Workshop

Remote Sensing and Biodiversity

Status and Prospects

Needs and Expectations from Remote Sensing for the Implemenation of the Strategic Plan for Biodiversity 2011-2020 and for the IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services)

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cirad

24th November 2014 Grenoble, France

UNIVERSITÉ RENNES 1

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CONSULTATIVE PROCESS TOWARDS AN
IMoSEB
INTERNATIONAL MECHANISM OF SCIENTIFIC EXPERTISE ON BIODIVERSITY

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Convention sur la diversité biologique

Réserves de BIOSPHERE
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LA RECHERCHE AGRONOMIQUE POUR LE DÉVELOPPEMENT


Bilicki
RESEARCH CONCLUDES:
WE ARE DESTROYING EARTH.
COULD YOU KINDLY REPHRASE THAT IN EQUIVOCAL, INACCURATE, VAGUE, SELF-SERVING AND ROUNDABOUT TERMS THAT WE CAN ALL UNDERSTAND?
GOVERNMENT

IPBES : an IPCC like Mechanism ?

Goal

- "strengthen the science-policy interface for biodiversity and ecosystem services for the conservation and sustainable use of biodiversity, long-term human well-being and sustainable development"

4 functions

- to catalyse the generation of new knowledge;
- to produce assessments of existing knowledge;
- to support policy formulation and implementation;
- and to build capacities relevant to achieving its goal.

9 December 2013 (before IPBES 2), 115 member States :

Albania, Algeria, Andorra, Antigua and Barbuda, Argentina, Australia, Austria, Azerbaijan, Bahrain, Bangladesh, Belgium, Benin, Bhutan, Bolivia (Plurinational State of), Bosnia and Herzegovina, Botswana, Brazil, Burkina Faso, Burundi, Cambodia, Canada, Central African Republic, Chad, Chile, China, Colombia, Comoros, Congo, Costa Rica, Côte d'Ivoire, Croatia, Cuba, Democratic Republic of the Congo, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Ethiopia, Fiji, Finland, France, Gabon, Georgia, Germany, Ghana, Grenada, Guatemala, Guinea-Bissau, Guyana, Honduras, Hungary, India, Indonesia, Iran (Islamic Republic of), Iraq, Ireland, Israel, Japan, Kenya, Kyrgyzstan, Latvia, Liberia, Libya, Lithuania, Luxembourg, Madagascar, Malawi, Malaysia, Mali, Mauritania, Mexico, Monaco, Montenegro, Morocco, Nepal, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Norway, Pakistan, Panama, Peru, Philippines, Portugal, Republic of Korea, Republic of Moldova, Russian Federation, Saint Kitts and Nevis, Saint Lucia, Saudi Arabia, Senegal, Slovakia, South Africa, Spain, Sri Lanka, Sudan, Swaziland, Sweden, Switzerland, Tajikistan, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Uganda, United Kingdom of Great Britain and Northern Ireland, United Republic of Tanzania, United States of America, Uruguay, Yemen and Zimbabwe.

Observers / UN :
Food and Agriculture Organization of the United Nations, United Nations Development Programme, United Nations Educational, Scientific and Cultural Organization, United Nations Environment Programme-World Conservation Monitoring Centre, United Nations University, United Nations World Tourism Organization, Arab League, ASEAN Centre for Biodiversity, European Union, Global Biodiversity Information Facility, Global Environment Facility, Group on Earth Observations, International Centre for Integrated Mountain Development, Intergovernmental Panel on Climate Change, International Union for the Conservation of Nature, Convention on Biological Diversity, United Nations Environment Programme-Environment Management Group, Convention on Migratory Species, African-Eurasian Waterbird Agreement, Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas, Convention on the International Trade in Endangered Species, Ramsar Convention on Wetlands, United Nations Convention to Combat Desertification, Agreement on the Conservation of Populations of European Bats, and United Nations Framework Convention on Climate Change.

Observers / IPBES 1. : Non available

Observers ADD / IPBES 2. :
DesertNet International, Doğa Koruma Merkezi (Nature Conservation Centre), Economic Cooperation Organization Science Foundation, Foundation for the Promotion of Indigenous Knowledge, Mediterranean Institute of Marine and Continental Biodiversity and Ecology, Protection of Environment and EcoSystem, Platform for Agrobiodiversity Research, Terra-1530, University of Hamburg Research Unit, Action Group on Erosion, Technology and Concentration, African Centre for Advocacy and Human Development, Collaboration for Environmental Evidence, Local Governments for Sustainability, Island Sustainability, Action jeunesse pour le développement, bioGENESIS, Inter-American Institute for Global Change Research, International Council for the Exploration of the Sea, Karlsruhe Institute of Technology, Zoï Environment Network, ArcMED, Asia-Pacific network for Global Change Research, The European Environment Agency, Fonce Congo, Forest Peoples Programme, Indigenous Partnership for Agrobiodiversity and Food Sovereignty, Lelewal Foundation, The University of Southampton, World Academy of Art and Science, Youth Action International, Sevalanka Foundation, Burundi Sustainable Development Agenda 21 Australian Research Council Centre of Excellence for Environment Decisions.

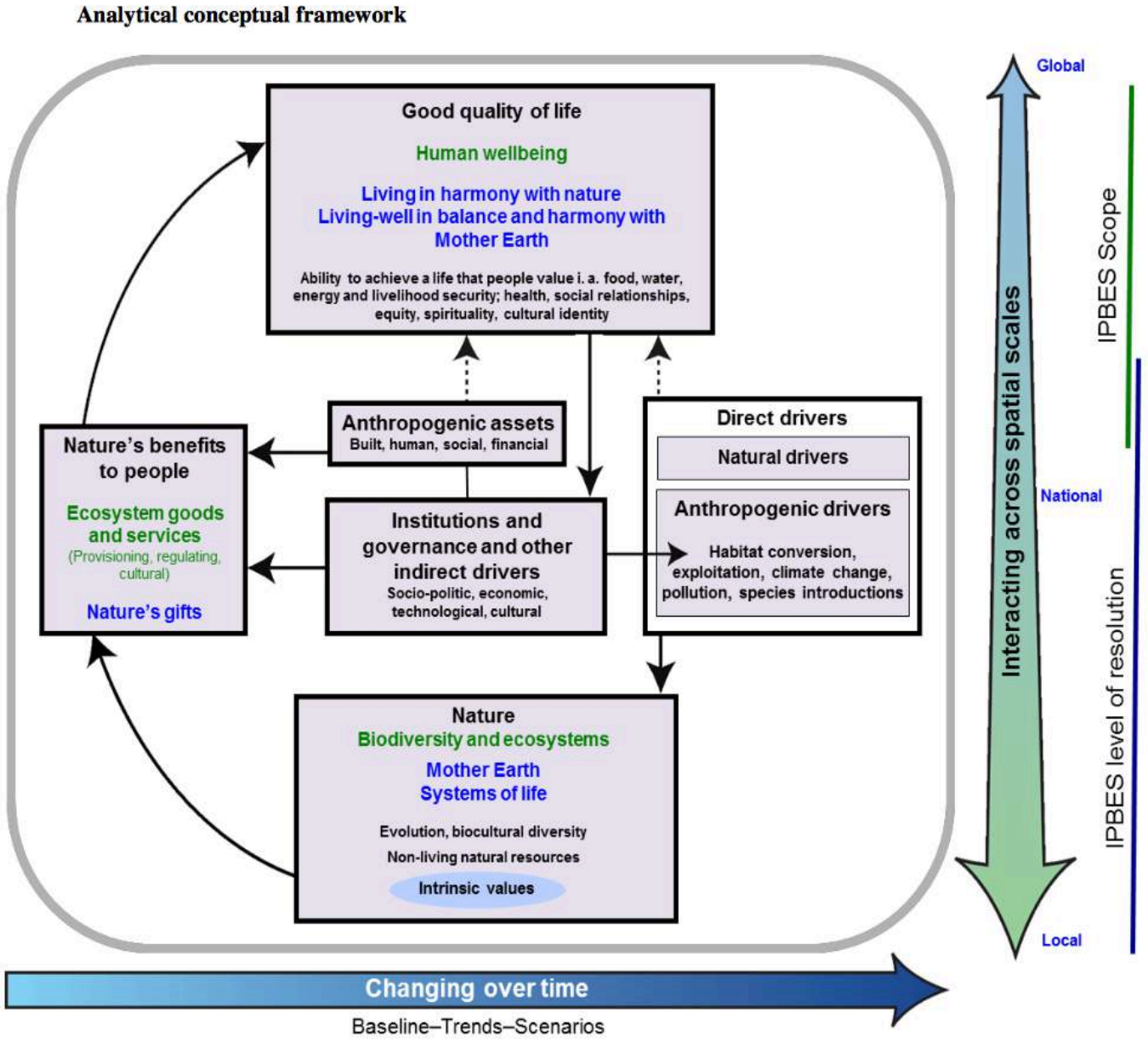
Functions of IPBES

- (a) To identify and prioritize key scientific information needed for policymakers on appropriate scales and to catalyse efforts to generate new knowledge by engaging in dialogue with key scientific organizations, policymakers and funding organizations, but not to directly undertake new research;

- (b) To perform regular and timely assessments of knowledge on biodiversity and ecosystem services and their interlinkages, which should include comprehensive global, regional and, as necessary, subregional assessments and thematic issues at appropriate scales and new topics identified by science and as decided upon by the Plenary;

- (c) To support policy formulation and implementation by identifying policy-relevant tools and methodologies to enable decision makers to gain access to those tools and methodologies and, where necessary, to promote and catalyse their further development;

- (d) To prioritize key capacity-building needs to improve the science-policy interface at appropriate levels and then provide and call for financial and other support for the highest-priority needs related directly to its activities, as decided by the Plenary, and to catalyse financing for such capacity-building activities by providing a forum with conventional and potential sources of funding.



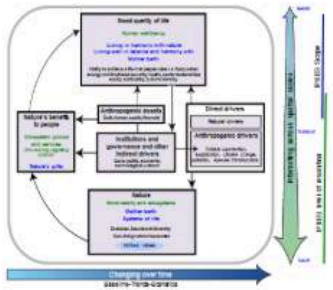
the conceptual framework is a tool for the achievement of a shared working understanding across different disciplines, knowledge systems and stakeholders that are expected to be active participants in the Platform

Operational conceptual model of the Platform

Science and other knowledge systems

Science-policy interface on biodiversity and ecosystems services

Analytical conceptual framework



IPBES processes, functions, and deliverables

Development and implementation of work

- Knowledge generation
- Assessments
- Policy tools and methodologies
- Capacity-building

Deliverables to advise and support policy for decision-making

Policy and decision-making

Platform goal

Strengthen the science-policy interface for biodiversity and ecosystem services
for the conservation and sustainable use of biodiversity, long-term human well-being and sustainable development

Platform functions, operational principles and procedures

Platform work programme 2014–2018: Objectives and associated deliverables

Objective 1: Strengthen the capacity and knowledge foundations of the science-policy interface to implement key functions of the Platform:

(a) Priority capacity-building needs to implement the Platform's work programme matched with resources through catalysing financial and in-kind support
(b) Capacities needed to implement the Platform work programme developed
(c) Procedures, approaches for participatory processes for working with indigenous and local knowledge systems developed
(d) Priority knowledge and data needs for policymaking addressed through catalysing efforts to generate new knowledge and networking

Objective 2: Strengthen the science-policy interface on biodiversity and ecosystem services at and across subregional, regional and global levels:

(a) Guide on production and integration of assessments from and across all scales
(b) Regional/subregional assessments on biodiversity, ecosystem services
(c) Global assessment on biodiversity and ecosystem services

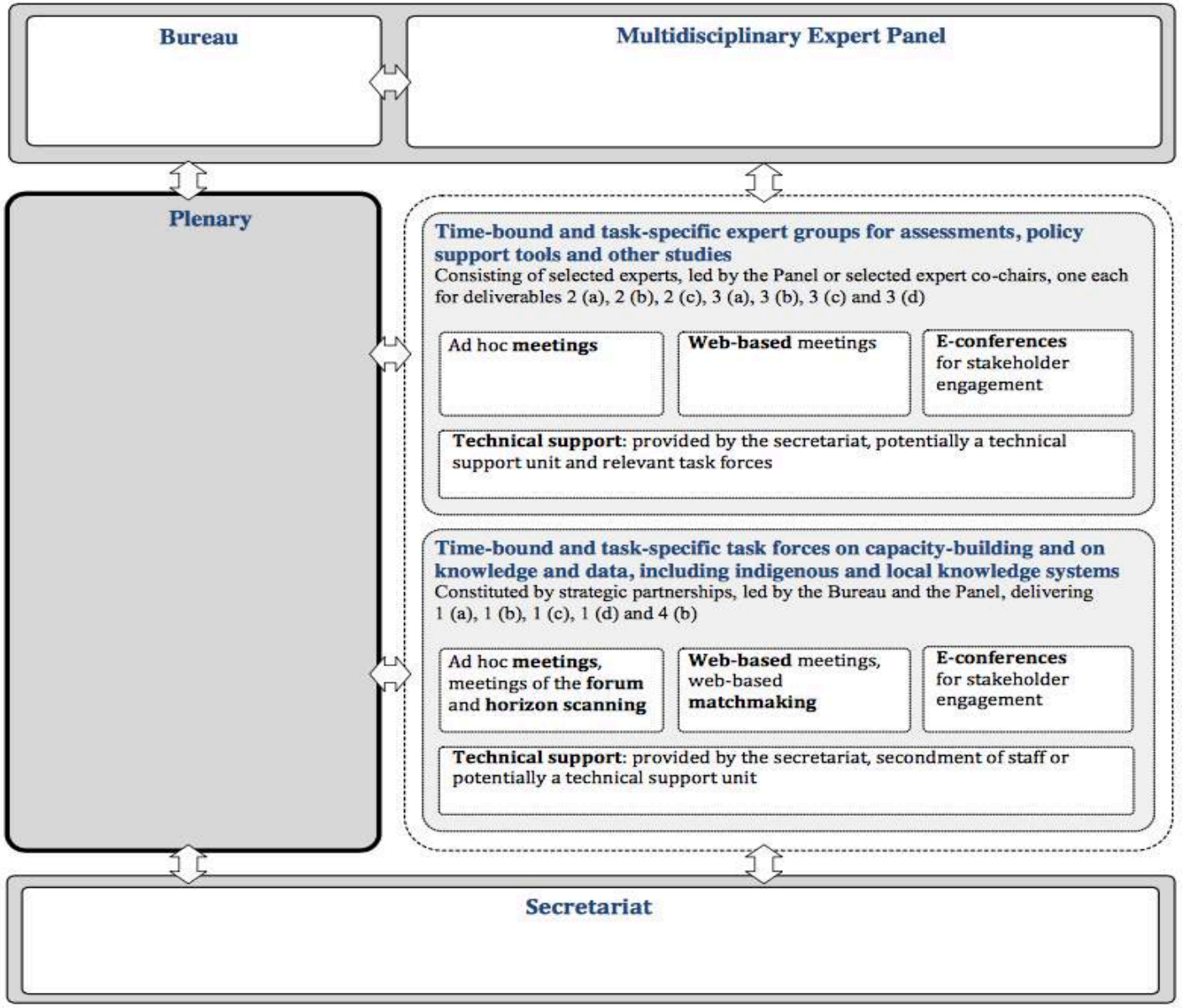
Objective 3: Strengthen the science-policy interface on biodiversity and ecosystem services with regard to thematic and methodological issues:

