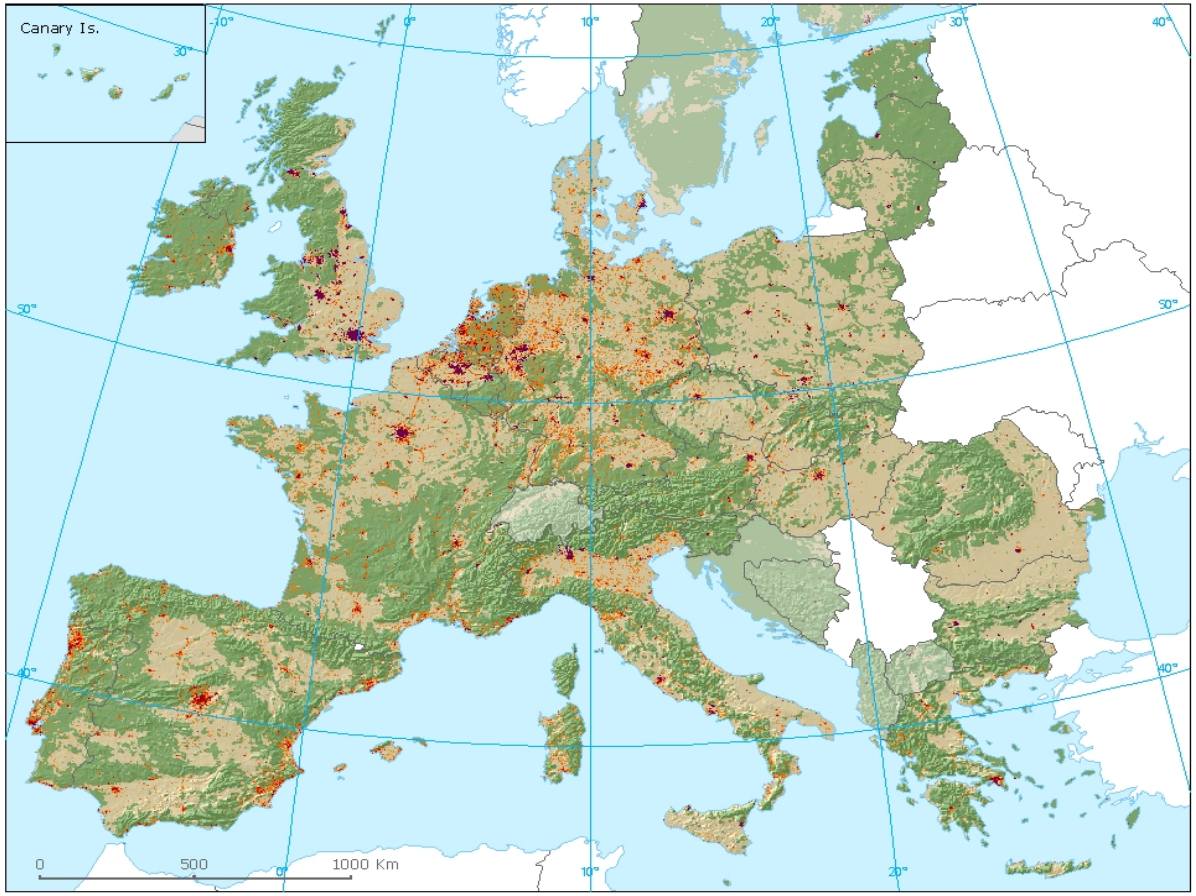
Land cover accounts for Europe
1990-2000 (26 countries)
2006 update (35 countries)

Land cover accounts are produced for
1 km² grid cells





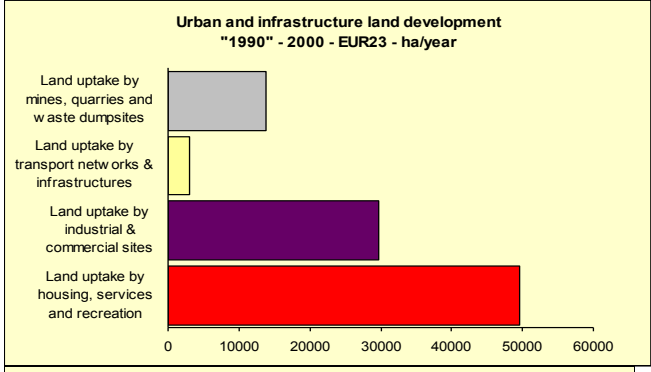
Sprawl of artificial areas 1990-2000

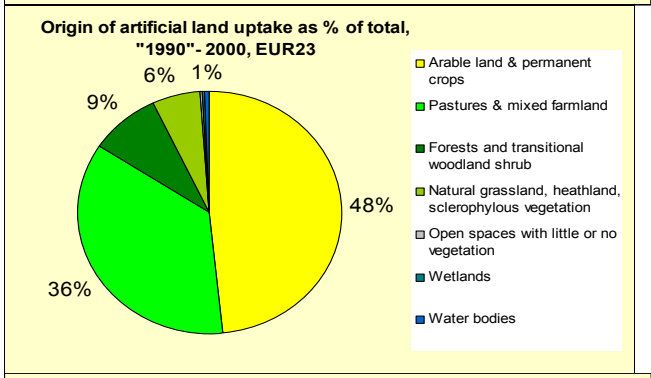


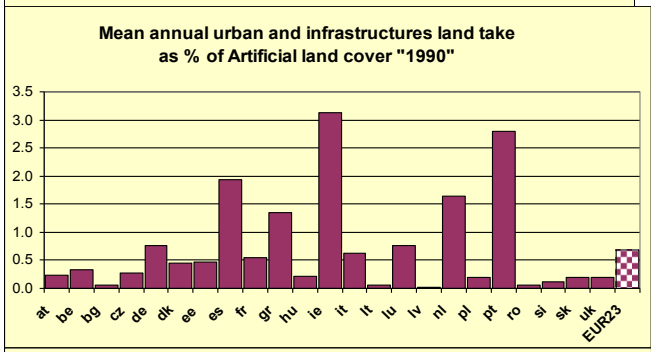
Urban and infrastructure development
- 1 to 5 %
- 5 to 10 %
- more than 10 %

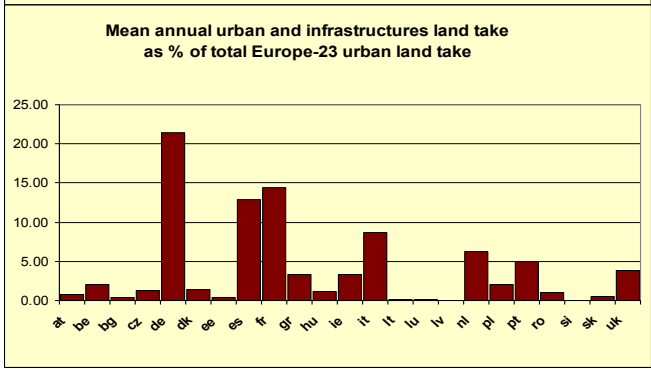
Urban zones 1990
- > 50000 people

Green background index (%)
- 0-60
- 61-100



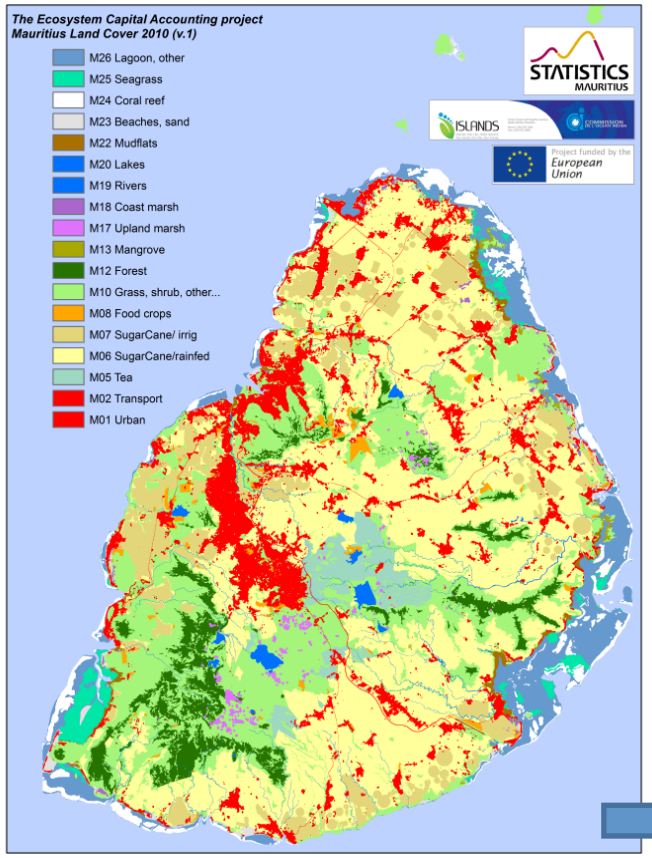






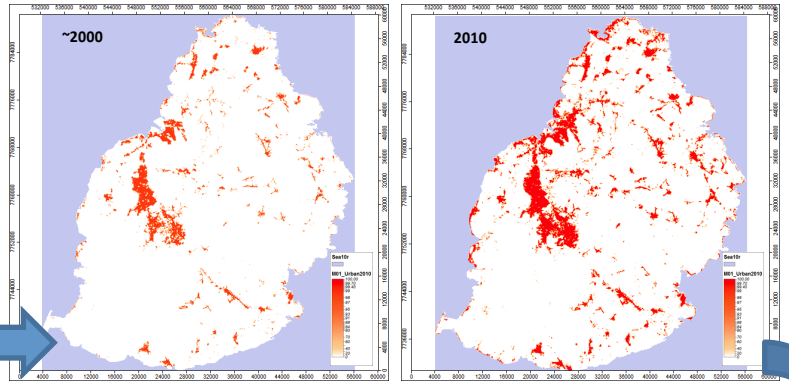
SEEA-ENCA Mauritius preliminary results :

Land cover and change from 2000 to 2010



The land cover data are stored using geographical datasets which use grids (10m x 10m and 100m x 100m) at the most detailed level.

