Economic Valuation of Ecosystem Services: Methodology, Application and Lessons Learned

Pushpam Kumar

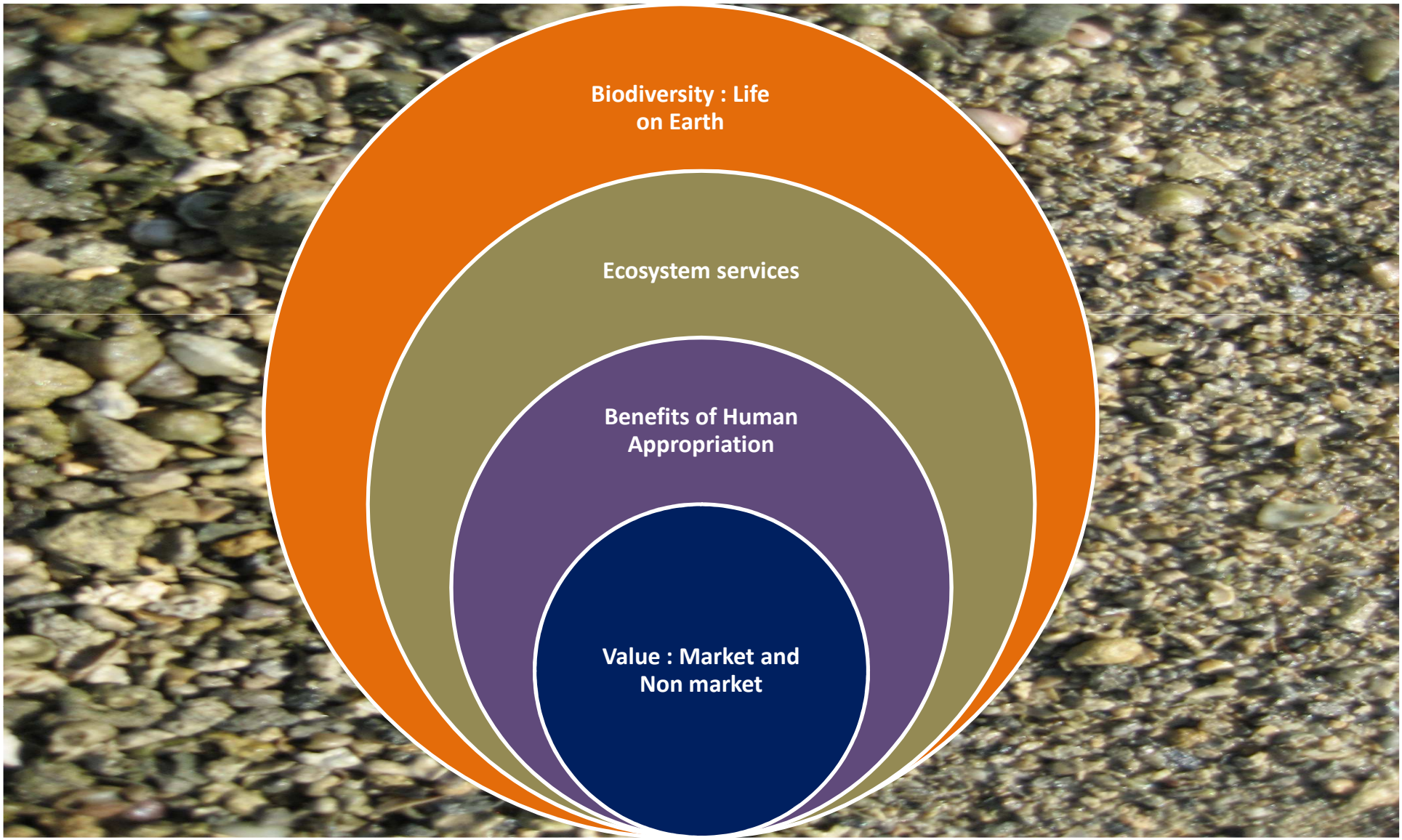
University of Liverpool, UK

pushpam@liv.ac.uk

Scheme of Presentation

- What is valuation of ES and biodiversity
- How is it done
- Where has it been done successfully
- What are the challenges
- What are the key messages

Context


Biodiversity : Life on Earth
Ecosystem services
Benefits of Human Appropriation
Value : Market and Non market