(a) One fast-track thematic assessment of pollinators, pollination and food production
(b) Three thematic assessments: land degradation and restoration; invasive alien species; and sustainable use and conservation of biodiversity and strengthening capacities/tools
(c) Policy support tools and methodologies for scenario analysis and modelling of biodiversity and ecosystem services based on a fast-track assessment and a guide
(d) Policy support tools and methodologies regarding the diverse conceptualization of values of biodiversity and nature's benefits to people including ecosystem services based on an assessment and a guide

Objective 4: Communicate and evaluate Platform activities, deliverables and findings:

(a) Catalogue of relevant assessments
(b) Development of an information and data management plan
(c) Catalogue of policy support tools and methodologies
(d) Set of communication, outreach and engagement strategies, products and processes
(e) Reviews of the effectiveness of guidance, procedures, methods and approaches to inform future development of the Platform

Institutional arrangements needed to deliver the work programme



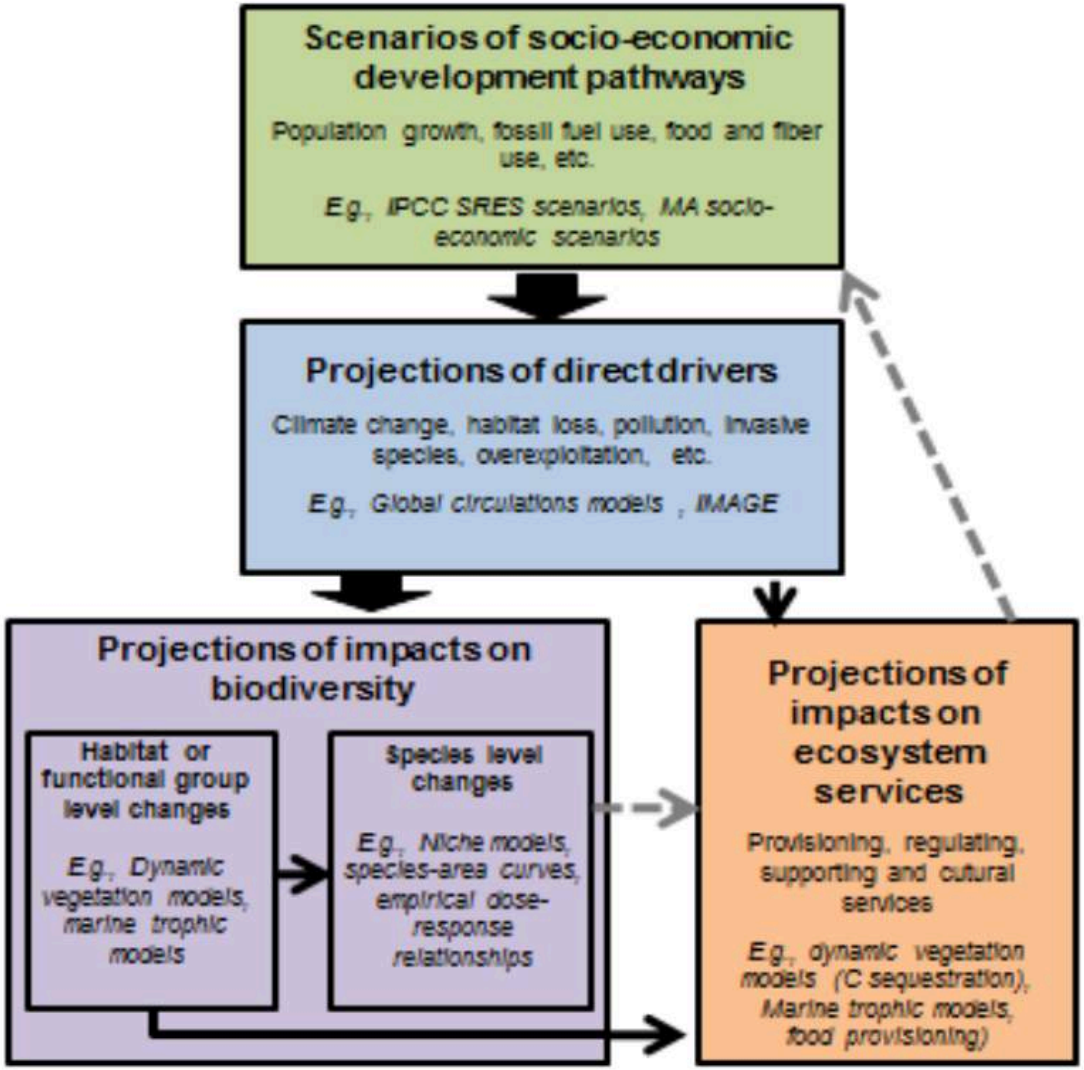
C. Estimated costs and opportunities for in-kind support

17. Cost estimates include consideration of and assumptions with regard to a range of variables that influence both the budget and the deliverable in various ways. A key assumption with regard to the costing of the work programme is that in-kind contributions in the form of the hosting of meetings (25 per cent) and technical support (50 per cent) will be provided.

18. The total estimated cost of the work programme is summarized in the budget table below.

Deliverable	*2014*	*2015*	*2016*	*2017*	*2018*	***Total***
1 (a)	258 750	172 500	258 750	172 500	258 750	**1 121 250**
1 (b)	450 000	450 000	450 000	450 000	450 000	**2 250 000**
1 (c)	273 750	341 250	267 500	217 500	217 500	**1 317 500**
1 (d)	172 500	258 750	172 500	258 750	172 500	**1 035 000**
2 (a)	86 250	50 000	0	0	0	**136 250**
2 (b)	396 250	1 931 250	3 660 000	1 755 000	0	**7 742 500**
2 (c)	0	146 250	712 500	712 500	1 432 500	**3 003 750**
3 (a)	270 000	362 250	117 000	0	0	**749 250**
3 (b) (i)	101 250	282 000	571 500	117 000	0	**1 071 750**
3 (b) (ii)	64 500	0	209 250	408 000	117 000	**798 750**
3 (b) (iii)	101 250	0	258 000	519 750	117 000	**996 000**
3 (c)	359 250	423 750	267 000	150 000	50 000	**1 250 000**
3 (d)	101 250	660 750	267 000	150 000	50 000	**1 229 000**
4 (a)	30 000	30 000	30 000	30 000	30 000	**150 000**
4 (b)	0	0	0	0	0	**0**
4 (c)	116 250	80 000	30 000	30 000	30 000	**286 250**
4 (d)	275 000	215 000	215 000	215 000	285 000	**1 205 000**
4 (e)	0	36 000	0	84 000	0	**120 000**
Total	**3 056 250**	**5 439 750**	**7 486 000**	**5 270 000**	**3 210 250**	**24 462 250**

Integration of socioeconomic scenarios (indirect drivers), models of direct drivers and models of impacts on biodiversity and ecosystem services, as currently used in most assessments at global and regional scales



Source: Pereira and others, 2010.

Note: Dotted lines indicate important interactions and feedbacks that have been infrequently treated in assessments.

Schedule for delivery of the work programme ¶

Nominations for the following Task Forces and Expert Groups (2014)

Deliverable Number:	Task Forces and Expert Groups:
Deliverable 1a and 1b	Task Force on capacity-building
Deliverable 1c	Task Force on indigenous and local knowledge systems
Deliverable 1d	Task Force on knowledge and data
Deliverable 2a	Expert Group to develop a guide on production and integration of assessments from and across all scales
Deliverable 3a	Expert Group for delivering an assessment on pollinators, pollination and food production
Deliverable 3c	Expert Group for scoping and delivering a methodological assessment and development of a guide on scenario analysis and modeling of biodiversity and ecosystem services
Deliverable 3d	Expert Group for scoping of a methodological assessment and development of a guide regarding diverse conceptualization of values of biodiversity and nature's benefits to people including ecosystem services
Deliverable 4c	Expert Group to develop a guide on and a catalogue of Policy support tools and methodologies

Mains Issues and Topics of IPBES / RS

- **ToRs for the task force on knowledge and data :**
  - (c) To identify opportunities for increasing access to existing data, information and knowledge so as to ensure their availability to support the work of the Platform;
  - (d) To advise on the indicators and metrics to be used in Platform products and on the standards necessary for capturing and managing associated data;

- **Initial scoping for the fast-track methodological assessment of scenarios and modelling of biodiversity and ecosystem services**
  - (a) Scenarios of socioeconomic development (e.g., population growth, economic growth, per capita food consumption, greenhouse gas emissions) and policy options (e.g., reducing carbon emissions from deforestation and forest degradation, subsidies for bioenergy, et cetera);
  - (b) Models projecting changes in direct drivers of biodiversity and ecosystem function (e.g., land use change, fishing pressure, climate change, invasive alien species, nitrogen deposition);
  - (c) Models assessing the impacts of drivers on biodiversity (e.g., species extinctions, changes in species abundance and shifts in ranges of species, species groups or biomes);
  - (d) Models assessing the impacts of drivers and changes in biodiversity on ecosystem services (e.g., ecosystem productivity, control of water flow and quality, ecosystem carbon storage, cultural values).

Chapter outline / scenarios & modelling

- Chapter 1. Overview of socioeconomic scenarios and models and critical review of their use in previous biodiversity and ecosystem assessments
- Chapter 2. Scenarios of the indirect drivers of change in biodiversity and nature's benefits to people including ecosystem services
- Chapter 3. Models of direct drivers of change in biodiversity, ecosystem function and nature's benefits to people, including ecosystem services
- Chapter 4: Models of the impacts of drivers on biodiversity and nature's benefits to people, including ecosystem services
- Chapter 5. Examining the feedbacks between biodiversity, nature's benefits to people, good quality of life, institutions and governance, and using scenarios and models
- Chapter 6. Compatibility and comparison of scenarios and models, including a discussion of how the use of a core set of socioeconomic scenarios and models can be combined with the use of multiple scenarios and models. This chapter would also include a discussion on how to address the issue of multiple spatial and temporal scales with scenarios and models
- Chapter 7. Building capacity for the development, use and interpretation of scenarios and models, including through the use of participatory and "backcasting" methods
- Chapter 8. Scenarios and models as currently used in decision-making and communication
- Chapter 9. Guidelines for improving the broader use of scenarios and models for decision support
- Chapter 10. Guide for the use of scenarios and models in assessments and other activities of the Panel

IPBES 3 (January 2015)

- **Task force on knowledge and data:**
  - (a) Establishment of standards and guidelines for managing information and data, including advice on the indicators and metrics to be used in the Platform's products for the standards necessary for capturing and managing associated data, and on the handling of knowledge gaps and uncertainty;
  - (b) Provision of access to the data, information, and knowledge needed in delivering scheduled assessments and using identified policy support tools and methodologies through a sustainable data and information platform;
  - (c) Identification of means of systematically identifying and addressing the data and information gaps and needs of the Platform's member States;
  - (d) Formation of close coordination and collaboration with relevant international initiatives to support the Platform in implementing the plan.

- Activity 3 : Developing a proposal for a discovery and access platform for sustainable knowledge, information, and data

- "The Platform's knowledge, information and data partners include those generating and storing raw data (e.g., species occurrences, satellite imagery, climate data), indigenous and local community knowledge, indicators and metrics, literature, and expert knowledge."

IPBES 3 (January 2015)

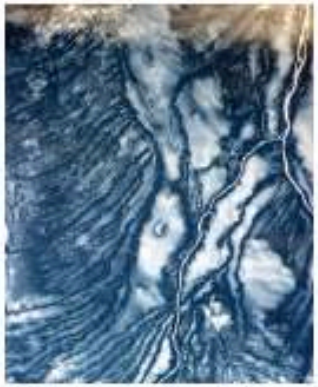
- **Implementation of the POW (2014-2018):** progress under ...
  - Obj. 2 : (a) A guide on production and integration of assessments from and across all scales
  - Obj. (3) : (d) an assessment on scenario analysis and modelling
  - Obj. (4): (a) the online catalogue of relevant assessments

IPBES 3 (January 2015)

- **Scoping for the methodological assessment regarding diverse conceptualization of multiple values of nature and its benefits, including biodiversity and ecosystem functions and services: deliverable 3 (d)**
  - Chapter 4 of will review and assess a range of valuation approaches and methods associated with diverse intellectual traditions and knowledge systems. It is envisaged that separate sections will be devoted to the following types of approach and method:
    - (a) Biophysical and ecological;
    - (b) Cultural and social;
    - (c) Economic;
    - (d) Holistic and indigenous and local knowledge-based;
    - (e) Public health.
- The operational structure will consist of a technical support unit, comprising one full-time – or full-time equivalent – Professional staff member. Two co-chairs, 80 authors and 14 review editors will be selected by the Multidisciplinary Expert Panel, in accordance with the procedures for the preparation of the Platform's deliverables.

Secretariat of the Convention on Biological Diversity

CBD Technical Series No. 72



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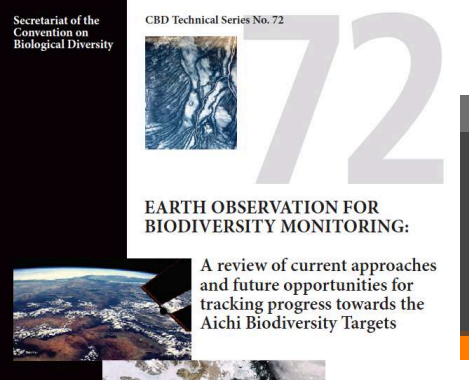
EARTH OBSERVATION FOR BIODIVERSITY MONITORING:

A review of current approaches and future opportunities for tracking progress towards the Aichi Biodiversity Targets



Content

KEY MESSAGES

- 1. The potential for remotely sensed earth observation data to support biodiversity policy is growing, but is yet to be fully realised.
- 2. There are clear opportunities presented by existing and emerging remote sensing capabilities to support monitoring of the Aichi Biodiversity Targets.
- 3. Remotely sensed data, when processed, packaged and communicated appropriately, can have impacts on policy and practice that yield positive biodiversity outcomes.
- 4. However, the use of remotely sensed Earth observation data is often constrained by access to data and processing capacity.
- 5. Priorities for future development of remote sensing products should be driven by end users needs.
- 6. Creating a dialogue between data providers and users is critical to realising the potential of remotely sensed data.