Urban land cover 2000 & 2010

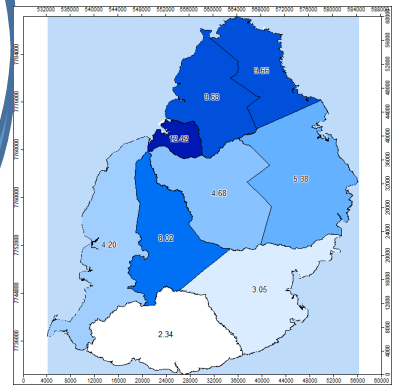


These grids allow computing statistics and producing ecosystems/natural capital accounts for various statistical units such as municipal and village council areas, districts, coastal zones, river basins, socio-ecological landscape units and any relevant zoning.

Land cover stock and change account/ urban sprawl **2000 2010 - km2**

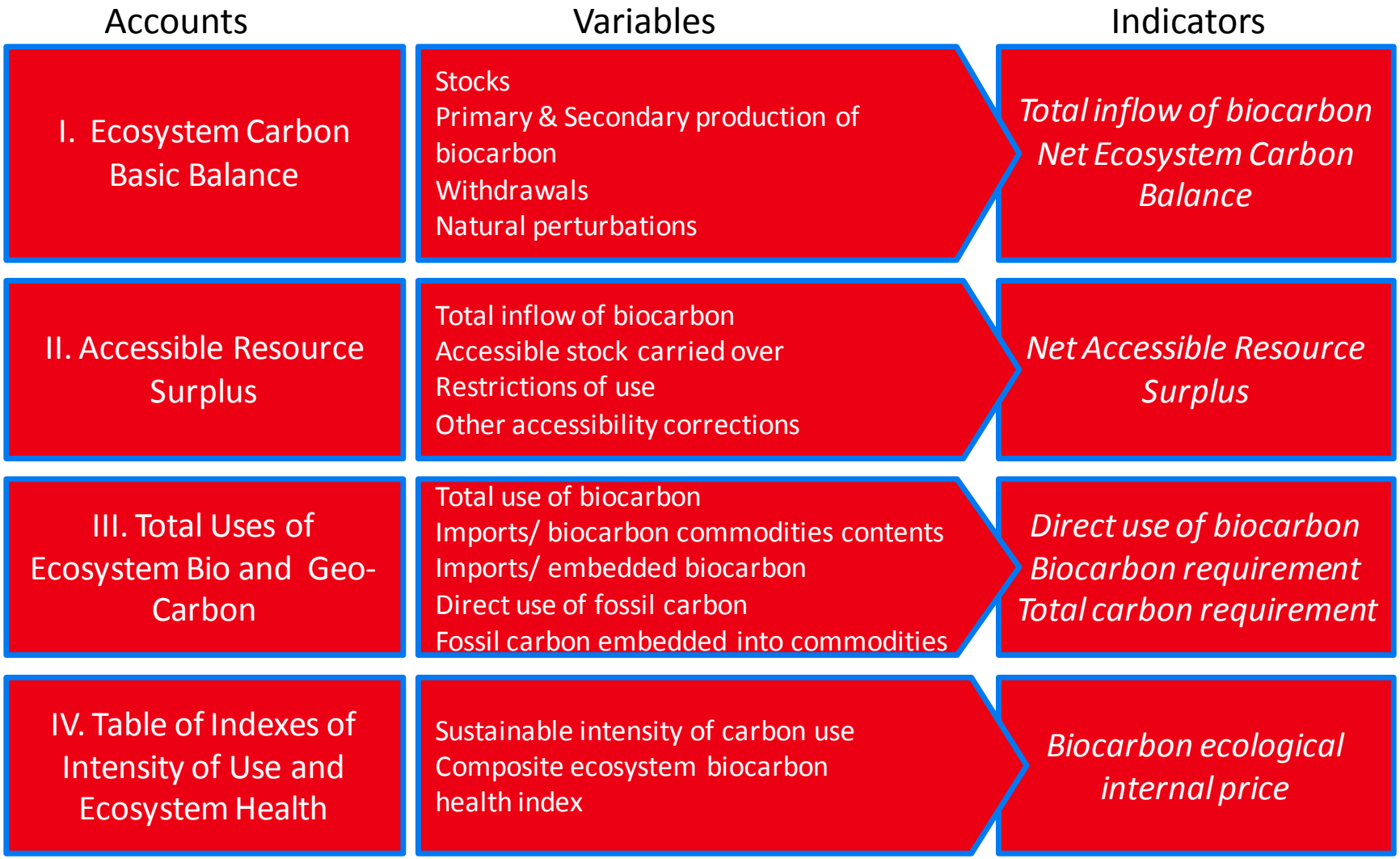
Provisional	Rivière du Rempart	Pamplemousses	Flacq	Moka	Grand Port	Plaines Wilhems	Black River	Savanne	Port Louis	TOTAL
District AREA SQKM	14703	18019	29826	23512	26134	19839	25558	24758	3976	186325
M01 Urban land cover 2000 v0	747	705	405	282	406	2060	334	266	2667	7872
M01 Urban land cover 2000 v1, adjusted	1225	1172	667	510	549	2456	542	379	3284	10782
lf1 Urban sprawl	478	467	263	228	143	396	208	112	616	2911
M01 Urban land cover 2010	1704	1639	930	738	691	2852	749	491	3900	13693

Urban sprawl
2000-2010 by Districts

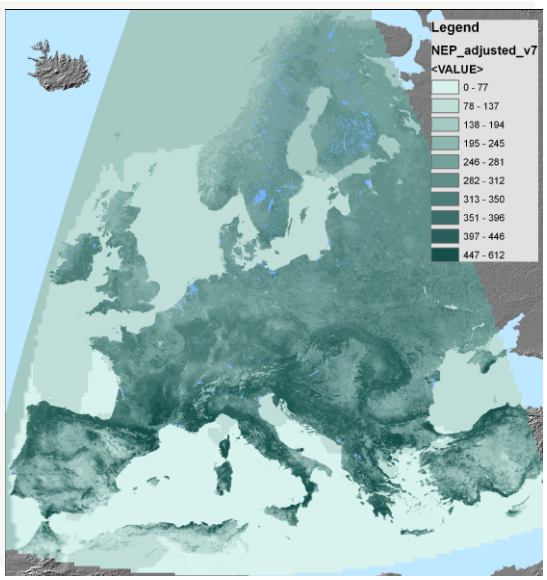


Jean-Louis Weber, 18 June 2013

SEEA-ENCA ecosystem carbon account structure



The carbon/biomass account



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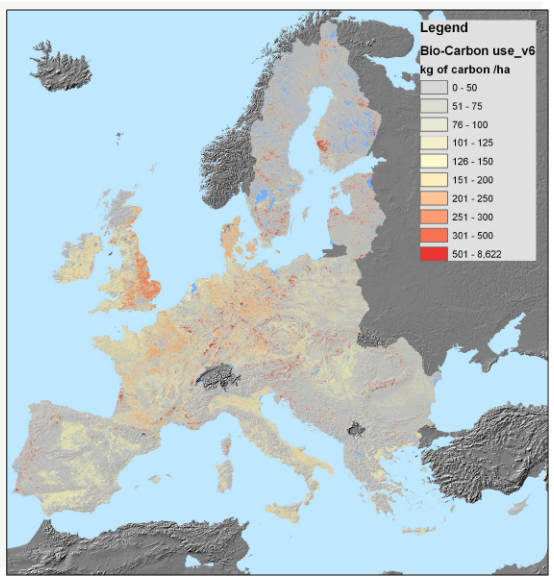

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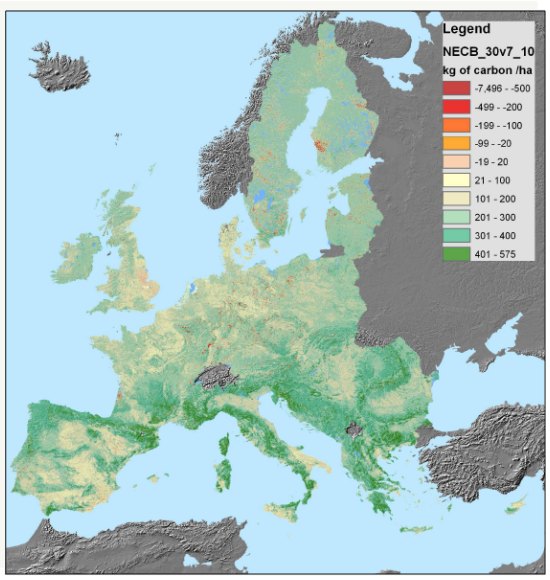


Net Primary Production of biomass:
satellite images (NDVI) and modeling, accessible bio-C surplus

Uses:
agriculture and forestry statistics by regions/ countries resampled to the1km2 or 1 ha grid f(land cover, NDVI)

Net Ecosystem Carbon Balance:
soil and vegetation (trees, shrubs, grass)

SEEA-ENCA Mauritius preliminary results :

The biomass-carbon account

Carbon Accounts show the capacity of the ecosystems to produce biomass and the way it is used by crops harvests and trees removal or sometimes sterilised by artificial developments or destroyed by soil erosion or forest fires (in line with IPCC guidelines).

