Monitoring ecosystem services for policy design

Patricia Balvanera

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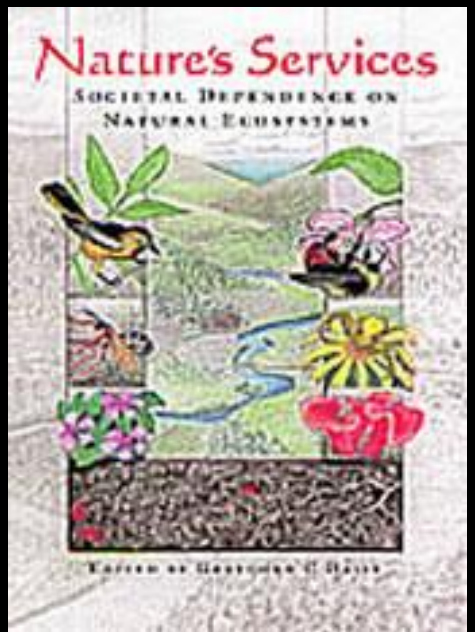
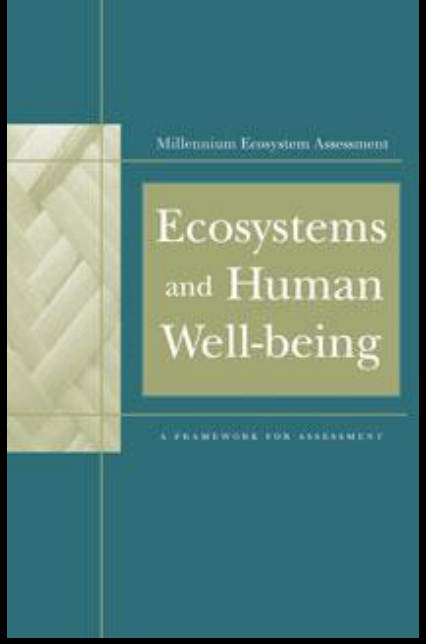
GEOBON WG6



Conserving Biodiversity and Ecosystem Services

The value of the world's ecosystem services and natural capital

Robert Costanza*†, Ralph d'Arge‡, Rudolf de Groot§, Stephen Farber‖, Monica Grasso†, Bruce Hannon¶, Karin Limburg#*, Shahid Naeem**, Robert V. O'Neill††, Jose Paruelo‡‡, Robert G. Raskin§§, Paul Sutton‖‖ & Marjan van den Belt¶¶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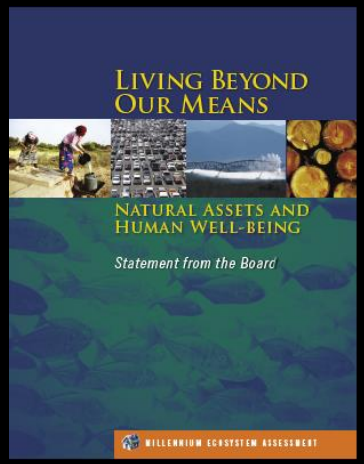
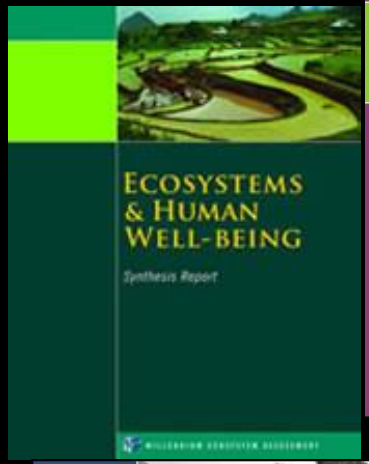
Ecosystems and Human Well-being
A FRAMEWORK FOR ASSESSMENT


Living Beyond Our Means
Natural Assets and Human Well-being
Statement from the Board
Millennium Ecosystem Assessment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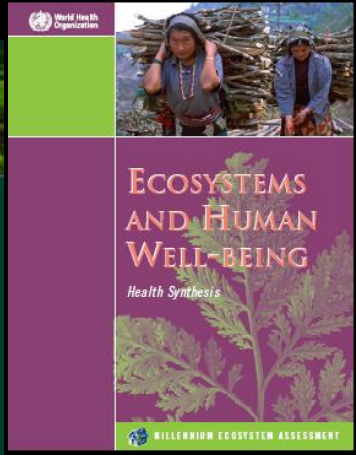
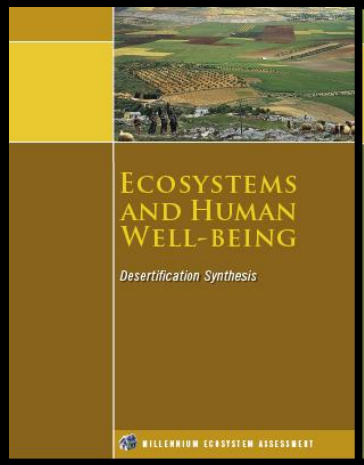
Synthesis Report


World Health Organization
Ecosystems and Human Well-being
Health Synthesis
Millennium Ecosystem Assessment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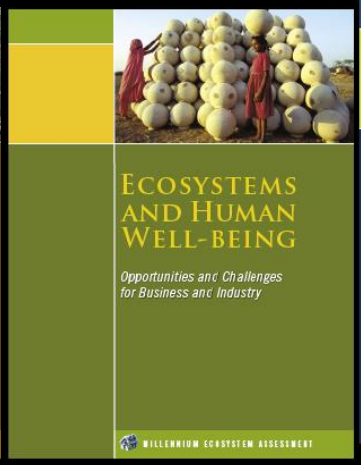
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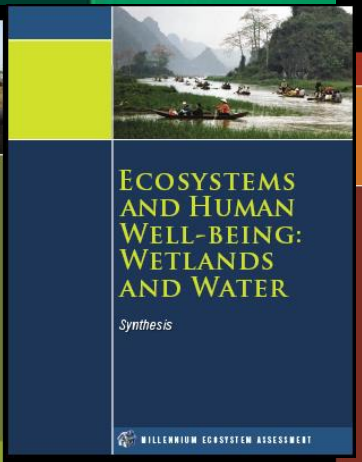
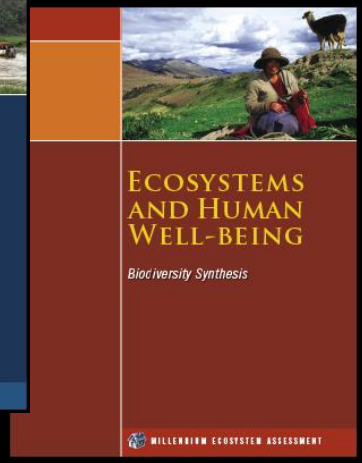
Opportunities and Challenges for Business and Industry
Millennium Ecosystem Assessment


Ecosystems and Human Well-being: Wetlands and Water
Synthesis
Millennium Ecosystem Assessment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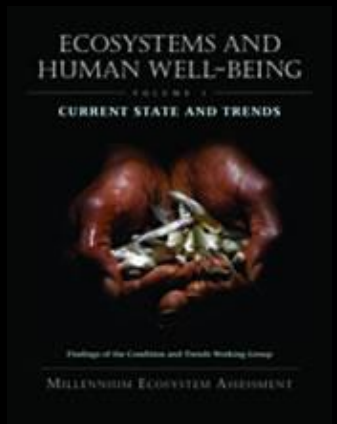
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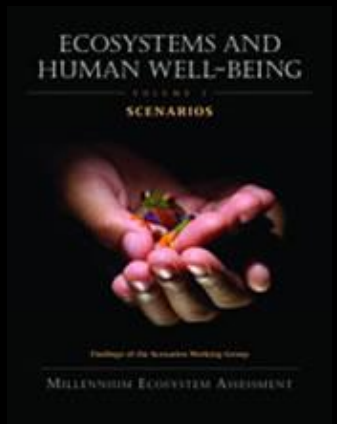
Current State and Trends
Millennium Ecosystem Assessment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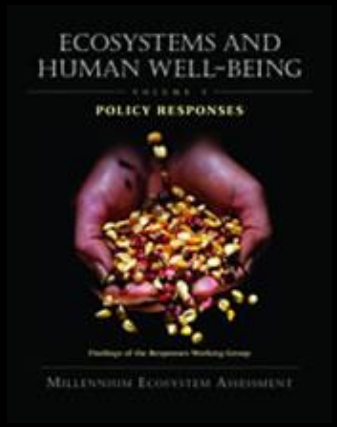
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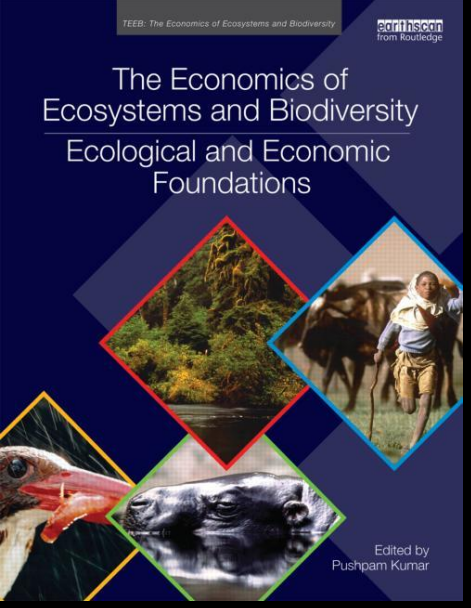
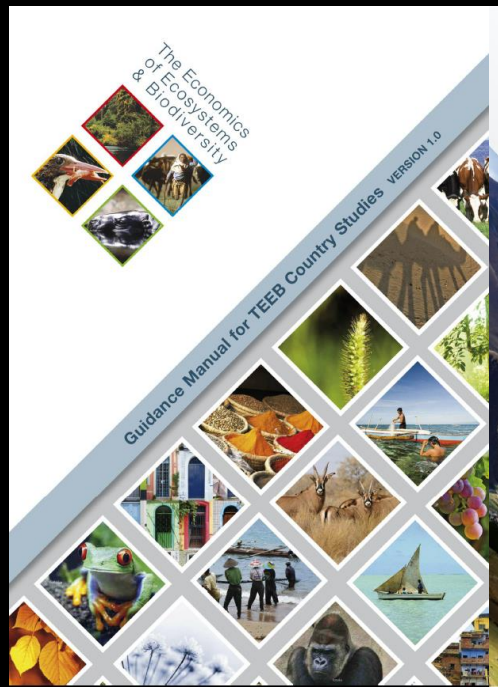
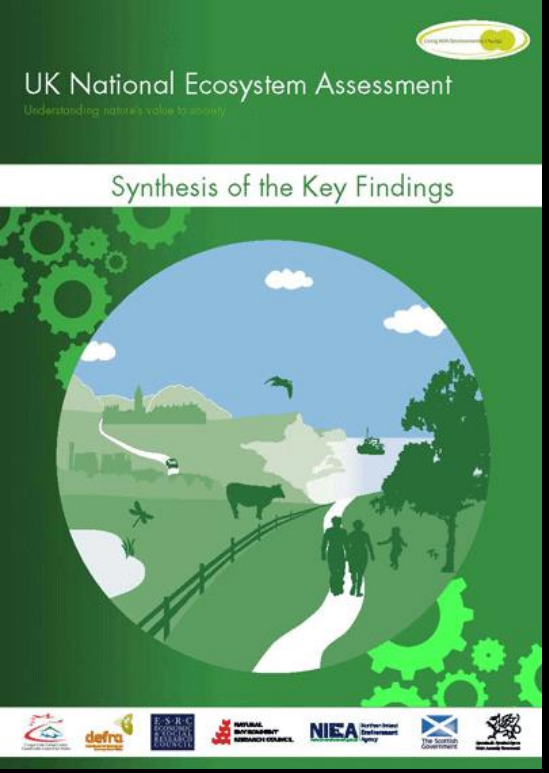

TEEB: The Economics of Ecosystems and Biodiversity
earthscan
from Routledge
The Economics of Ecosystems and Biodiversity
Ecological and Economic Foundations
Edited by
Pushpam Kumar


The Economics of Ecosystems & Biodiversity
TEEB FOR BUSINESS
EXECUTIVE SUMMARY
The Economics of Ecosystems & Biodiversity
TEEB FOR POLICY MAKERS
SUMMARY: RESPONDING TO THE VALUE OF NATURE
The Economics of Ecosystems & Biodiversity
TEEB FOR LOCAL AND REGIONAL POLICY MAKERS


TEEB for Agriculture & Food
Interim Report
The Economics of Ecosystems & Biodiversity
A report by
'The Economics of Ecosystems & Biodiversity'


The Economics of Ecosystems & Biodiversity
Guidance Manual for TEEB Country Studies
VERSION 1.0


TEEB
SCOPING STUDY FOR
Georgia
November 2013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Understanding nature's value to society
Synthesis of the Key Findings
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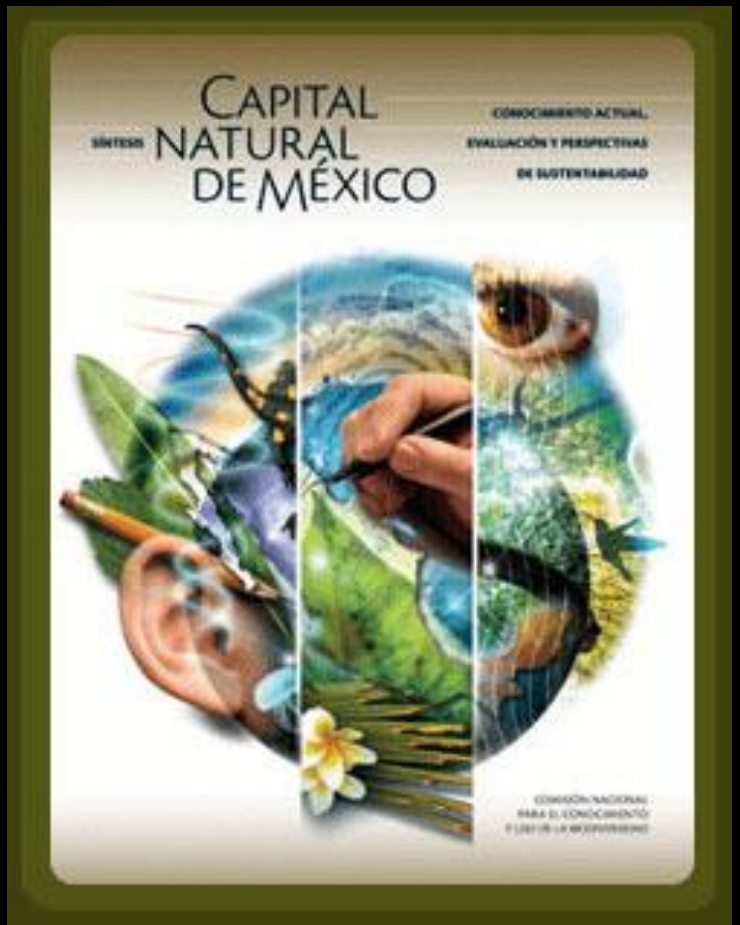
NIEA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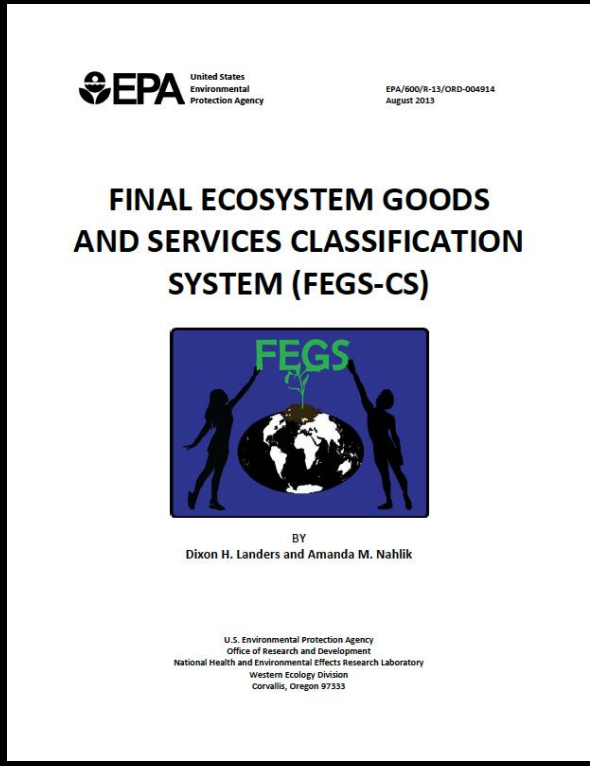
SÍNTESIS
CONOCIMIENTO ACTUAL, EVALUACIÓN Y PERSPECTIVAS DE SUSTENTABILIDAD


EPA
United States Environmental Protection Agency
EPA/600/R-13/ORD-004914
August 2013
FINAL ECOSYSTEM GOODS AND SERVICES CLASSIFICATION SYSTEM (FEGS-CS)
FEGS
BY
Dixon H. Landers and Amanda M. Nahlik
U.S. Environmental Protection Agency
Office of Research and Development
National Health and Environmental Effects Research Laboratory
Western Ecology Division
Corvallis, Oregon 97333


InVEST
integrated valuation of
ecosystem services
and tradeoffs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NATURA 2000


SolVES
Social Values for Ecosystem Services


ProEcoServ
Project for Ecosystem Services


ARIES
ARtificial Intelligence for Ecosystem Services


EcoServ-GIS
Mapping nature's benefits

Earth Observation of Ecosystem Services

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CRC Press
Taylor & Francis Group

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Ecosystem Services

journal homepage: www.elsevier.com/locate/ecoser

A comparative assessment of decision-support tools for ecosystem services quantification and valuation

Kenneth J. Bagstad [a,*], Darius J. Semmens [a], Sissel Waage [b], Robert Winthrop [c]

[a] U.S. Geological Survey, Geosciences & Environmental Change Science Center, Denver, CO, USA
[b] BSR, San Francisco, CA, USA
[c] Socioeconomics Program, USDI—Bureau of Land Management, Washington, DC, USA

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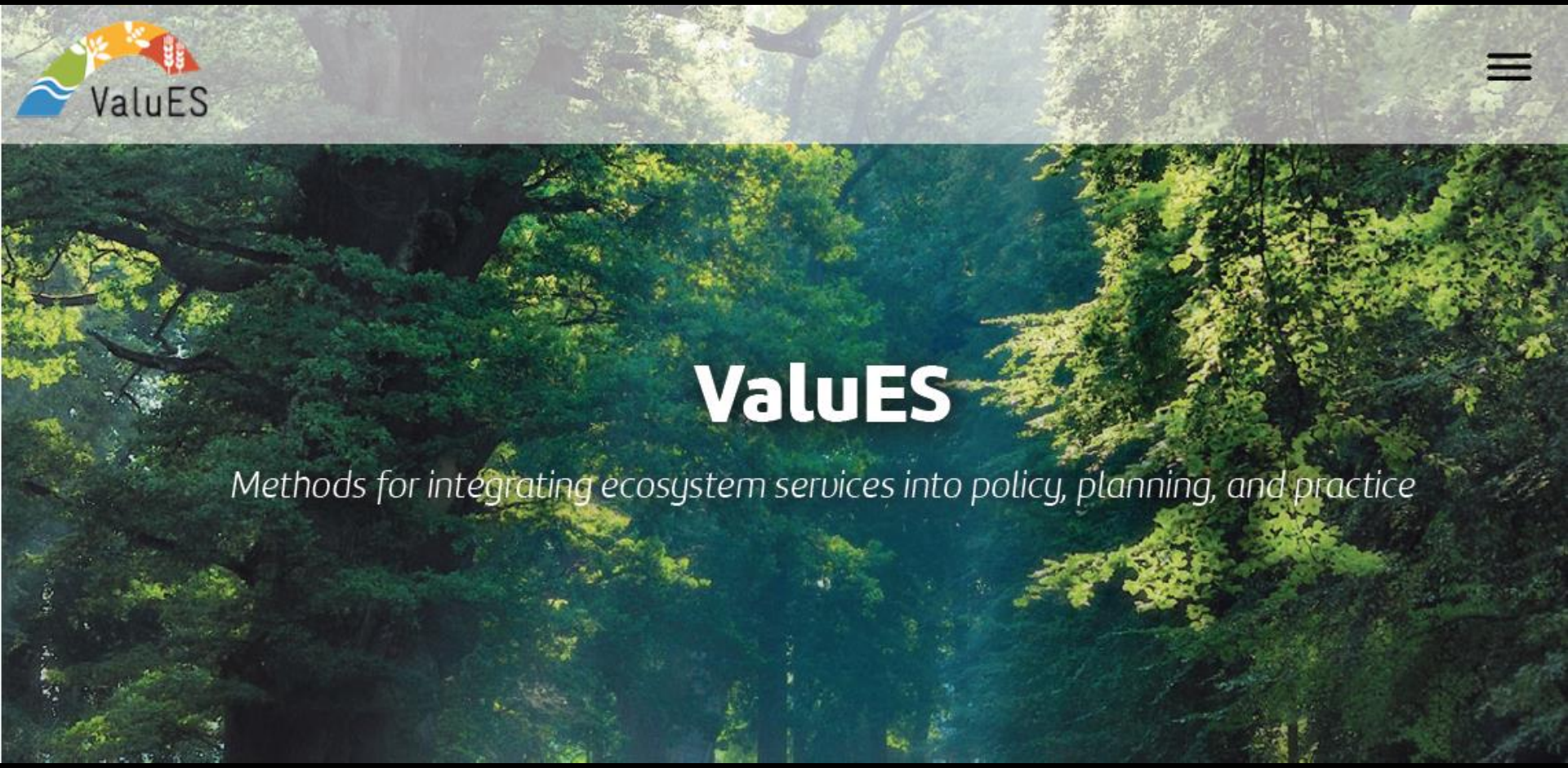
A blueprint for mapping and modelling ecosystem services

Neville D. Crossman [a,*], Benjamin Burkhard [b], Stoyan Nedkov [c], Louise Willemen [d,1], Katalin Petz [e], Ignacio Palomo [f], Evangelia G. Drakou [d], Berta Martín-Lopez [f], Timon McPhearson [g], Kremena Boyanova [c], Rob Alkemade [h], Benis Egoh [d], Martha B. Dunbar [d], Joachim Maes [d]