Strategic Goal	Aichi Biodiversity Target	Current remote sensing adequacy		
A	1. Awareness of biodiversity values	●		
	2. Integration of biodiversity values	●		
	3. Incentives	●		
	4. Sustainable production and consumption		●	
B	5. Habitat loss, fragmentation and degradation			●
	6. Sustainable exploitation of marine resources		●	
	7.Biodiversity-friendly agriculture, forestry and aquaculture		●	
	8. Pollution reduction			●
	9. Control of invasive alien species		●	
	10. Coral reefs and other vulnerable ecosystems		●	

Strategic Goal	Aichi Biodiversity Target	Current remote sensing adequacy		
C	11. Protected areas			●
	12. Prevented extinction of threatened species		●	
	13. Genetic diversity of socio-economically and culturally valuable species	●		
D	14. Ecosystem services			●
	15. Ecosystem resilience		●	
	16. Access and benefit sharing	●		
E	17. NBSAPs	●		
	18. Traditional Knowledge and customary use	●		
	19. Biodiversity knowledge improvement and transfer	●		
	20. Resource mobilisation	●		

Target 5. Habitat loss fragmentation and degradation

By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.

●	EO-based information can make a significant contribution to monitoring this Target and is already widely in use in assessing changes in forest cover
Operational Indicators that can be (partly) derived from remotely-sensed data	17. Trends in extent of selected biomes, ecosystems and habitats (A) 18. Trends in proportion of degraded/threatened habitats (B) 19. Trends in fragmentation of natural habitats (B) 20. Trends in condition and vulnerability of ecosystems (C) 21. Trends in the proportion of natural habitats converted (C) 22. Trends in primary productivity (C) 23. Trends in proportion of land affected by desertification (C) 24. Population trends of habitat dependent species in each major habitat type (A) 25. Trends in fire regimes and fire frequency (B)
Relevant Operational EO products	Land cover, NVDI, LAI, FAPAR, and marine EO-products (ocean chlorophyll-a concentration, ocean primary productivity, suspended sediment, sea surface wind speed, sea surface temperature, sea surface salinity, and sea surface state).

Limitations	Although a global forest cover change dataset has very recently been made available, and planned to be periodically updated, no such dataset exists for non-forest habitats. The global forest data are limited, however, in that the classification of forests only considers trees > 5m tall. In addition, land use type is not considered in the classification, making the separation of primary, secondary and plantation forest challenging without additional contextual information. Although EO-based landcover data do exist for the development of **indicator 17**, there are limitations due to the lack of consistent time series of landcover to conduct a robust change analysis to assess trends in habitat extent over time VHR satellite, airborne or unmanned aerial vehicle (UAV)-based imagery can provide fine scale mapping of habitats with high spatial heterogeneity but are generally expensive and perhaps time consuming to procure and process. Although hyperspectral data can greatly improve mapping and understanding of the situation on the ground, it is mostly limited to airborne sensors and so is limited in geographic scope. This is also true of LiDAR, which is excellent for describing the vegetation architecture of a habitat, especially forests. The different intra- and international definitions of various types of habitats make it difficult to develop global or often regional views, even when the EO observations exist, hindering the ability to track progress toward achieving Target 5. Key gaps in data on habitat extent, fragmentation and degradation include: the condition of temperate coastal marine habitats, offshore marine breeding and spawning grounds, kelp forests, intertidal and sub-tidal ecosystems, vulnerable shelf habitats, seamounts, hot-and cold seeps, ocean surface, benthic and deep sea habitats; inland wetland, non-forested terrestrial habitats and polar habitats. Better information is also needed on small-scale habitat degradation in all habitats.
Upcoming EO-based products	Recent very high resolution (VHR) satellites such as WorldView-2 are beginning to open up the possibility of combining high spatial and spectral resolution in the same platform. This holds promise for applications in the intertidal zone which has traditionally been difficult to monitor due to wave action, tides, and other challenges to interpretation. Active remote sensing using Radar and LiDAR also holds great potential for the mapping and identification of structurally complex habitats, especially in tropical areas where there is high and/or frequent cloud cover. Satellite-based hyperspectral sensors are being developed and these can greatly improve species discrimination of vegetation.

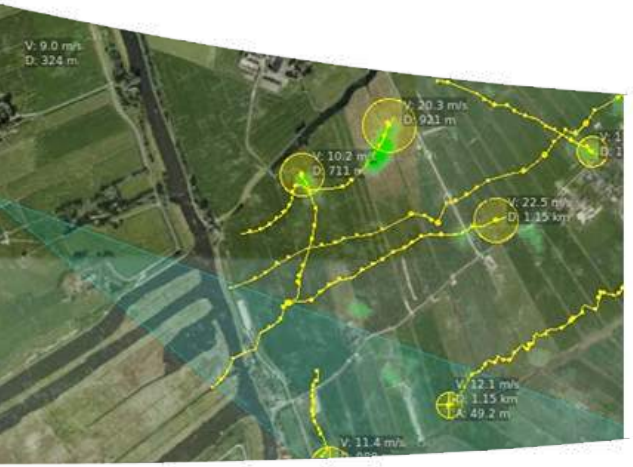
Target 2. Integration of biodiversity values

By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.

●	Currently not measurable by an EO-based approach
Operational Indicators that can be (partly) derived from remotely-sensed data	None
Limitations	Green infrastructure such as ecological networks, forest corridors, viaducts, natural water flows and other realisations of the integration and implementation of biodiversity values into spatial planning are potentially possible to measure with remote sensing, if they are represented by visible features on the surface of the Earth. Whilst monitoring these might inform national accounting, it says little about actual integration into accounting, planning and development strategies.

Unusual Business ?

Bird- and Bat research with ‘ROBIN 3D flex’ radar system



Joris Everaert

inbo
Research Institute for Nature and Forest

Detection of birds, bats, and insects

S-band (pulse) radar (60 kW)

Horizontal scanning. Viewing angle of 12.5°above the horizon.

Small birds and bats (≥ 5 cm)	1.5 km
Large birds:	7-10 km
Flocks of birds:	10-20 km

FMCW radar = Low power 0.5 W X-band, incl. Doppler filtering.

Viewing angle of 20°horizon to horizon in scanning mode (vertical)

Insects (≥ 1.5 cm)	± 0.5 / 1 km ?
Small birds and bats (≥ 5 cm)	1.5 km
Large birds:	3.5-5 km
Flocks of birds:	> 3.5 km

Classification is based on (corrected) RCS, location, altitude, speed, …

→ Automatic discrimination of bird '<u>species groups</u>'.

Automatic '<u>species</u>' recognition in development (wing-beat frequency detection !)

Advantage of modern radar systems

- no limitation of the human eye (e.g. greater distance, also at night);
- no limitation of human estimation skills (e.g. flight altitude);
- possibility for continuous 24/7 surveys.
- objective and neutral (the radar detects, and computers process the data).
- fixed protocol with classification algoritms, and automatic clutter filtering.
- automatic registration and (partly) processing of the data.
- many possibilities for further detailed analysis in GIS, SQL-database,…

Planned research on birds and bats

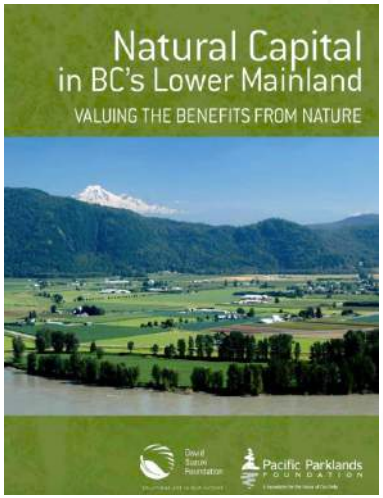
Wind farms

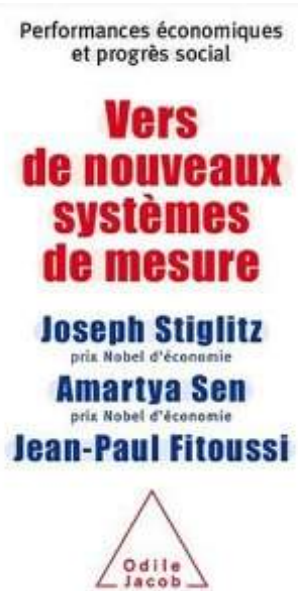
- **Field surveys at proposed locations**
  incl. updates of regional risk-atlas (“fine-tuning“)
- **Monitoring of the impact**
  Collision risk, avoidance rates, mitigation measures,…

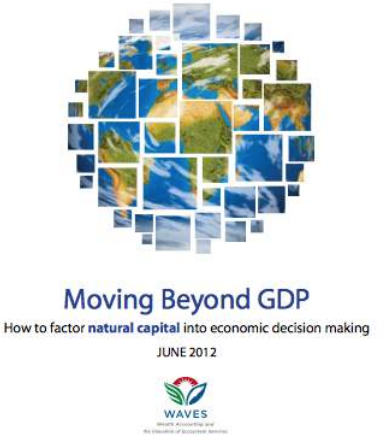
Biodiversity monitoring

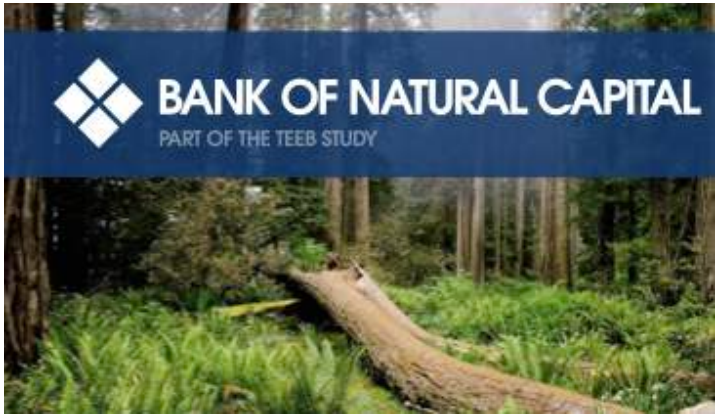
- **Especially at Natura 2000 sites**
  Feeding behaviour, migration corridors (networks between sites), …
- **Airport safety (Bird Control)**
  Warning system for intense (local) migration.

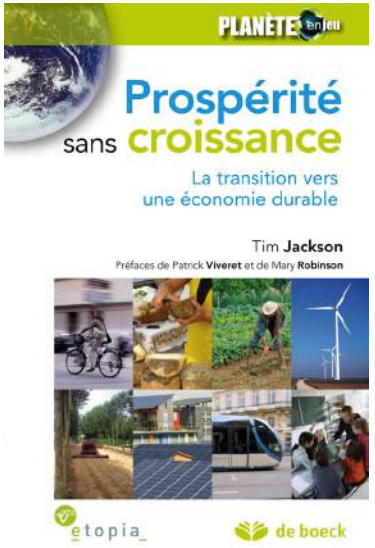
Towards the incorporation of Natural Capital in National Accounting Systems