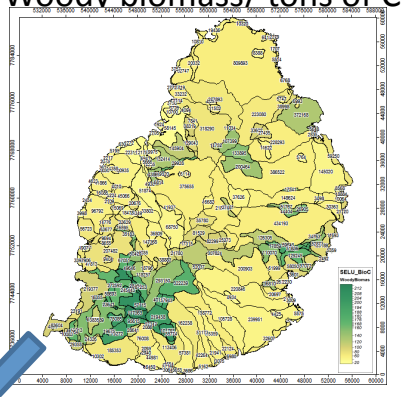
Accounts are compiled using various sources such as products based on earth observation by satellite (e.g. MODIS NPP), on in situ monitoring (for IPCC-LULUCF, FAO/soil, FRA2010) and official statistics .

Simplified bio-carbon accounts by districts, 2010 — **Tons of carbon**

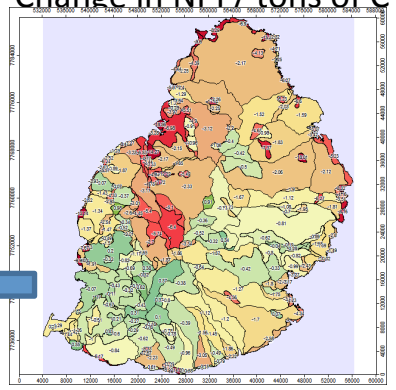
Provisional

2010	Riviere du Rempart	Pamplemousses	Flacq	Moka	Grand Port	Plaines Wilhems	Black River	Savanne	Port Louis	Tot
Initial stock 2010	**1457955**	**2101934**	**4135543**	**4165122**	**2855365**	**3327114**	**3173857**	**3196601**	**432317**	**24845808**
Woody biomass	873403	1137222	2068571	1744337	1796040	1643485	2224653	2409579	265193	**14162483**
Topsoil organic carbon	584551	964712	2066972	2420785	1059325	1683629	949204	787022	167124	**10683324**
Flows/inputs	**335582**	**417954**	**819601**	**675923**	**736068**	**454057**	**642970**	**739278**	**68922**	**4890354**
Net Primary Production	335582	417954	819601	675923	736068	454057	642970	739278	68922	**4890354**
Flows/outputs and decrease	**349143**	**448659**	**870542**	**708508**	**725853**	**481532**	**650835**	**744290**	**74976**	**5054339**
Removals, harvests	65446	90345	108405	56498	90172	35596	87914	81900	1698	**617974**
Wood removals										**0**
Sugarcane	*63718*	*86585*	*104230*	*52531*	*87208*	*31984*	*83773*	*80223*	*912*	**591165**
Food crops	*1727*	*3759*	*4175*	*3656*	*2918*	*3565*	*4141*	*1633*	*786*	**263**
Other cops	*0*	*0*	*0*	*311*	*46*	*46*	*0*	*44*	*0*	**447**
Decrease due to land use change	4102	4761	5762	3629	3240	5216	2881	2290	1388	**33269**
Other decrease (fire, erosion…)	14580	21019	41355	41651	28554	33271	31739	31966	4323	**248458**
Soil/decomposers respiration v2	265016	332534	715020	606730	603888	407449	528301	628133	67567	**4154638**
Net Ecosystem Carbon Balance 1 (flows)	***-13562***	***-30705***	***-50941***	***-32585***	***10215***	***-27475***	***-7865***	***-5012***	***-6054***	**-163985**
Statistical adjustment	16597	28379	33235	15034	-29421	11163	-19714	-15632	6178	**45819**
Net Ecosystem Carbon Balance 2 (stocks)	***3035***	***-2326***	***-17706***	***-17551***	***-19206***	***-16312***	***-27579***	***-20644***	***123***	**-118166**
Final Stock 2010	**1460990**	**2099608**	**4117837**	**4147571**	**2836159**	**3310802**	**3146278**	**3175957**	**432440**	**24727642**
Woody biomass	876438	1134896	2050865	1726786	1776835	1627173	2197074	2388935	265316	**14044318**
Topsoil organic carbon	584551	964712	2066972	2420785	1059325	1683629	949204	787022	167124	**10683324**
Net accessible bio-carbon resource 2010	**73600**	**83094**	**86875**	**51642**	**112974**	**30296**	**87089**	**90500**	**1479**	**617550**
Change in stocks in the previous year	3035	-2326	-17706	-17551	-19206	-16312	-27579	-20644	123	**-118166**
Flows/inputs (+)	335582	417954	819601	675923	736068	454057	642970	739278	68922	**4890354**
Soil/decomposers respiration v2 (-)	265016	332534	715020	606730	603888	407449	528301	628133	67567	**4154638**
Index of intensity of use of bio-carbon 2010	**112**	**92**	**80**	**91**	**125**	**85**	**99**	**111**	**87**	**100**