[a] CSIRO Ecosystem Sciences, PMB 2, Glen Osmond, South Australia, 5064, Australia
[b] Institute for Natural Resource Conservation, University of Kiel, Olshausenstr. 40, 24098 Kiel, Germany
[c] National Institute of Geophysics, Geodesy and Geography, Bulgarian Academy of Sciences Acad. G. Bonchev Street, bl. 3, 1113 Sofia, Bulgaria
[d] European Commission, Joint Research Centre, Via E. Fermi 2749, TP 460, Ispra, VA 21027, Italy
[e] Environmental Systems Analysis Group, Wageningen University, PO Box 47, 6700 AA, Wageningen, The Netherlands
[f] Social-Ecological Systems Laboratory, Department of Ecology, Universidad Autónoma de Madrid, Madrid, Spain
[g] Tishman Environment and Design Center, The New School, 79 Fifth Avenue, 16th Floor, New York, NY 10003, USA
[h] Netherlands Environmental Assessment Agency (PBL), PO Box 303, 3720 AH Bilthoven, The Netherlands

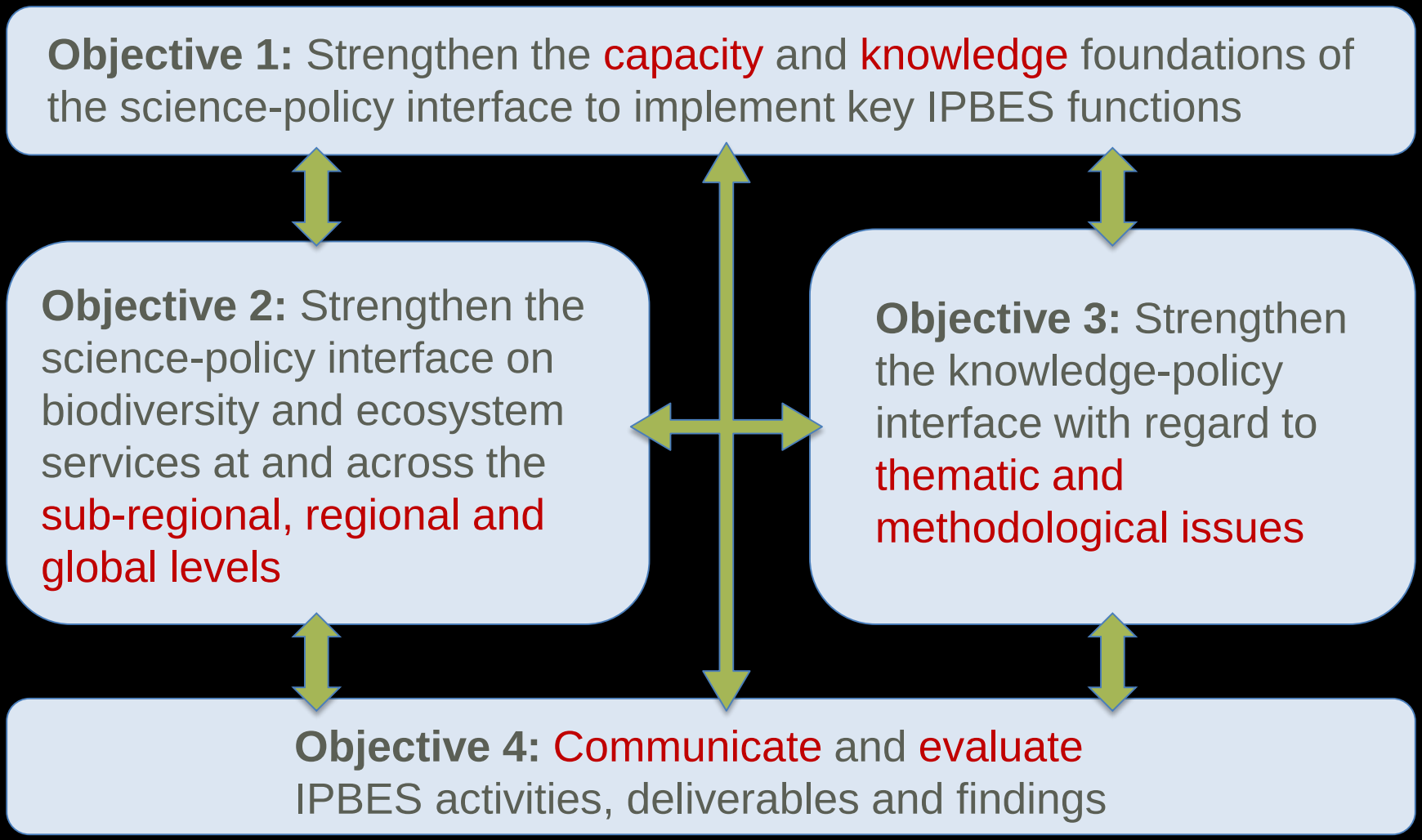

ValuES
ValuES
Methods for integrating ecosystem services into policy, planning, and practice

Intergovernmental Platform on Biodiversity & Ecosystem Services

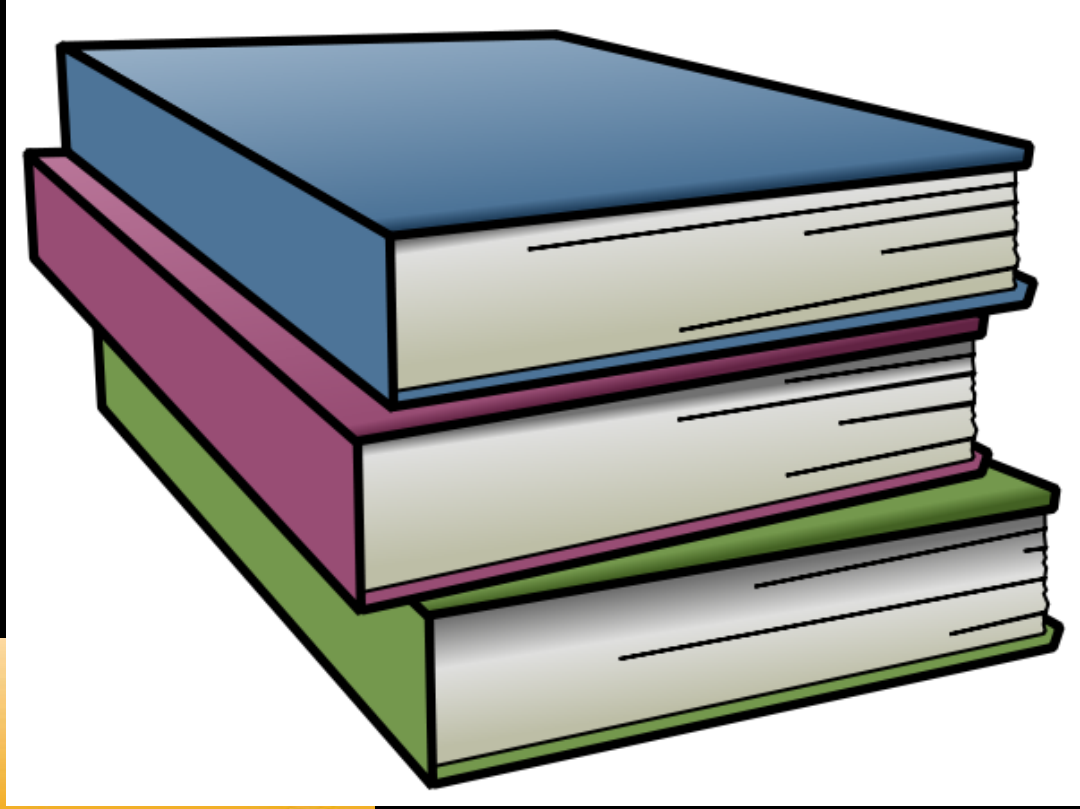
ipbes

Science and Policy for People and Nature

IPBES 1st work programme



How to monitor ecosystem services to support policy design?

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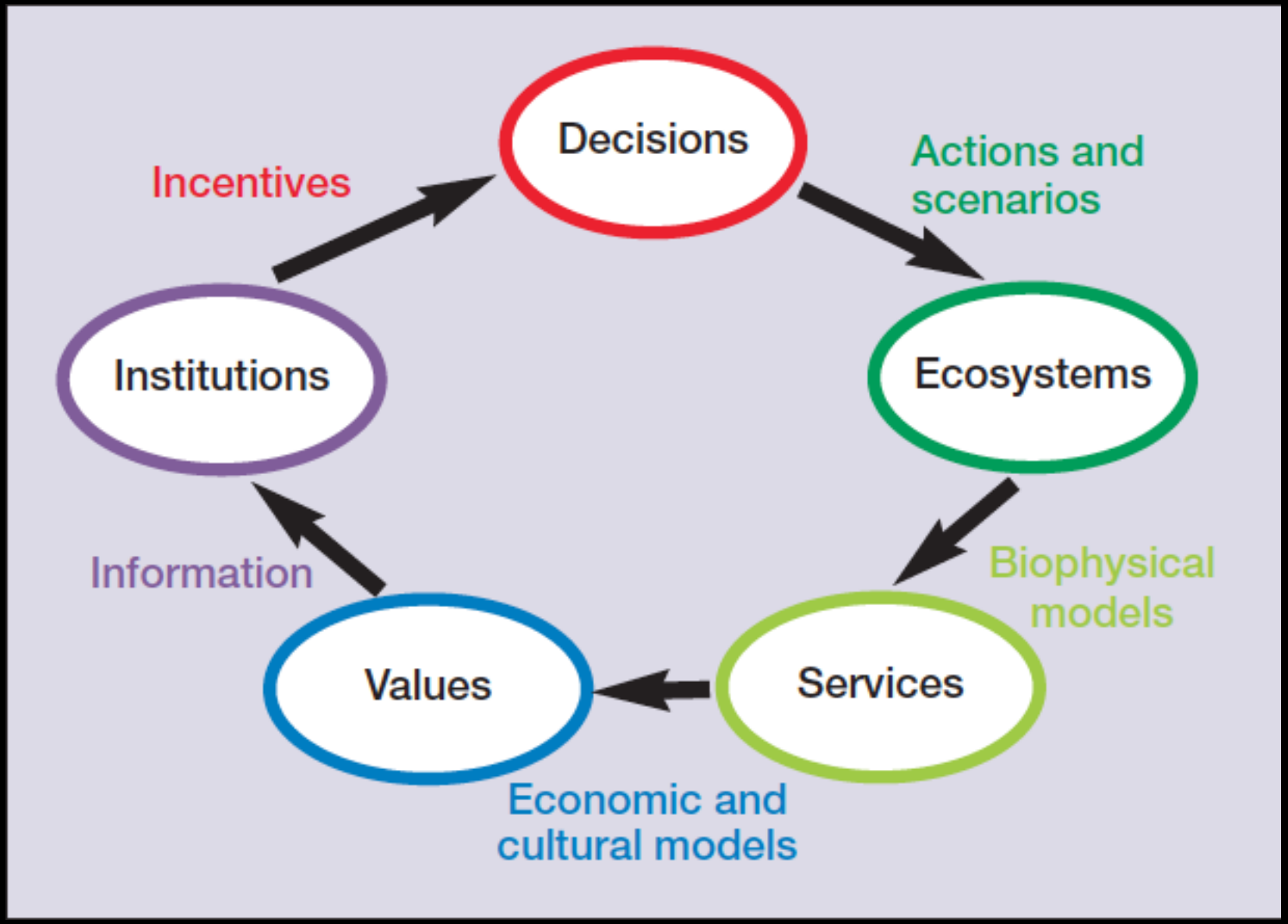
Really????

- KEY QUESTIONS
- KEY CHALLENGES
- THE ROLE FOR GEOBON

- KEY QUESTIONS
- KEY CHALLENGES
- THE ROLE FOR GEOBON

What decision is at stake?



Daily et al. 2009 Frontiers in Ecol. And Env.

COP13 -COPMOP8-COPMOP2
CANCUN, MEXICO 2016

From December 4 to 17

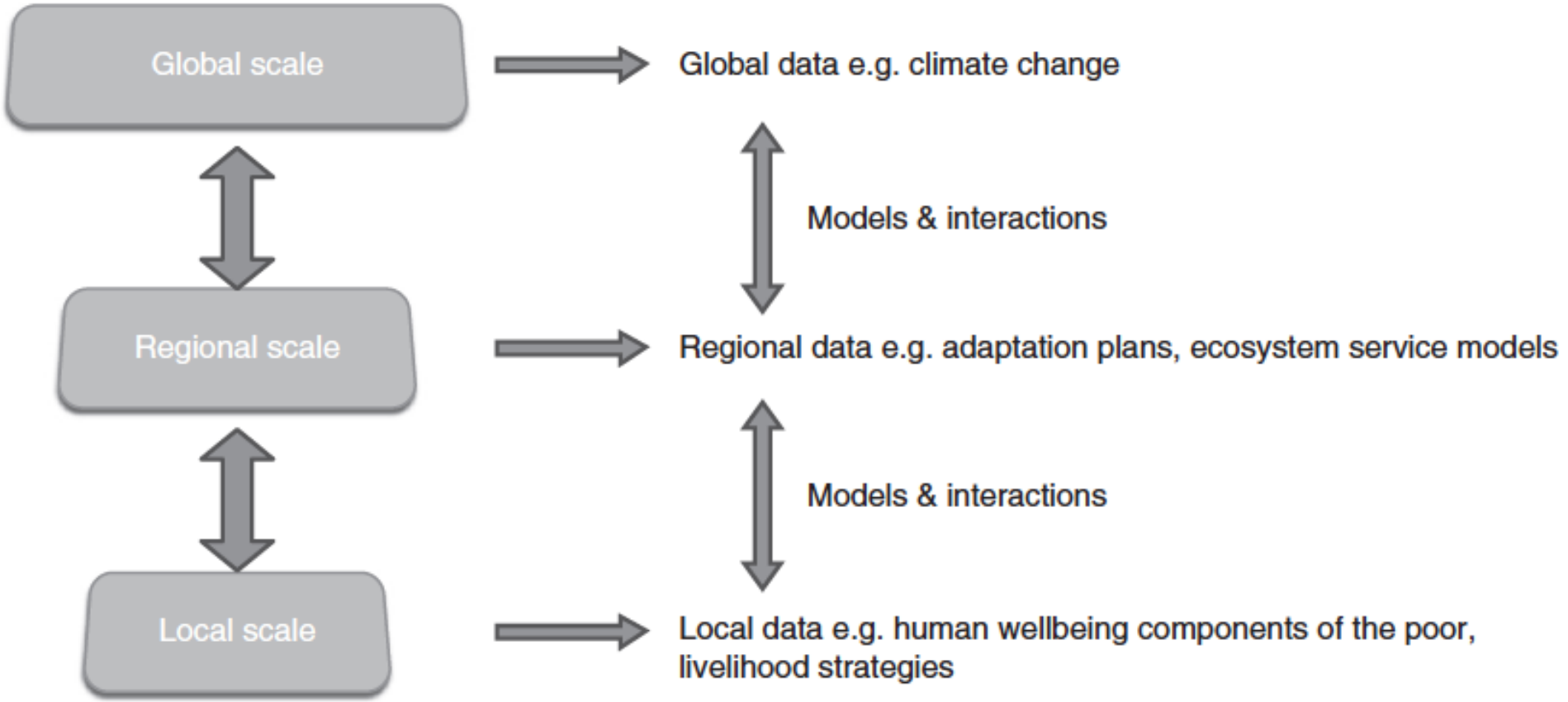
MAINSTREAMING BIODIVERSITY FOR WELL-BEING

CONVENTION ON BIOLOGICAL DIVERSITY

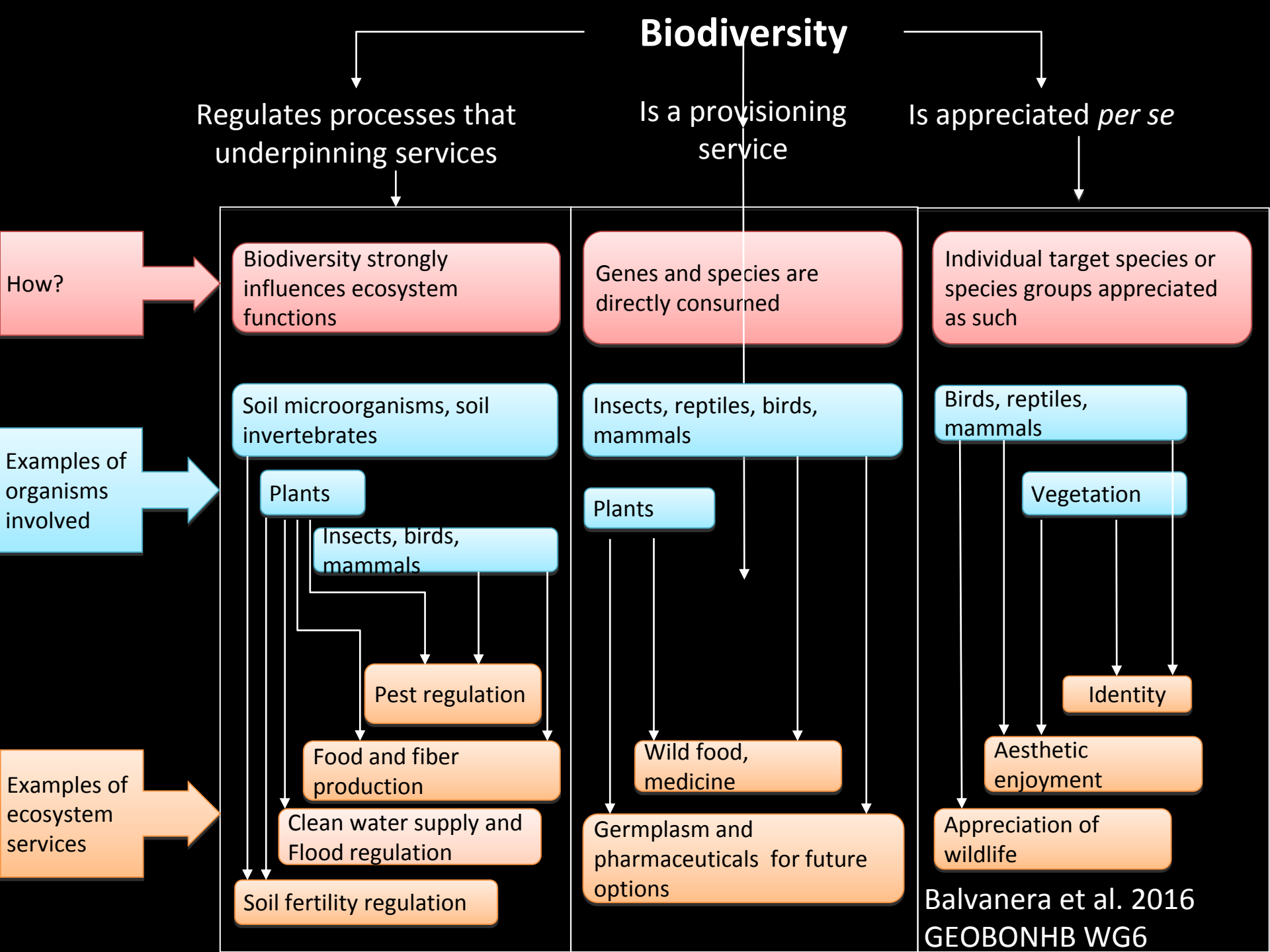
The world's population is expected to grow to 9.6 billion by 2050, requiring an estimated 70–100% increase in food production.

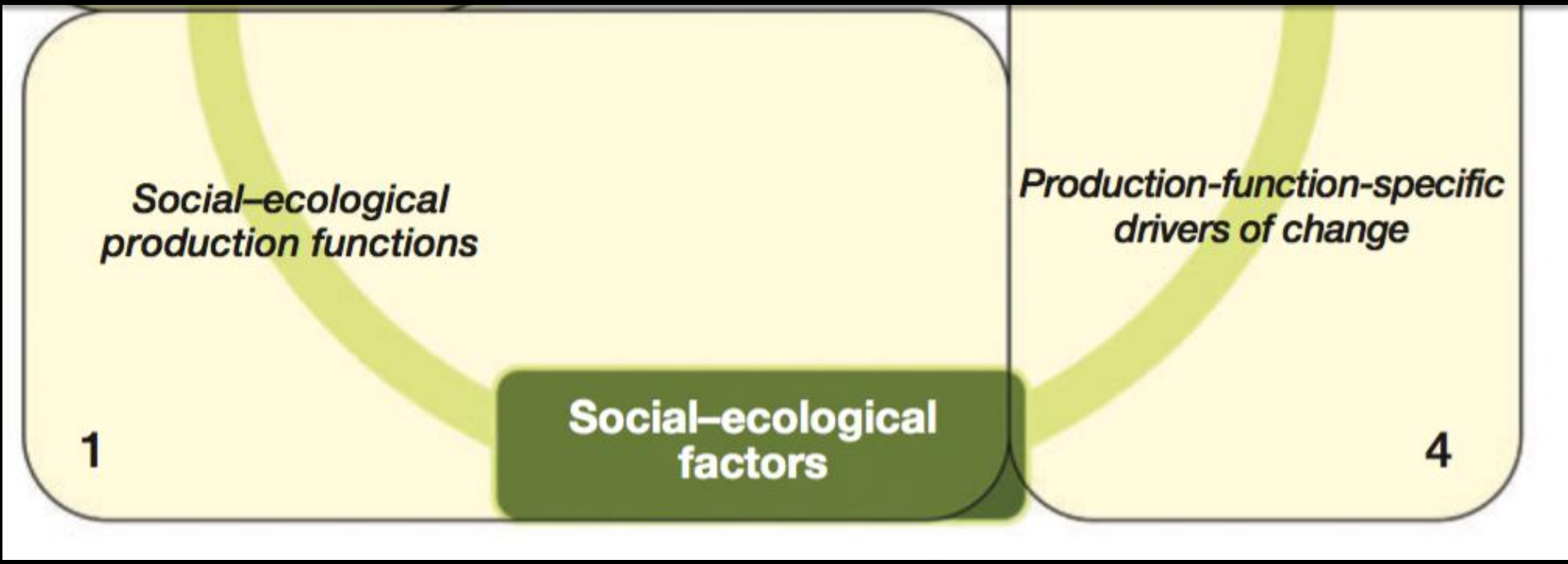
But agricultural activities are affecting ecosystems, and the benefits they provide for people, more than ever before. There is an urgent need for better data and risk management tools that can guide decisions about agricultural development — and ensure that this development protects both people and nature.