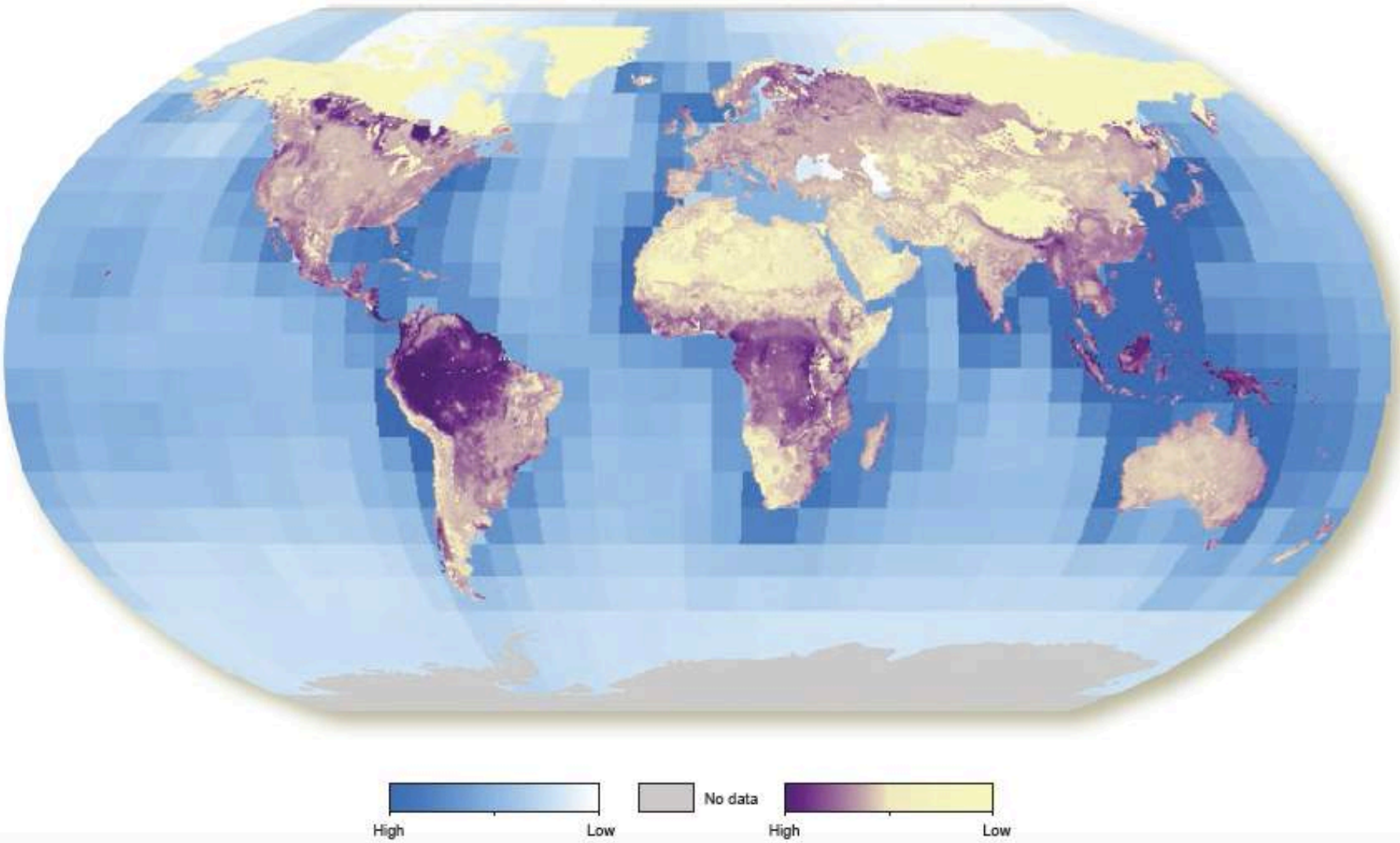






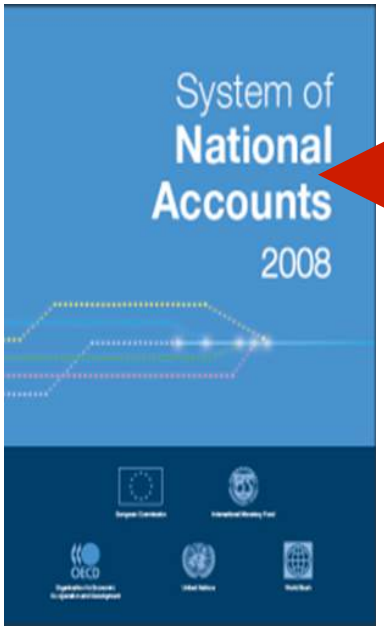


Towards a global map of natural capital: key ecosystem assets

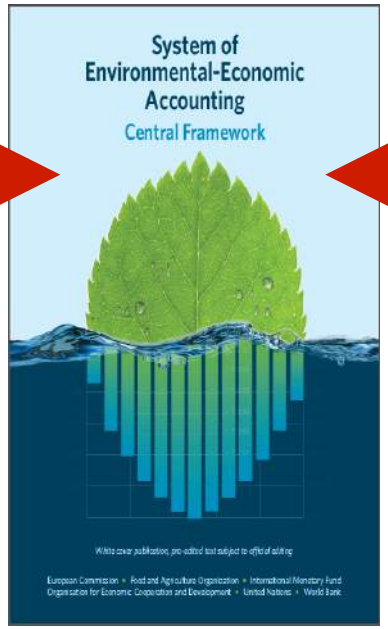


National Accounts: SNA/SCN and SEEA /SCEE

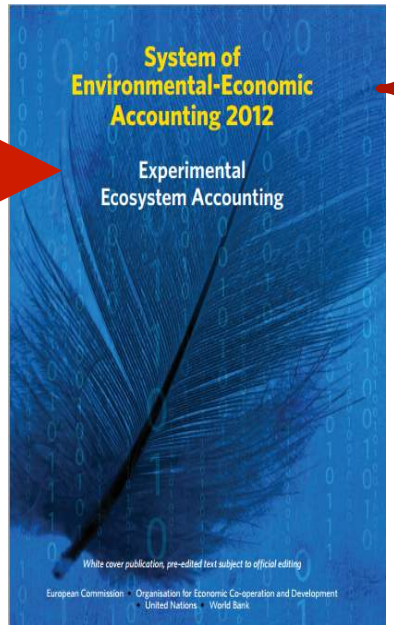
SNA/SCN



SEEA Part 1
"Central Framework"

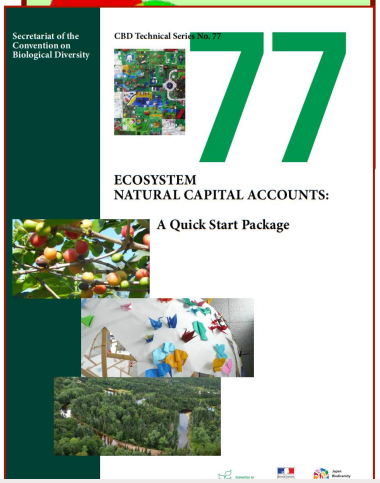


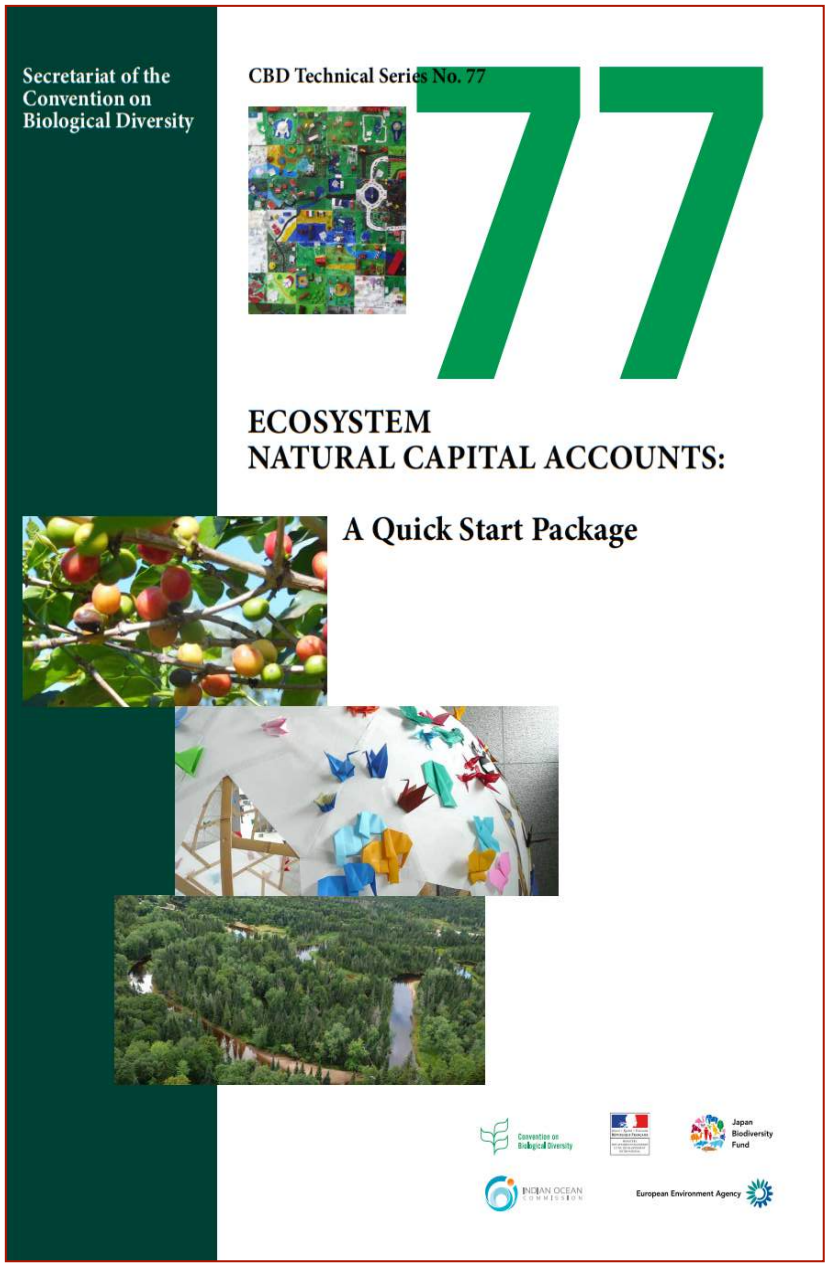
SEEA Part 2
"Experimental Ecosystem Accounting"



SEEA-ECA

Ecosystem Capital Accounts

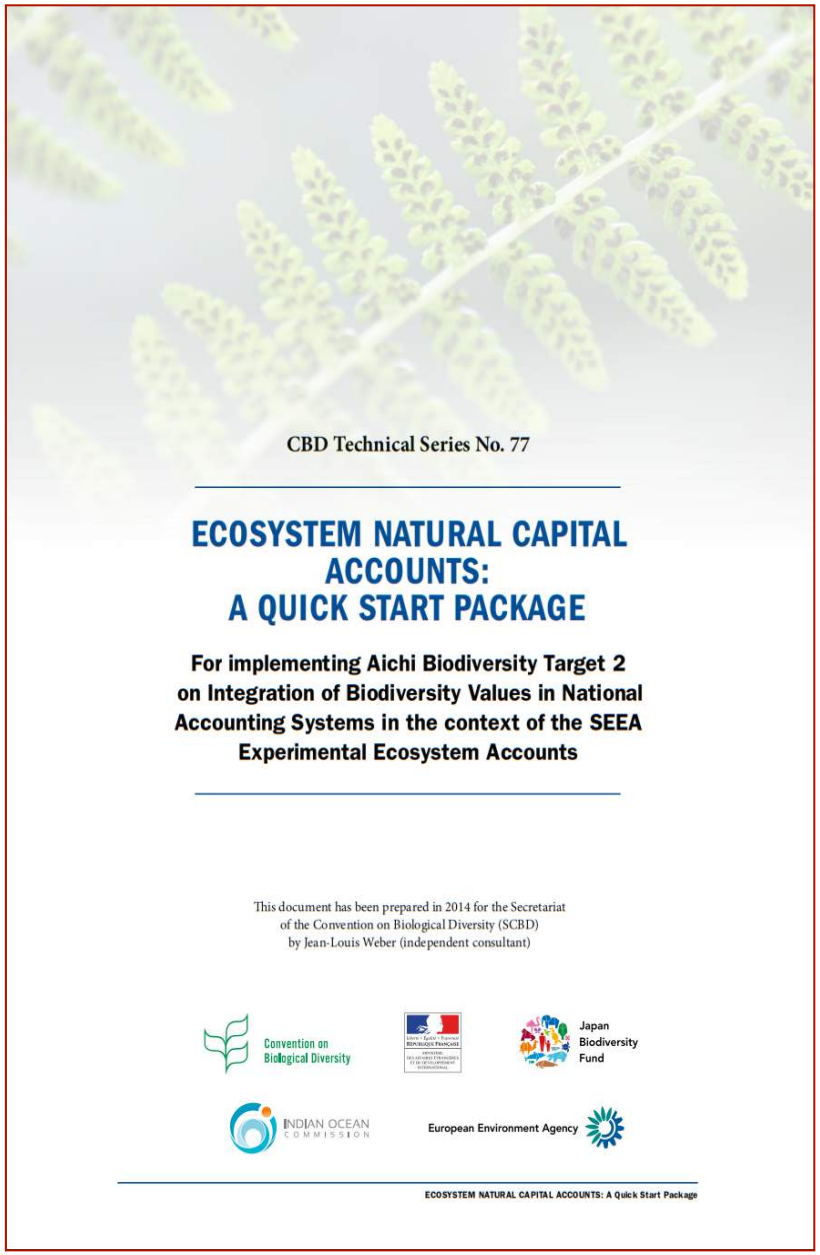




"In 2010, Parties to the CBD adopted Aichi Biodiversity Target 2, which calls for incorporating, as appropriate and by 2020 at the latest, biodiversity values into national accounting. This target is crucial to implementing the Strategic Plan for Biodiversity 2011-2020 and thereby addressing the underlying causes of biodiversity loss, in order to achieve its vision that "*by 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people*".

This edition of the CBD Secretariat's Technical Series n°77 "*Ecosystem Natural Capital Accounts: A Quick Start Package*" provides the technical nuts and bolts for getting started in implementing this goal. Using existing data, countries can begin ecosystem accounting in accordance with the rules of national accounting and biodiversity data and indicators."

ENCA: a Quick Start Package

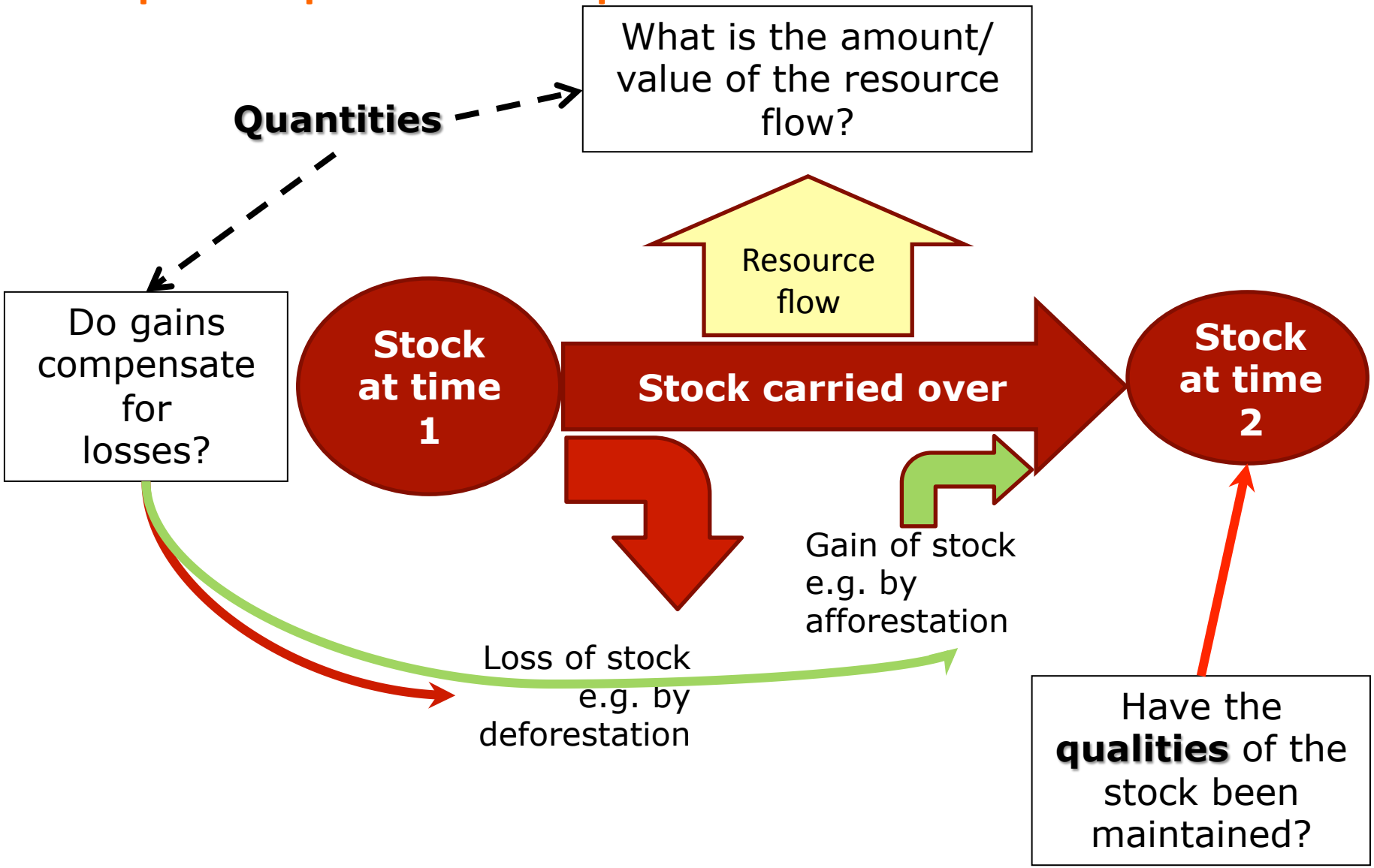


Meet an **urgency**

- **Focus on core accounts in physical units** and calculation of ecosystem capability and degradation or enhancement.
- **Fast track implementation** with existing data; learning by doing
- **First test accounts**:
  - ➔ involvement of producers, data holders and stakeholder.
  - ➔policy relevance of results discussed with stakeholders.
  - ➔identification of data gaps and framing of an action plan for regular implementation
- In the **last chapter, further steps** are described : liability of economic sectors and ecological balance-sheet, restoration costs, valuation of services...