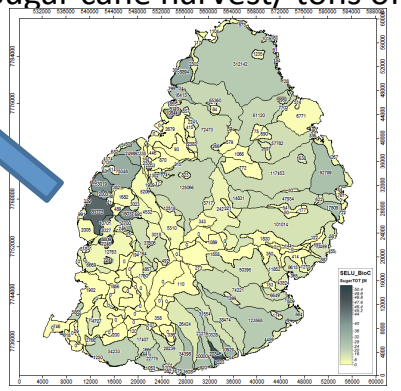
Woody biomass/ tons of C



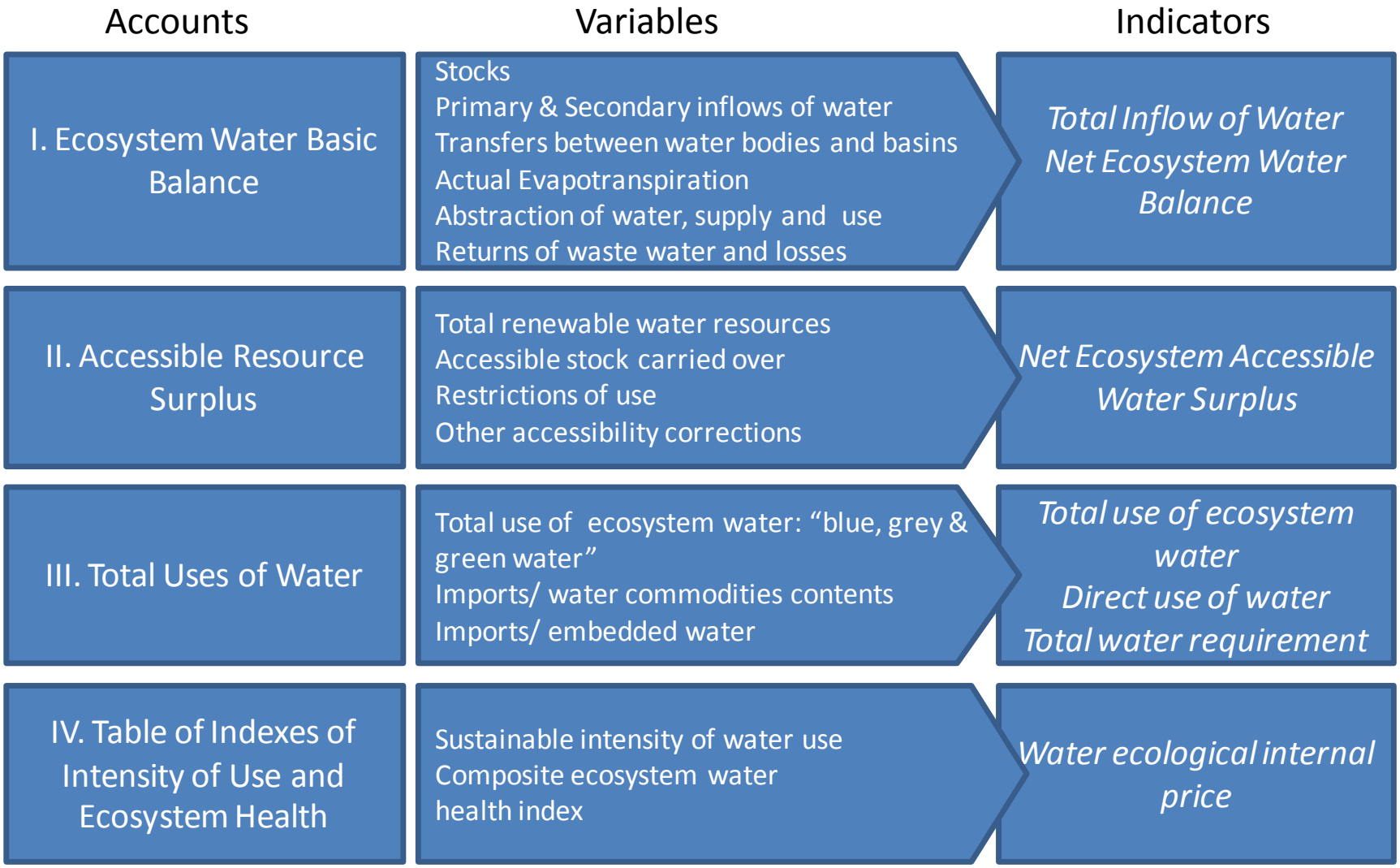
Change in NPP/ tons of C



Sugar cane harvest/ tons of C



SEEA-ENCA ecosystem water account structure

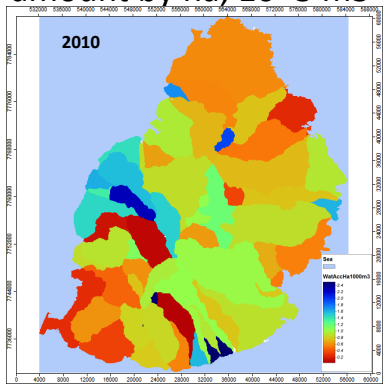


SEEA-ENCA Mauritius preliminary results :

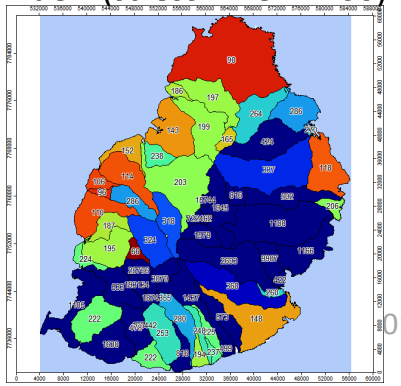
The ecosystem water account

The ecosystem water accounts follows the SEEA Water methodology and use preliminary results of the national water accounts. They are detailed by river basins and sub-basins where the hydrological system can be described consistently. Stocks of water are mainly aquifers and lakes/reservoirs, which play important role in Mauritius. Data have provided by the meteorological and water agencies. Water use by sub-basins is estimated from population census data and irrigation map. Satellite products have been used for evapotranspiration. The outcome is the calculation of the water really accessible for use and of an index of stress from water use intensity.

Accessible water, mean amount by ha, 10^3 m3



Water use intensity stress index (stress when <100)

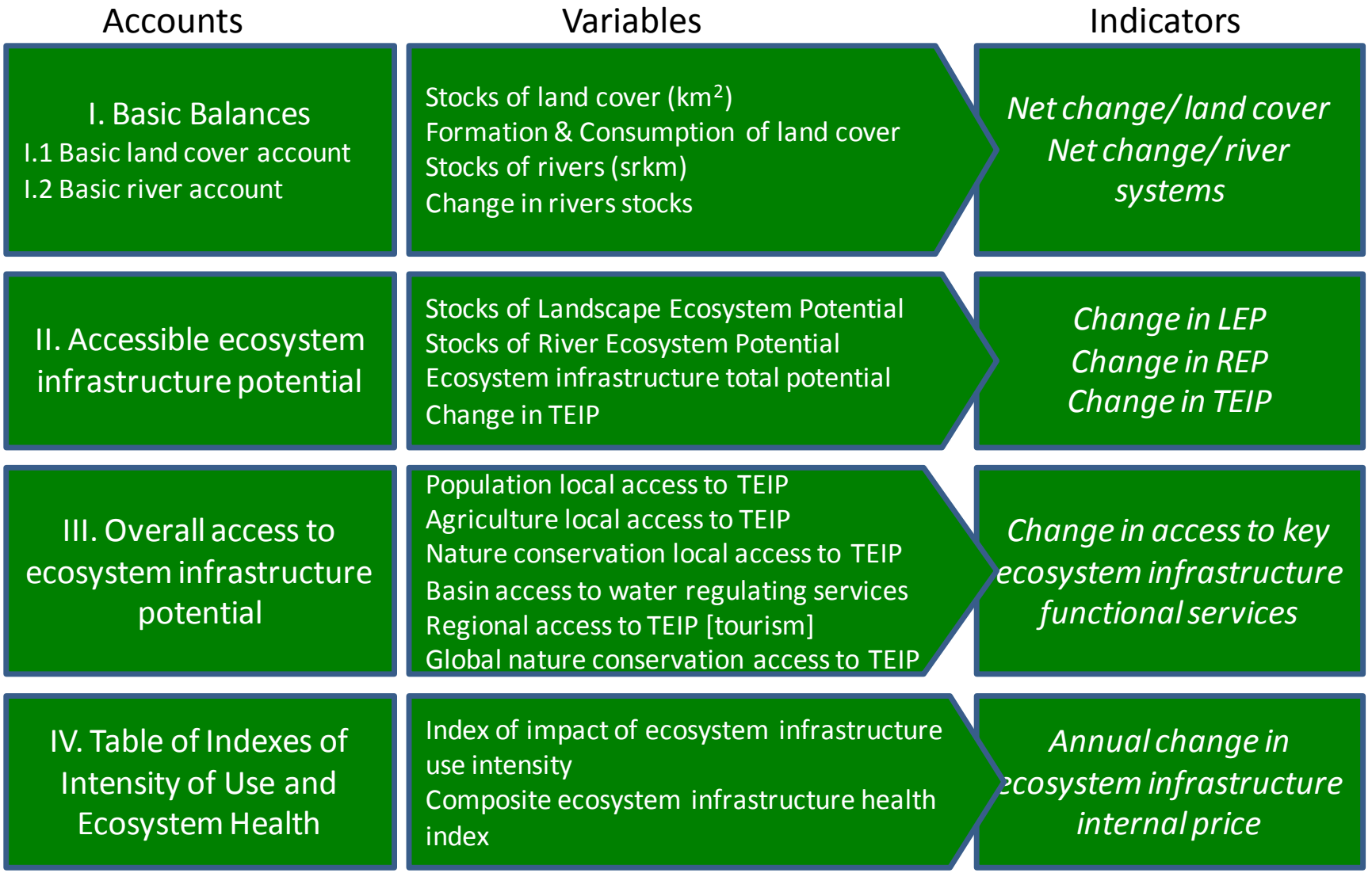


Simplified water accounts by Districts, 2010 — Mm3

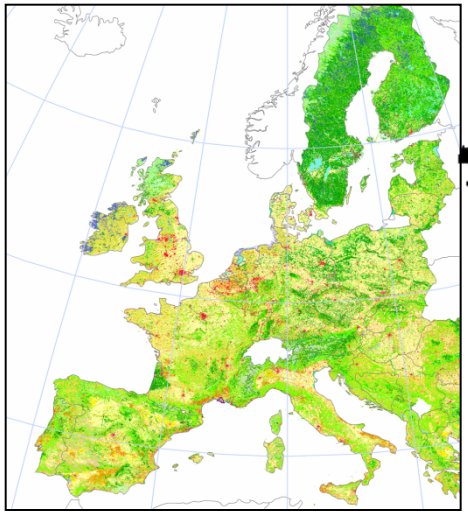
Provisional

2010	Riviere du Rempart	Pamplemousses	Flacq	Moka	Grand Port	Plaines Wilhems	Black River	Savanne	Port Louis	Total
AREA_ha	*14703*	*18019*	*29826*	*23512*	*26134*	*19839*	*25558*	*24758*	*3976*	*186325*
Boreholes_nb	*105*	*164*	*100*	*83*	*110*	*146*	*131*	*30*	*12*	*881*
River runoff districts coeff	*35*	*20*	*150*	*150*	*100*	*100*	*80*	*100*	*20*	*755*
Lake 2010 ha	*0*	*103*	*0*	*468*	*41*	*511*	*109*	*19*	*0*	*1251*
Stocks	**3345**	**5231**	**3189**	**2681**	**3510**	**4687**	**4183**	**961**	**383**	**28170**
Aquifers	3343	5222	3184	2643	3503	4649	4171	955	382	28052
Lakes/reservoirs	0	7	0	32	3	35	7	1	0	86
Rivers	2	2	5	6	5	3	4	4	1	32
Soil/vegetation										
Net Inflows	**75**	**176**	**292**	**342**	**355**	**293**	**155**	**353**	**12**	**2052**
Rainfall	173	236	579	633	629	484	302	603	49	3688
EvapoTranspitation (actual), total	155	199	367	290	338	224	308	326	40	2247
EvapoTranspitation (actual), spontaneous	109	115	310	268	294	207	167	269	40	1779
Net transfers surface - groundwater	11	14	23	18	20	15	20	19	3	143
Transfers between basins		41		-41						0
Abstraction and Uses	**63**	**109**	**80**	**36**	**63**	**83**	**152**	**69**	**23**	**678**
Municipal Water Production	17	23	23	13	18	64	11	11	22	202
Use of water	*8*	*12*	*11*	*7*	*9*	*32*	*5*	*6*	*11*	*101*
Loss of water in distribution	*8*	*12*	*11*	*7*	*9*	*32*	*5*	*6*	*11*	*101*
Irrigation	46	85	57	22	44	17	141	57	0	468
Other	1	1	1	1	1	3	0	0	1	8
Waste water to rivers	**6**	**8**	**8**	**5**	**6**	**22**	**4**	**4**	**8**	**70**
Outflow to the sea	**78**	**46**	**324**	**318**	**217**	**212**	**172**	**213**	**50**	**1632**
Rivers runoff	74	42	318	318	212	212	170	212	42	1602
Waste water to the sea	4	4	6	0	5	0	2	1	8	30
Induced ETA, Evaporation	**46**	**85**	**57**	**22**	**44**	**17**	**141**	**57**	**0**	**468**
Net Flows	-103	-52	-156	-29	41	2	-304	19	-46	-626
Closing stocks	**3242**	**5179**	**3034**	**2652**	**3551**	**4690**	**3879**	**980**	**337**	**27544**
Accessible renewable water	**83**	**124**	**217**	**200**	**219**	**187**	**228**	**213**	**36**	**1507**
Water use intensity (1): Average/ha	**132**	**114**	**270**	**561**	**345**	**224**	**150**	**310**	**155**	
Water use intensity (2): 1st decile	**90**	**90**	**118**	**203**	**148**	**114**	**110**	**222**	**143**	