What is the context?



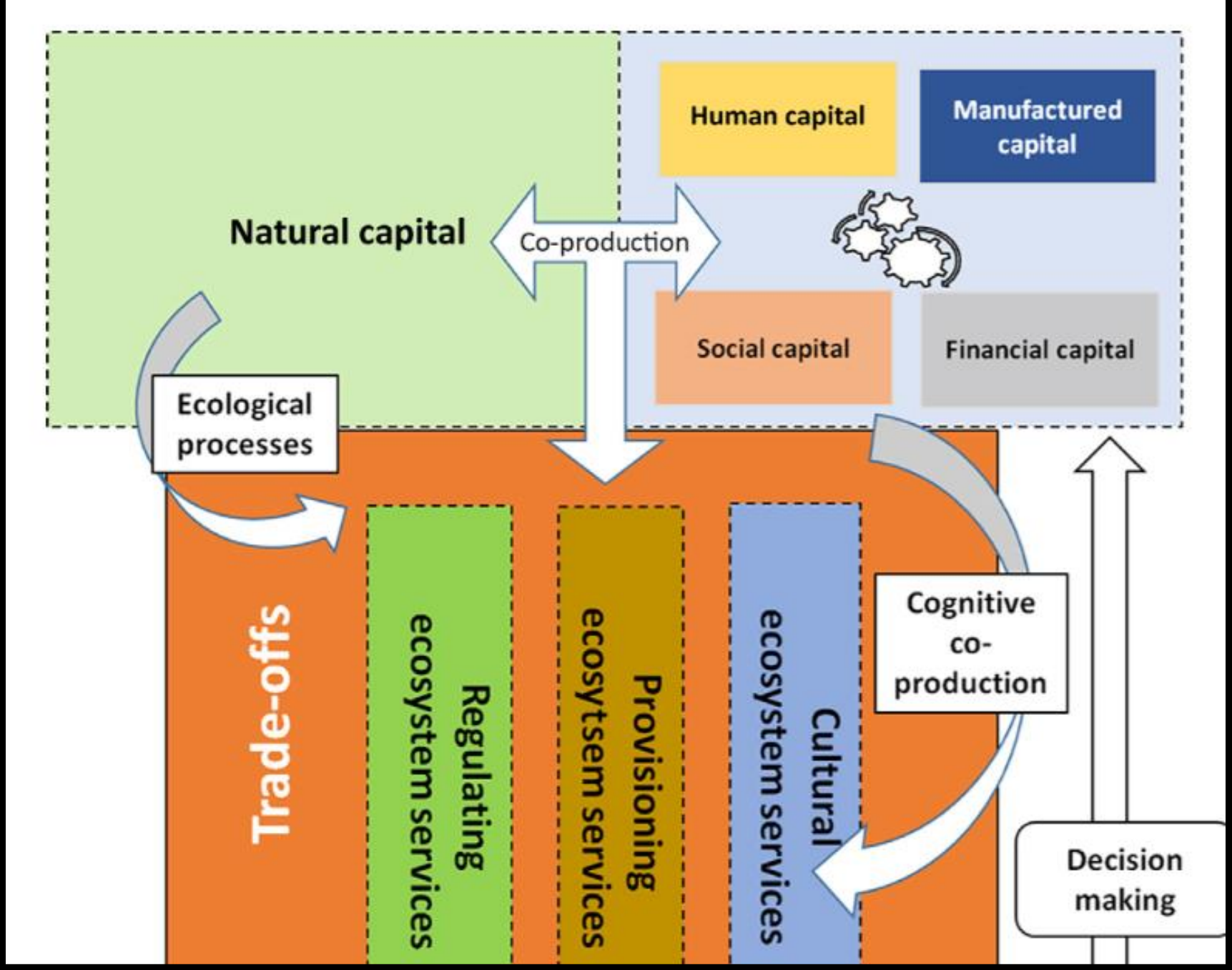
Scholes et al. 2014 COSUST


Biodiversity
Regulates processes that underpinning services
Is a provisioning service
Is appreciated *per se*
How?
Examples of organisms involved
Examples of ecosystem services
Biodiversity strongly influences ecosystem functions
Genes and species are directly consurned
Individual target species or species groups appreciated as such
Soil microorganisms, soil invertebrates
Insects, reptiles, birds, mammals
Birds, reptiles, mammals
Plants
Insects, birds, mammals
Plants
Vegetation
Pest regulation
Identity
Food and fiber production
Wild food, medicine
Aesthetic enjoyment
Clean water supply and Flood regulation
Germplasm and pharmaceuticals for future options
Appreciation of wildlife
Soil fertility regulation
Balvanera et al. 2016
GEOBONHB WG6



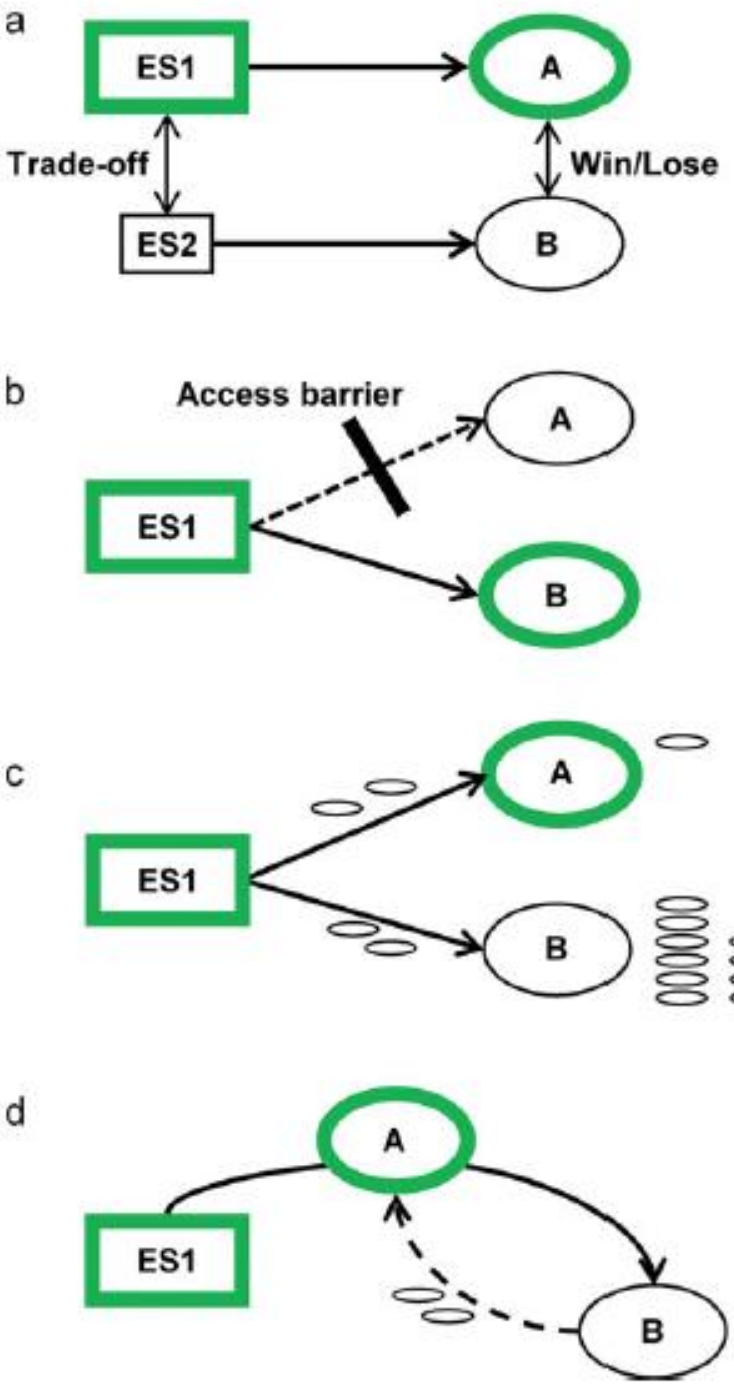
Reyers et al. 2013 Frontiers in Ecology

How are ecosystem services being co-produced?



Palomo et al 2015Adv Ecol Res

Who is involved?



Win/lose

Access

Decisions

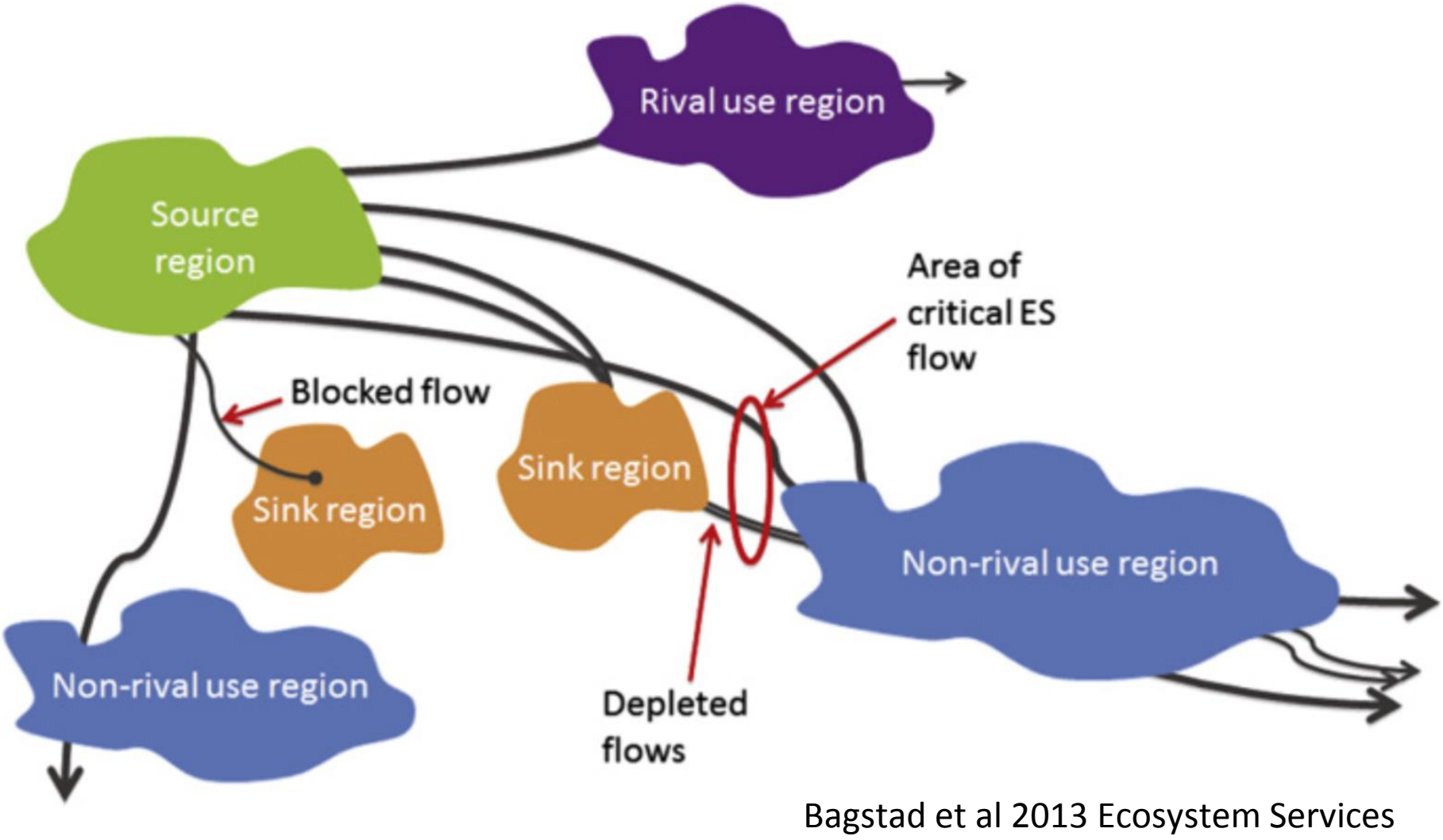
Benefit

Heard

Compensate

Daw et al 2012 Env Conserv

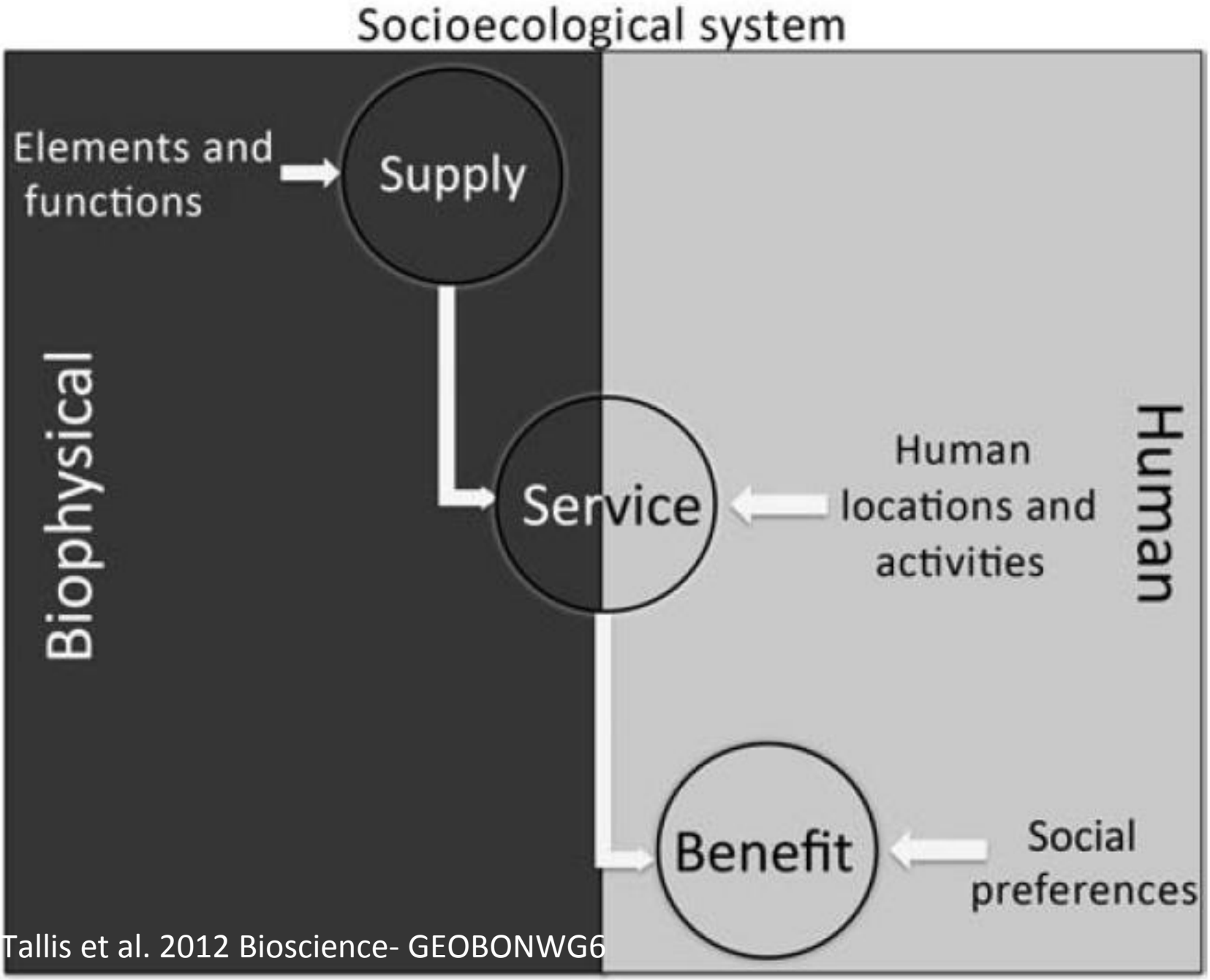
Where?



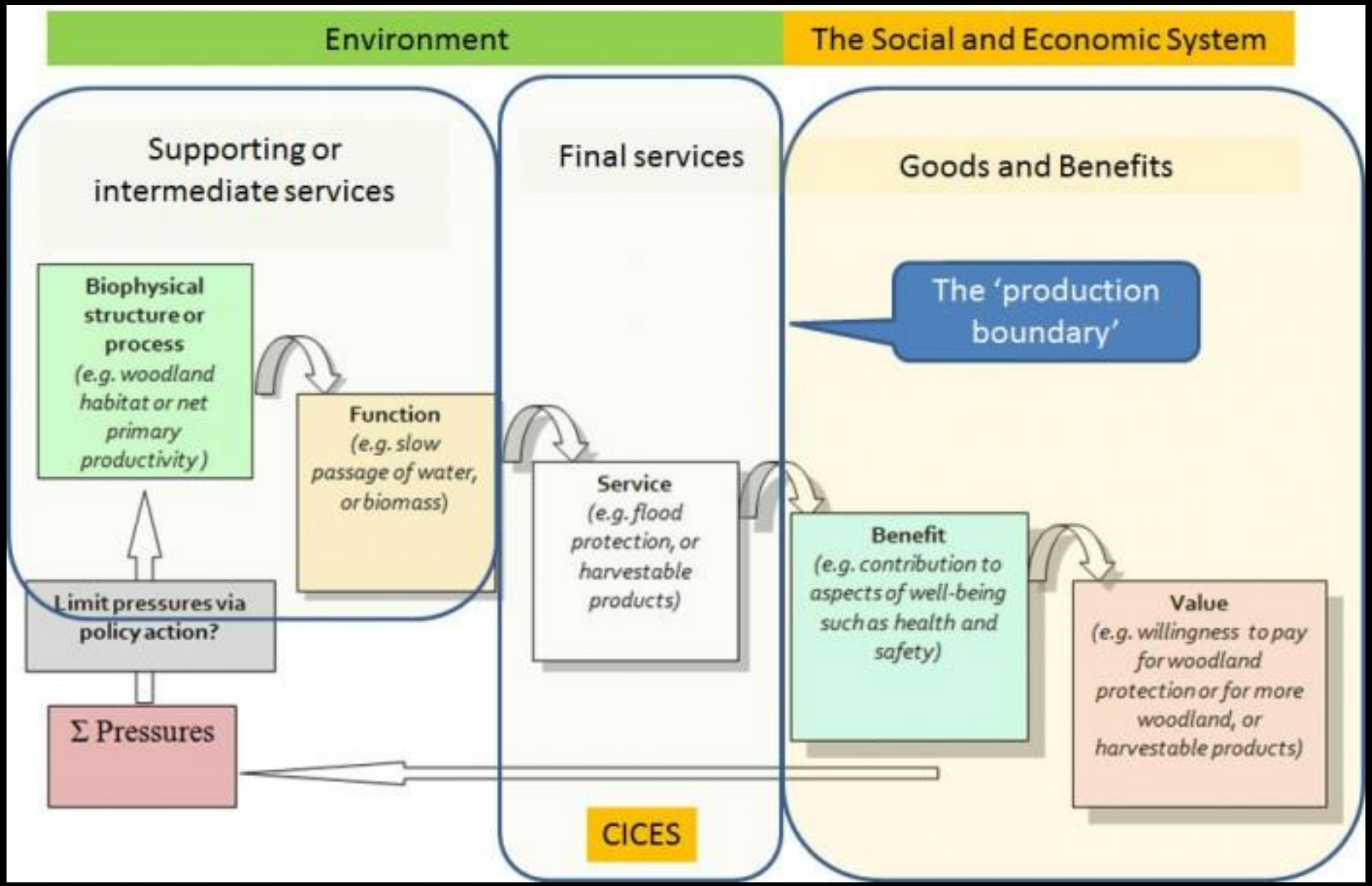
Bagstad et al 2013 Ecosystem Services

What should we monitor?

Dimensions of
ecosystem service change



Tallis et al. 2012 Bioscience- GEOBONWG6



CICES.eu Potschin and Haines-Young, 2011

Which services?