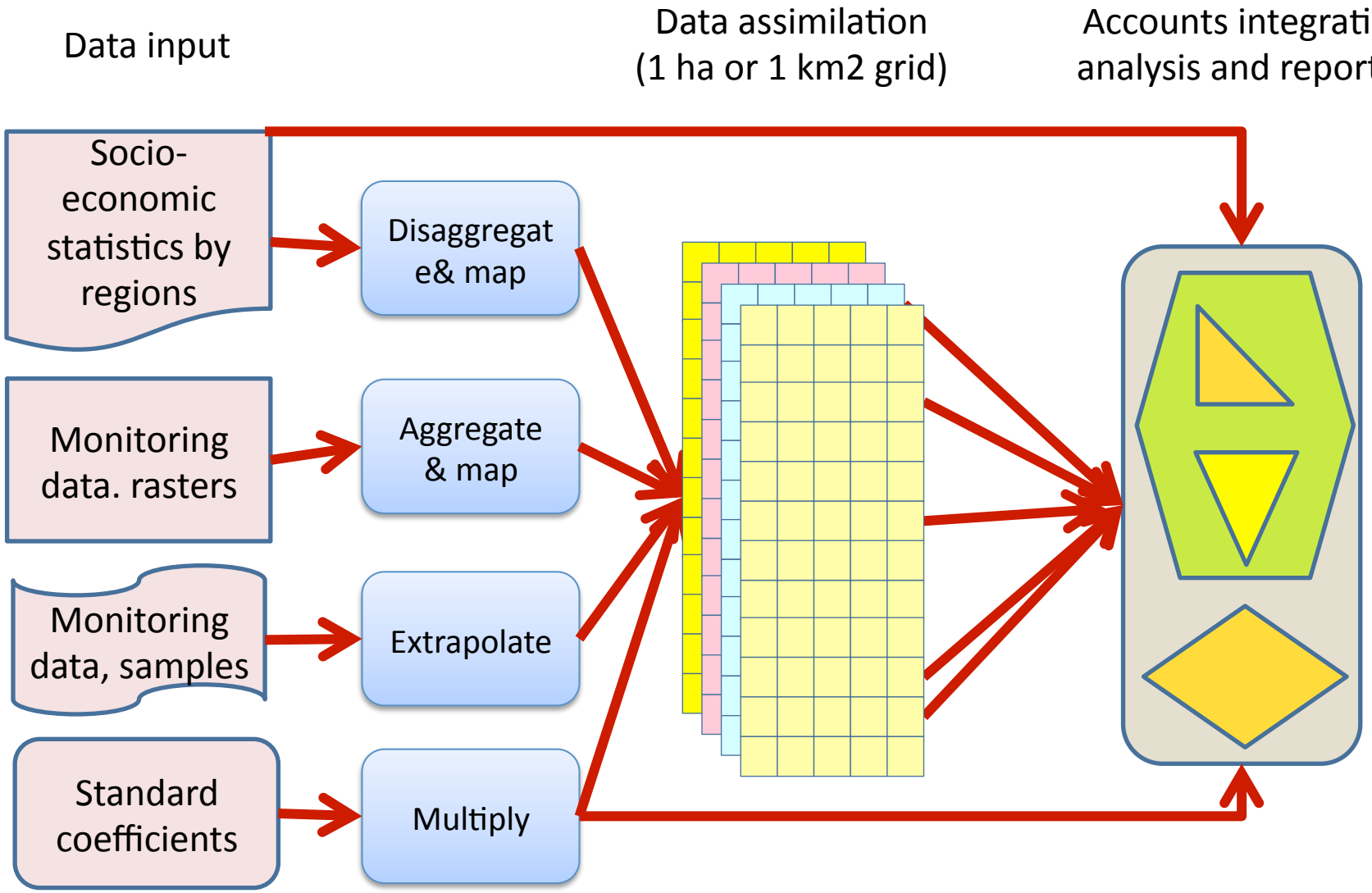
Ecosystem Natural Capital Account:

attempt to respond to basic questions

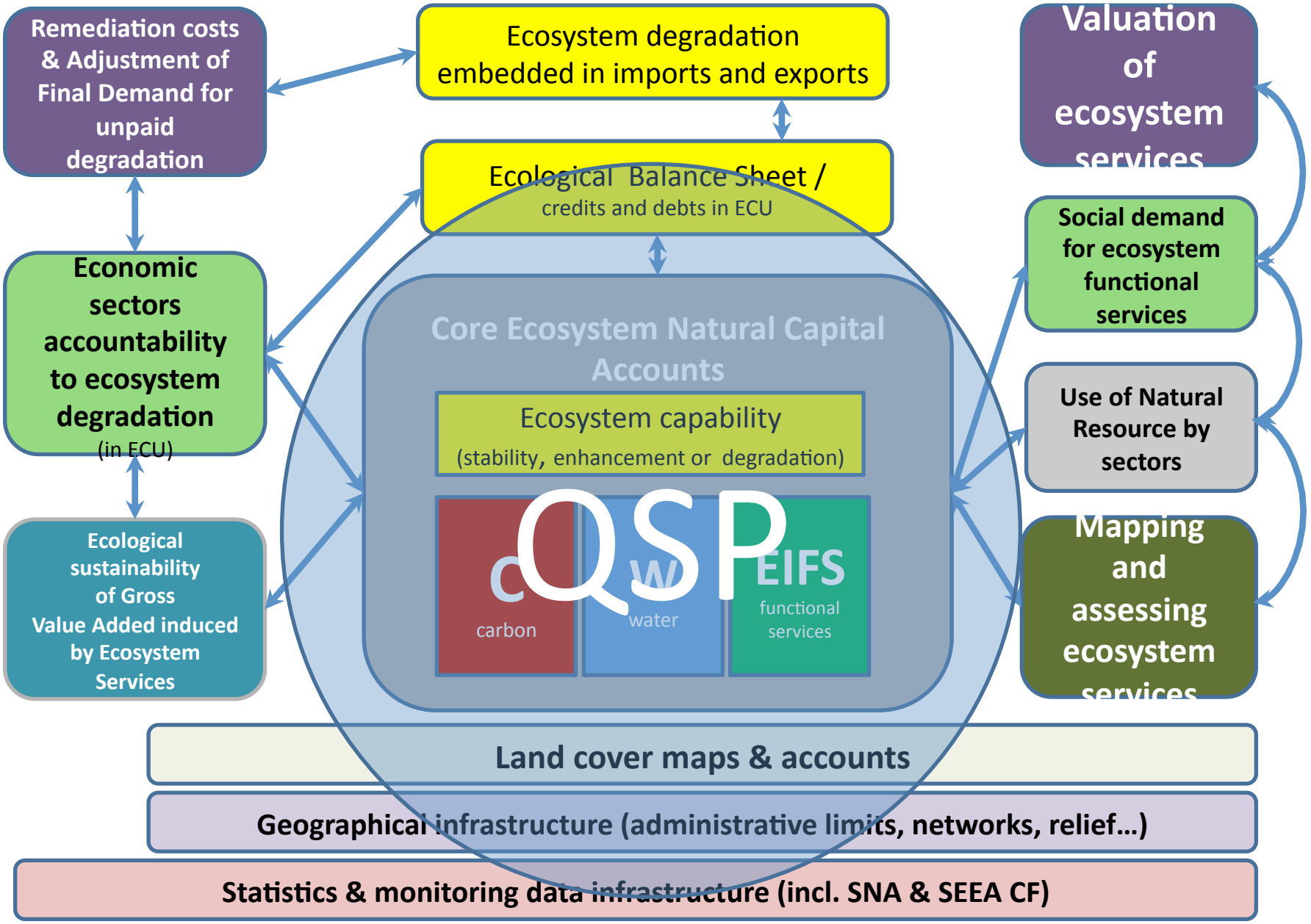


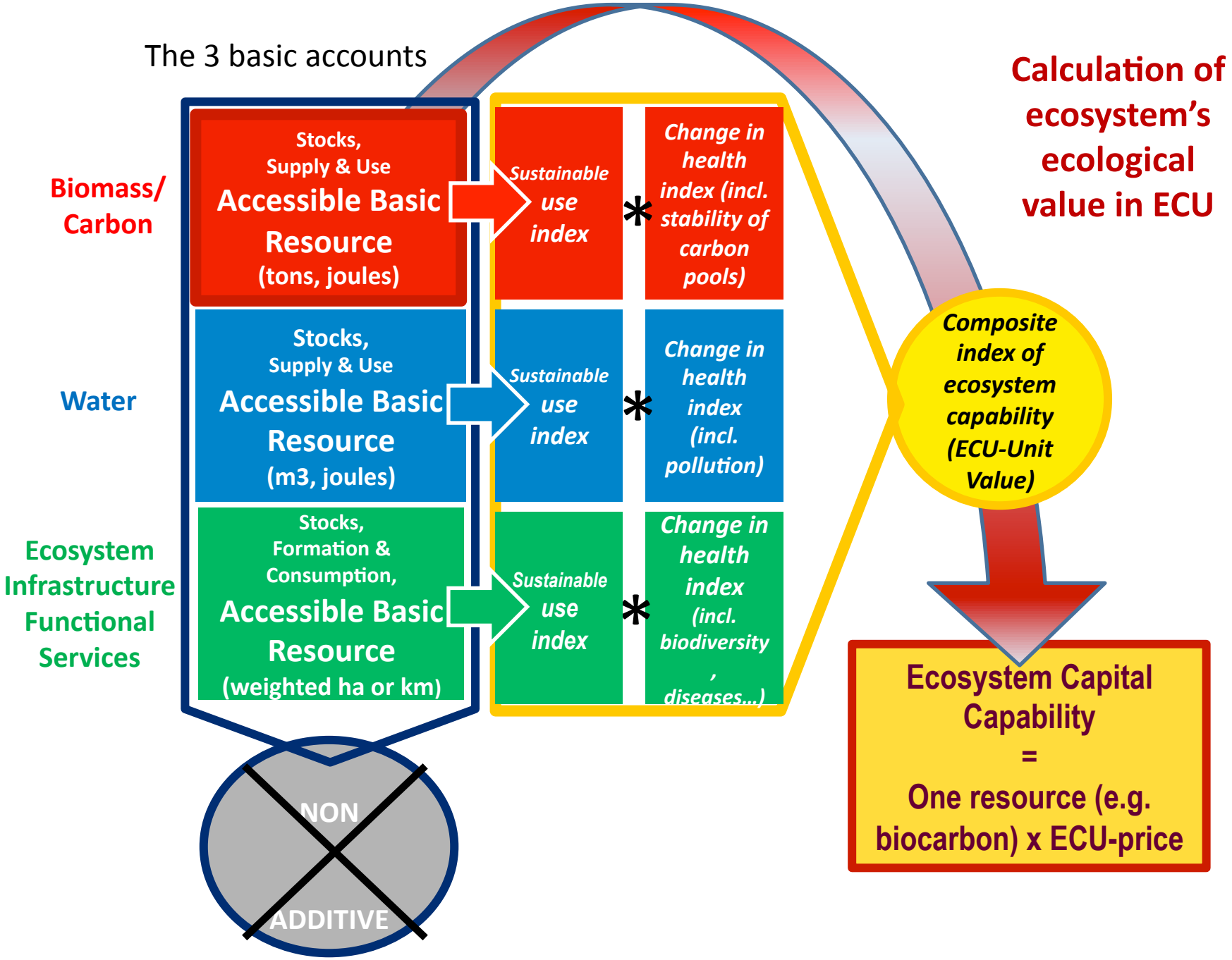
Adapted from Roy Haines-Young

Main data flows to compile ecosystem capital accounts

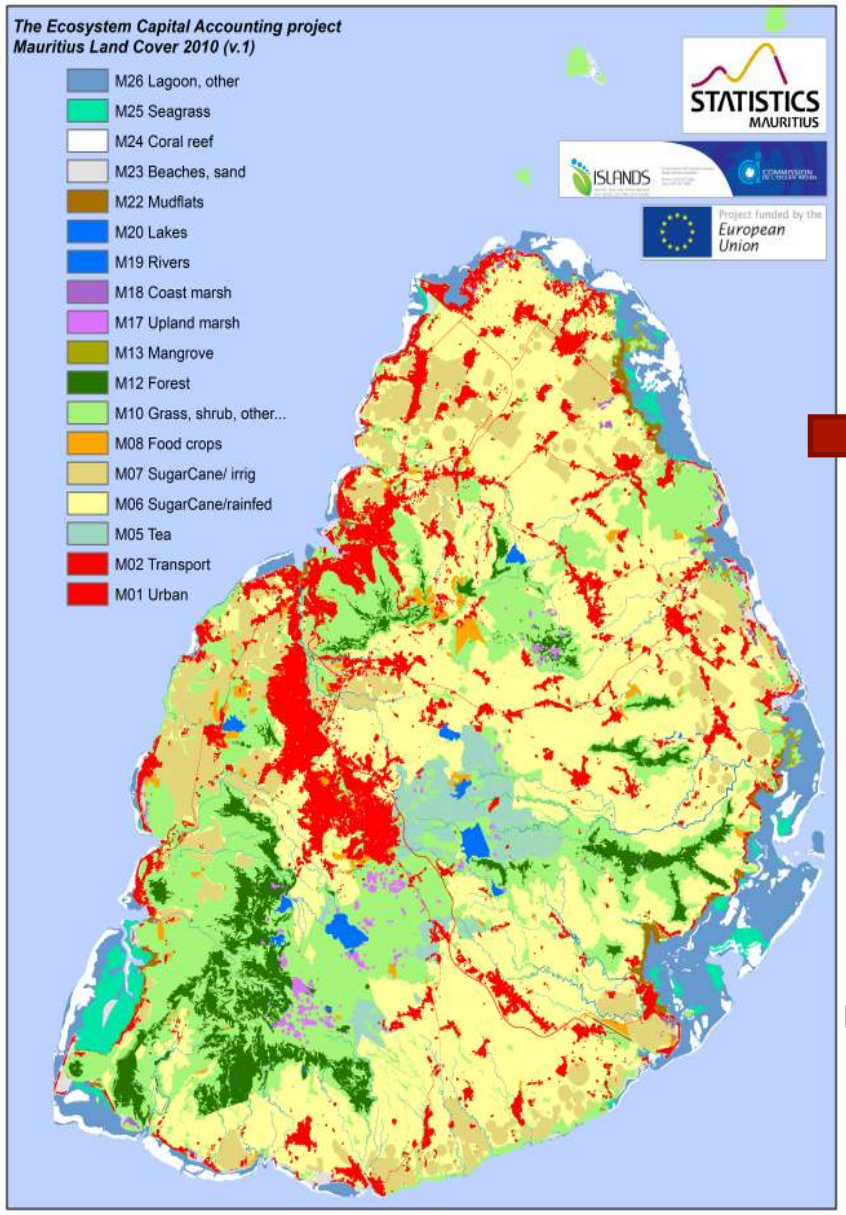


Structure of Ecosystem Natural Capital Accounts




The 3 basic accounts
Biomass/ Carbon
Stocks, Supply & Use
Accessible Basic Resource
(tons, joules)
Sustainable use index
*
Change in health index (incl. stability of carbon pools)
Water
Stocks, Supply & Use
Accessible Basic Resource
(m3, joules)
Sustainable use index
*
Change in health index (incl. pollution)
Ecosystem Infrastructure Functional Services
Stocks, Formation & Consumption,
Accessible Basic Resource
(weighted ha or km)
Sustainable use index
*
Change in health index (incl. biodiversity , diseases…)
NON
ADDITIVE
Calculation of ecosystem's ecological value in ECU
Composite index of ecosystem capability (ECU-Unit Value)
Ecosystem Capital Capability
=
One resource (e.g. biocarbon) x ECU-price