SEEA-ENCA biodiversity functional services account structure

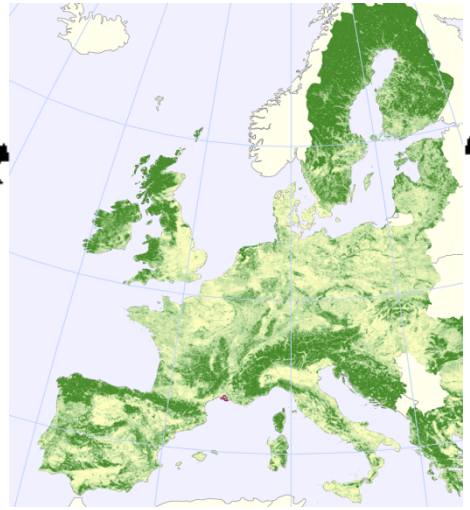


Landscape Integrity & Systemic Services: Landscape Ecological Potential



Corine land cover map *(CLC is derived from satellite images)*

*



Green Landscape Index *(derived from CLC)*

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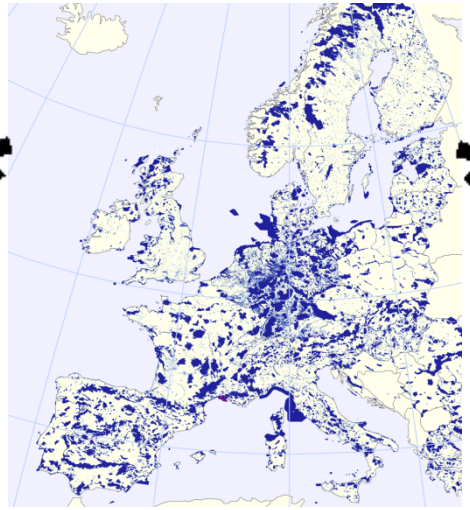

Nature Value (*Naturilis, derived from Natura2000 designated areas)*

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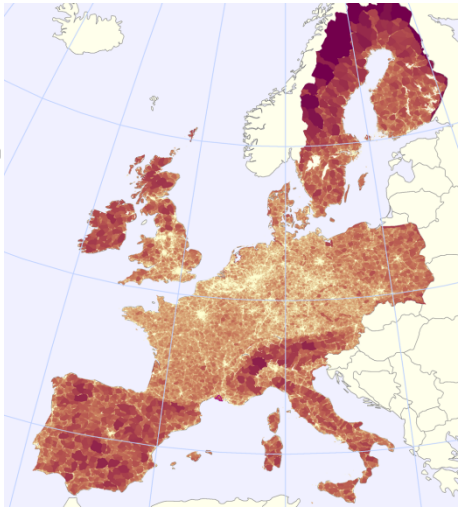
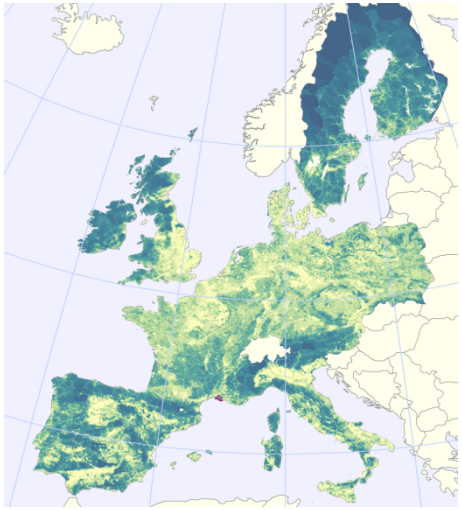


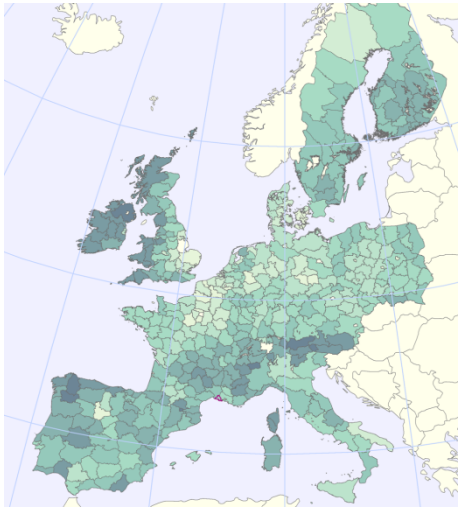
Fragmentation (*Effective Mesh Size (MEFF) derived from TeleAtlas Roads and CLC)*