Usual Practice

Timber
NTFPs
Tourism

- Conventionally Accounted and monetarily valued

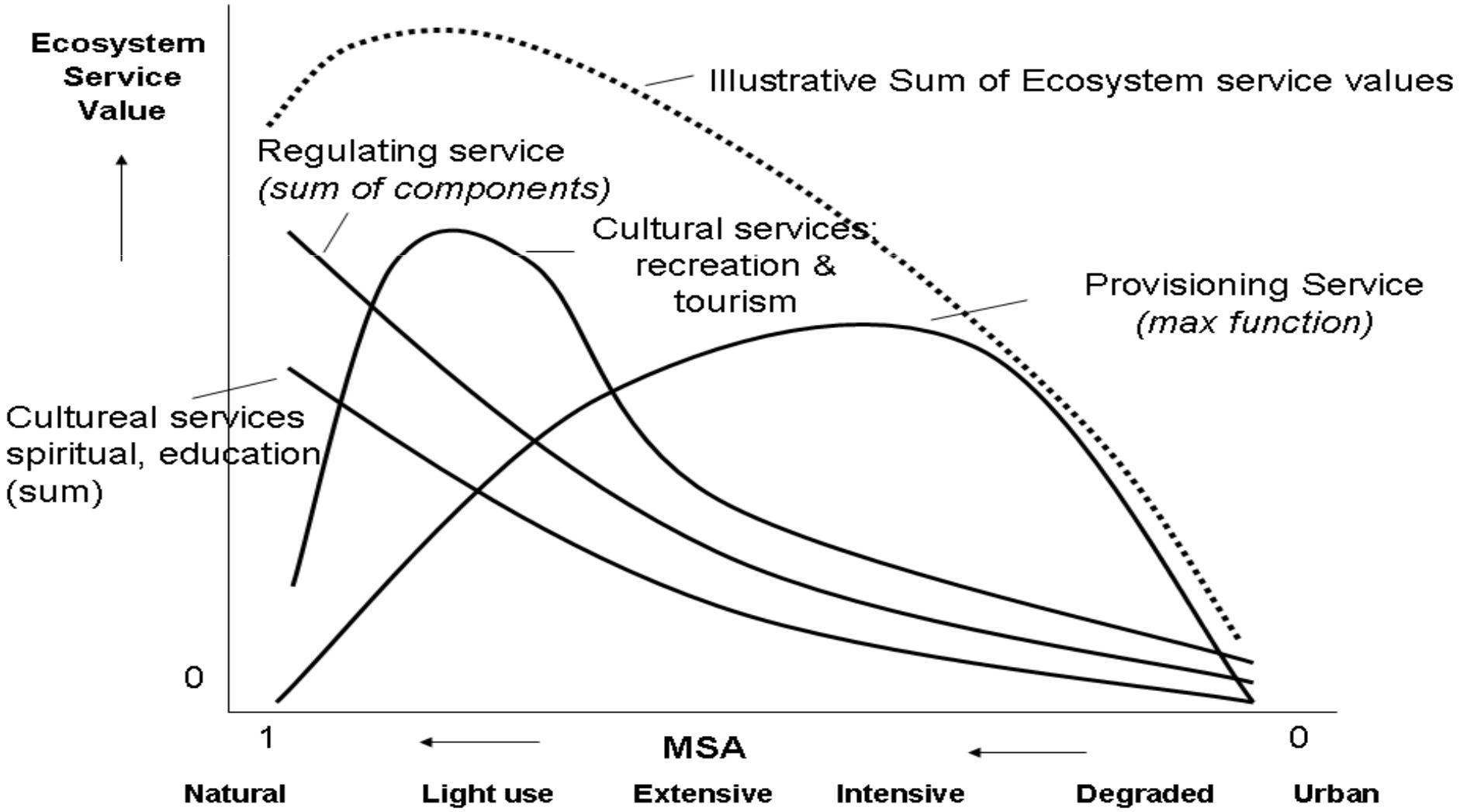
Carbon
Watersheds
Services

- Partially Valued
- Unaccounted

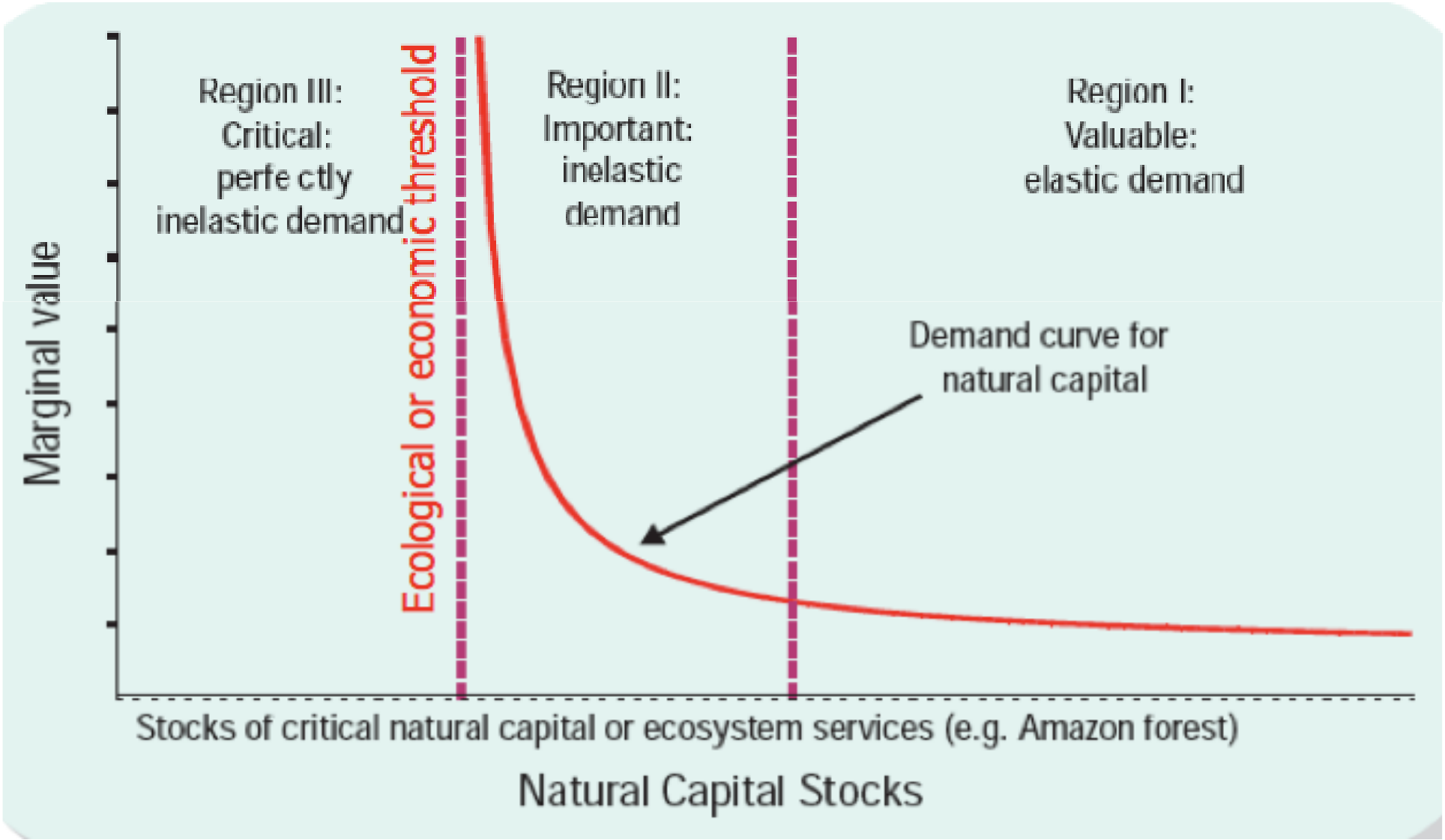
Culture
Educational

- Acknowledged
- Unpriced

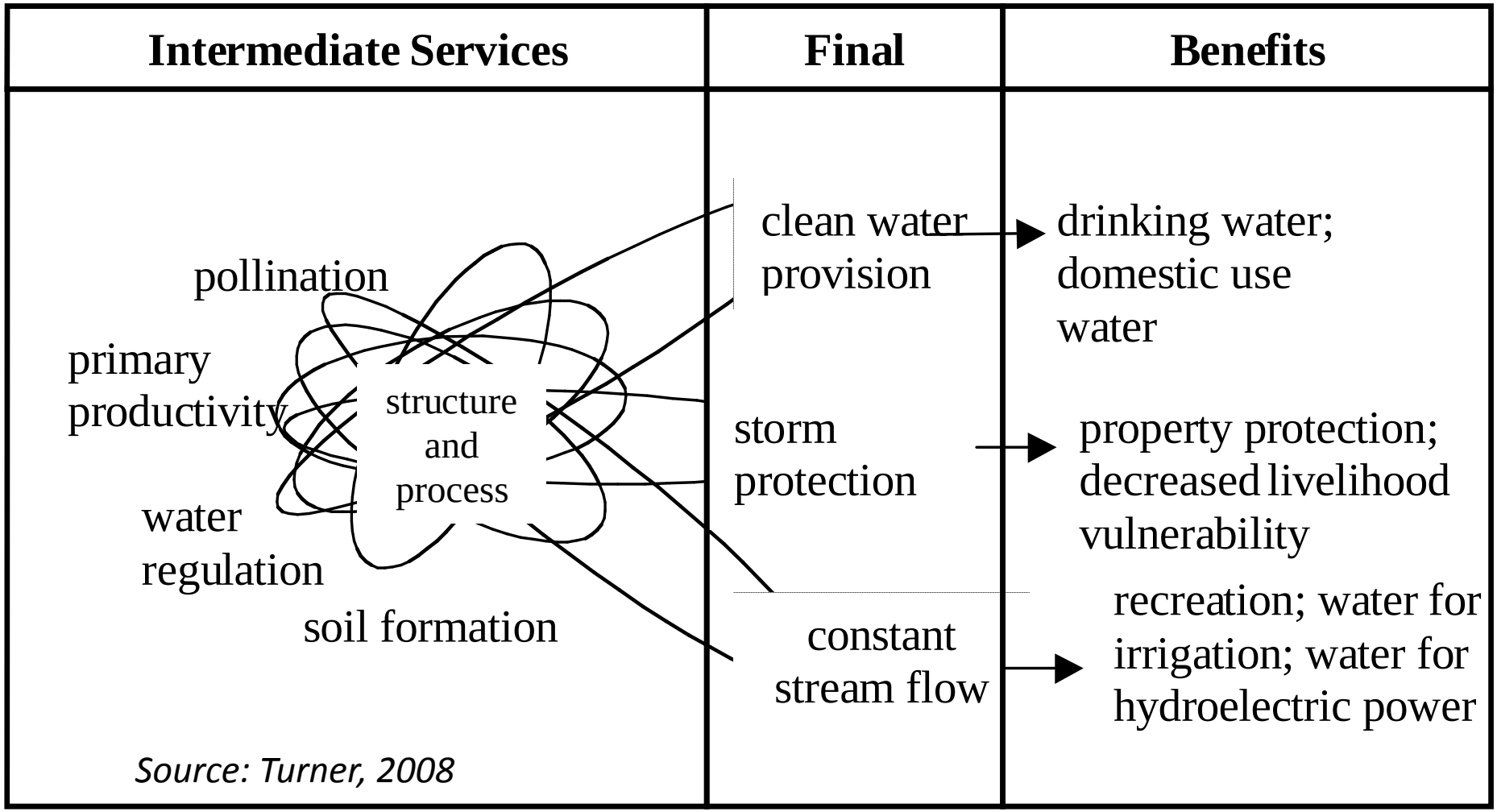
Relation of Ecosystem Services, land use types and biodiversity (MSA indicator)



When Valuation yields useful result?