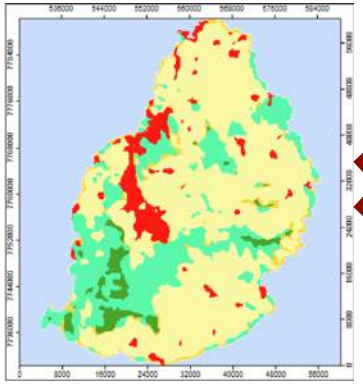
SEEA-ENCA Mauritius preliminary results :



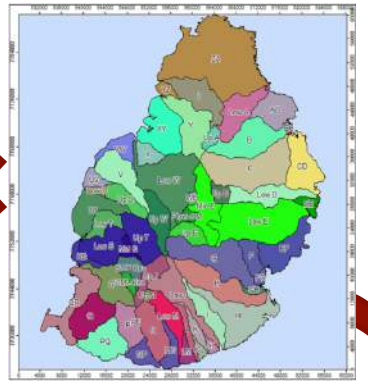
A land cover map has been produced from the start for:

1. **Defining statistical units for accounting (EAU) and**
2. **Computing the land cover account (next slide)**

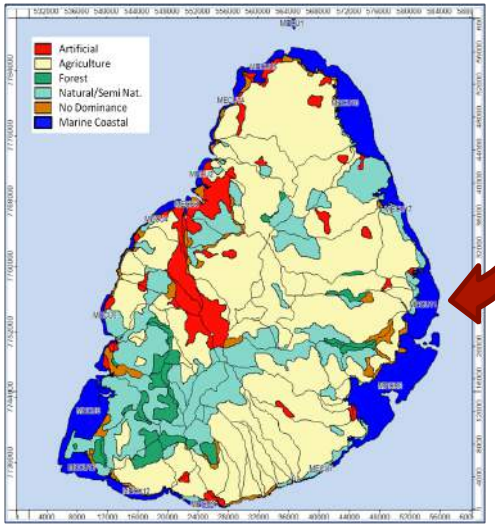
Dominant land cover types (>50%)



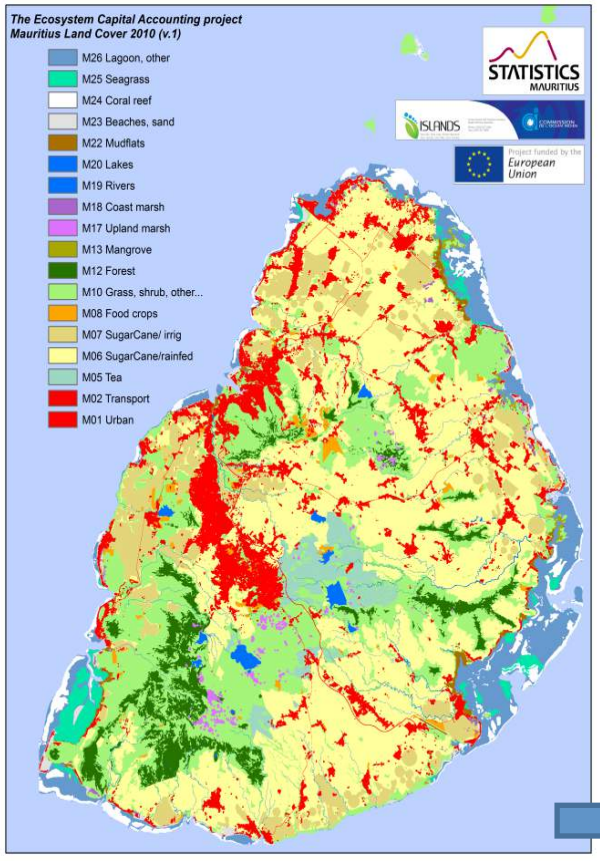
River sub-basins



Socio-ecological landscape units (SELU) & Marine Coastal Units (MCU)

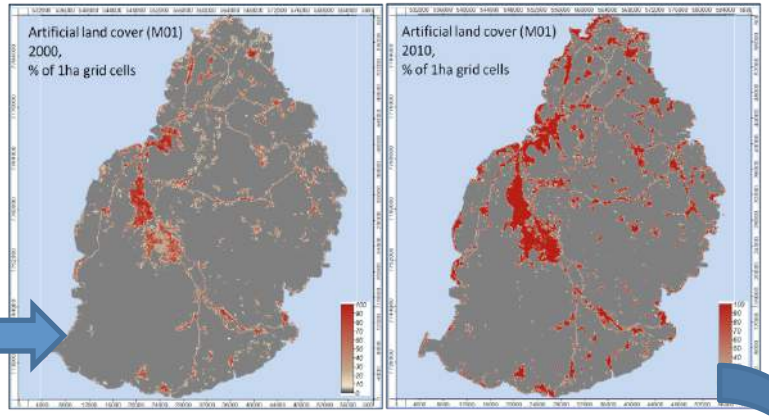


ENCA Mauritius preliminary results :
Land cover and change from 2000 to 2010



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



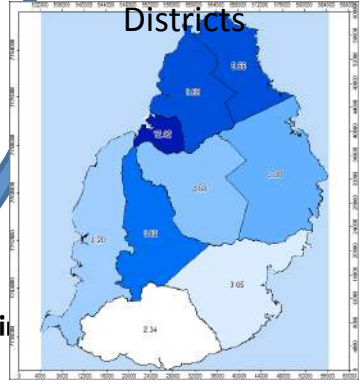
These grids allow computing statistics and producing ecosystems/natural capital accounts for various statistical units such as municipal and village council areas, districts, coastal zones, river basins, socio-ecological landscape units and any relevant zoning.

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



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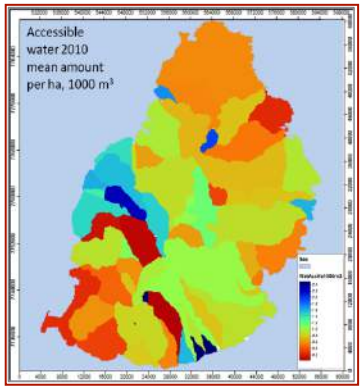
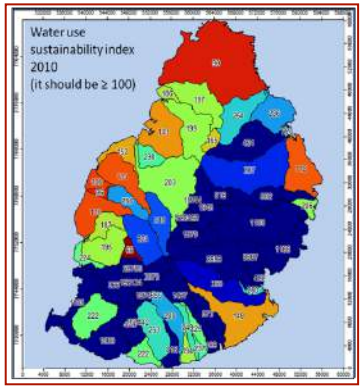
SEEA-ENCA Mauritius preliminary results :

The ecosystem water account

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



Water use intensity stress index (stress when <100)



Simplified water accounts by Districts, 2010 — **Mm3**

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 Mauritius preliminary results :

The biomass-carbon account

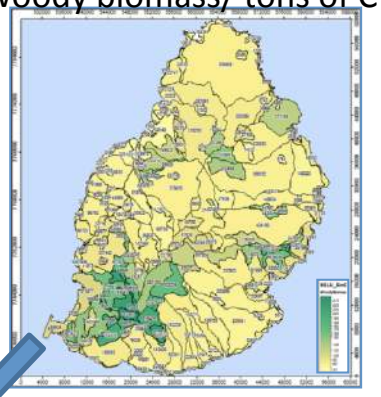
Carbon Accounts show the capacity of the ecosystems to produce biomass and the way it is used by crops harvests and trees removal or sometimes sterilised by artificial developments or destroyed by soil erosion or forest fires (in line with IPCC guidelines).
Accounts are compiled using various sources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

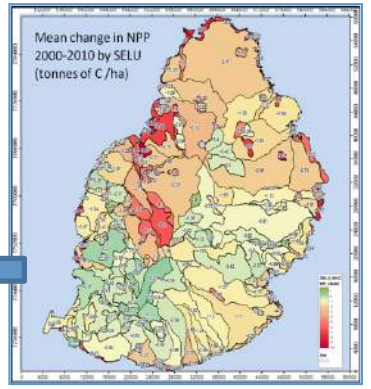
Provisional

2010	Riviere du Rempart	Pamplemousses	Flacq	Moka	Grand Port	Plaines Wilhems	Black River	Savanne	Port Louis	T
Initial stock 2010	**1457955**	**2101934**	**4135543**	**4165122**	**2855365**	**3327114**	**3173857**	**3196601**	**432317**	**24845**
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*	**44**
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**

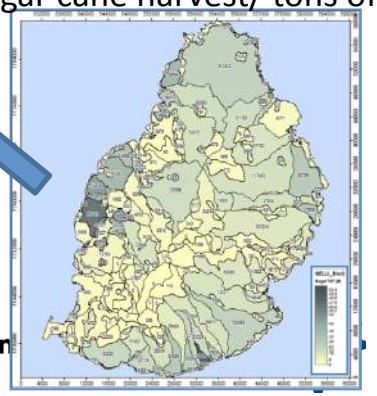
Woody biomass/ tons of C



Change in NPP/ tons of C



Sugar cane harvest/ tons of C



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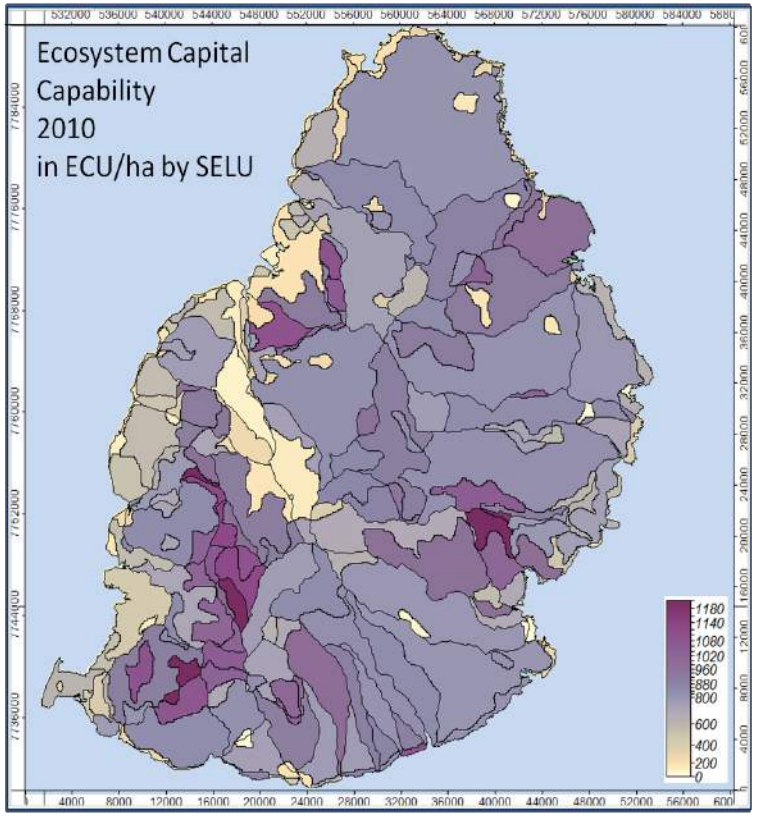
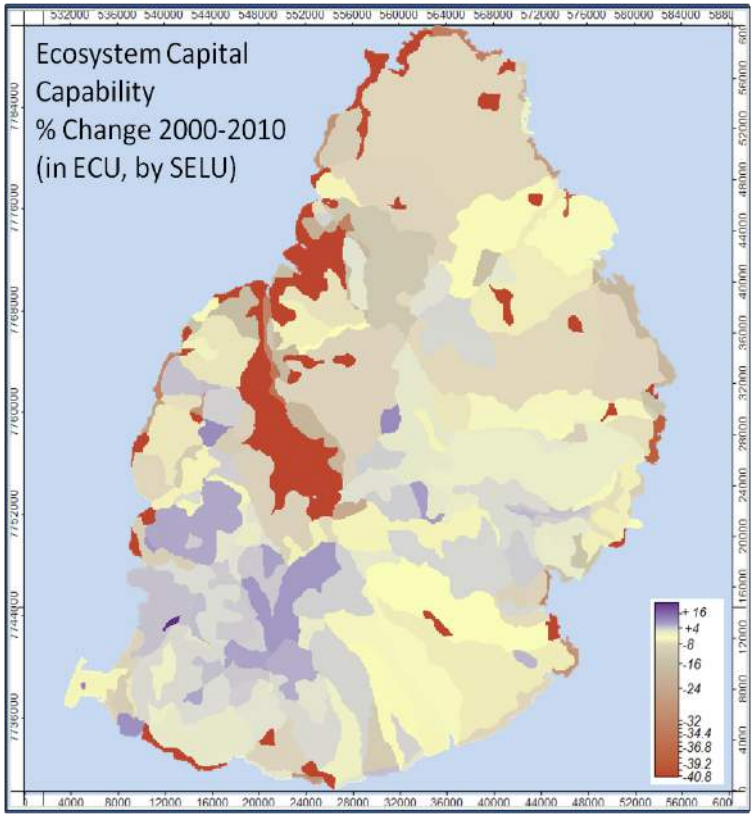
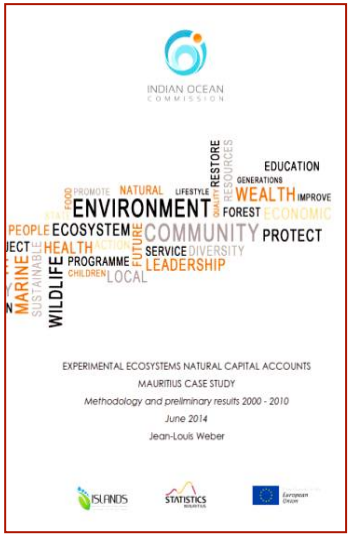
A first attempt to calculate Ecosystem Capital Capability (in ECU) for Mauritius