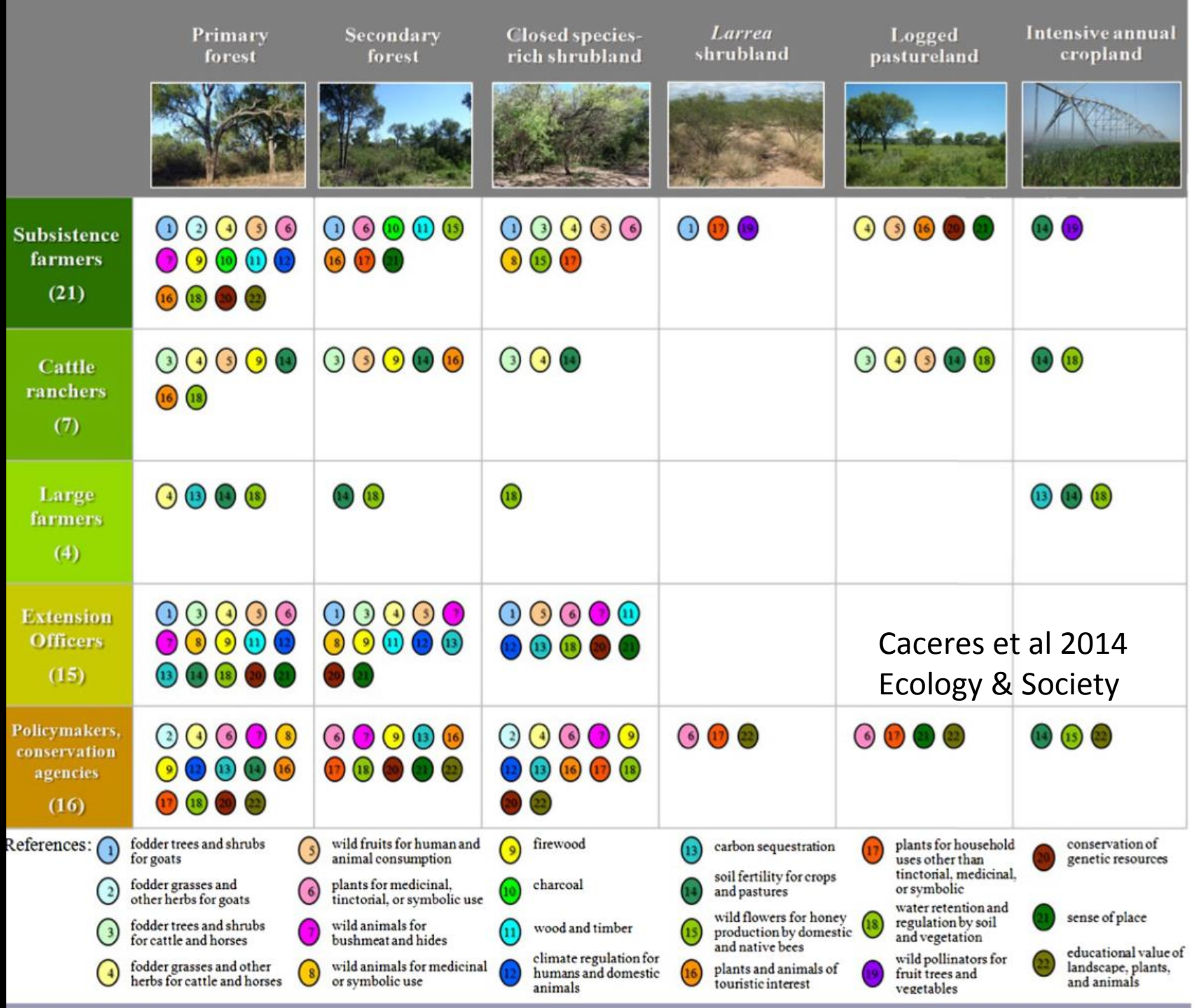
Section	Division	Group	Class	MA	TEEB
Provisioning	Nutrition	Biomass	Cultivated crops	Food	Food
			Reared animals and their outputs		
			Wild plants, algae and their outputs		
			Wild animals and their outputs		
			Plants and algae from in-situ aquaculture		
			Animals from in-situ aquaculture		
		Water	Surface water for drinking	Water	Water
			Ground water for drinking		
	Materials	Biomass	Fibres and other materials from plants, algae and animals for direct use or processing	Fibre, Timber, Ornamental, Biochemical	Raw materials, medicinal resources
			Materials from plants, algae and animals for agricultural use		
			Genetic materials from all biota	Genetic materials	Genetic materials
		Water	Surface water for non-drinking purposes	Water	Water
			Ground water for non-drinking purposes		
	Energy	Biomass-based energy sources	Plant-based resources	Fibre	Fuels and fibres
			Animal-based resources		
		Mechanical energy	Animal-based energy		
Regulation & Maintenance	Mediation of waste, toxics and other nuisances	Mediation by biota	Bio-remediation by micro-organisms, algae, plants, and animals	Water purification and water treatment, air quality regulation	Waste treatment (water purification), air quality regulation
			Filtration/sequestration/storage/accumulation by micro-organisms, algae, plants, and animals		
		Mediation by ecosystems	Filtration/sequestration/storage/accumulation by ecosystems		
			Dilution by atmosphere, freshwater and marine ecosystems		
			Mediation of smell/noise/visual impacts		
	Mediation of flows	Mass flows	Mass stabilisation and control of erosion rates	Erosion regulation	Erosion prevention
			Buffering and attenuation of mass flows		
		Liquid flows	Hydrological cycle and water flow maintenance	Water regulation	Regulation of water flows, regulation of extreme events
			Flood protection	Natural hazard regulation	
		Gaseous / air flows	Storm protection		
			Ventilation and transpiration		
	Maintenance of physical, chemical, biological conditions	Lifecycle maintenance, habitat and gene pool protection	Pollination and seed dispersal	Pollination	Pollination
			Maintaining nursery populations and habitats		
		Pest and disease control	Pest control	Pest regulation	Biological control
			Disease control	Disease regulation	
		Soil formation and composition	Weathering processes	Soil formation (supporting services)	Maintenance of soil fertility
			Decomposition and fixing processes		
		Water conditions	Chemical condition of freshwaters	Water regulation	Water
			Chemical condition of salt waters		
		Atmospheric composition and climate regulation	Global climate regulation by reduction of greenhouse gas concentrations	Atmospheric regulation	Climate regulation
			Micro and regional climate regulation	Air quality regulation	Air quality regulation
Cultural	Physical and intellectual interactions with biota, ecosystems, and land-/seascapes [environmental settings]	Physical and experiential interactions	Experiential use of plants, animals and land-/seascapes in different environmental settings	Recreation and ecotourism	Recreation and tourism
			Physical use of land-/seascapes in different environmental settings		
		Intellectual and representative interactions	Scientific	Knowledge systems and educational values, cultural diversity, aesthetic values	Inspiration for culture, art and design, aesthetic information
			Educational		
			Heritage, cultural		
			Entertainment		
			Aesthetic		
	Spiritual, symbolic and other interactions with biota, ecosystems, and land-/seascapes [environmental settings]	Spiritual and/or emblematic	Symbolic	Spiritual and religious values	Information and cognitive development
			Sacred and/or religious		
		Other cultural outputs	Existence		
			Bequest		

CICES

MA

TEEB

- Universal vs. unique lists?
- Exhaustive vs. Strategic?
- Available info vs. Info needed?



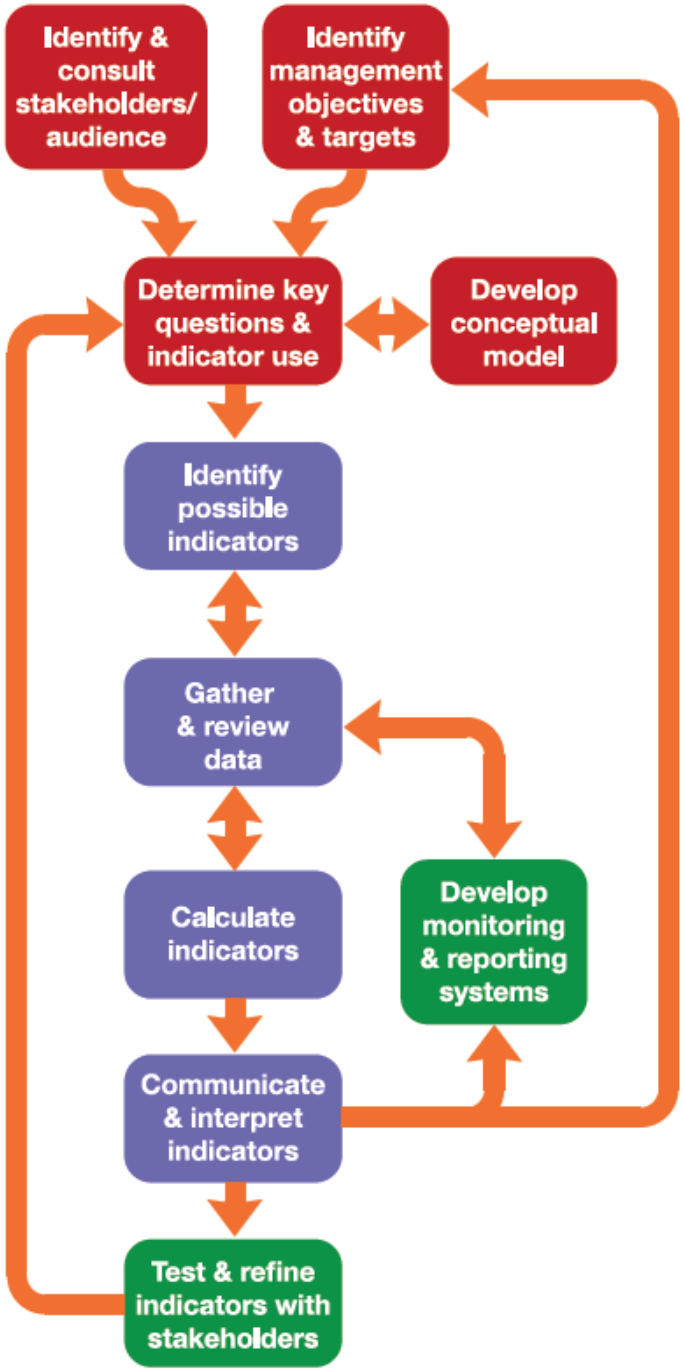
Caceres et al 2014
Ecology & Society

Who will monitor?

- Researchers
  - Individuals
  - Teams
  - Networks
- Governments
  - Local
  - Global
- Practitioners

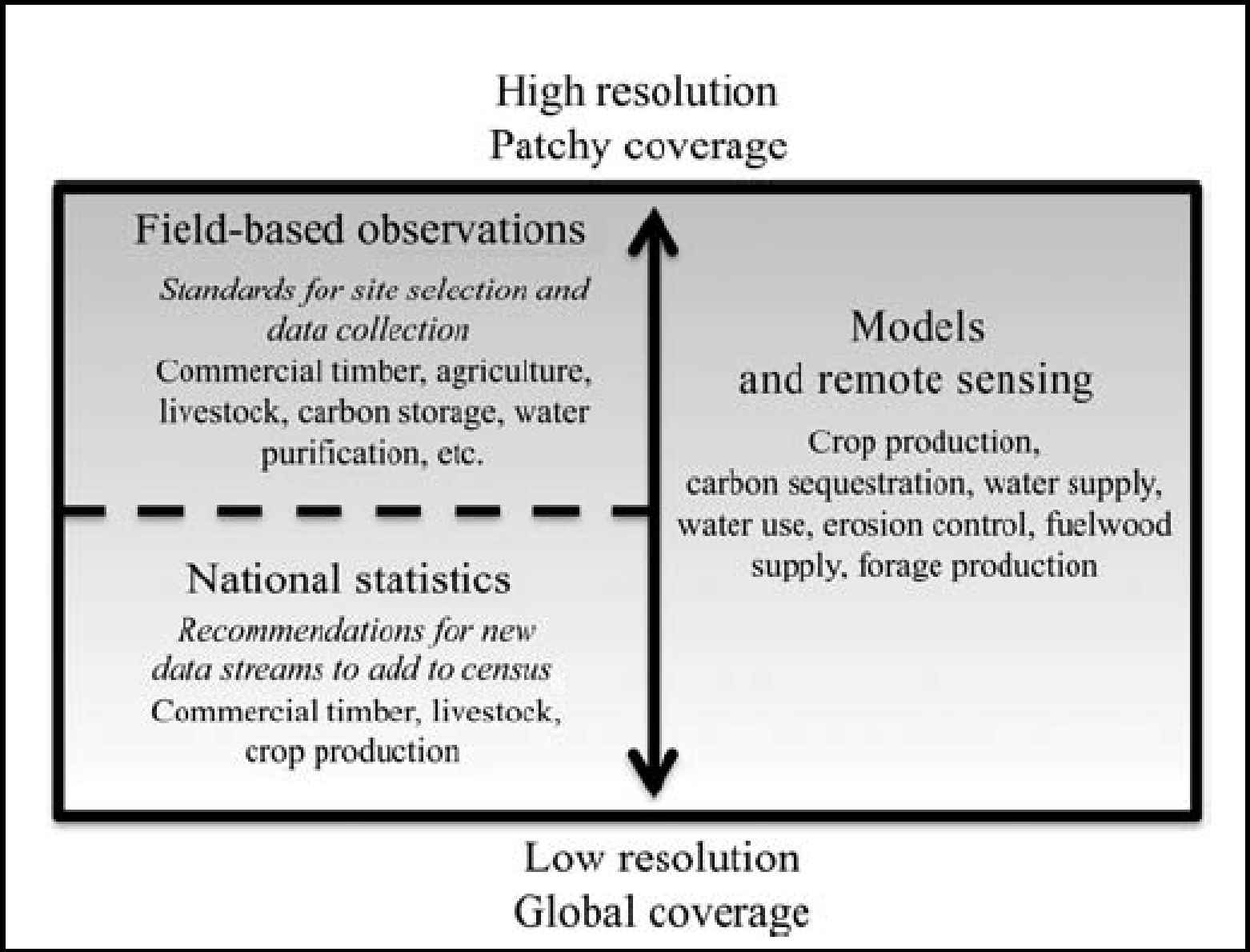
What is to be measured?

Indicators

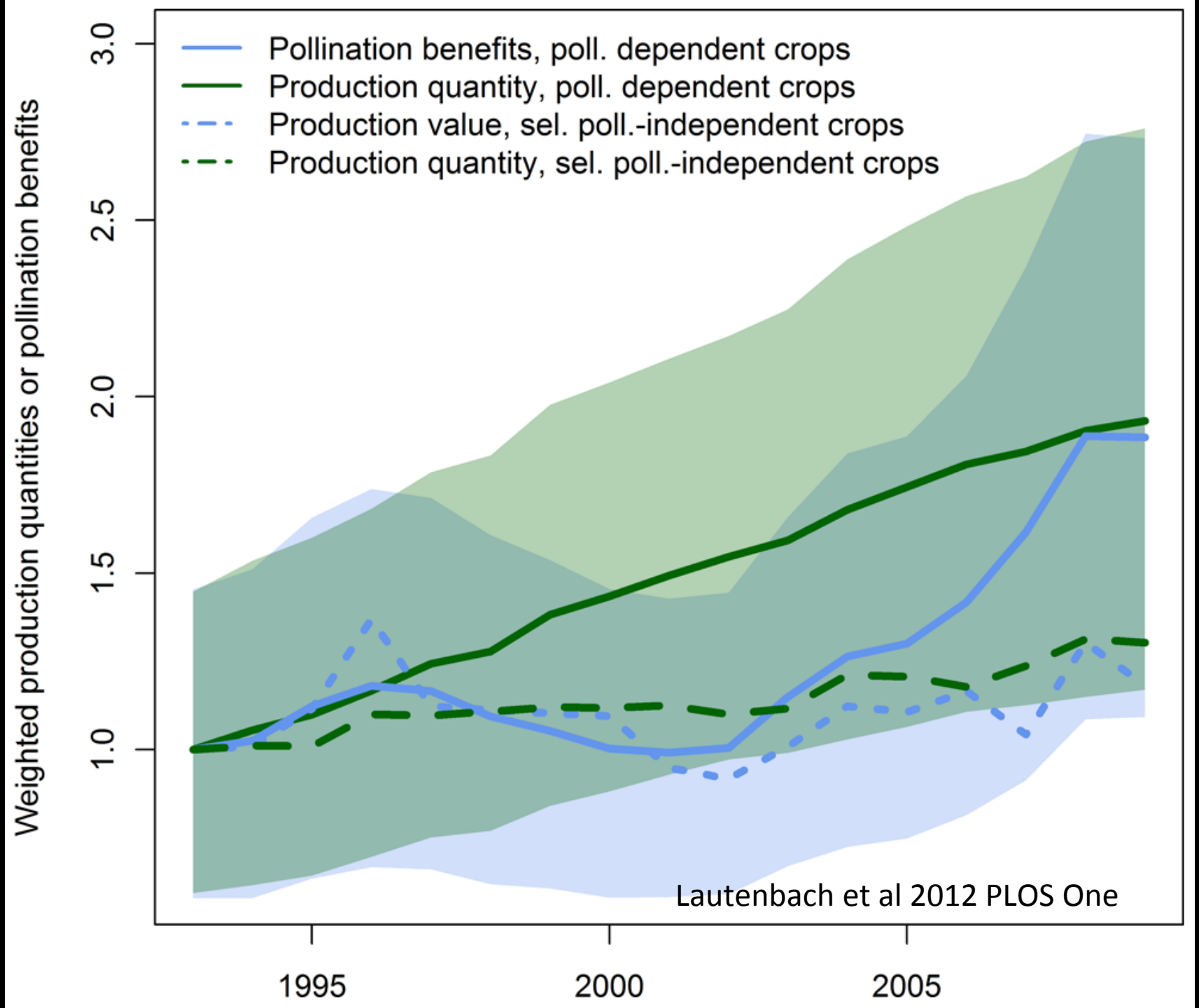


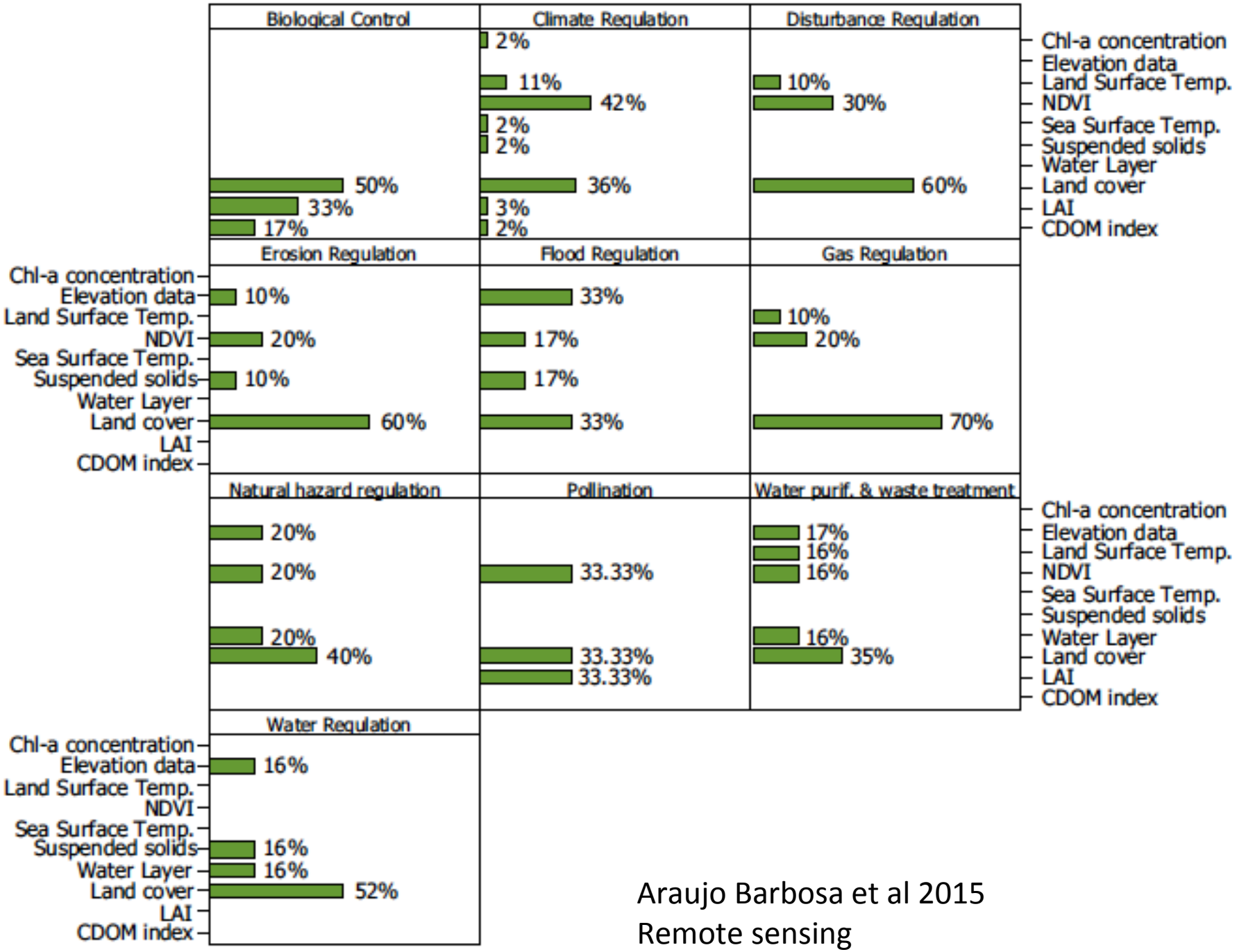
Brown et al 2014
WCMC
WG6

What data sources?