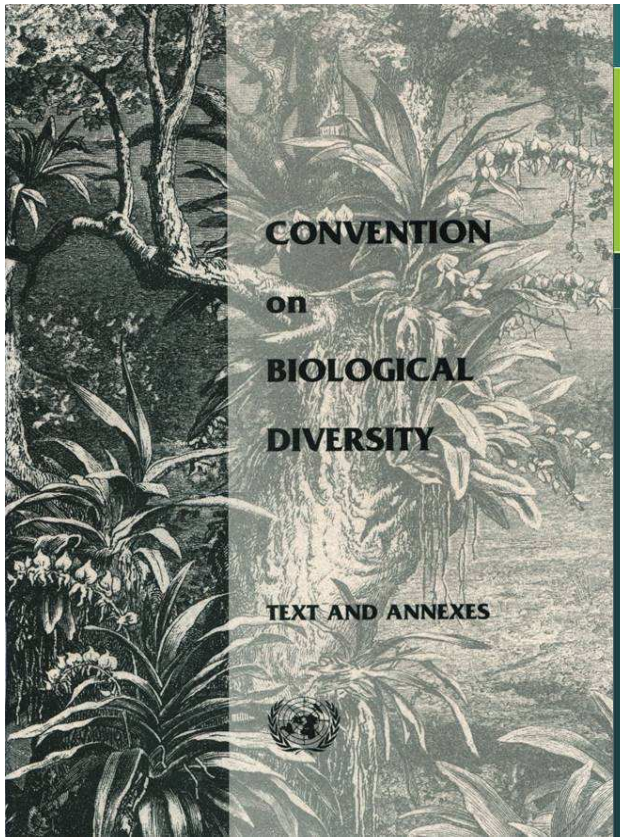
What to value

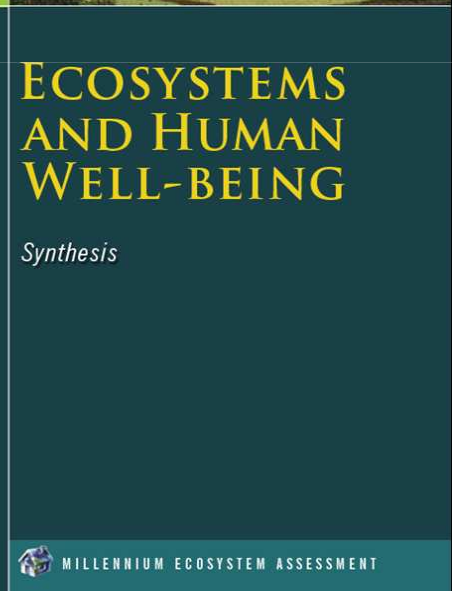


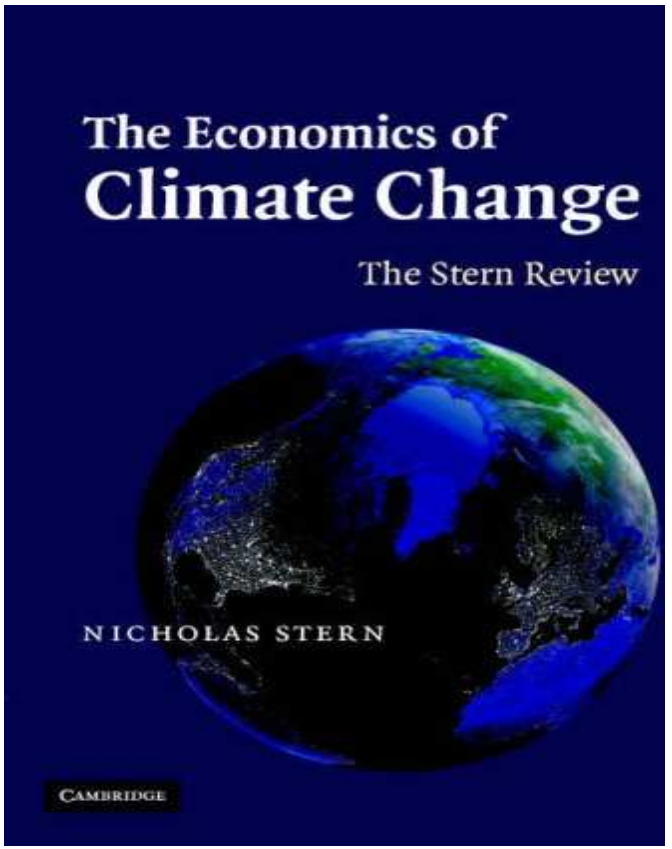
Hydrological ecosystem processes, hydrologic services and HWB

Ecohydrologic process (what the ecosystem does)		**Hydrologic attribute** (direct effect of the ecosystem)	**Hydrologic service** (what the beneficiary receives)
Local climate interactions Water use by plants	→	Quantity (surface and ground water storage and flow)	**Diverted water supply:** Water for municipal, agricultural, commercial, industrial, thermoelectric power generation uses **In situ water supply:** Water for hydropower, recreation, transportation, supply of fish and other freshwater products **Water damage mitigation:** Reduction of flood damage, dryland salinization, saltwater intrusion, sedimentation **Spiritual and aesthetic:** Provision of religious, educational, tourism values **Supporting:** Water and nutrients to support vital estuaries and other habitats, preservation of options
Environmental filtration Soil stabilization Chemical and biological additions/subtractions	→	Quality (pathogens, nutrients, salinity, sediment)	
Soil development Ground surface modification Surface flow path alteration River bank development	→	Location (ground/surface, up/downstream, in/out of channel)	
Control of flow speed Short- and long-term water storage Seasonality of water use	→	Timing (peak flows, base flows, velocity)	