→



Landscape Ecological Potential (LEP) 2000, by 1km² grid cell

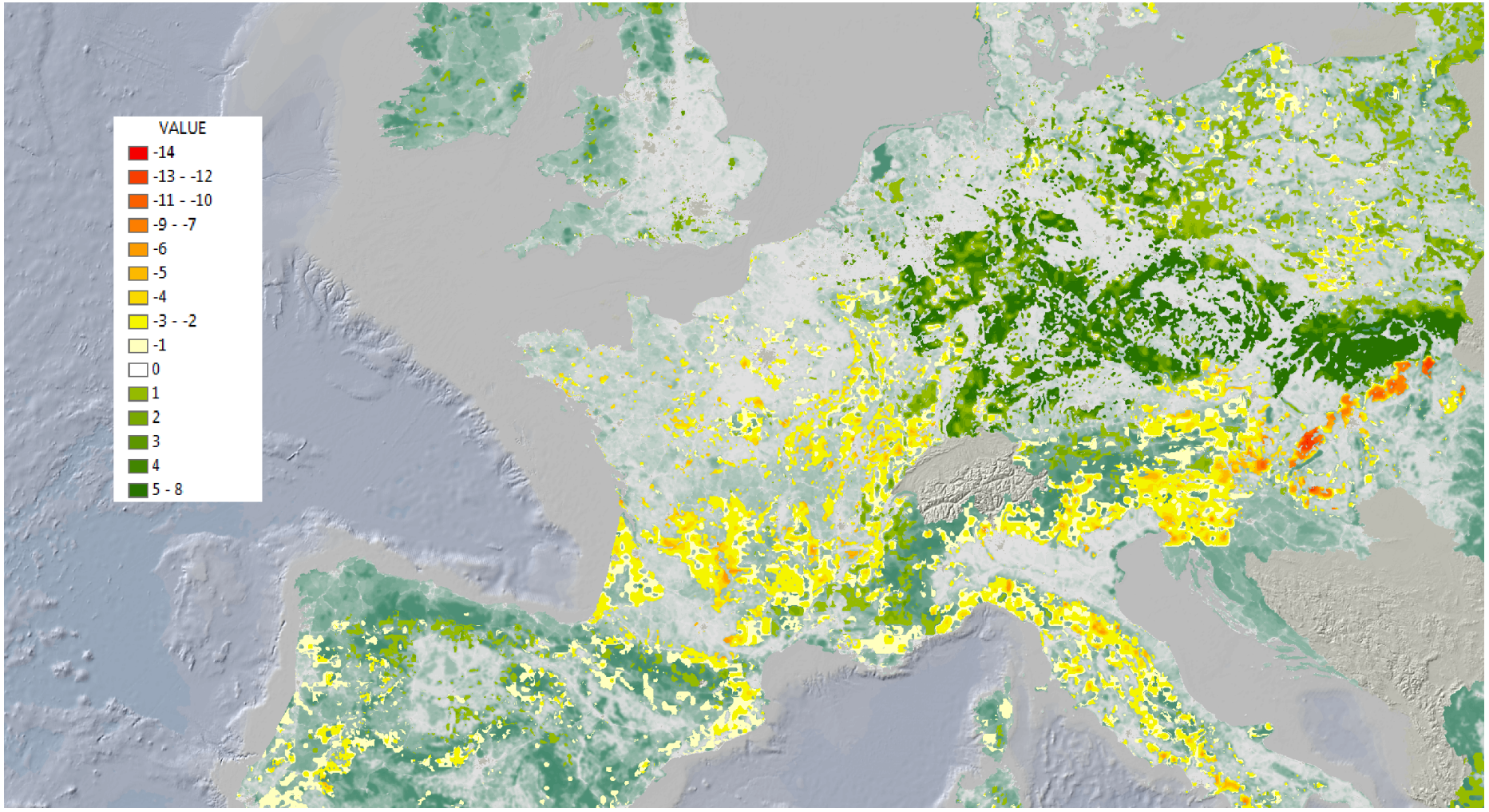
and



LEP 2000 by NUTS 2/3

Species biodiversity change account

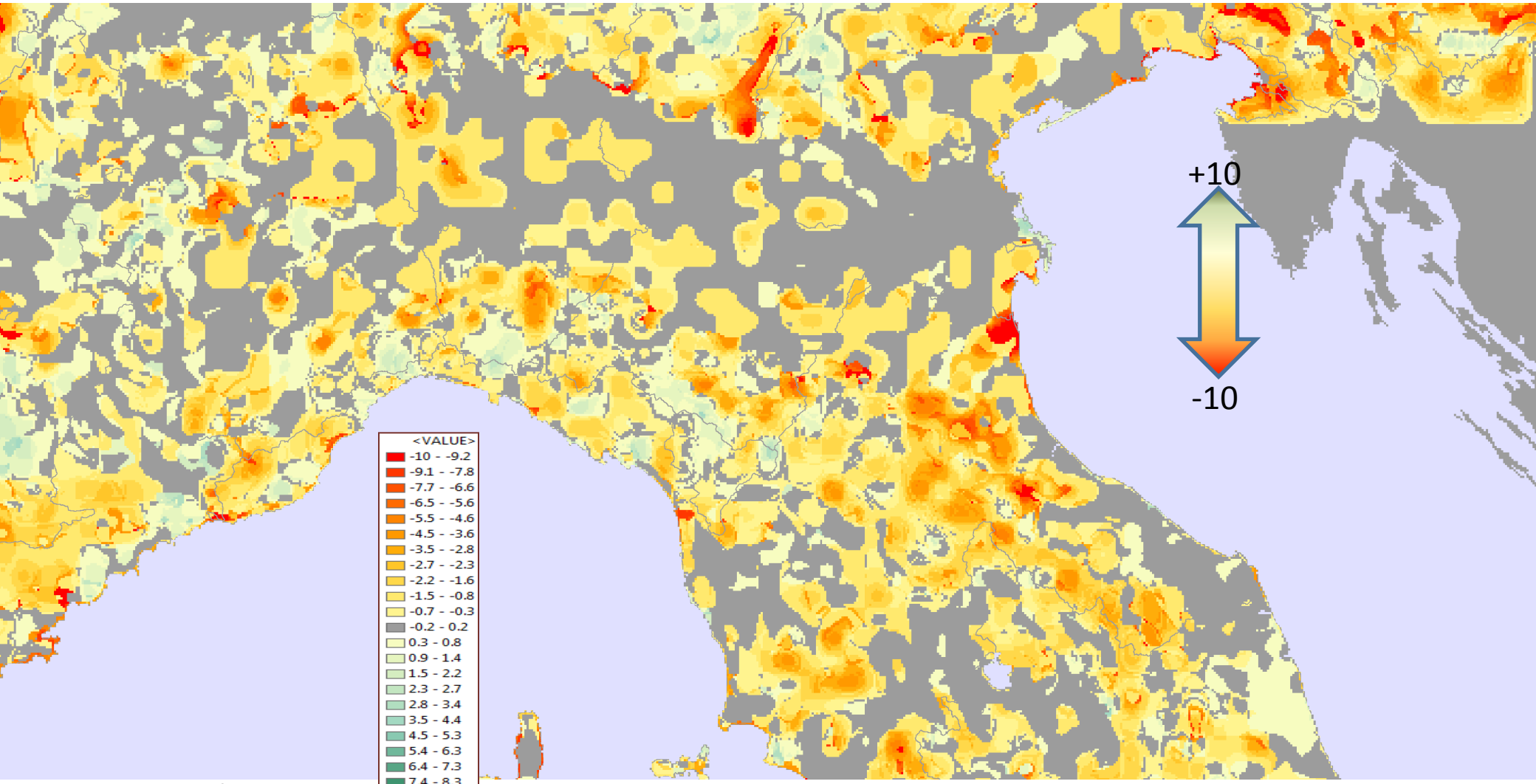
Index for **forest** species population trend before 2006: Number of species with population “increase” and “stable” *minus* “population decrease” (based on the 2006 countries’ reporting to the EC (Art. 17) on status of threatened species)



Jean-Louis Weber , Rania Spyropoulou, Emil Ivanov & Oscar Gomez

Species biodiversity change account

Index for all ecosystem types: future prospects (after 2006) measured as “good” status minus “poor +bad” (based on the 2006 countries’ reporting to the EC (Art. 17) on status of threatened species)

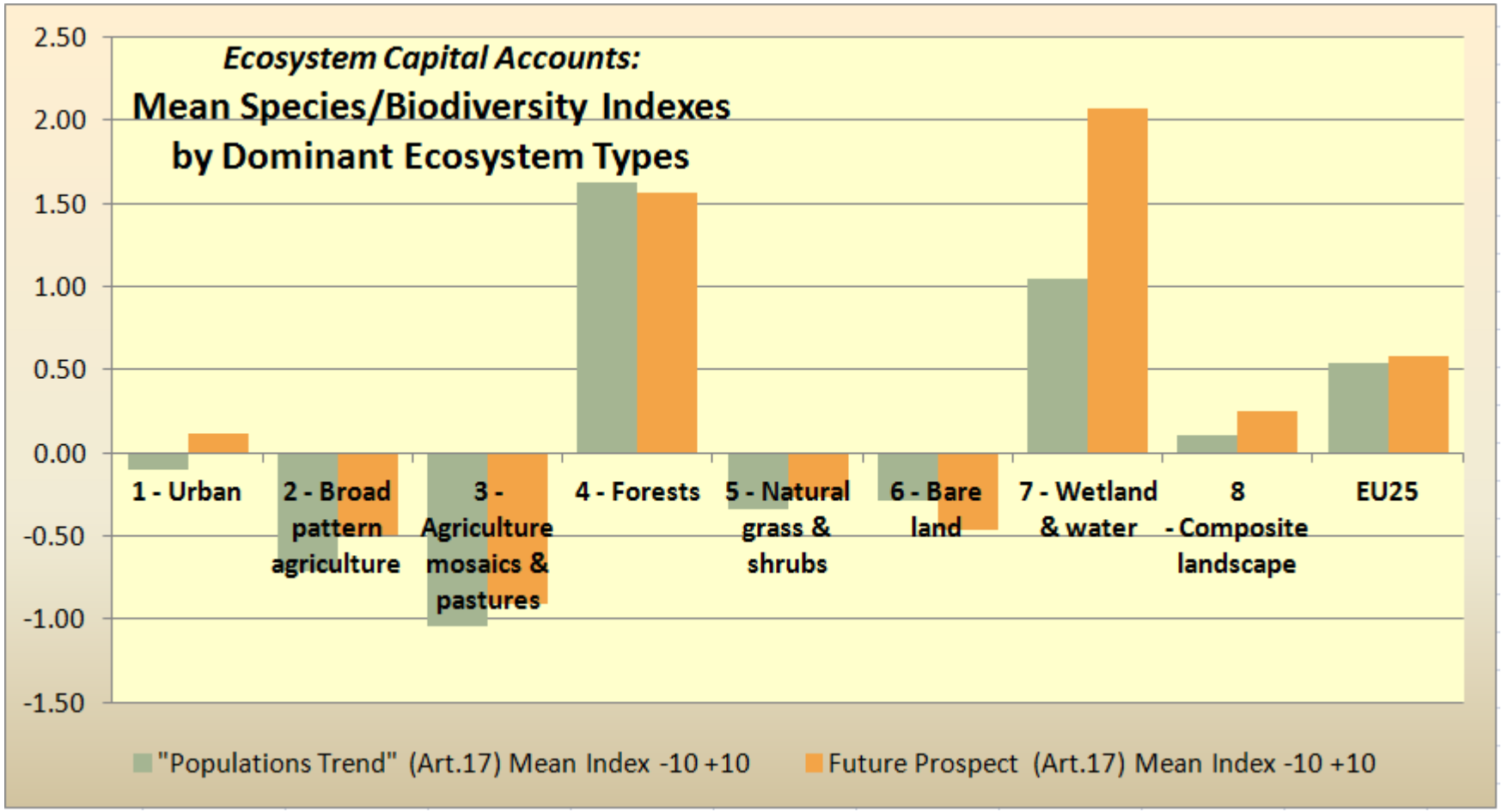


Jean-Louis Weber , Rania Spyropoulou, Emil Ivanov & Oscar Gomez

Preliminary results:

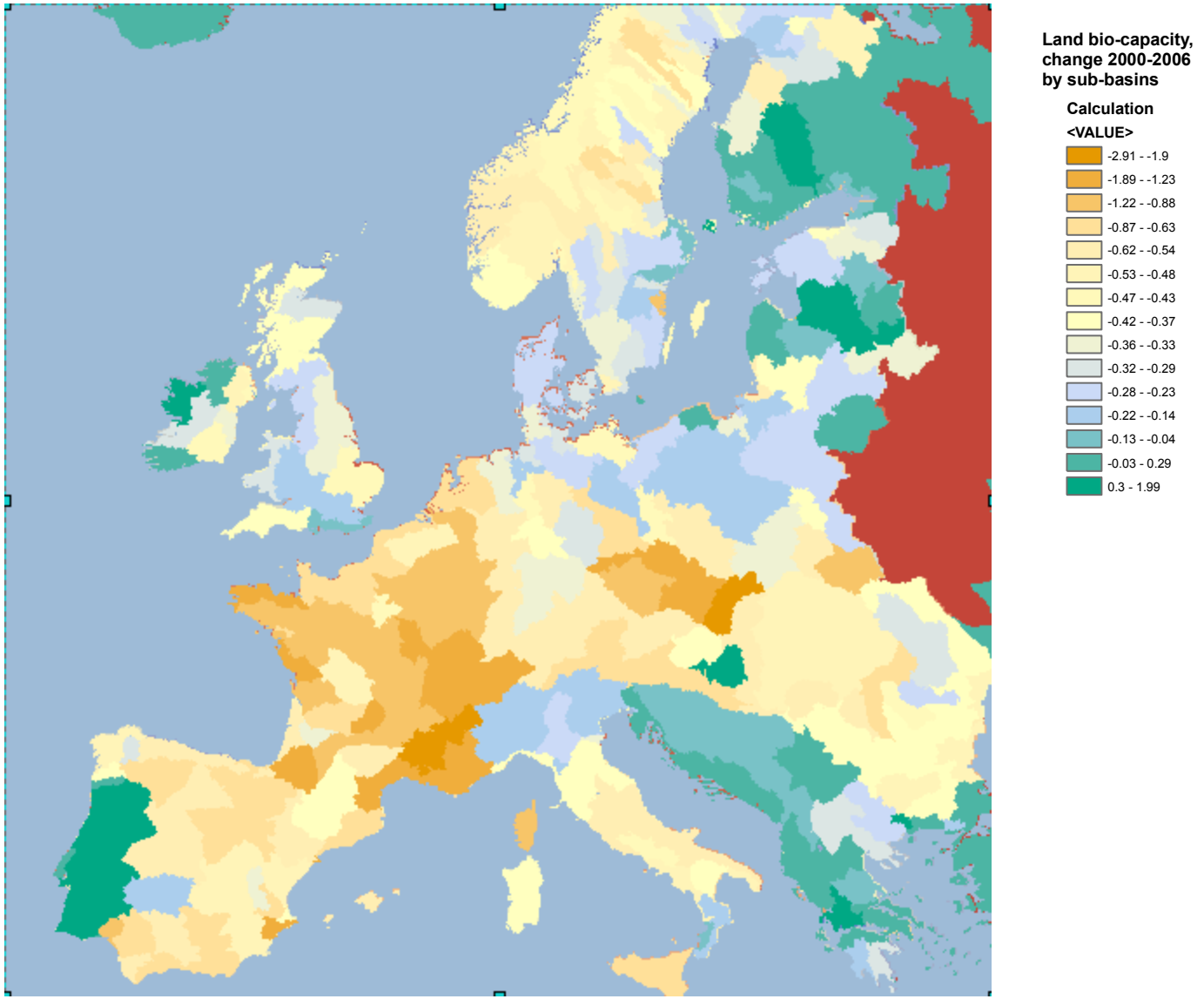
Ecosystem Capital Accounts: Landscape/Biodiversity Capacity Account

Species/biodiversity change mean indexes pre- and post 2006, by ecosystems



Jean-Louis Weber , Rania Spyropoulou, Emil Ivanov & Oscar Gomez

Change in landscape/biodiversity capacity 2000-2006, by sub-basins



SEEA-ENCA Mauritius preliminary results :

The functional services account (depending from integrity and biodiversity)

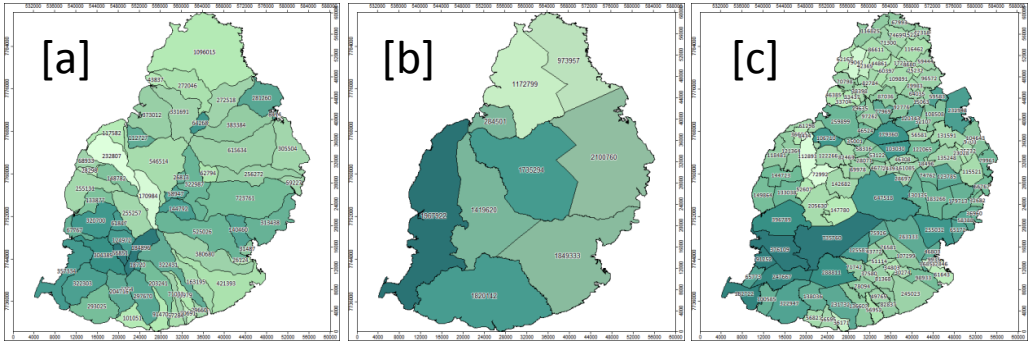
The biodiversity of systems and species account is made of two accounts which describe the state of ecosystems green infrastructure (landscapes, rivers and sea coastal zones) on the one hand and changes in species biodiversity on the other hand.

The NLEP index combines the green character of ecosystems and their fragmentation by roads which may alter their good functioning. Land cover is then weighted with NLEP.
Highest NLEP values can be found where forests, shrubs, grass and natural habitats are predominant, in particular in mountainous and land coastal areas. Low NLEP values correspond to urbanised areas and intermediate score reflect agriculture dominated catchments.

Green Infrastructure Accounts

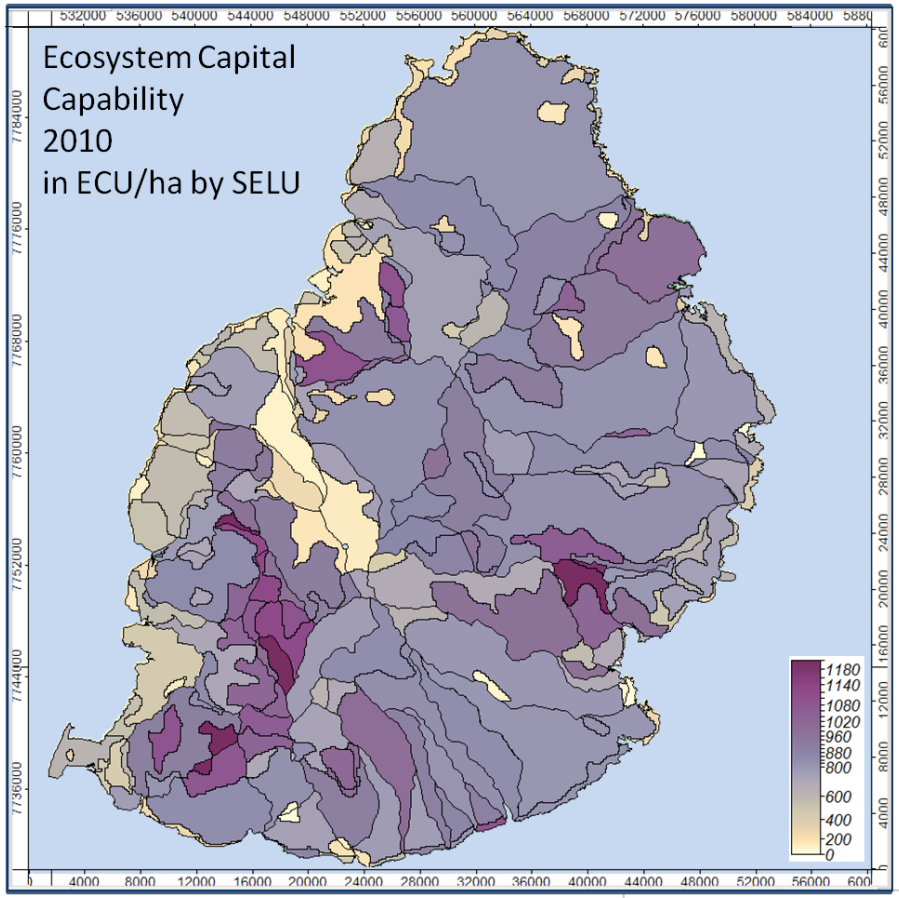
Provisional	*Riviere du Rempart*	*Pamplemousses*	*Flacq*	*Moka*	*Grand Port*	*Plaines Wilhems*	*Black River*	*Savanne*	*Port Louis*	**Total** / *Mean values*
AREA_ha	14703	18019	29826	23512	26134	19839	25558	24758	3976	186325
Indexes (0-100 value per ha)										
GBL 2000 index	*43.4*	*41.7*	*49.7*	*55.6*	*50.1*	*53.4*	*61.0*	*53.7*	*58.6*	*51.9*
Fragmentation index	*8.6*	*9.8*	*7.3*	*6.2*	*6.9*	*7.9*	*5.1*	*5.1*	*6.9*	*6.9*
nLEP 2000 index	*39.7*	*37.6*	*46.0*	*52.1*	*46.6*	*49.2*	*57.9*	*51.0*	*54.5*	*48.4*
Green Infrastructure Account										
GBL 2000 / weighted ha	638105	751152	1481482	1307506	1309039	1060139	1559660	1330151	232911	9670145
nLEP 2000 / weighted ha	583021	677761	1373059	1226033	1218167	976061	1479992	1262700	216727	9013521
Indexes (0-100 value per ha)										
GBL 2010 index	*42.0*	*40.6*	*49.2*	*55.1*	*49.8*	*52.4*	*60.5*	*53.5*	*50.7*	*51.1*
Fragmentation index	*8.6*	*9.8*	*7.3*	*6.2*	*6.9*	*7.9*	*5.1*	*5.1*	*6.9*	*6.9*
nLEP 2010 index	*38.4*	*36.7*	*45.6*	*51.6*	*46.4*	*48.2*	*57.4*	*50.8*	*47.2*	*47.7*
Green Infrastructure Account										
GBL 2010 / weighted ha	617999	732184	1468542	1294945	1301938	1039397	1547086	1324150	201660	9527900
nLEP 2010 / weighted ha	564651	660647	1361066	1214254	1211558	956963	1468060	1257003	187648	8881851
Change in nLEP 2000-2010	**-18370**	**-17114**	**-11993**	**-11779**	**-6608**	**-19097**	**-11932**	**-5697**	**-29079**	**-131670**
Change in nLEP index % 2000-2011	**-3.2**	**-2.5**	**-0.9**	**-1.0**	**-0.5**	**-2.0**	**-0.8**	**-0.5**	**-13.4**	**-1.5**