Tallis et al. 2012 Bioscience WG6


Pollination benefits, poll. dependent crops
Production quantity, poll. dependent crops
Production value, sel. poll.-independent crops
Production quantity, sel. poll.-independent crops
Weighted production quantities or pollination benefits
1.0
1.5
2.0
2.5
3.0
1995
2000
2005
Lautenbach et al 2012 PLOS One



Araujo Barbosa et al 2015
Remote sensing

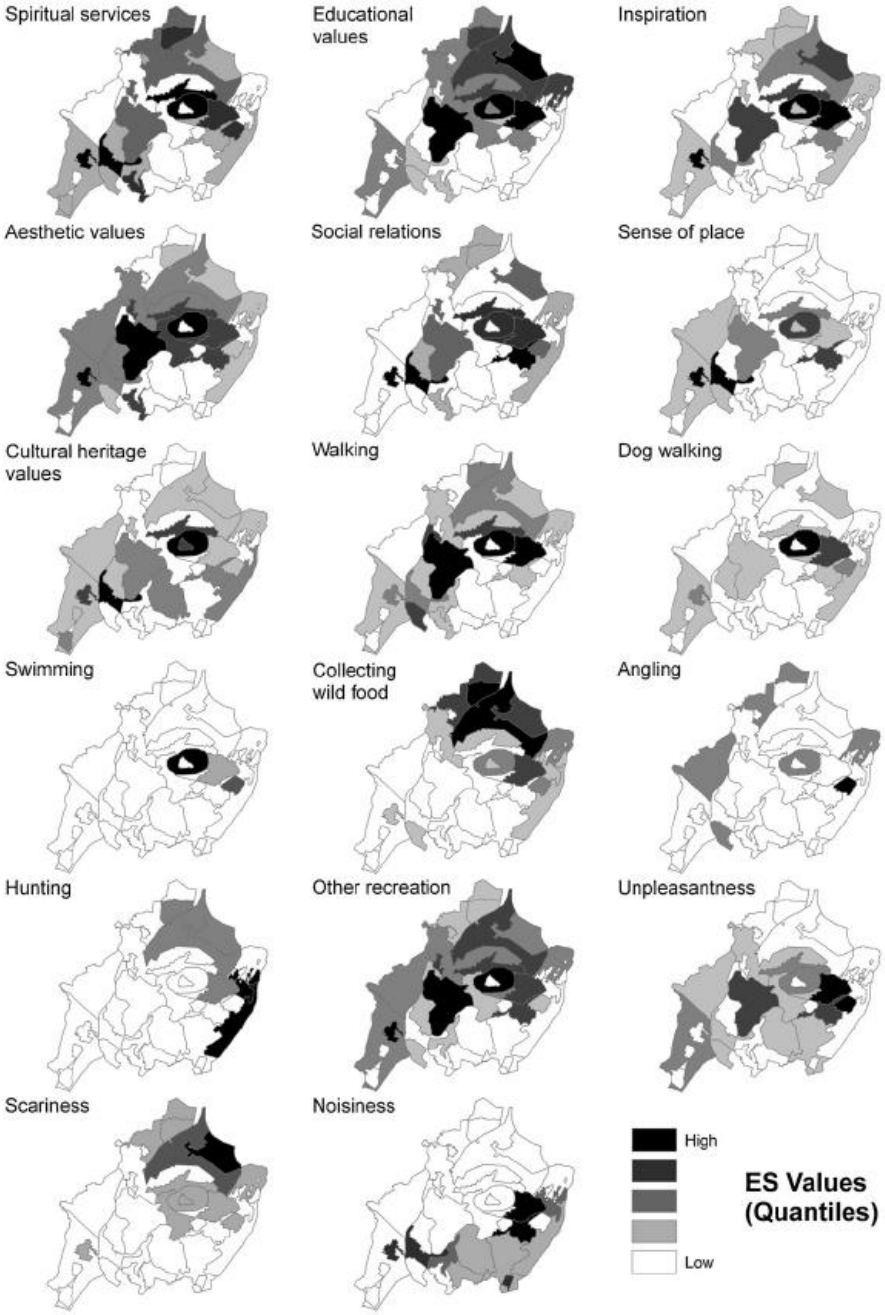


Fig. 4. Maps of individual cultural (dis)services.

Pleininger et al 2013 Land use policy

	National statistics	Remote sensing		Field estimations		Models				
	FAOSTAT WORLD BANK	High resolution	Low resolution	TESSA	Natura	InVEST	LPJmL	ARIES	ESTA	MIMES
Ecosystem service component										
Supply		✓	✓			✓	✓	✓	✓	✓
Delivery	✓	✓		✓	✓	✓		✓		✓
Contribution to well-being				✓	✓					✓
Economic value	✓			✓	✓	✓		✓	✓	✓
Spatial scale										
Local/landscape		✓		✓	✓	✓		✓	✓	✓
National	✓	✓	✓			✓	✓	✓		✓
Global			✓			✓				✓

Balvanera et al. GEOBON Handbook WG6

- KEY QUESTIONS
- KEY CHALLENGES
- THE ROLE FOR GEOBON

Monitoring strategy design

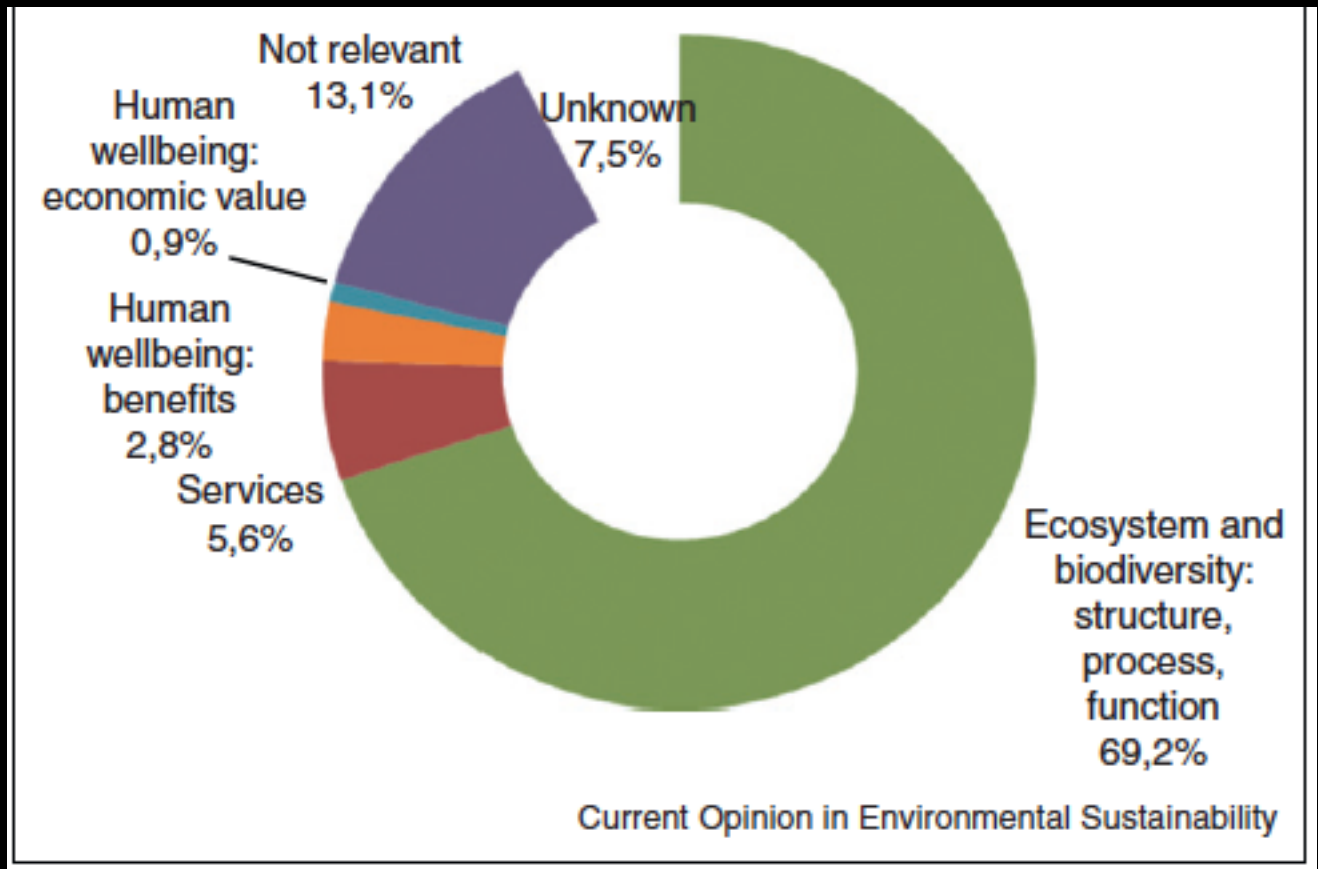
- $
- Spatial design
- Frequency of updates

Standards for data collection

Sampling Frame for the Vital Signs Global Monitoring System

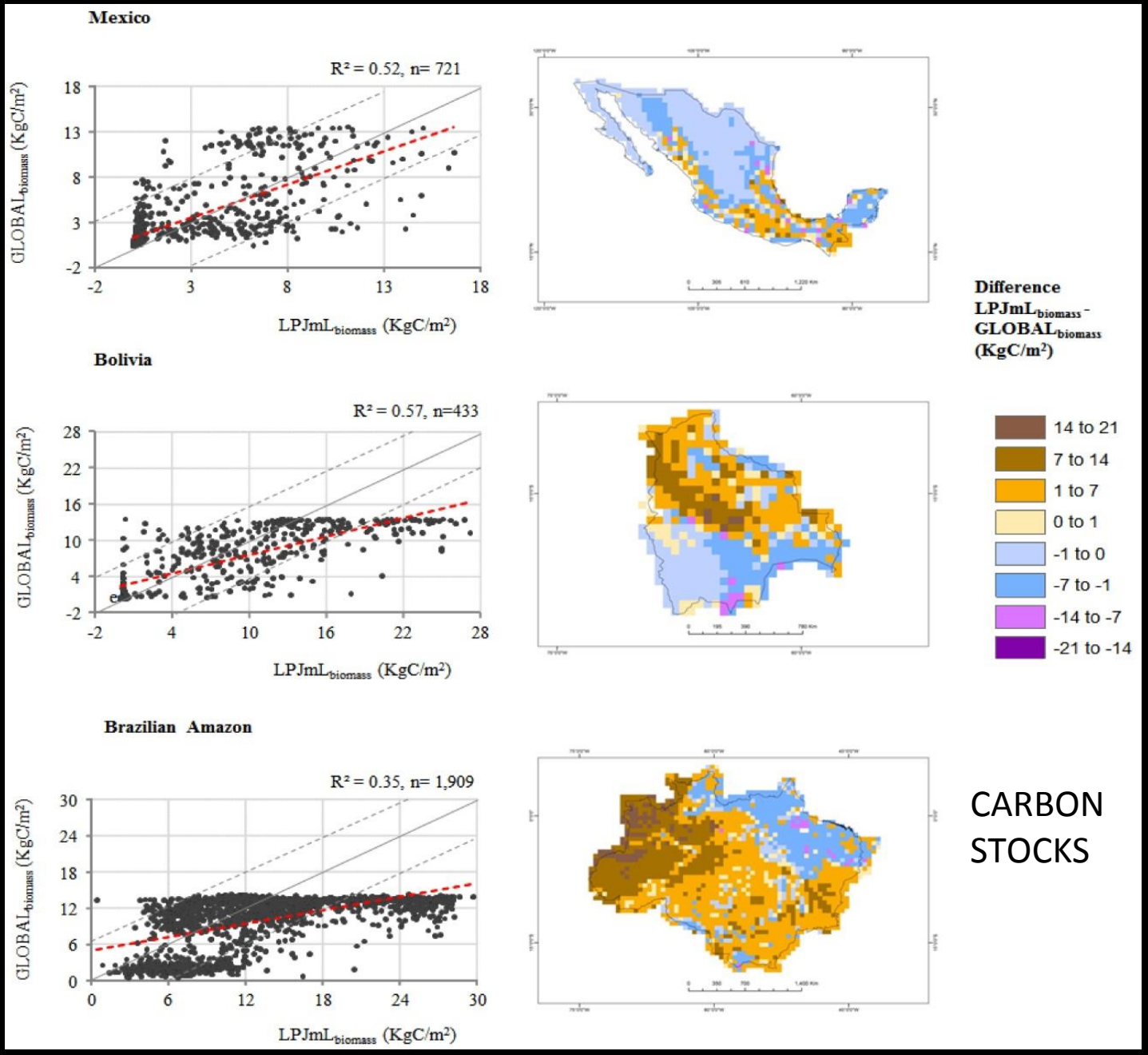
Scholes
Et al
2013

Long-term monitoring



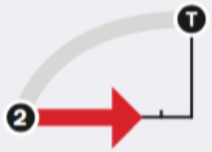
The research focus of the ILTER articles according to the ecosystem service cascade model (see Refs. [9,10]).

Validation



Quijas et al. submitted

Progress towards targets

Element	Current Status	Comments	Confidence
Ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded...		High variation across ecosystems and services. Ecosystems particularly important for services, e.g., wetlands and coral reefs, still in decline	Low
...taking into account the needs of women, indigenous and local communities, and the poor and vulnerable		Poor communities and women especially impacted by continuing loss of ecosystem services	Low

Walpole & Balvanera 2014 GBO4 WG6


SUSTAINABLE DEVELOPMENT GOALS
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

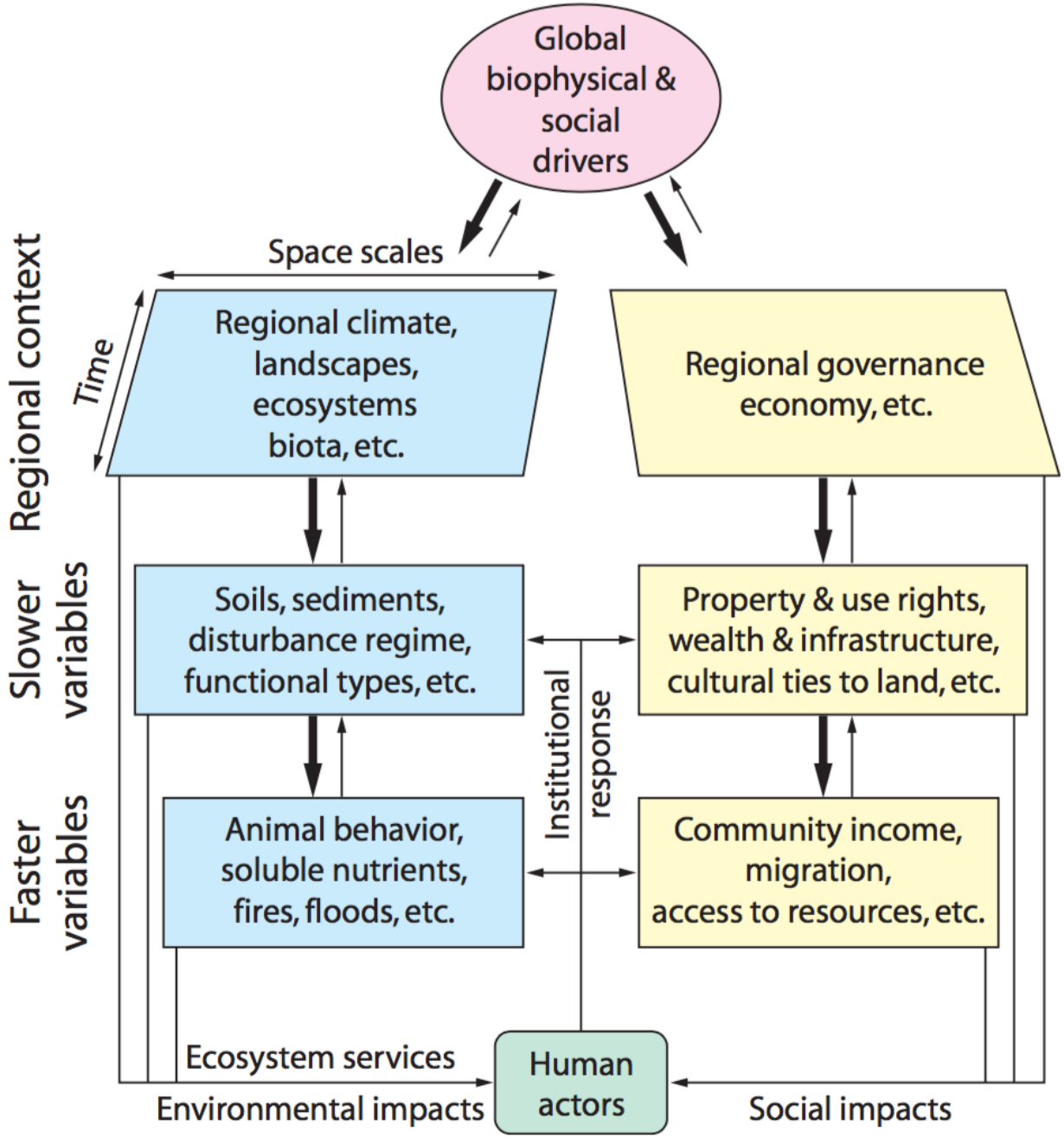
Standards

		Information Base				
User	Use Context	Definition of terms and approach (1)	Methods for evaluating provision of goods and services (2)	Methods for evaluating values (3)	General Standard Setting Entity	Ecosystem Services Standards Entity
Governments	**national income & wealth accounts**				UNSC, GA	
	land use and/or development planning				GA	GA
	environmental impact assessment				IAIA, GA	CBD
	mitigation (environmental offsets)				BBOP, CDM, GA	
	agricultural subsidies				GA, WTO	
	mining subsidies				GA, WTO	
	water pricing				GA, IBNET	
	electricity pricing				GA, CEER, ERRA	EPRI
	property tax				GA, TAF	
	(flood) disaster response				GA	TNC
	risk assessment				ISO	ICES
	fisheries management				GA, UN	ICES
	environmental-economic accounts				UN SC, GA	WAVES
	public lands management				GA	GA
	payments for ecosystem services				GA, UN-REDD	FE
Corporations	**supply chain analysis**				ISO, CSCMP	NVI
	risk assessment				ISO	NCD
	corporate accounting				IASB, GA	NCC, NCD
	corporate sustainability reporting				GRI	SASB
	life-cycle assessment				ISO, LCI	LCI
	product certification				ISO	RA

Polasky et al 2015 PNAS

Resilience
Sustainability

Burkhad et al. 2012 Ecol Ind



Carpenter et al 2009 PNAS

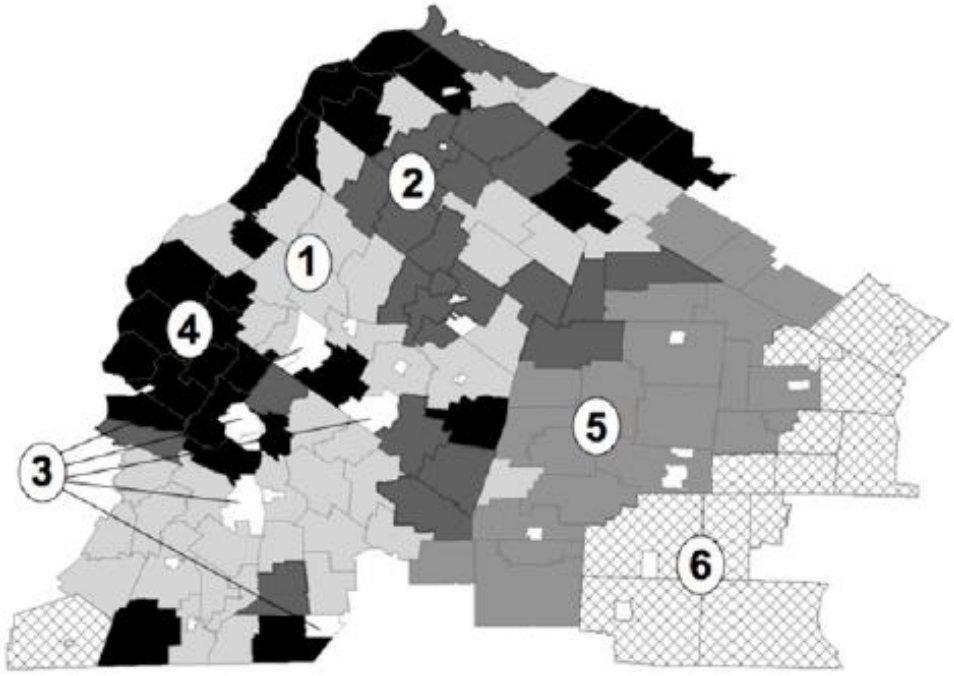
Principles for Building Resilience

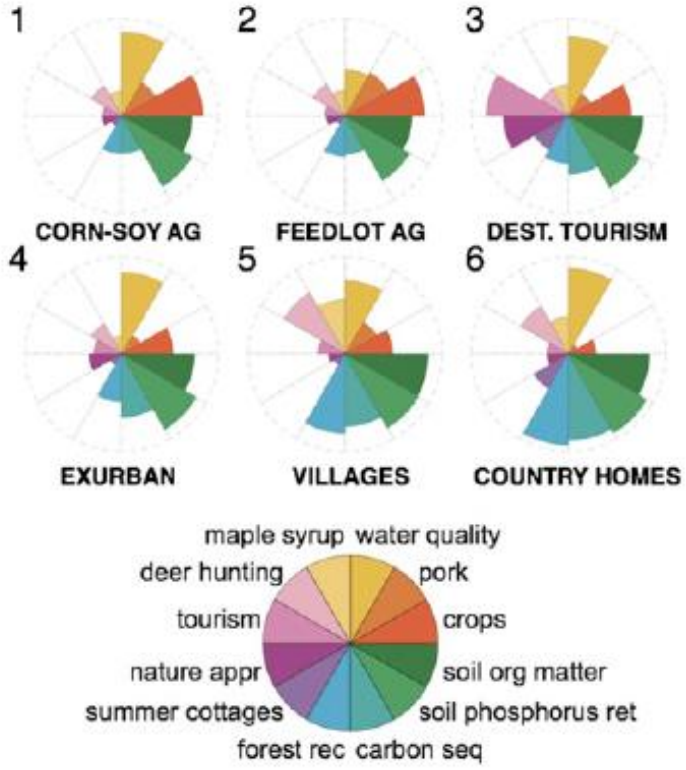
Sustaining Ecosystem Services in Social–Ecological Systems