Valuation of ES: Legacies





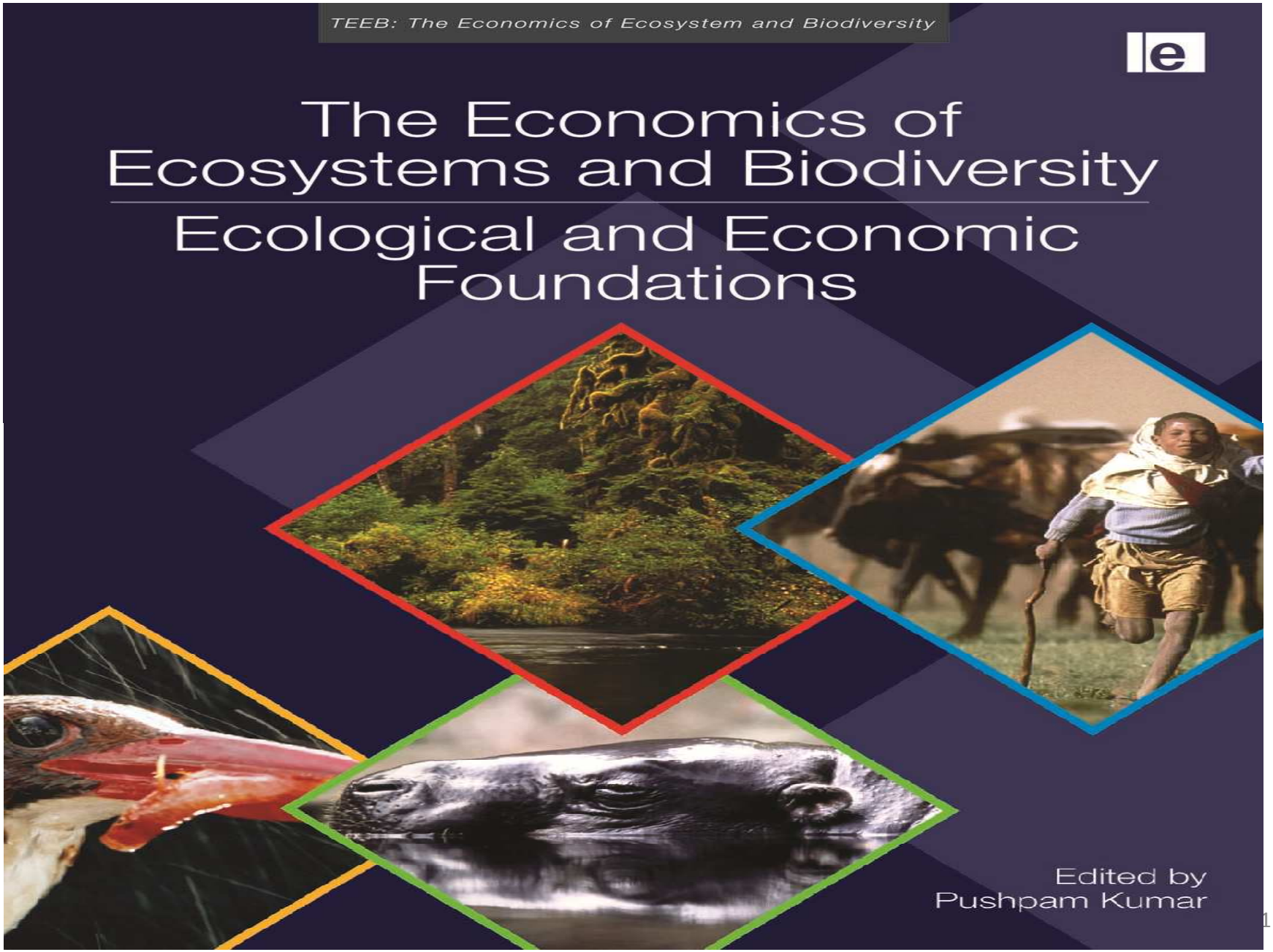


Parallel Influential Initiatives….