Net Landscape Ecosystem Potential (NLEP) 2010 by River basins [a], Districts [b] and Municipalities [c]

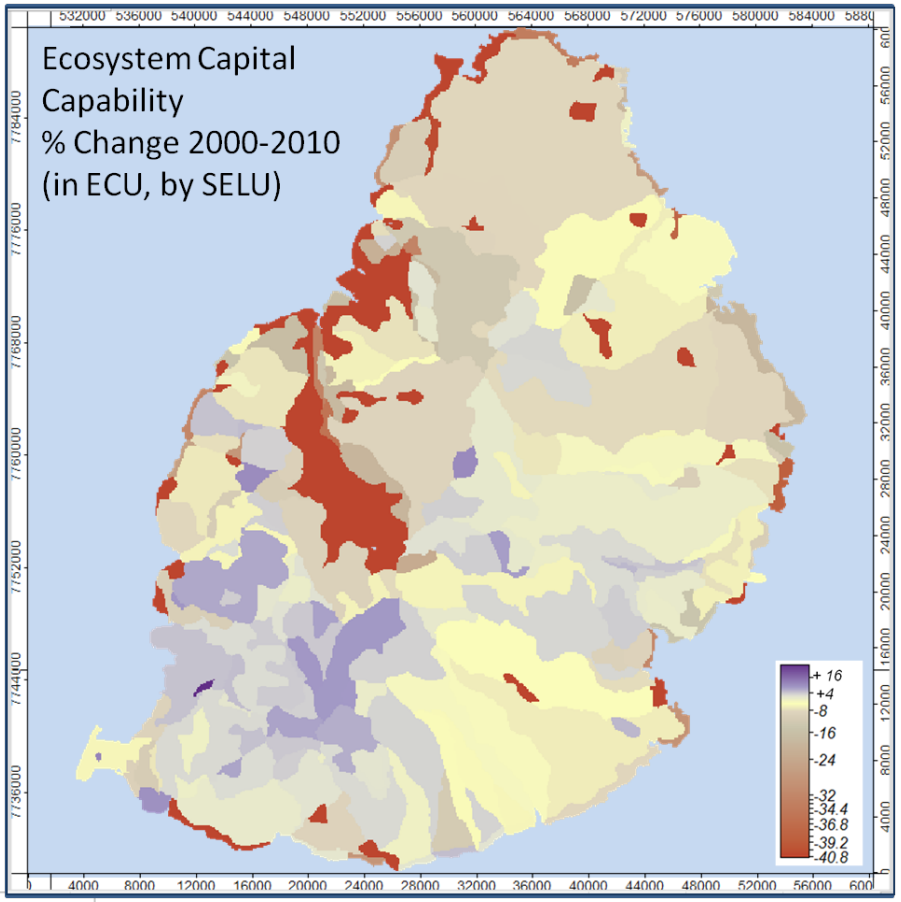


Ecosystem capital capability and change (in ECU)

Ecosystem Capital Capability:
ECU value by Socio-Ecological Landscape Units, 2010



Ecosystem Capital Capability (inland):
Change in ECU value, % by Socio-Ecological Landscape Units, 2000-2010



Provisional

5 steps for implementing Ecosystem Natural Capital Accounts

Objective	*Datasets/ Accounts*	*Tasks to the accountant*
Step 1: Create the data infrastructure needed for accounting		
Collect reference geographical datasets and create the database of Ecosystem Accounting Units	Geographical features/zonings • Physical boundaries (coastline, river basins & sub-basins limits, climate zoning, elevation classes) • Administrative boundaries (municipalities, districts, regions) • Transport network • Hydrological network, rivers, aquifers • Sea/fisheries zoning(s) Regular grid(s) for accounting (1 ha and 1 km^2)	*Collect from relevant organisations the basic geographical layers which will structure the physical accounts. Check their consistency (geometry, projection). Produce a set of regular grids (based on official geographical standards).* *Create the database of Ecosystem Accounting Units for terrestrial ecosystems, rivers, marine coastal units and other sea accounting units* *(NB: requires land cover map for the baseline year)*
Step 2: Collect the basic datasets		
Collect the basic datasets for ecosystem natural capital accounting	• Land cover change (including marine coastal areas) • Meteorological data • Hydrological data • Soil data • Data on forest stocks and growth • Population data • Regular agriculture, forestry and fishery statistics • Data/statistics on water use • Indicators on species and systems biodiversity	*Produce a consistent multi-annual (10 to 20 years period) land cover map/database using satellite images and other sources available (forest maps, cadastre, buildings and roads…).* *Collect and organise the various sets of data needed for accounting. Official data sources are given priority: official statistics, meteorological data, hydrological data… where available, accounts produced for IPCC reporting, REDD+, SEEA Water… are important inputs. Satellite data sometimes as second best.*

5 steps for implementing Ecosystem Natural Capital Accounts

Objective	*Datasets/Accounts*	*Tasks to the accountant*
Step 3: Produce the core accounts		
Produce the core accounts of ecosystem natural capital capability, assess ecosystem capital degradation or enhancement	• Land cover change account • Ecosystem carbon account • Ecosystem water account • Ecosystem integrity and functional services accounts • Ecosystem overall capability account (including exchanges between ecosystems)	*Compile the accounts with basic data collected at step 2, additional data for specific items and physical data modelling. Geo-process datasets. Estimate of missing data. Integrate of the accounts.*
Step 4: Functional accounts in physical units		
Functional analysis of ecosystem capital and services in physical units	• Accountability of economic sectors to ecosystem capital degradation /enhancement • Ecosystem degradation embedded into trade • Ecological Balance Sheet (in ECU) • Social demand for ecosystem services (by ecosystem units, municipalities, regions…)	*Targeted, detailed analysis to be carried out with statistical offices, planning agencies, environment agencies, research sector…* *Compilation of the ecological balance-sheet* *Mapping and assessing ecosystem services*
Step 5: Functional accounts in monetary units		
Functional analysis of ecosystem capital and services in monetary units: measurement of unpaid degradation costs; valuation of ecosystem services	• **Unpaid remediation costs**: Accountability of economic sectors to ecosystem capital degradation /enhancement • Ecosystem degradation embedded in trade • Ecological Balance Sheet in money • Adjustment of the Final Demand from unpaid costs • **Monetary value of key ecosystem services** • Total (direct and indirect) value added induced by ecosystem services (agriculture, forestry, fishery, water, tourism…)	*Economic analysis of remediation costs (restoration works, alleviation, opportunity costs of reducing pressure on ecosystems…).* *Economic analysis of ecosystem services monetary value.* *Input/Output analysis of Value Added induced by ecosystem services; sustainability assessment*
Steps 1 to 3 have to be done for all ecosystems and sectors. Steps 4 and 5 can focus on one particular ecosystem, service or economic sector.		

Conclusions

- Integrated ecosystem natural capital accounts are feasible with existing data which are available in countries or/and from international programmes.
- Simplified accounts can be produced (rather) quickly and deliver relevant results; their accuracy can be improved in a second step on the basis of the data gaps identified in the first test.
- The cost of IT investments is no more an issue; performing freeware can be used as well as commercial software packages – and cloud computing has started to propose solutions and deliver products from the web.
- **Staffing & Training (in statistics and accounting, data management, GIS applications) are the main capacity building issues (2 to 3 staff in the central unit + correspondents in partner organisations).**
- Institutional cooperation between the various agencies holding data and knowledge is essential. Creation of shared environmental information system is recommended.
- **The implementation of integrated physical accounts should facilitate further work on assessment, modelling and valuation of ecosystem services (*today, data collection alone represents up to 80% of the cost of an environmental study*)**

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