Edited by
Reinette Biggs, Maja Schlüter
and Michael L. Schoon

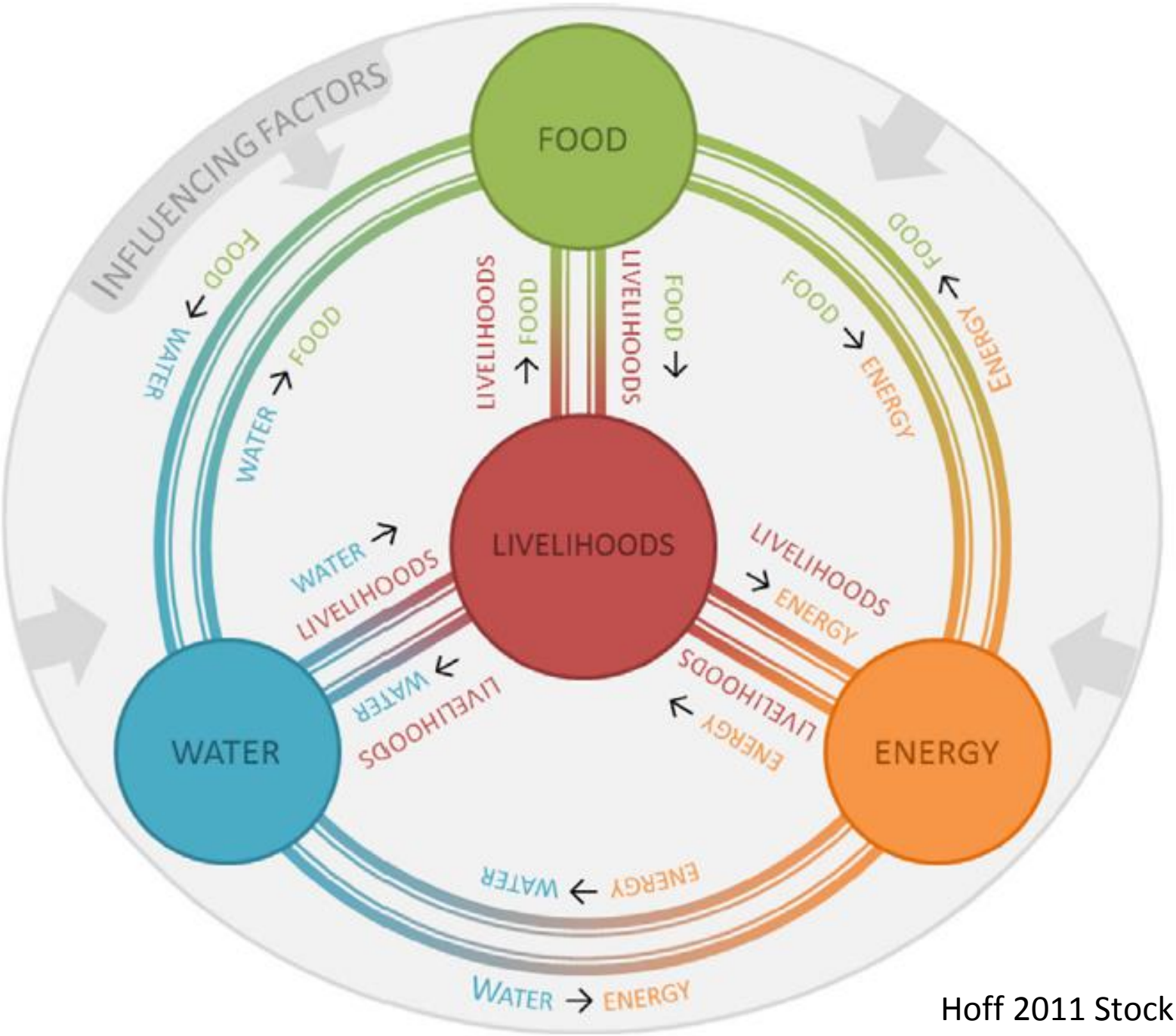
Integration

Bundles of ecosystem services



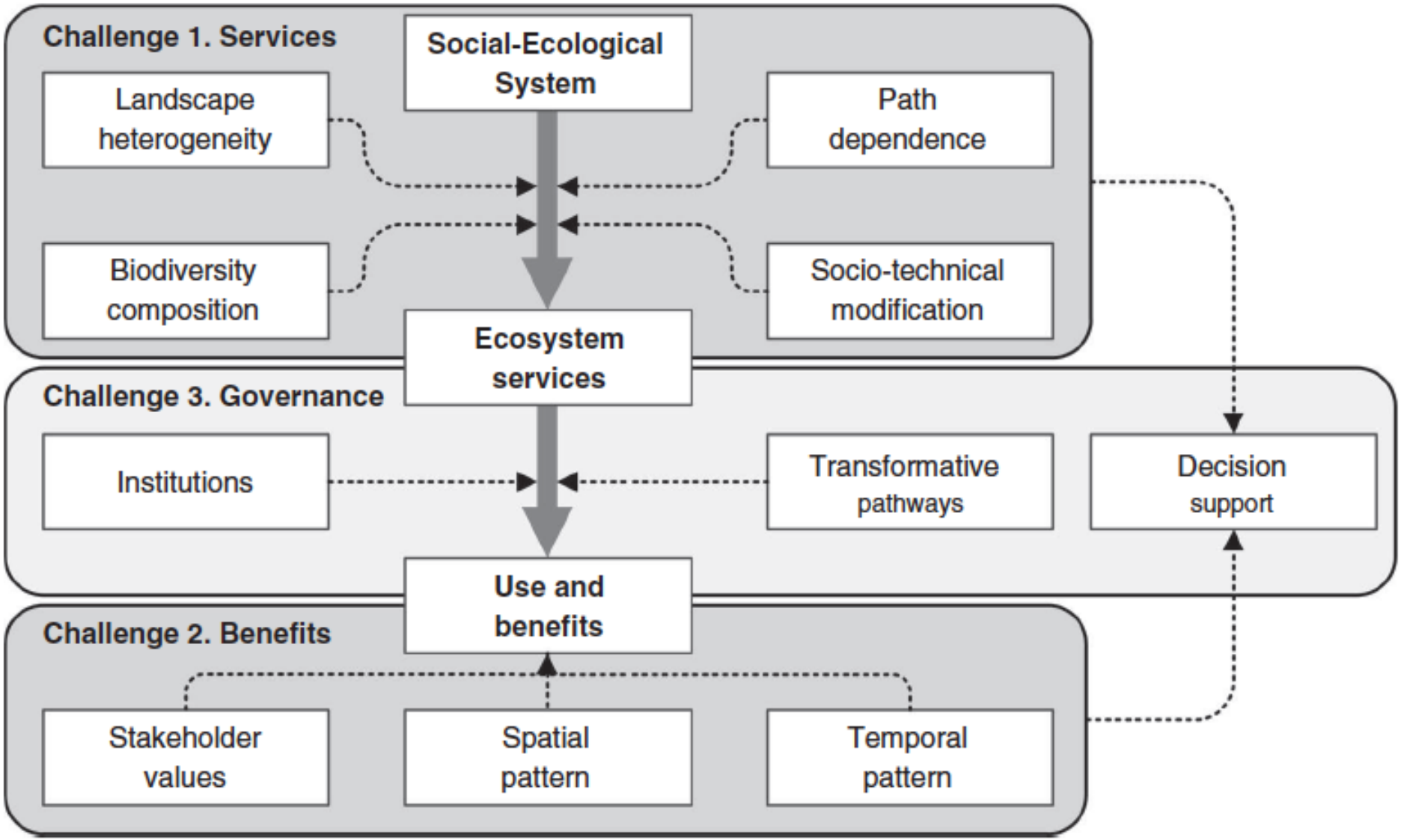


Raudsepp-Hearne et al 2010 PNAS



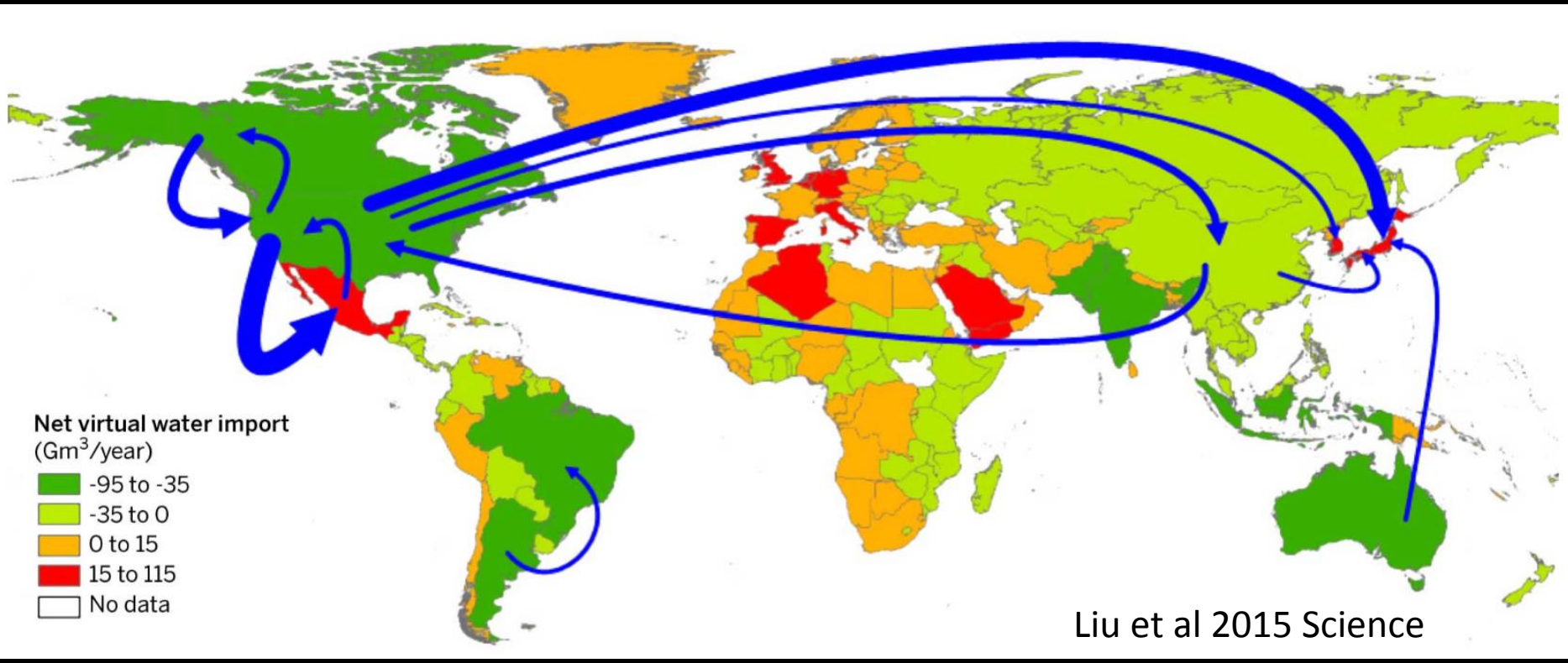
Hoff 2011 Stock Inst Env

Conceptual understandings



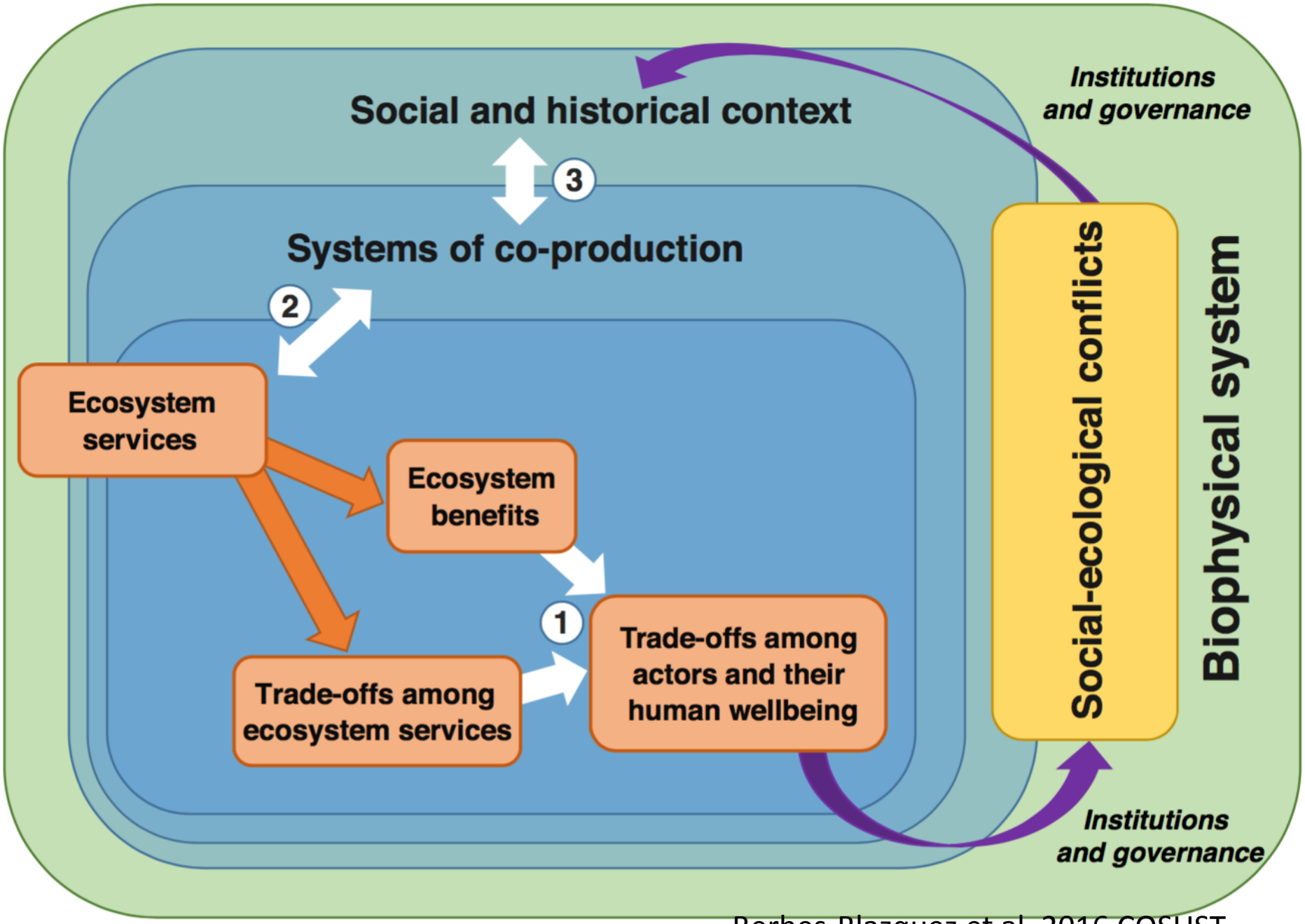
Bennett et al. 2015 COSUST

Telecoupling



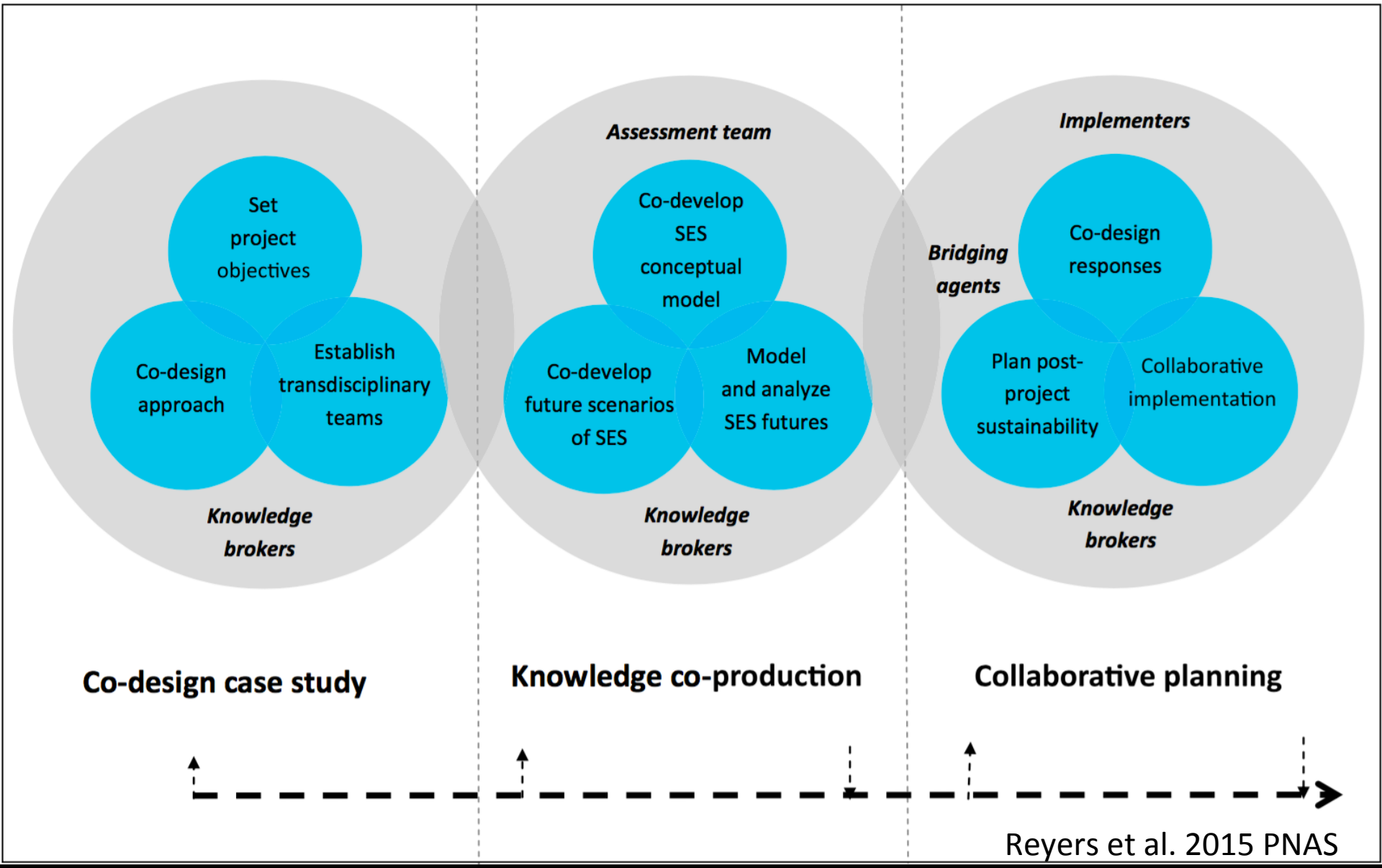
Liu et al 2015 Science

Power, equity and justice



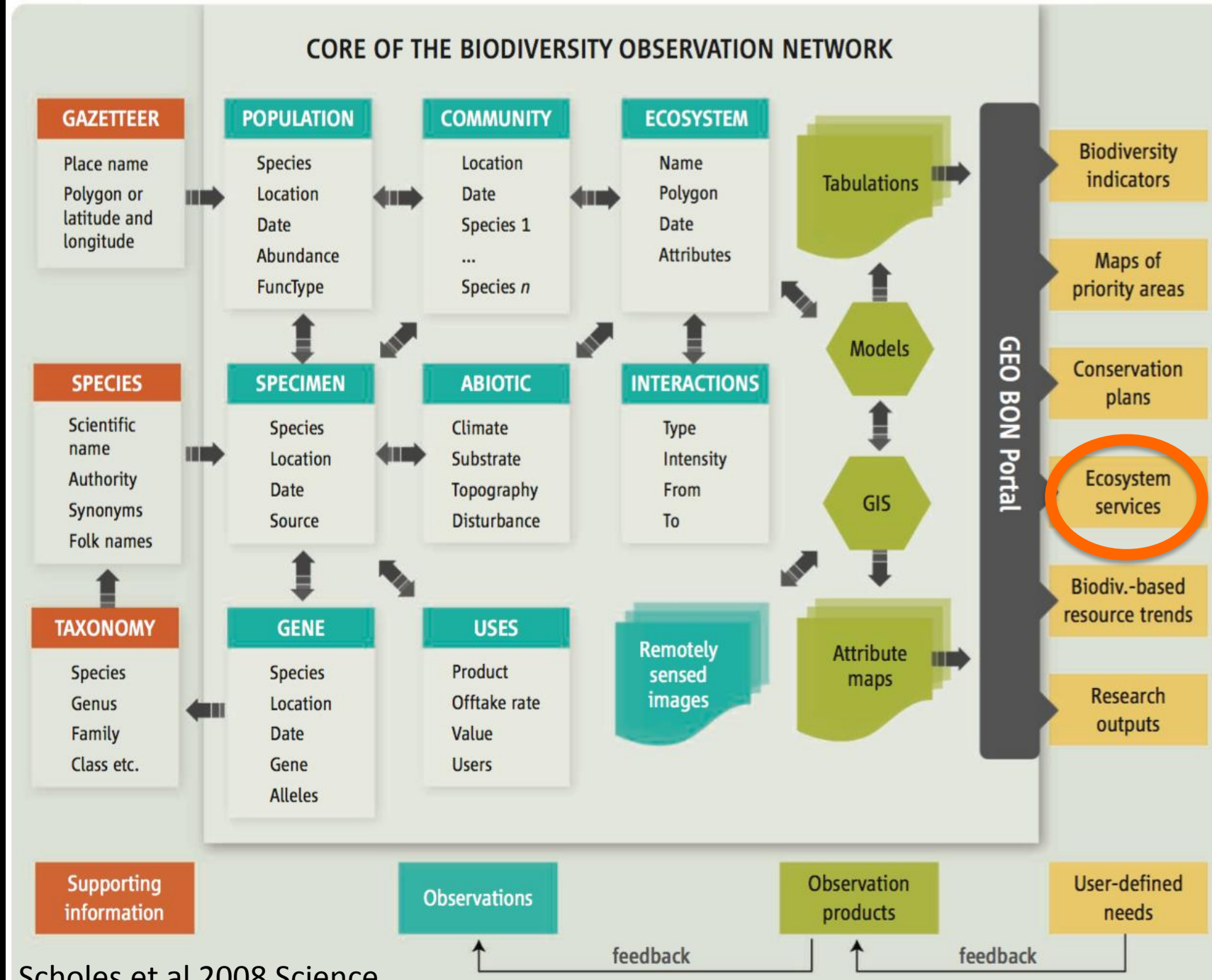
Berbes-Blazquez et al. 2016 COSUST

Strengthening the science-policy interphase



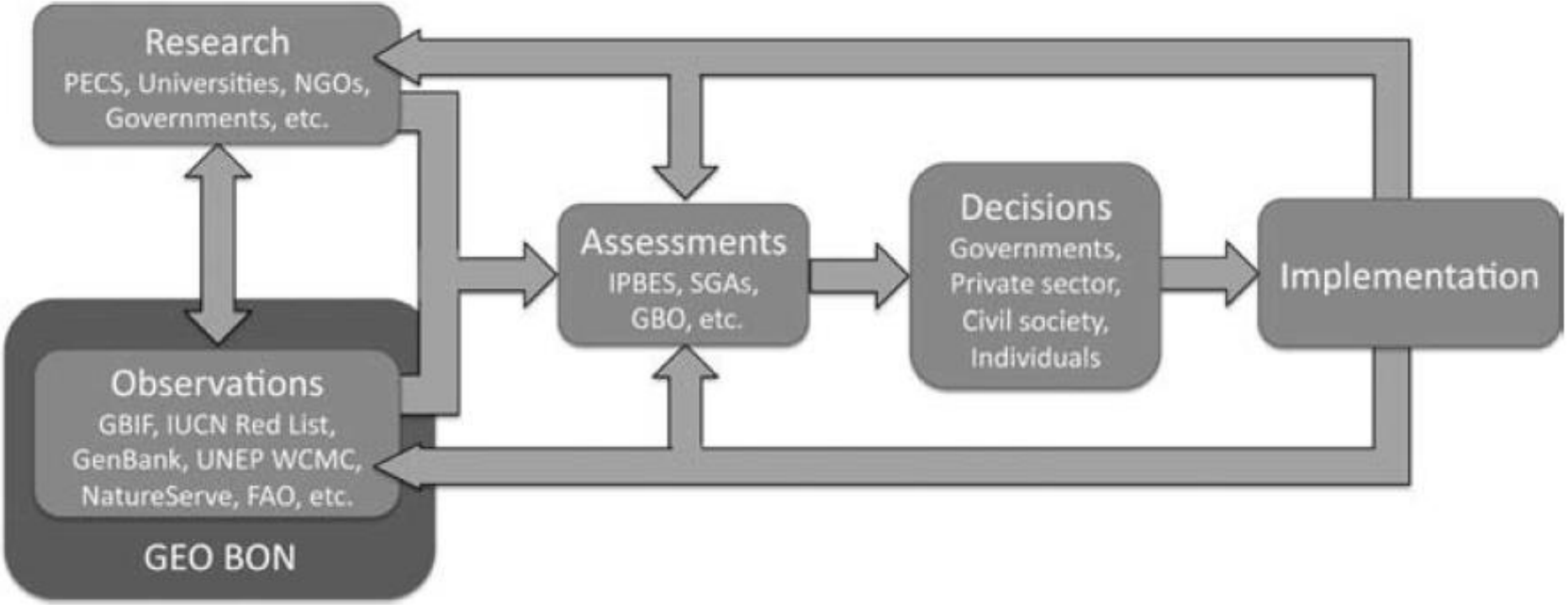
Reyers et al. 2015 PNAS

- KEY QUESTIONS
- KEY CHALLENGES
- THE ROLE FOR GEOBON



Scholes et al 2008 Science

Observations

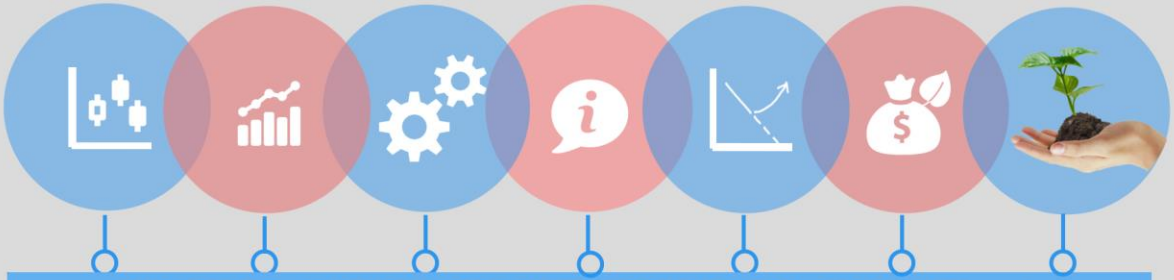


Tallis et al. 2012 Bioscience WG6

Fostering accessibility to tools and data

BON-in-a-Box

ToolKit for MAPPING and MONITORING BioDiversity and EcoSystem SERVICES



ENHANCED, HARMONISED, iNTEROPERABLE BioDIVERSITY and EcoSYSTEM OBSERVATIONS

GLOBAL SCALE

REGIONAL

NATIONAL

Monitoring Methods

Mapping Software

Data Management

Models

Field Methods 4 Protocols

NEW

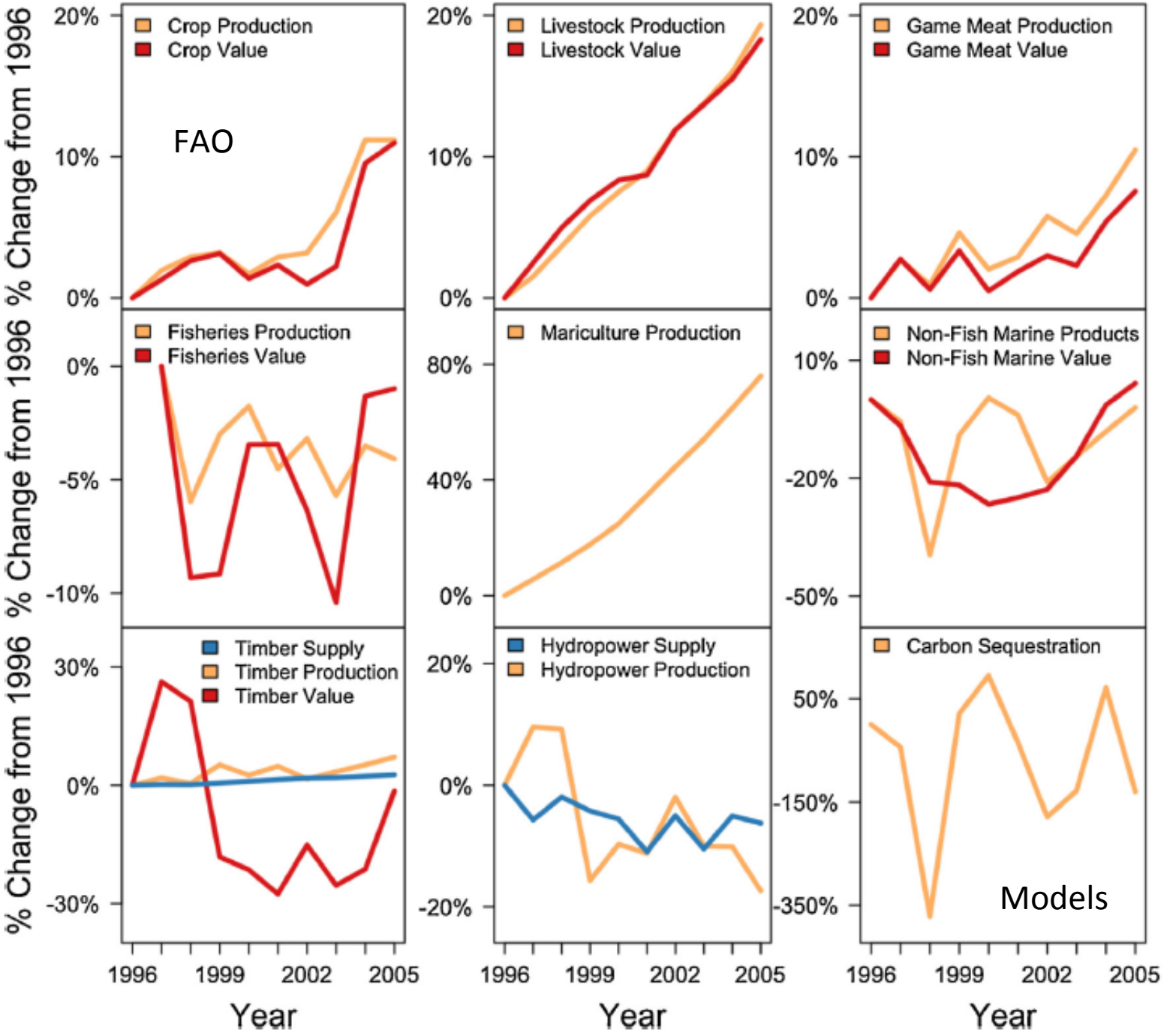
Essential Ecosystem Services Variables