http://www.naturalcapitalproject.org/

MISTRA
THE FOUNDATION FOR STRATEGIC ENVIRONMENTAL RESEARCH

Useful Products on Valuation in recent time



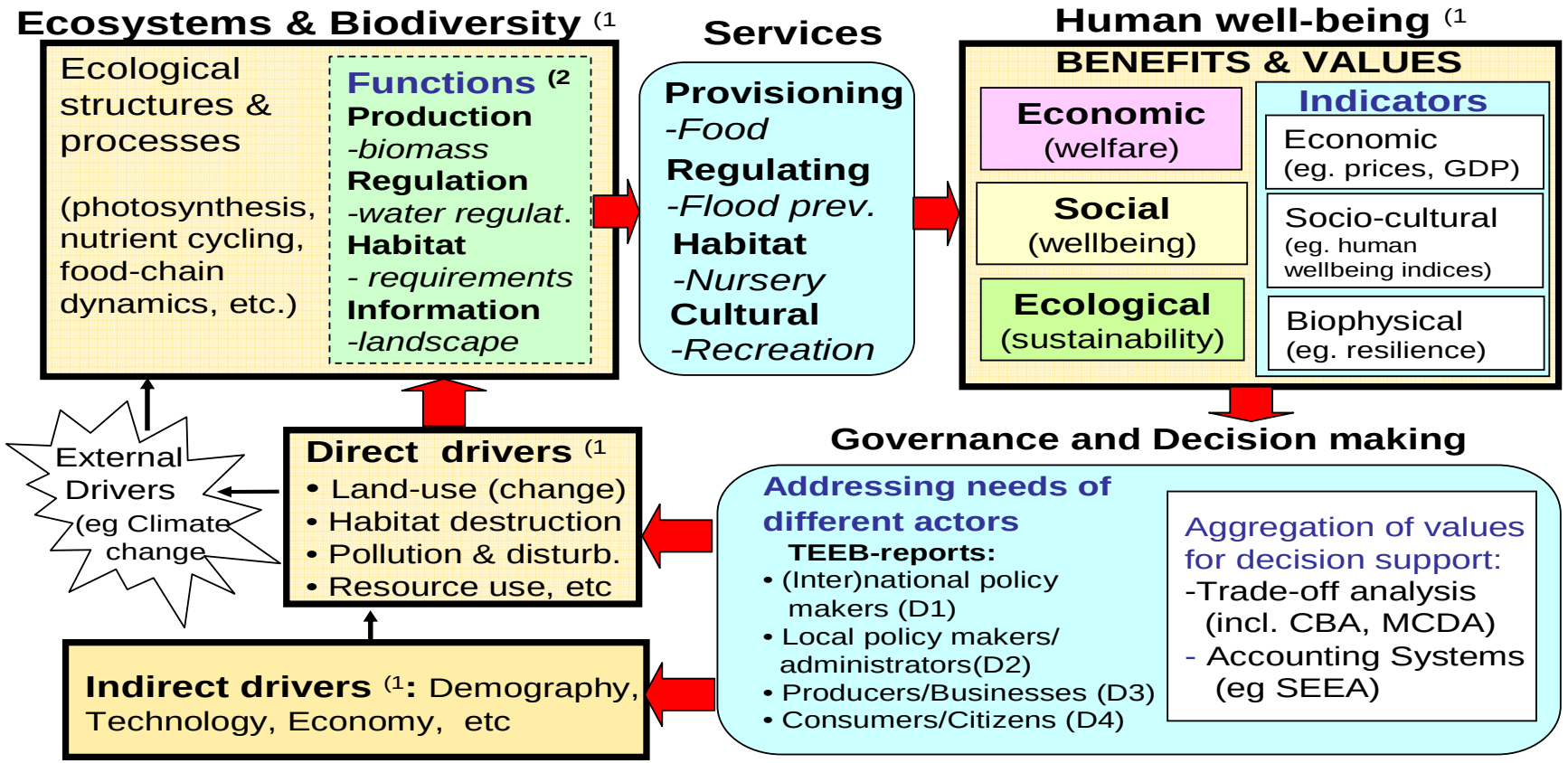
Overarching Objectives of TEEB

✓TEEB aims to strengthen economics as an instrument in biodiversity policy

✓TEEB synthesizes state-of-the-art scientific and applied knowledge

✓TEEB aims to help policy makers, local authorities, companies and individuals

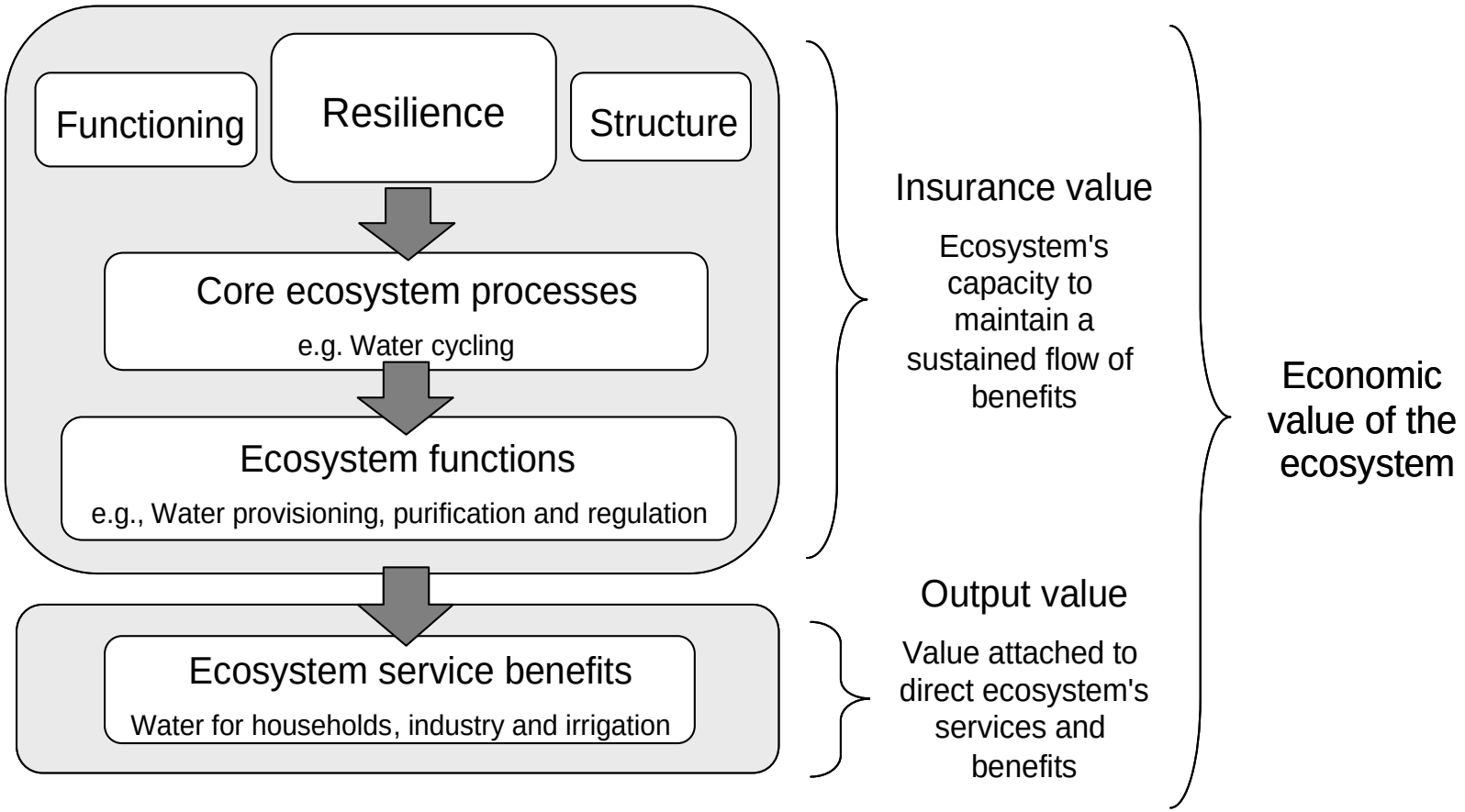
Framework

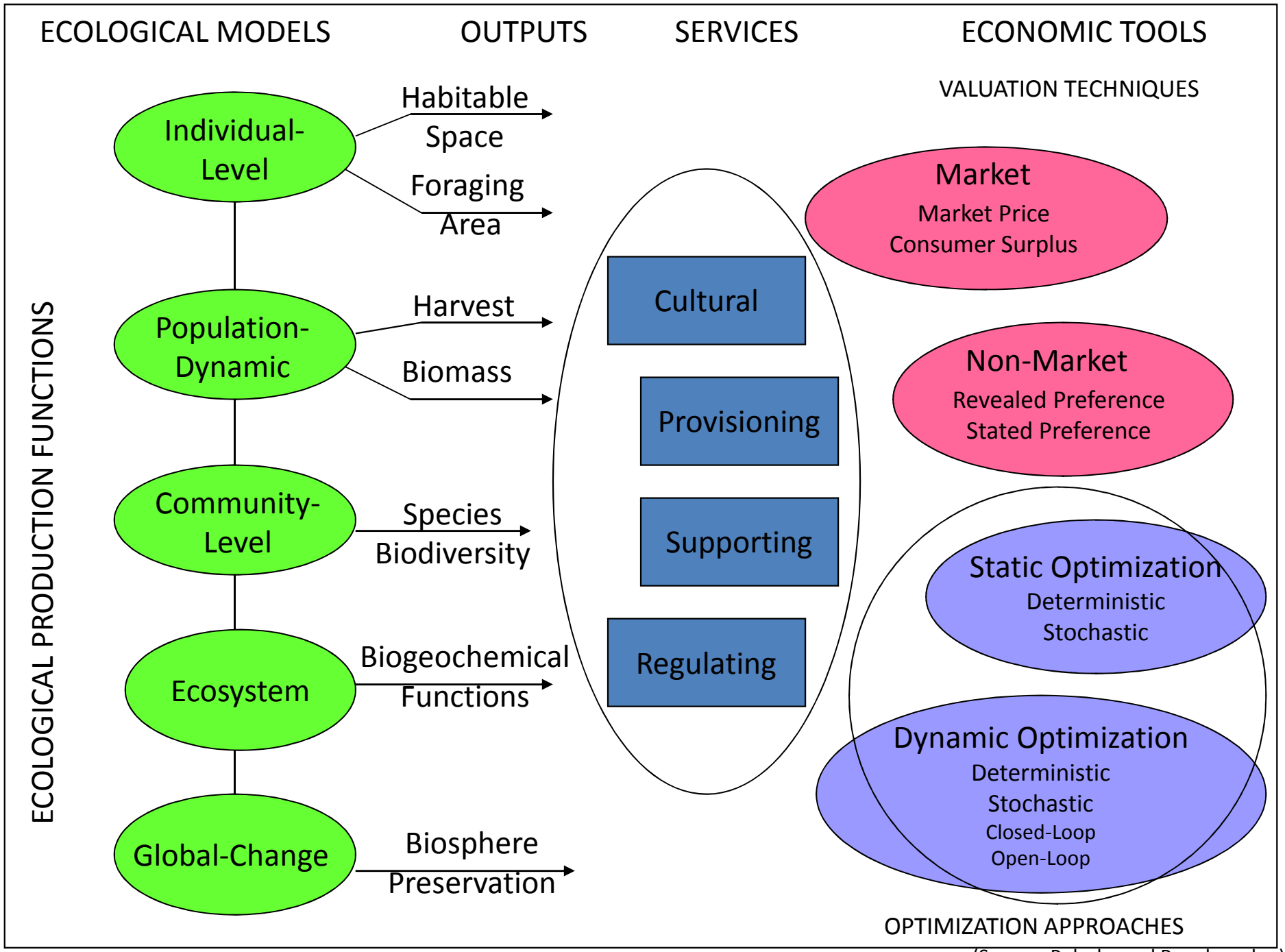


1) The four bold-lined, brown filled boxes coincide with the overall MA-Framework

2) subset of ecosystem processes & components that is directly involved in providing the service