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





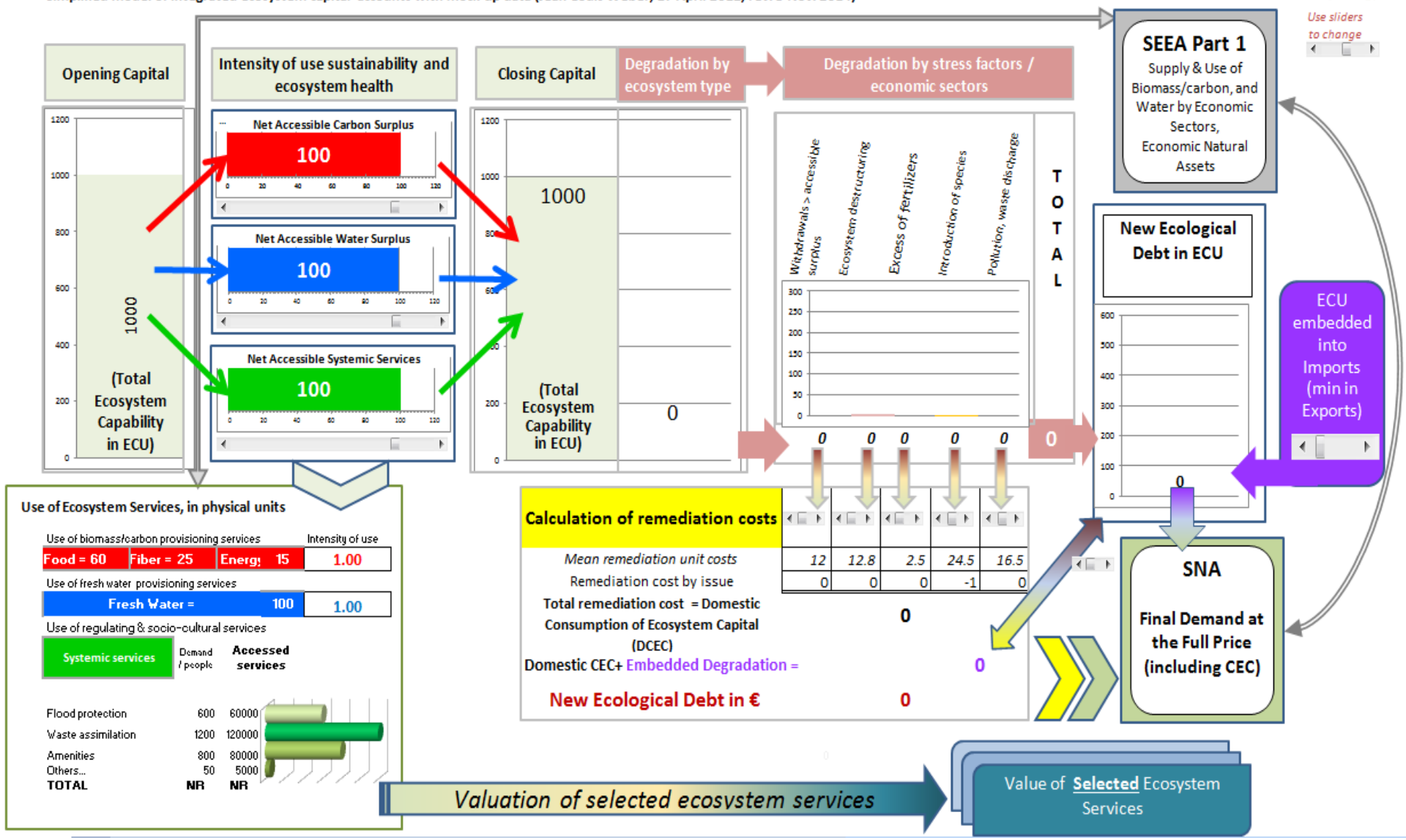
Provisional results

Experimental ENCA,
Mauritius Case Study (IOC, 2014)

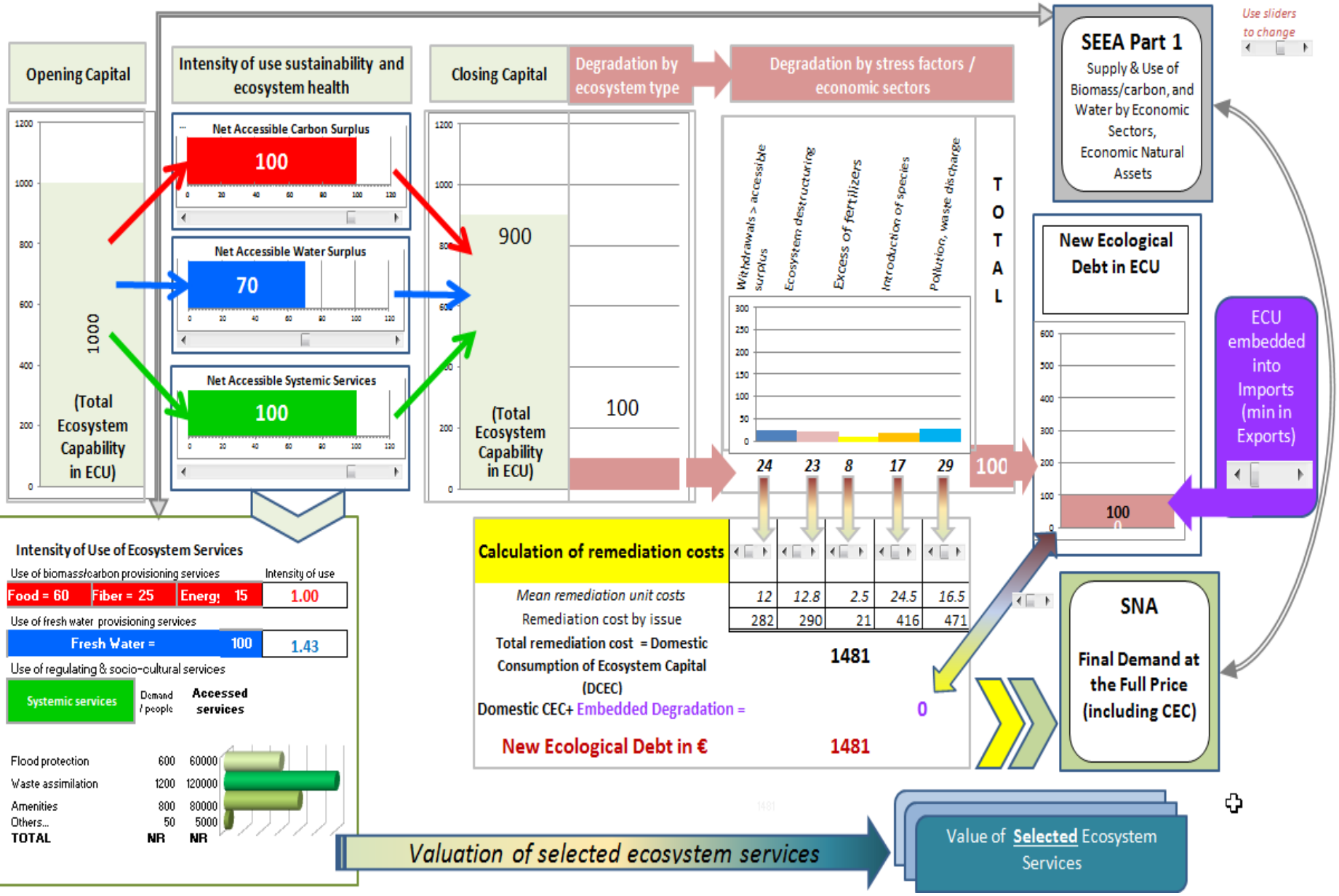
Experimental account of ecosystem capital capability in ECU, inland ecosystems, Mauritius

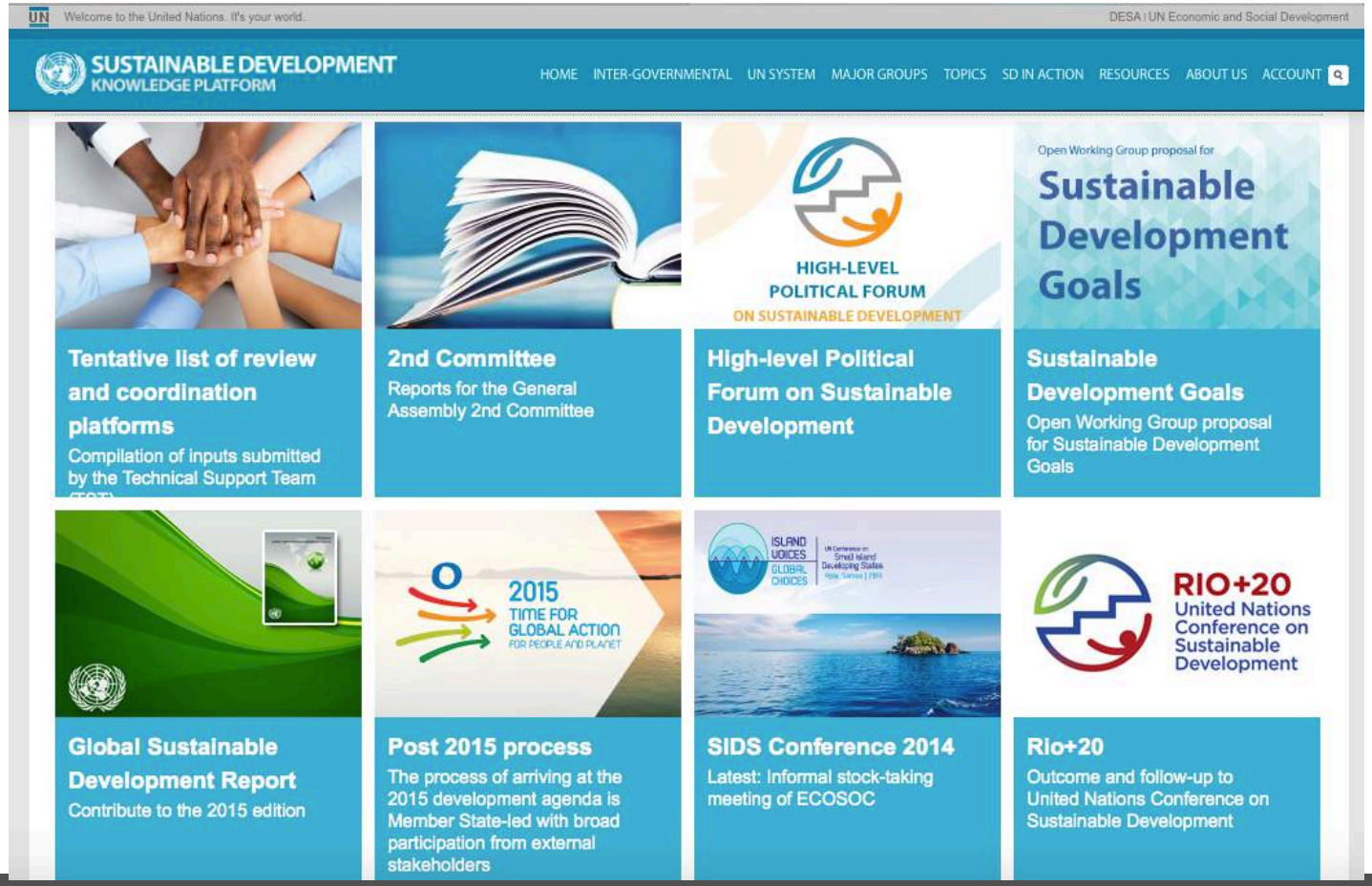
2000 - 2010	Rivière du Rempart	Pamplemousses	Flacq	Moka	Grand Port	Plaines Wilhems	Black River	Savanne	Port Louis	TOTAL
Inland ecosystems (Socio-Ecological Landscape Units)										
Accessible bio-carbon resource 2000	85170	96492	101805	61687	125035	40148	97693	100355	2555	710938
Index of sustainable use of bio-carbon 2000	108.9	89.6	78.8	92.1	116.2	95.6	93.3	102.5	135.9	96.6
Accessible bio-carbon resource 2010	73600	83094	85875	51642	112974	30296	87089	90500	1479	617550
Index of sustainable use of bio-carbon 2010	112.5	92.0	80.1	91.4	125.3	85.1	99.1	110.5	87.1	99.9
Accessible renewable water, 2000, Mm3	65	90	217	237	227	183	174	224	37	1470
Water sustainable use (2): 1st decile, 2000 (adjusted)	90.6	84.5	122.2	227.8	166.3	131.4	112.4	253.6	155.6	
Accessible renewable water, 2010, Mm3	83	124	217	200	219	187	228	213	36	1507
Water sustainable use (2): 1st decile, 2010	90.1	90.1	117.6	203.1	147.8	114.4	110.2	221.8	143.1	
Accessible systemic services (nLEP 2000 / weighted ha)	583021	677761	1373059	1226033	1218167	976061	1479992	1262700	216727	9013521
nLEP 2000 index	39.7	37.6	46.0	52.1	46.6	49.2	57.9	51.0	54.5	48.4
Accessible systemic services (nLEP 2010 / weighted ha)	564651	660647	1361066	1214254	1211558	956963	1468060	1257003	187648	8881851
nLEP 2010 index	38.4	36.7	45.6	51.6	46.4	48.2	57.4	50.8	47.2	47.7
Change in BioCarbon sustainable use index % 2000-2010	3.2	2.6	1.7	-0.7	7.8	-11.0	6.1	7.8	-35.9	
Change in Water sustainable use index (2) % 2000-2010	-0.5	6.7	-3.7	-10.8	-11.1	-13.0	-2.0	-12.5	-8.0	
Change in nLEP index % 2000-2010	-3.2	-2.5	-0.9	-1.0	-0.5	-2.0	-0.8	-0.5	-13.4	-1.5
Mean ECU price 2000, v0	79	70	82	124	110	92	88	136	113	
Mean ECU price 2010, v0	80	73	81	115	105	83	89	128	92	
Inland Ecosystem Capability in ECU, 2000, v0	6754512	6779076	8366804	7638831	13704307	3684073	8568899	13609354	288508	69394364
Inland Ecosystem Capability in ECU, 2010, v0	5912136	6059187	7048015	5959329	12028249	2501975	7741432	11556887	136714	58943924
Net change in inland Ecosystem Capability 2000-2010, in ECU, v0	-842376	-719889	-1318789	-1679502	-1676057	-1182098	-827467	-2052467	-151794	-10450441
Net change in inland Ecosystem Capability 2000-2010, in ECU, % v0	**-12.5**	**-10.6**	**-15.8**	**-22.0**	**-12.2**	**-32.1**	**-9.7**	**-15.1**	**-52.6**	**-15.1**

Simplified model of integrated ecosystem capital accounts with mock-up data (Jean-Louis Weber, 17 April 2012, rev. 5 Nov. 2014)