Essential Biodiversity Variables (EBV)

"A Digital, Customized, Smart & Advanced Toolkit for Biodiverity and Ecosystem Observation"

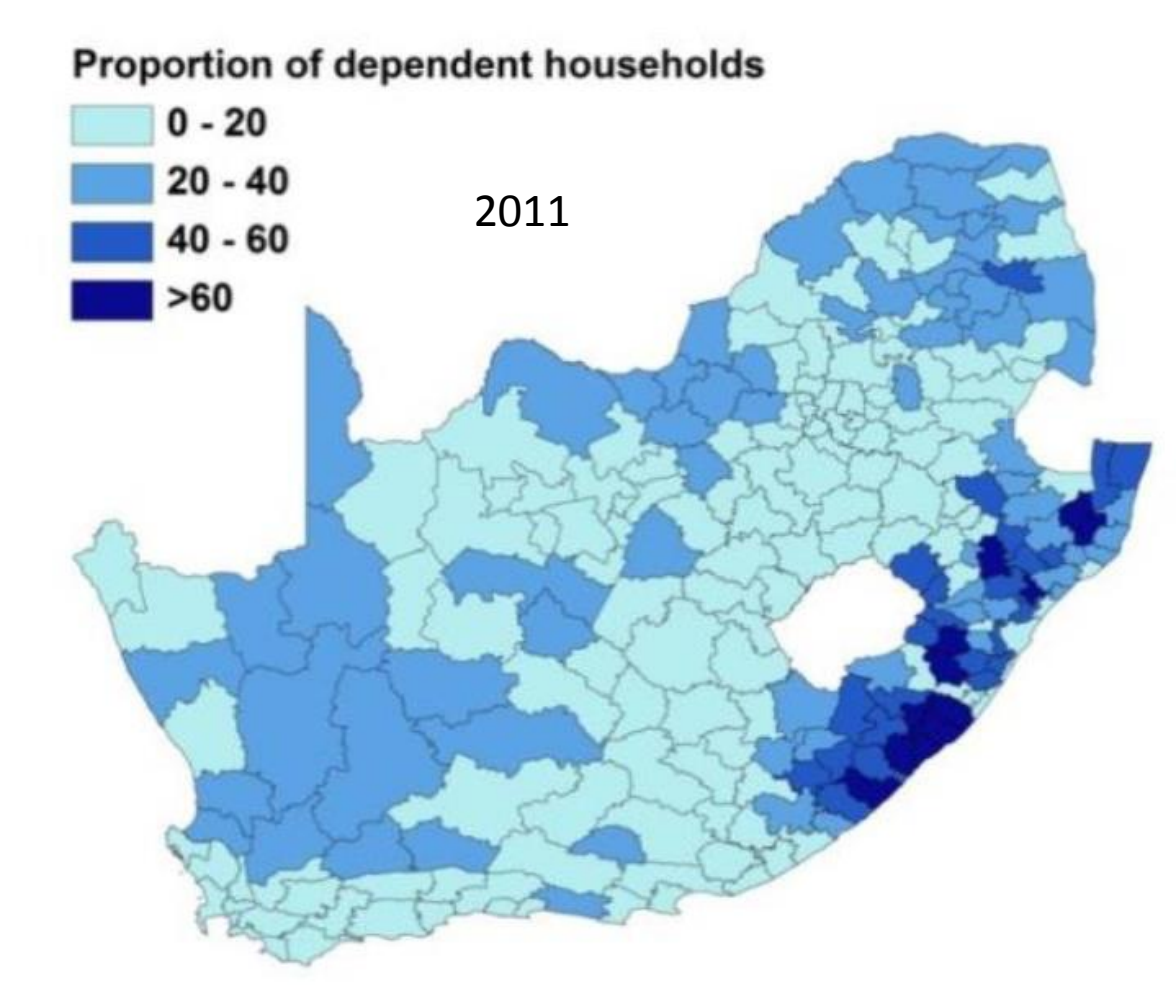
Urbina, Egoh, Londono Gill et al In prep WG6

Proofs of concept



Karp et al
2015
GEC
WG6

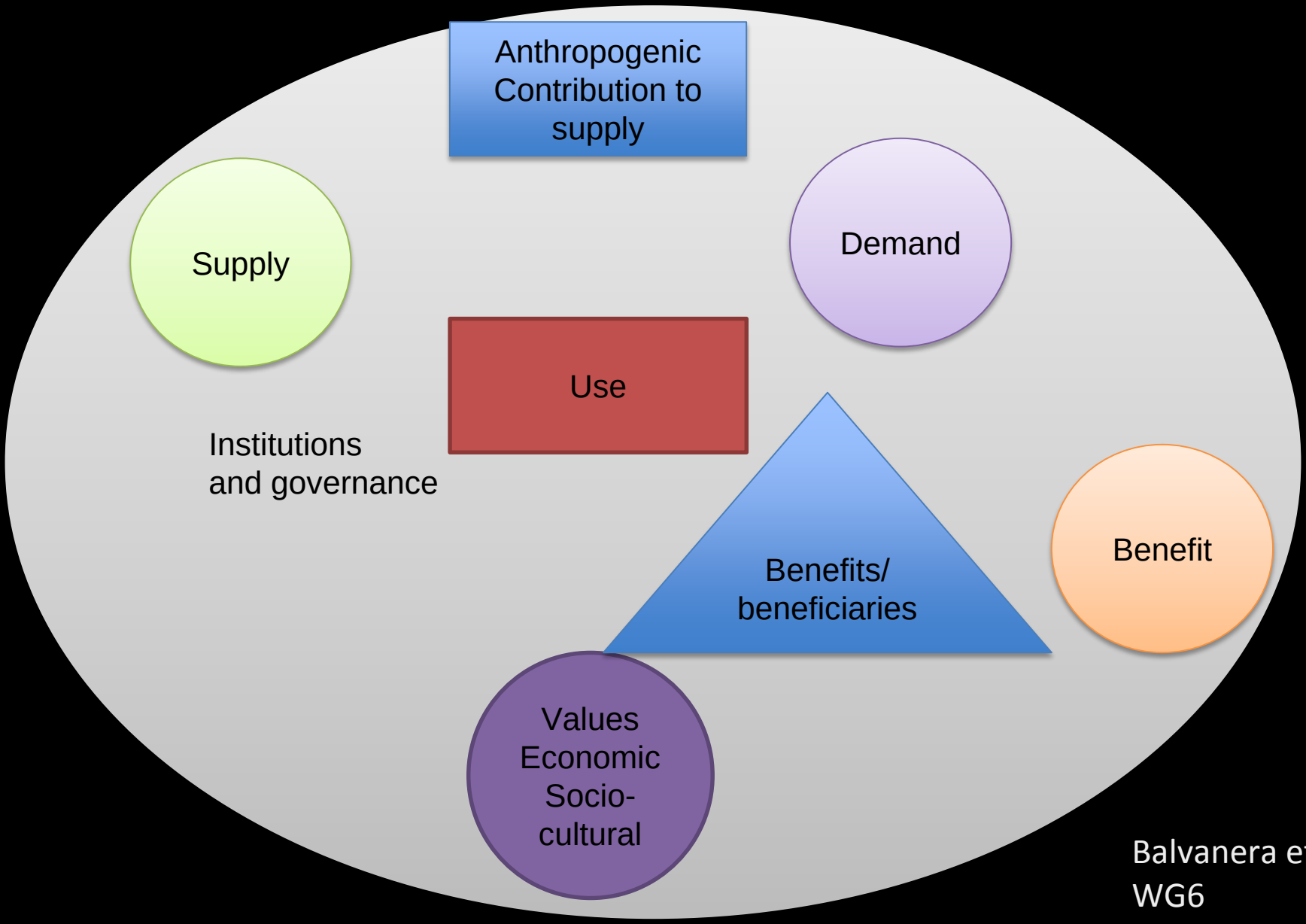
Demand: access to sources of water for domestic uses



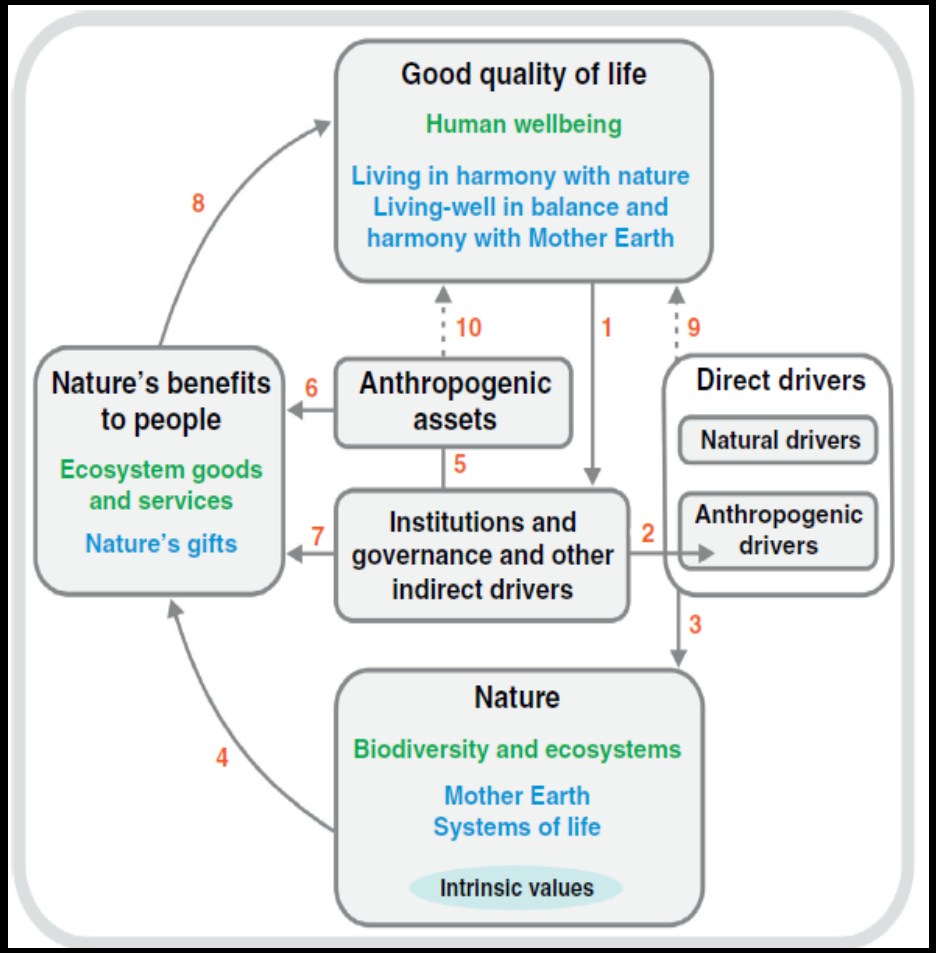
Reyers et al. 2014 CSIRO

Guidance

Essential ecosystem Service Variables

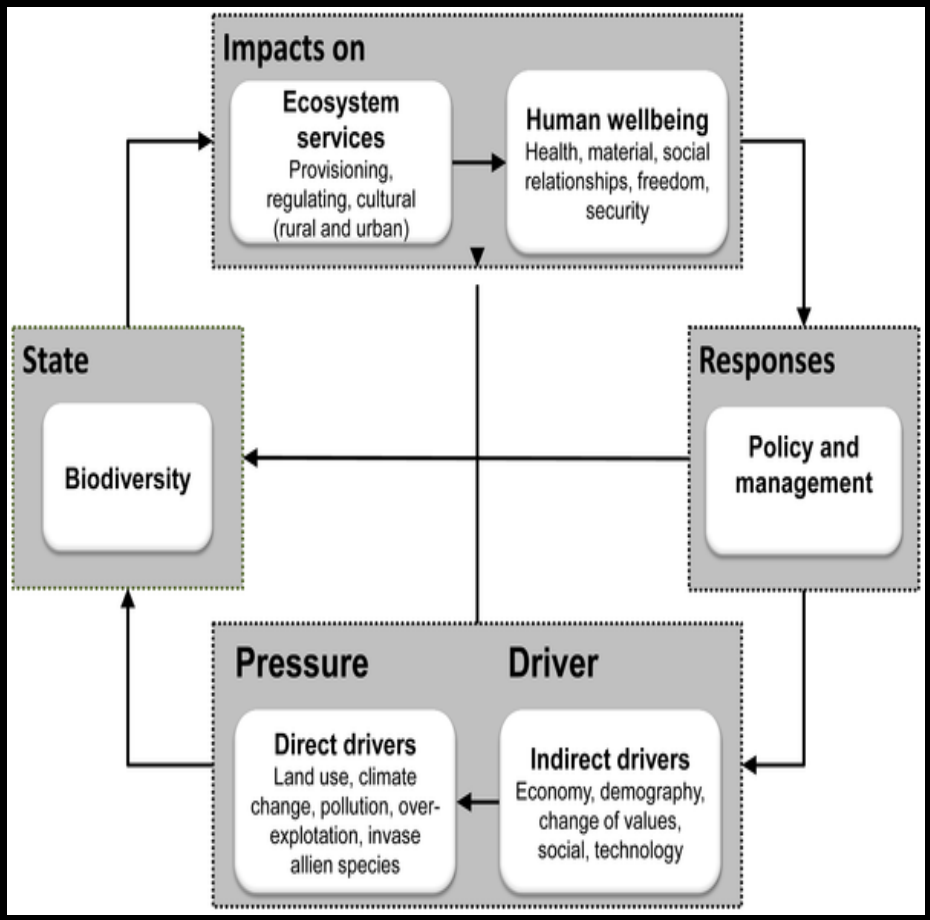


Balvanera et al
WG6



IPBES

Díaz et al. 2015 COSUST

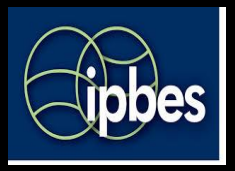


DPSIR

Santos-Martín et al. 2013 PLoS ONE

Boxes and Arrows of the CF

DPSIR



Nature | Nature's benefits | Quality of life | Institutions and Governance | Anthropogenic assets | Drivers

Food-Energy-Water Nexus
- Food security
- Energy security
- Water security

Natural Assets
- Biodiversity Ecosystem services

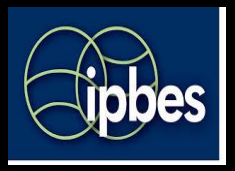
SDGs
- Health and HWB
- Income
- Livelihoods and subsistence

- Tradeoffs, Sustainability and transformation

futureearth
research for global sustainability

Boxes and Arrows of the CF

DPSIR



Nature | Nature's benefits | Quality of life | Institutions and Governance | Anthropogenic assets | Drivers