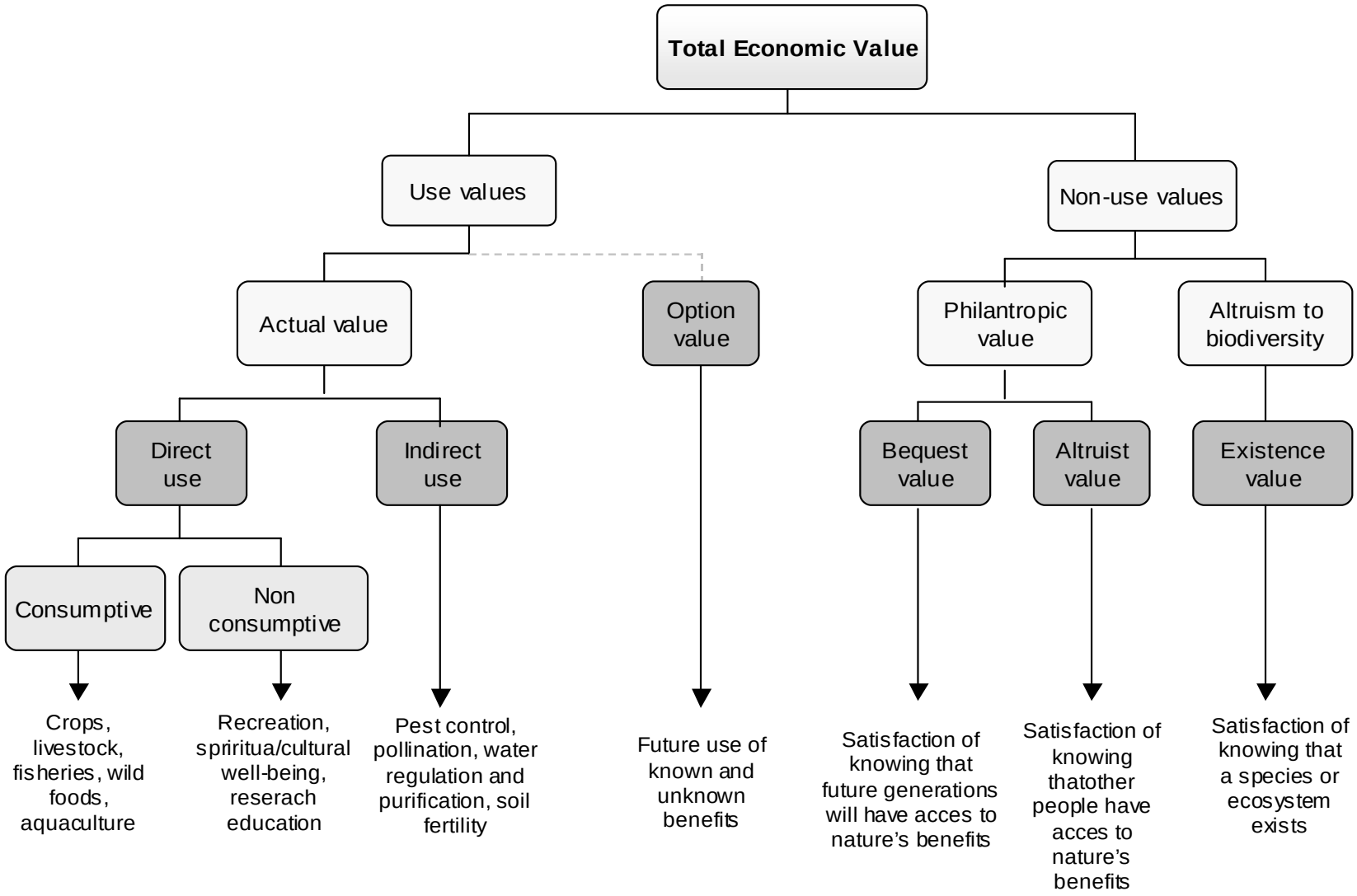
Valuation of ES: Understanding the Basics





(Source: Polasky and Roughgarden)

Taxonomy of Values



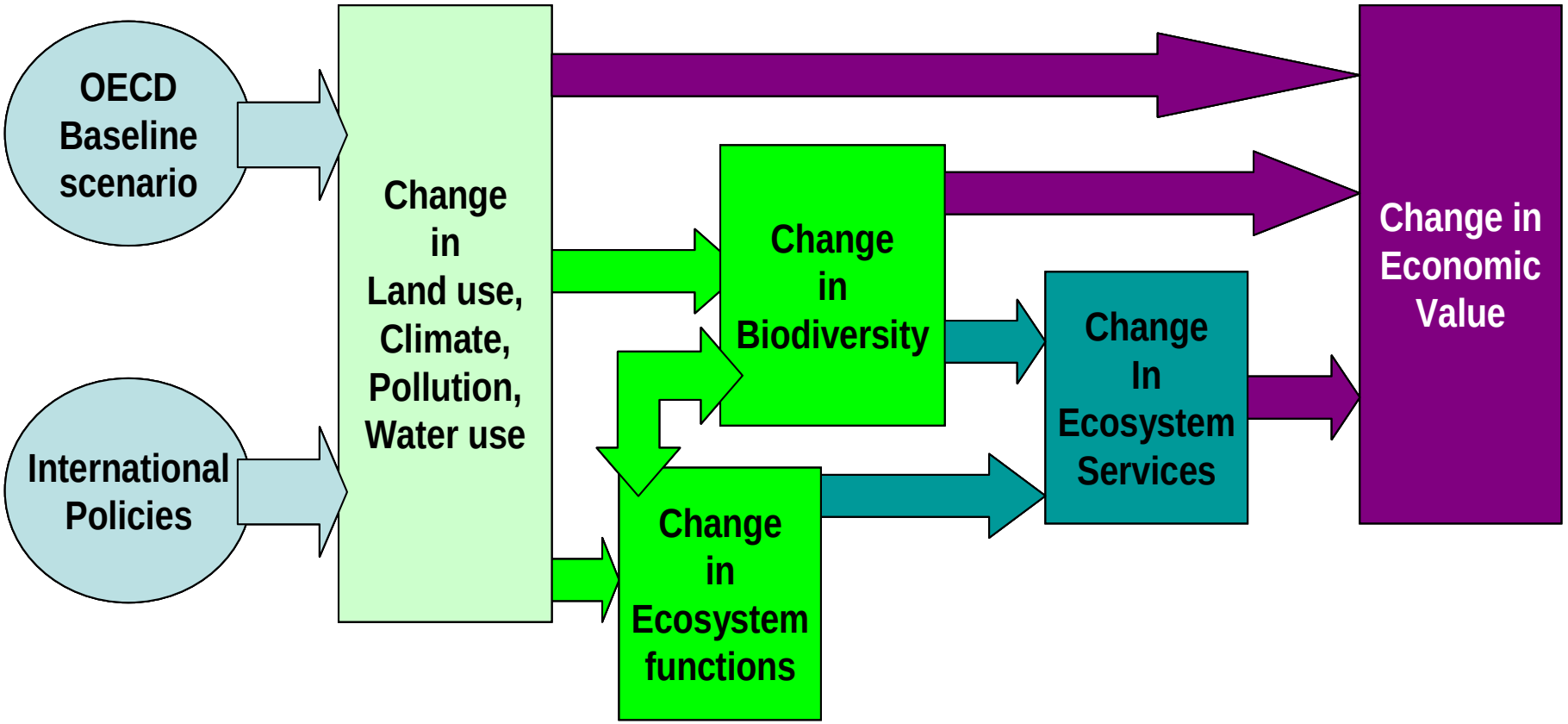
Further Illustration....

Value type	**Value sub-type**	**Meaning**
Use values	Direct use value	Results from direct human use of biodiversity (consumptive or non consumptive).
	Indirect use value	Derived from the regulation services provided by species and ecosystems
	Option value	Relates to the importance that people give to the future availability of ecosystem services for personal benefit (option value in a strict sense).
Non-use values	Bequest value	Value attached by individuals to the fact that future generations will also have access to the benefits from species and ecosystems (intergenerational equity concerns).
	Altruist value	Value attached by individuals to the fact that other people of the present generation have access to the benefits provided by species and ecosystems (intragenerational equity concerns).
	Existence value	Value related to the satisfaction that individuals derive from the mere knowledge that species and ecosystems continue to exist.