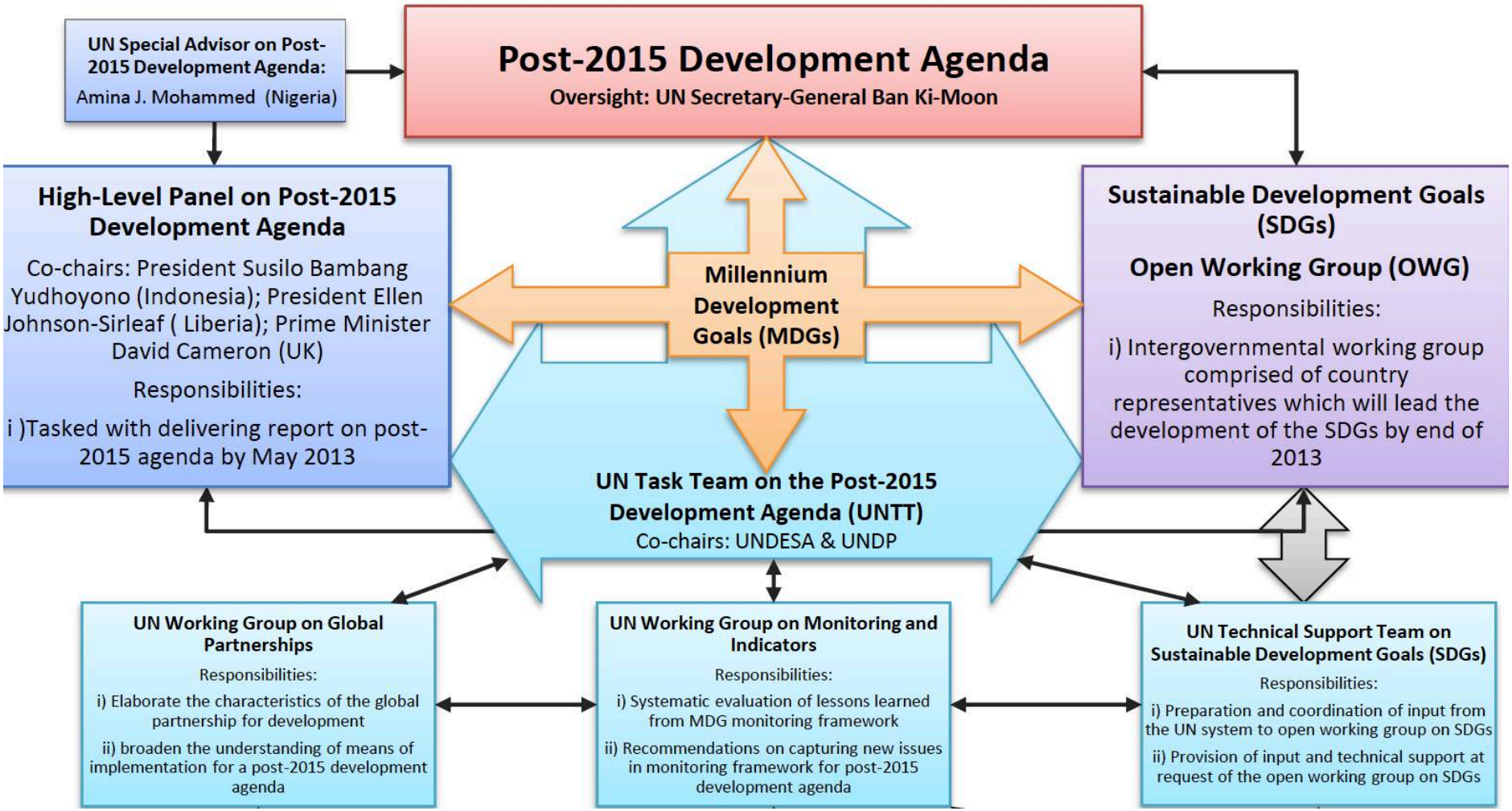


Simplified model of integrated ecosystem capital accounts with mock-up data (Jean-Louis Weber, 17 April 2012, rev. 5 Nov. 2014)





http://sustainabledevelopment.un.org


UN Special Advisor on Post-2015 Development Agenda:
Amina J. Mohammed (Nigeria)
Post-2015 Development Agenda
Oversight: UN Secretary-General Ban Ki-Moon
High-Level Panel on Post-2015 Development Agenda
Co-chairs: President Susilo Bambang Yudhoyono (Indonesia); President Ellen Johnson-Sirleaf (Liberia); Prime Minister David Cameron (UK)
Responsibilities:
i)Tasked with delivering report on post-2015 agenda by May 2013
Millennium Development Goals (MDGs)
Sustainable Development Goals (SDGs)
Open Working Group (OWG)
Responsibilities:
i) Intergovernmental working group comprised of country representatives which will lead the development of the SDGs by end of 2013
UN Task Team on the Post-2015 Development Agenda (UNTT)
Co-chairs: UNDESA & UNDP
UN Working Group on Global Partnerships
Responsibilities:
i) Elaborate the characteristics of the global partnership for development
ii) broaden the understanding of means of implementation for a post-2015 development agenda
UN Working Group on Monitoring and Indicators
Responsibilities:
i) Systematic evaluation of lessons learned from MDG monitoring framework
ii) Recommendations on capturing new issues in monitoring framework for post-2015 development agenda
UN Technical Support Team on Sustainable Development Goals (SDGs)
Responsibilities:
i) Preparation and coordination of input from the UN system to open working group on SDGs
ii) Provision of input and technical support at request of the open working group on SDGs

MDG	Targets	Indicators	
Goal 7: Ensure environmental sustainability	Target 7.A: Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources Target 7.B: Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss	7.1 Proportion of land area covered forest 7.2 CO2 emissions, total, per capita and per $1 GDP (PPP) 7.3 Consumption of ozone-depleting substances 7.4 Proportion of fish stocks within safe biological limits 7.5 Proportion of total water resources used 7.6 Proportion of terrestrial and marine areas protected 7.7 Proportion of species threatened with extinction	7.1 FAO 7.2 UNFCC/CDIAC 7.3 UNEP 7.4 FAO 7.5 FAO/UN Water 7.6 UNEP-WCMC 7.7 UNEP-WCMC
	Target 7.C: Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation	7.8 Proportion of population using an improved drinking water source 7.9 Proportion of population using an improved sanitation facility	7.8 UNICEF/WHO 7.9 UNICEF/WHO
	Target 7.D: By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers	7.10 Proportion of urban population living in slums	7.10 UN-HABITAT

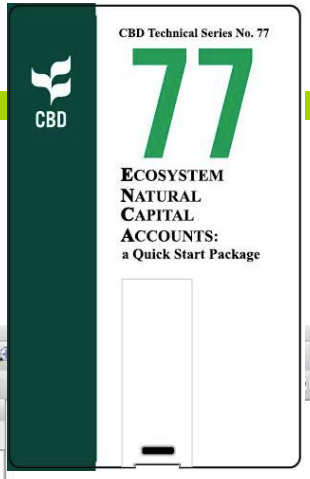
Indicators for monitoring the Sustainable Development Goals and Targets (UNSDSN) to be developped

- [Indicator on urban-rural economic linkages]
- [Indicator on the deployment of a sustainable development strategy for each urban agglomeration above [250,000]]
- [Indicator on chemical pollution]
- [Climate Change Action (CCA) Index]
- [Strategic environmental and social impact assessments required]
- [Indicator on Integrated Water Resources Management (IWRM)]
- [Use of destructive fishing techniques]
- [Eutrophication of major estuaries]
- [Disaster Risk Reduction Index]
- [Improved land ownership and governance of forests]
- [Vitality Index of Traditional Environmental Knowledge (VITEK)]
- [Excessive loss of reactive nitrogen [and phosphorus] to the environment (kg/ha)]
- [Reducing food waste, efficiency in agricultural inputs and sustainable agriculture]
- [Reporting of international river shed authorities on transboundary river-shed management]
- [Indicator on the conservation of mountain ecosystems]
- [Indicator on the implementation of spatial planning strategies for coastal and marine areas]

Sustainable Development Goals and Targets / Ecosystem Natural Capital Accounts

- 15.9. by 2020, integrate ecosystems and biodiversity values into national and local planning, development processes and poverty reduction strategies, and accounts
- 17.19 by 2030, build on existing initiatives to develop measurements of progress on sustainable development that complement GDP, and support statistical capacity building in developing countries

PACKAGE : TUTORIAL / SOFTWARE / TABLES



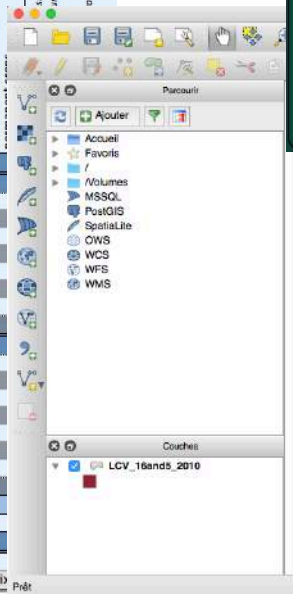
Edition | Police | Alignement | Nombre

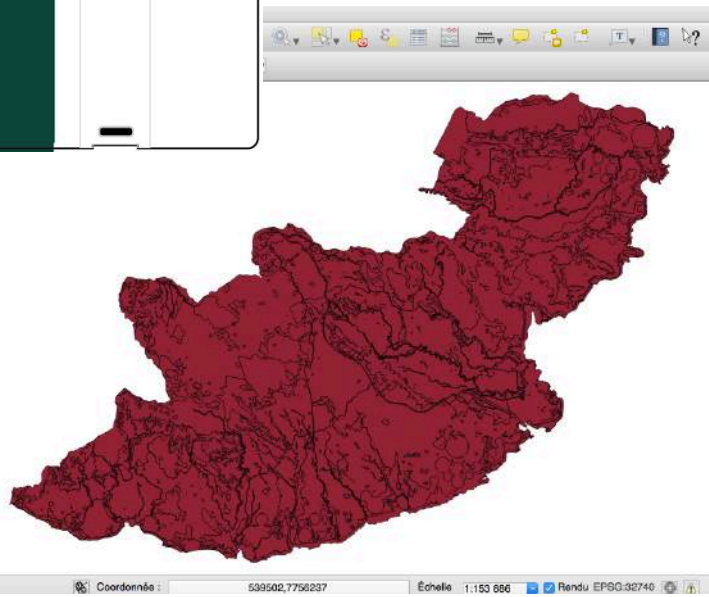
Calibri (Corps) 16 — Renvoyer à la ligne automatiquement — Standard — Fusionner

A1: Ecosystem Natural Capital Accounts: Land Cover Stocks and Flows Account

	A	B	C	D	E	F	G	H	I	J	K
4	Land cover stocks and flows (lf)		Urban fabric and associated developed areas	Dispersed human settlements	Urban and associated developed areas	Rainfed homogeneous herbaceous cropland	Irrigated or aquatic homogeneous herbaceous cropland	Homogeneous herbaceous cropland	Agriculture plantations, permanent crops, rainfed	Agriculture plantations, permanent crops, irrigated	Agriculture plantations,
5	I. Opening Stock										
6	II. Formation of land cover										
7	F_lf1	Artificial development									
8	F_lf2	Agriculture development									
9	F_lf3	Internal conversions, rotations									
10	F_lf4	Management and alteration of forested land									
11	F_lf5	Restoration and development of habitats									
12	F_lf6	Changes of land-cover due to natural and multiple causes									
13	F_lf7	Other land cover changes n.e.c. and reclassification									
14	Total formation of land cover										
15	III. Consumption of land cover										
16	C_lf1	Artificial development									
17	C_lf2	Agriculture development									
18	C_lf3	Internal conversions, rotations									
19	C_lf4	Management and alteration of forested land									
20	C_lf5	Restoration and development of habitats									
21	C_lf6	Changes of land-cover due to natural and multiple causes									
22	C_lf7	Other land cover changes n.e.c. and reclassification									
23	Total consumption of land cover										
24	Net change in land cover (formation - consumption)										
25	No change										
26	IV. Closing Stock										
27											

LC_Account_DET | LCEFU | LCEFU_corresp. | LFlows | Computation & flat matrixes | Accounting matri





Prêt — Coordonnée : 539502,7756237 — Échelle 1:153 886 — Rendu EPSG:32740

Year T1

Year T0		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	Total Consumption of land cover	No Change	TOTAL t1
Urban and associated developed areas	01	lf3	lf7	lf7	lf7	lf7	lf7	lf7	lf7	lf7	lf7	lf7	lf7	lf1	lf6	lf6		lf0	
Homogeneous herbaceous cropland	02	lf1	lf3	lf3	lf5	lf5	lf5	lf5	lf5	lf5	lf6	lf7	lf5	lf1	lf6	lf6		lf0	
Agriculture plantations, permanent crops	03	lf1	lf3	lf3	lf5	lf5	lf5	lf5	lf6	lf5	lf6	lf7	lf5	lf1	lf6	lf6		lf0	
Agriculture associations and mosaics	04	lf1	lf2	lf2	lf3	lf5	lf5	lf5	lf6	lf5	lf6	lf7	lf5	lf1	lf6	lf6		lf0	
Pastures and natural grassland	05	lf1	lf2	lf2	lf2	lf3	lf5	lf5	lf6	lf5	lf6	lf7	lf5	lf1	lf6	lf6		lf0	
Forest tree cover	06	lf1	lf2	lf2	lf2	lf4	lf3	lf4	lf4	lf4	lf4	lf7	lf4	lf1	lf6	lf6		lf0	
Shrubland, bushland, heathland	07	lf1	lf2	lf2	lf2	lf6	lf5	lf3	lf6	lf6	lf6	lf7	lf6	lf1	lf6	lf6		lf0	
Sparsely vegetated areas	08	lf1	lf2	lf2	lf2	lf2	lf5	lf6	lf3	lf6	lf6	lf7	lf6	lf1	lf6	lf6		lf0	
Natural vegetation associations and mosaics	09	lf1	lf2	lf2	lf2	lf2	lf5	lf6	lf6	lf3	lf6	lf7	lf6	lf1	lf6	lf6		lf0	
Barren land	10	lf1	lf2	lf2	lf2	lf2	lf5	lf6	lf6	lf5	lf3	lf7	lf6	lf1	lf6	lf6		lf0	
Permanent snow and glaciers	11	lf1	lf6	lf6	lf6	lf6	lf6	lf6	lf6	lf6	lf6	lf3	lf6	lf6	lf6	lf6		lf0	
Open wetlands	12	lf1	lf2	lf2	lf2	lf2	lf5	lf6	lf6	lf6	lf6	lf7	lf3	lf6	lf6	lf6		lf0	
Inland water bodies	13	lf1	lf2	lf2	lf2	lf2	lf5	lf6	lf6	lf6	lf6	lf7	lf6	lf3	lf6	lf6		lf0	
Coastal water bodies and inter-tidal areas	14	lf1	lf6	lf6	lf6	lf6	lf5	lf6	lf6	lf6	lf6	lf7	lf6	lf6	lf3	lf6		lf0	
Sea (interface with land)	15	lf1	lf6	lf6	lf6	lf6	lf6	lf6	lf6	lf6	lf6	lf6	lf6	lf6	lf6	lf3		lf0	
Total Formation of land cover																			
No Change	99	lf0	lf0	lf0	lf0	lf0	lf0	lf0	lf0	lf0	lf0	lf0	lf0	lf0	lf0	lf0			
TOTAL t2																			

Land cover flows

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.c. and reclassification
lf0	No observed land-cover change

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Merci de votre attention

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