Food-Energy-Water Nexus

Food security

Energy security

Water security

Natural Assets

Biodiversity Ecosystem services

SDGs

Health and HWB

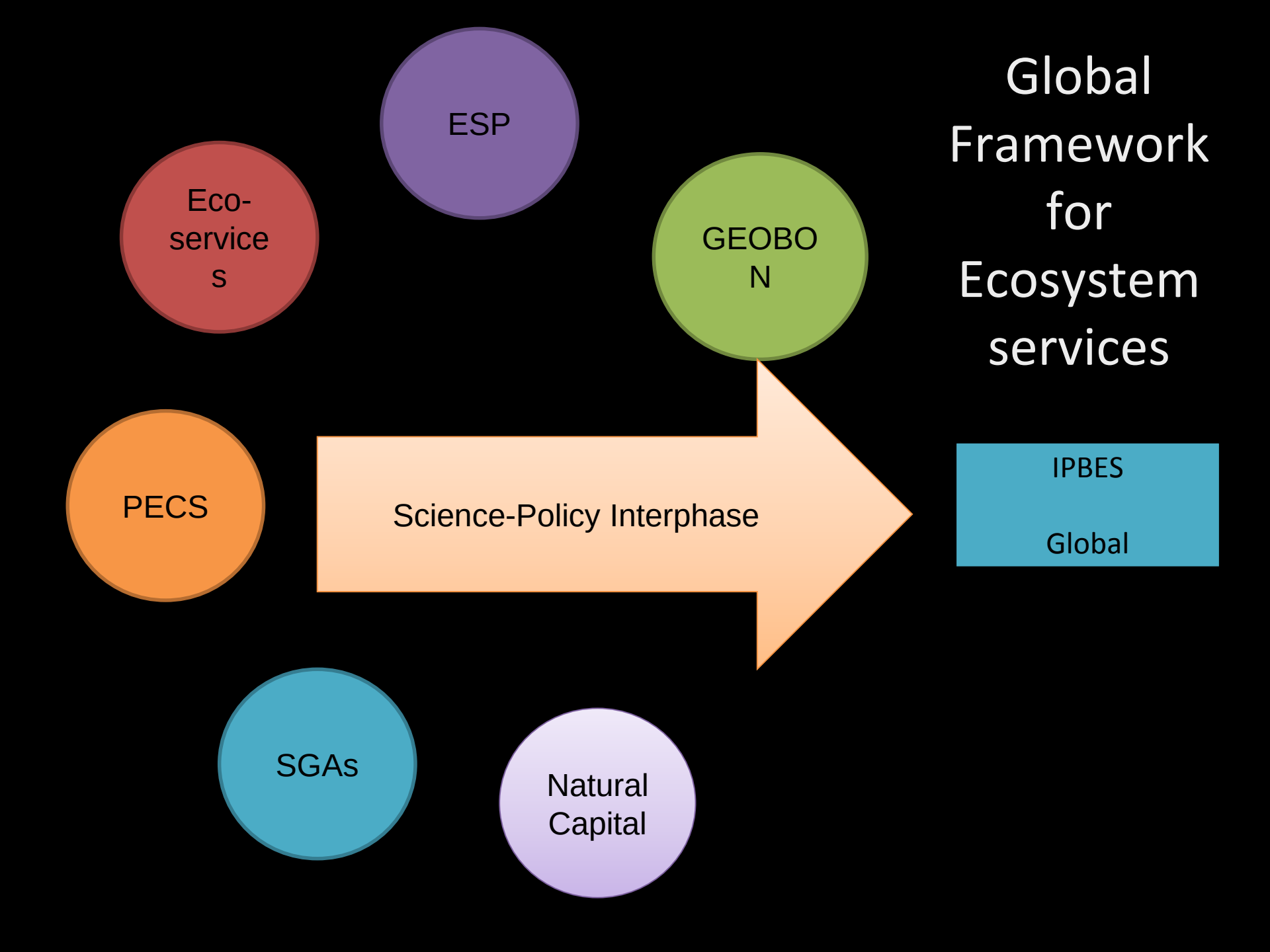
Income

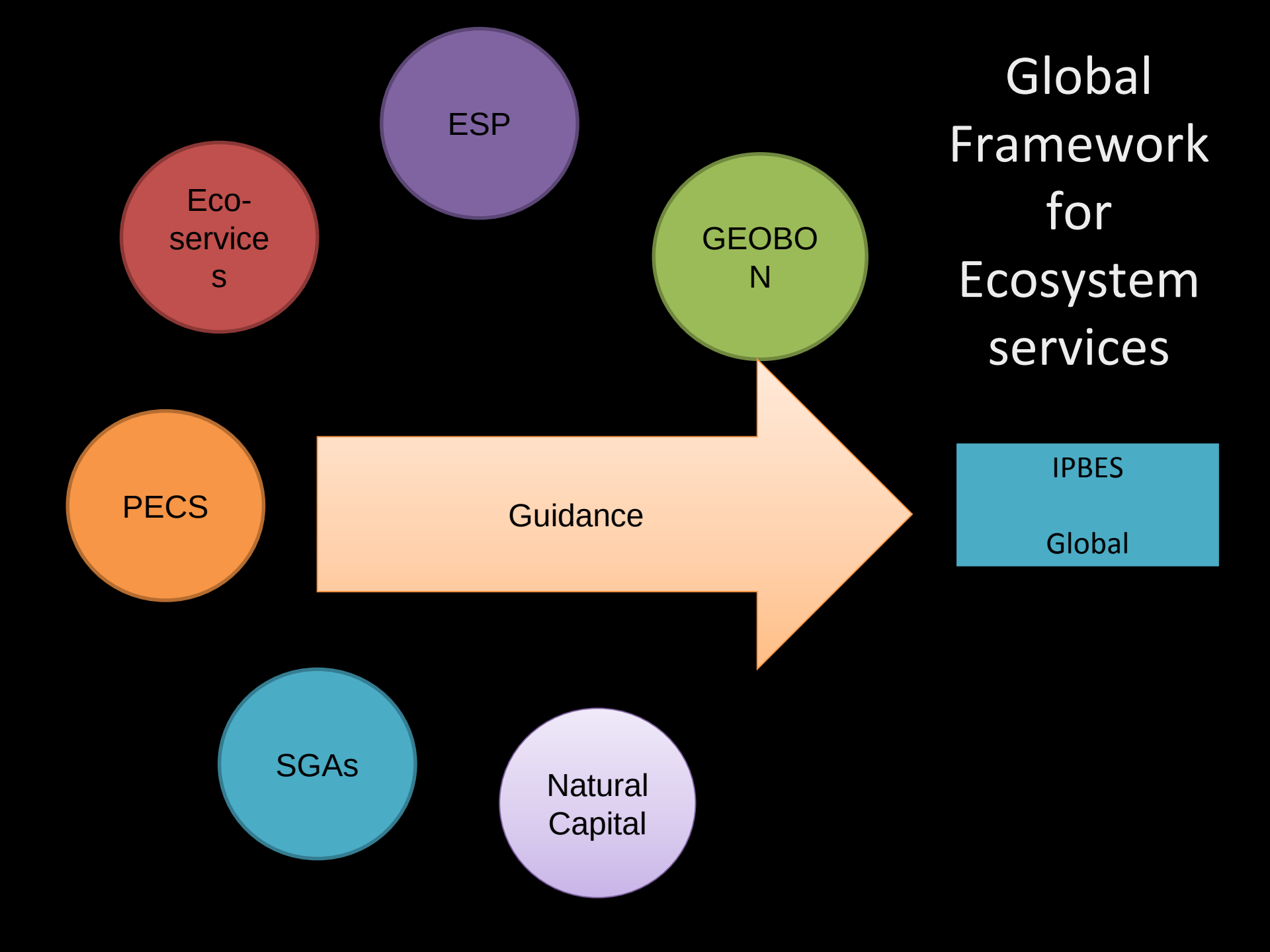
Livelihoods and subsistence

Tradeoffs, Sustainability and transformation

futureearth
research for global sustainability

Facilitate strategic interconnections


ESP
Eco-
service
s
GEOBO
N
Global
Framework
for
Ecosystem
services
PECS
Science-Policy Interphase
IPBES
Global
SGAs
Natural
Capital


ESP
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SGAs
Natural
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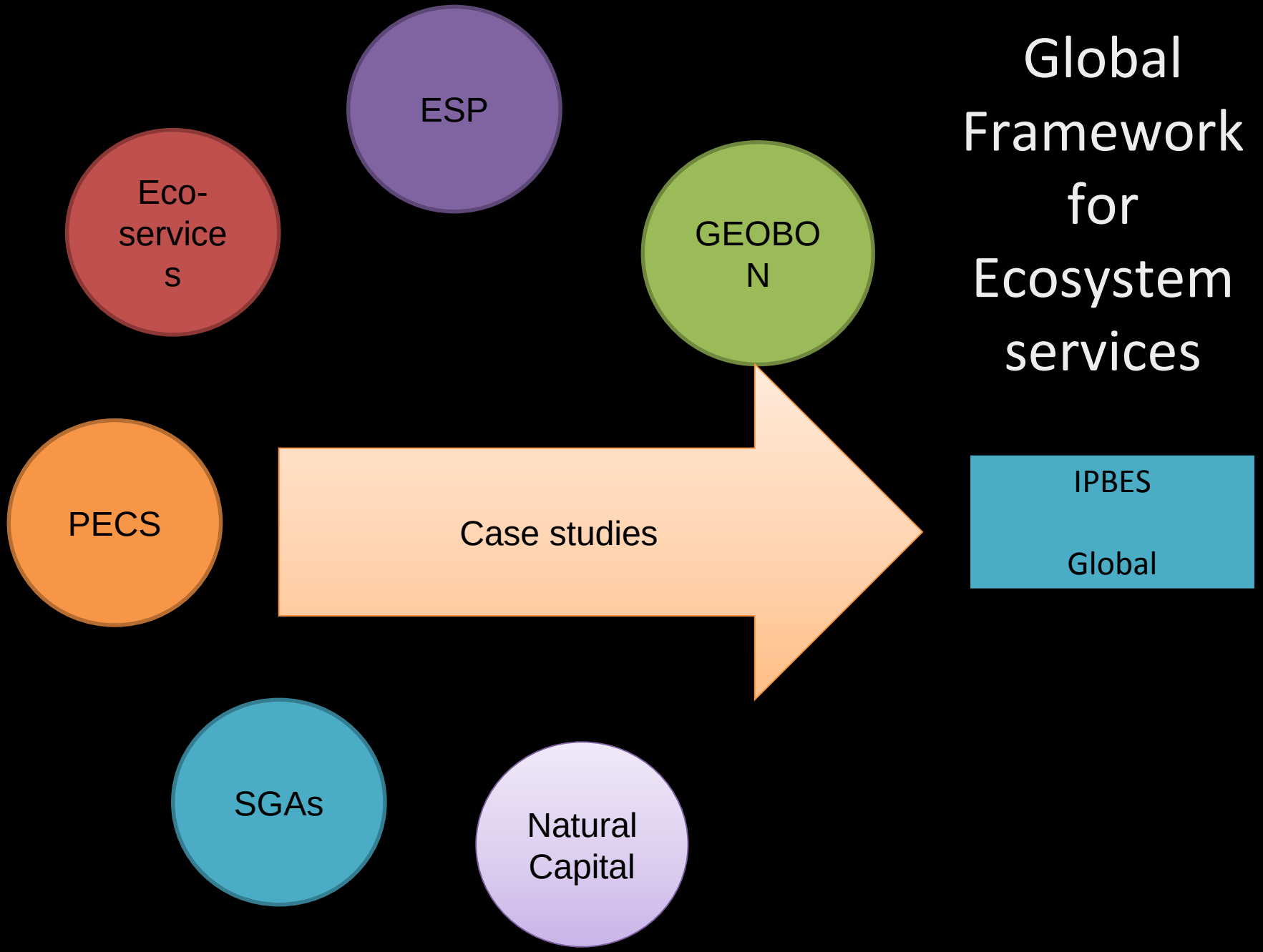
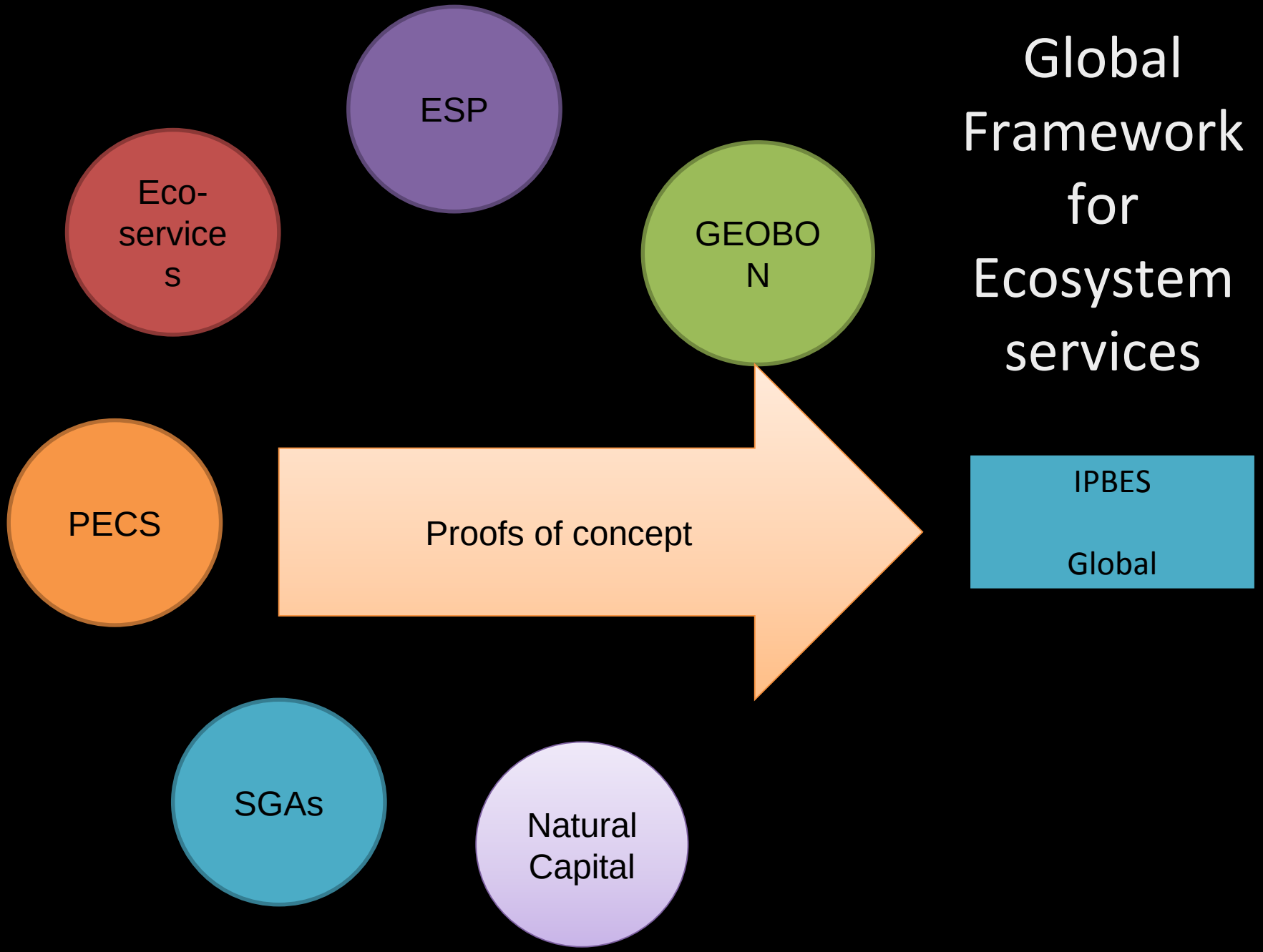
Global Framework for Ecosystem services



Global Framework for Ecosystem services



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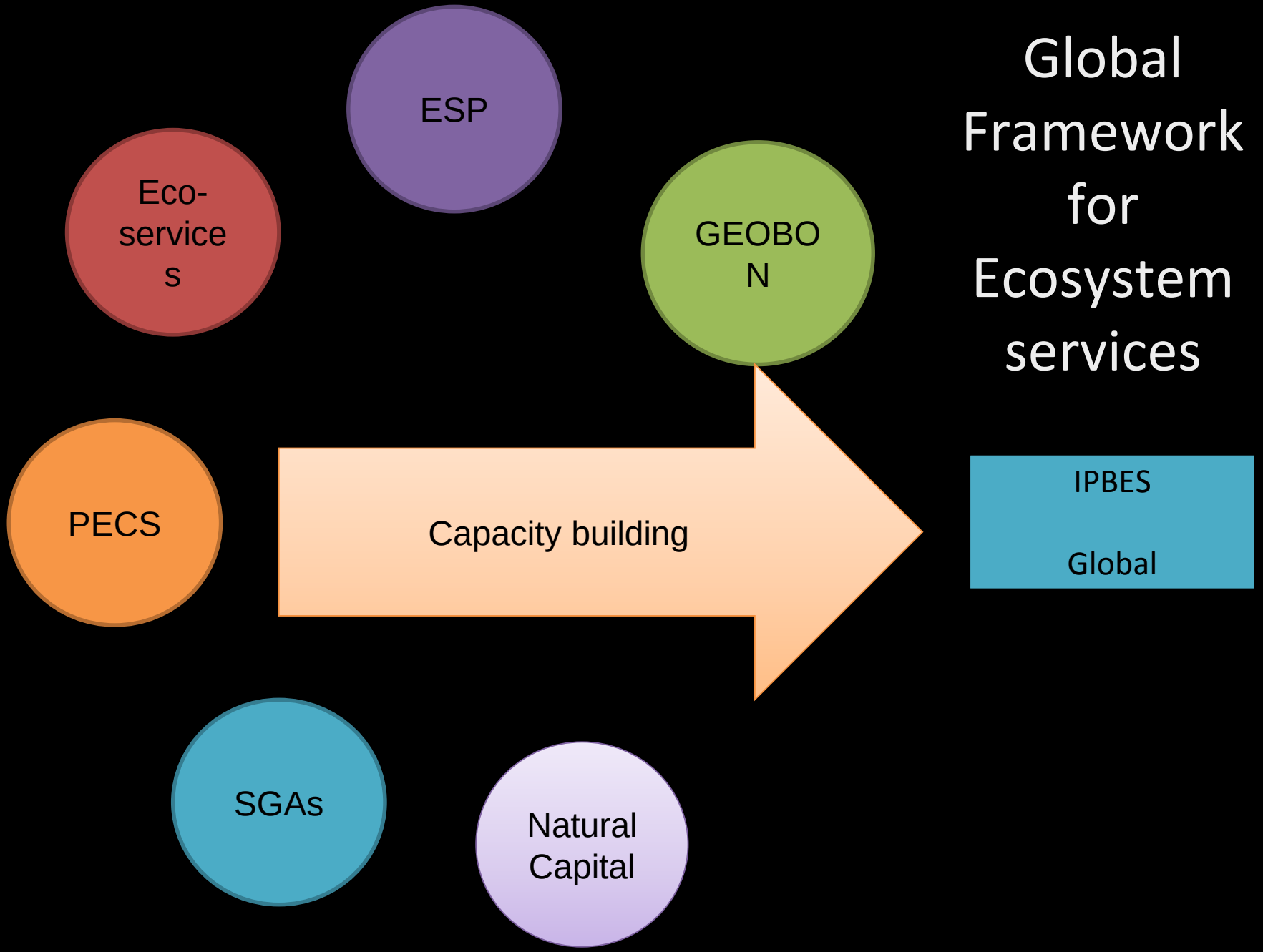


IN SYNTHESIS

- Monitoring ecosystem services for policy design requires careful consideration
- There are important challenges to be faced
- GEOBON can play a key role

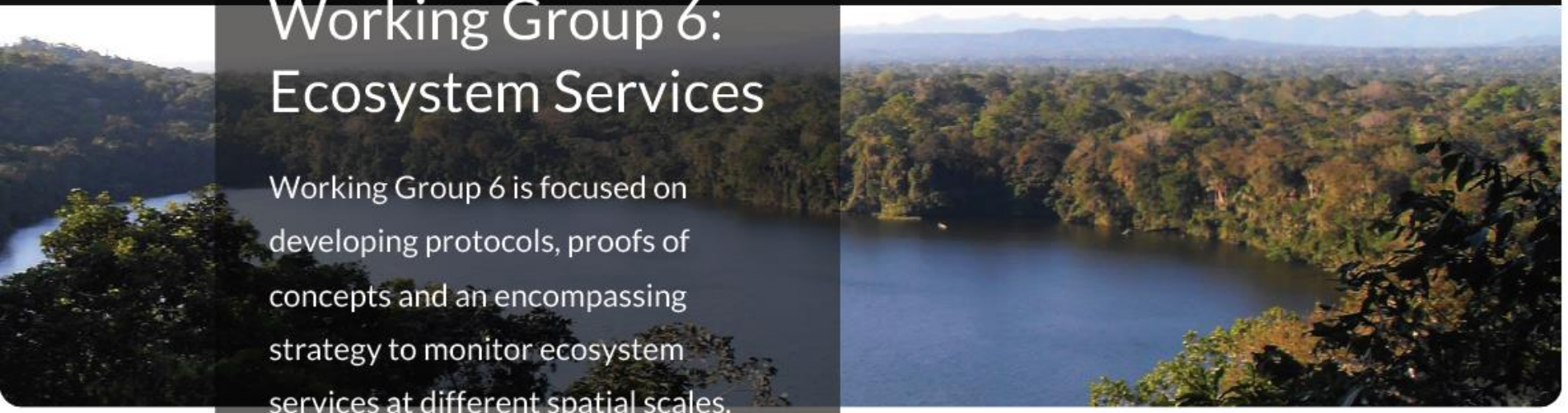
GEO BON

Home About News Networks Essential Biodiversity Variables BON in a Box

Working Groups Documents Contact

Working Group 6: Ecosystem Services

Working Group 6 is focused on developing protocols, proofs of concepts and an encompassing strategy to monitor ecosystem services at different spatial scales.



Ecosystem Services