Another View

Valuation Tools (Quantitative)	Valuation Tools (Qualitative)
Market price approaches Market cost approaches Replacement costs approaches Damage cost avoided approaches Production function approaches Revealed preference methods Travel cost method Hedonic pricing method Stated preference methods Choice modelling Contingent valuation Participatory approaches to valuation Deliberative valuation Mediated modelling	Consultative methods: Questionnaires In-depth interviews Deliberative and participatory approaches: Focus groups, in-depth groups Citizen juries Health-based valuation approaches Q-methodology Delphi surveys Rapid rural appraisal Participatory rural appraisal Participatory action research Methods for reviewing information:

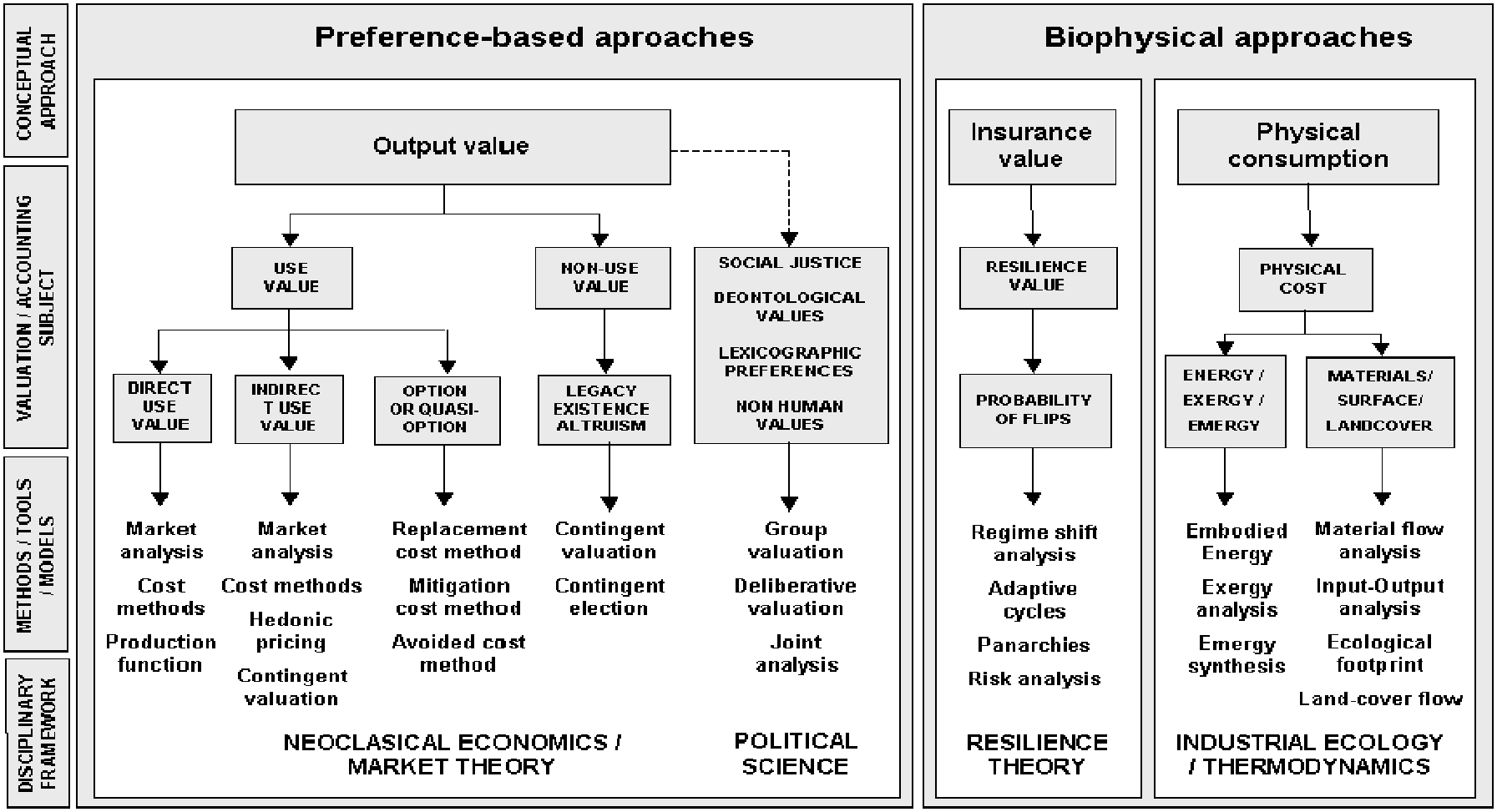
Biodiversity, Ecosystems, and their Services



Global
Loss of Ecosystem services
Forestry biomes

Forest biomes	Partial Estimation	Fuller Estimation
Boreal forest	**-163**	**-1999**
Tropical forest	**-536**	**-3362**
Warm mixed forest	**-249**	**-2332**
Temperate mixed forest	**-190**	**-1372**
Cool coniferous forest	**-47**	**-701**
Temperate deciduous forest	**-133**	**-1025**
Forest Total	**-1317**	**-10791**
Natural areas	**-1552**	**-12310**
World GDP in 2050 (trillion (10^12) EUR)*	195.5	
Losses of ESS from forests as share of % GDP	**-0.7%**	**-5.5%**
Losses of ESS from natural areas in forest biomes as share of % GDP	-0.8%	-6.3%

Context and Theory of 'Value'



Source: drafted from Gómez-Baggethun and de Groot, in press

Valuation Changes the Decision Making Criteria

Table 1: Benefits from ecosystem services in coral reef ecosystems

CORAL REEFS	Value of ecosystem services (in US$ / ha / year – 2007 values)		
Ecosystem Service	**Average**	**Maximum**	**Number of Studies**
Provisioning services			
Food	470	3,818	22
Raw materials	400	1,990	5
Ornamental resources	264	347	3
Regulating services			
Climate regulation	648	648	3
Moderation of extreme events	25,200	34,408	9
Waste treatment / water purification	42	81	2
Biological control	4	7	2
Cultural Services			
Aesthetic information / Amenity	7,425	27,484	4
Opportunities for recreation and tourism	79,099	1,063,946	29
Information for cognitive development	2,154	6,461	4
Total	**115,704**	**1,139,190**	**83**
Supporting Services			
Maintenance of genetic diversity	13,541	57,133	7

Note: these estimates are based on ongoing analyses for TEEB (TEEB Ecological and Economic Foundations, Chapter 7). As the TEEB data base and value-analysis are still under development, this table is for illustrative purposes only.

Sensitivity Analysis….

Ecosystem	Typical cost	Avg. benefit	NPV	IRR	BCR
Coral	542,497	129,245	1,165,988	7%	2.8
Coastal	232,674	73,852	935,379	11%	4.4
Mangroves	2,876	4,346	88,297	40%	26.8
Inland wetlands	33,007	14,245	171,296	12%	5.4
Lakes / rivers	4,032	3,803	69,687	27%	15.5
Tropical forest	3,448	7,022	148,675	50%	37.3
Temperate forests	2,387	1,618	26,273	20%	10.3
Woodland / shrubland	987	4,343	97,696	85%	84.3
Grasslands / rangelands	257	1,012	22,624	79%	75.1

	Ecosystem	Typical cost	Avg. benefit	NPV	IRR	BCR
	Tropical forest	**3,448**	**7,022**	**148,675**	**50%**	**37.3**
1	**Benefits peak @ 70%, instead of 80% of Generic**				**42%**	**31.5**
2	**Costs @ 100%, instead of 120% of Typical**				**57%**	**45.4**
3	**Maintenance Cost (10%) stops after 5 years**				**51%**	**40.0**
4	**Benefits flows accounted for 50 yrs, instead of 40**				**50%**	**45.4**
5	**Discount rate 4%, instead of 1%**				**50%**	**21.7**

Steps for undertaking a contingent valuation study (Kontoleon and Pascual, 2006)

1. Survey design

Start with focus group sessions and consultations with stakeholders to define the good to be valued.

Decide the nature of the market, i.e., determine the good being traded, the status quo, and the improvement or deterioration level of the good that will be valued.

Determine the quantity and quality of information provided over the traded 'good', who will pay for it, and who will benefit from it.

Set allocation of property rights (determines whether a willingness-to-pay (WTP) or a willingness-to-accept (WTA) scenario is presented).

Determine credible scenario and payment vehicle (tax, donation, price).

Choose elicitation method (e.g. dichotomous choice vs. open-ended elicitation method).

2. Survey implementation and sampling

Interview implementation: on site or face-to-face, mail, telephone, internet, groups, consider inducements to increase the response rate.

Interviewers: private companies, researchers themselves.

Sampling: convenience sample, representative and stratified sample.

3. Calculate measures of welfare change

Open-ended – simple mean or trimmed mean (with removed outliers; note that this is a contentious step).

Dichotomous choice – estimate expected value of WTP or WTA.

4. Technical validation

Most CV studies will attempt to validate responses by investigating respondents WTP (or WTA) bids by estimating a bid function

5. *Aggregation and discounting*

Calculating total WTP from mean/median WTP over relevant population – for example by multiplying the sample mean WTP of visitors to a site by the total number of visitors per annum.

Discount calculated values as appropriate.

6. *Study appraisal*

Testing the validity and reliability of the estimates produced

What are Ecosystem Services?

Answer depends on the purpose!

❖If the purpose is mass awareness and education, MA's classification and purpose are most relevant .

❖If the purpose is valuation, accounting, executing PES Scheme etc, then a different approach would be needed

Ecosystem Services

Provisioning

G or

•Regulating

•Be
reg

Cultural

N
b
c

Photo credits (left to right, top to bottom): Purdue University, WomenAid.org, LSUP, NASA, unknown, CEH Wallingford, unknown, W. Reid, Staffan Widstrand

Established Fact-Ecosystem Services are like any other Capital Assets!


fodder production


slope stability


tourist attraction


recreation


water purification


Beauty


pollination


fibre production


food production


flood protection


carbon sequestration


Biodiversity


recreation


stabilising micro-climate


game reserve


shelter for life

Economics of Ecosystem Services

Ecosystem Services

Conceptual Lenses of Economics

Stock Vs Flow

- Metrics of ES- Stocks (ecological) and flow (ecosystem services)
- ES are flow on DD and SS side and imbalance would affect the stock!

Contd..

Ecosystem Services

- Timber, water, fodder

Lenses of Economics

The equivalent economic value of a stock that underlies a flow can be estimated from the present and assumed time course of ecosystem services flows by applying appropriate discount rate (natural capital)

Contd

Ecosystem Services

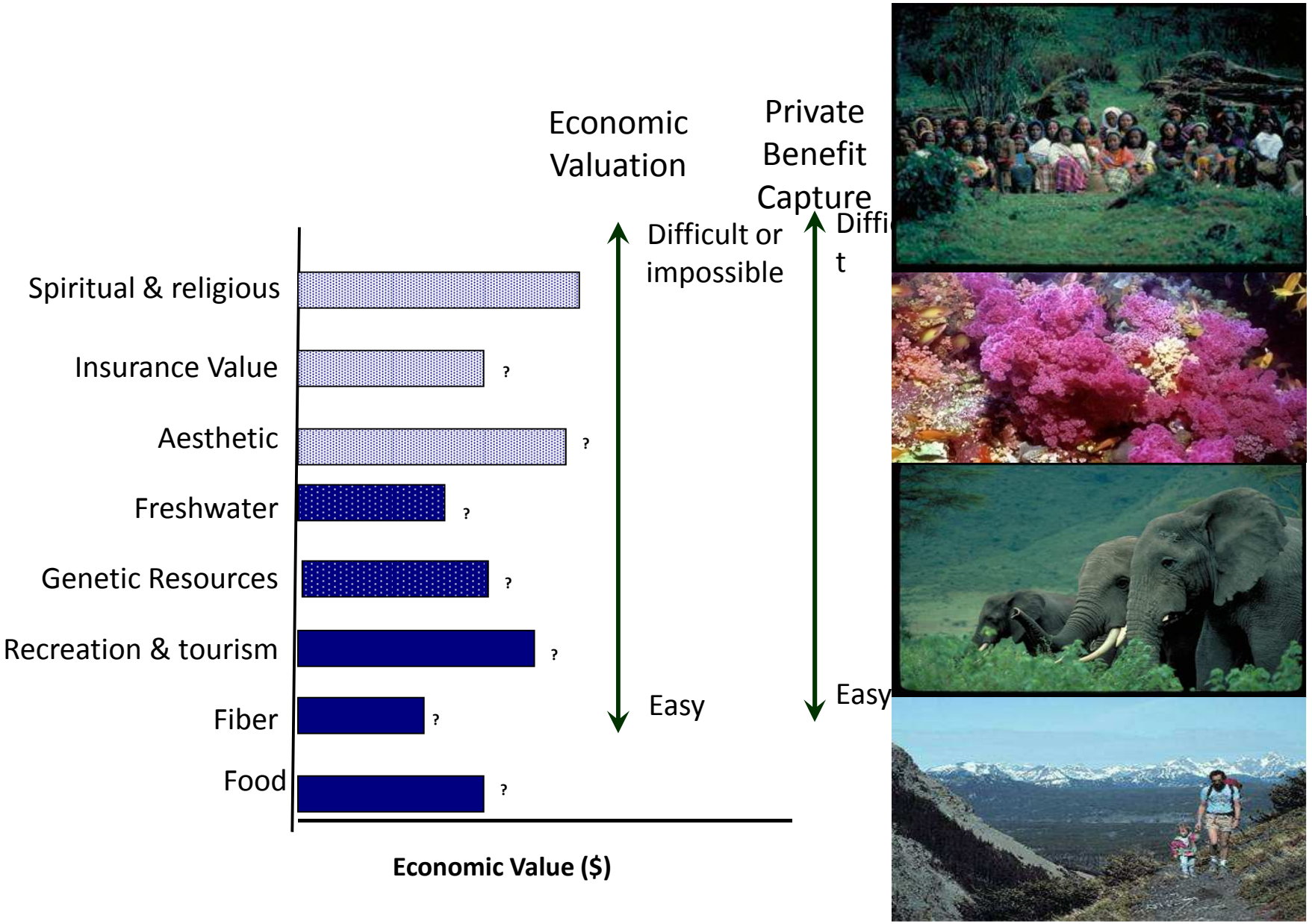
- Charachteristics

Lenses of Economics

- ES can have consumptive vs productive
- ES can have private good or public good features

Many BENEFITS of ES are public goods (Rivalness and

Excludability, Spatial and Temporal Dynamics
Joint Production, Complexity, Resilience and Interdependence of the Benefit)



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Ecosystem Services

Lenses of Economics

- vector of services produced by a vector of inputs
- intermediate / final goods
- externalities over space and time (soil erosion and flooding)

Valuation of Ecosystem Services

Agreements already on

- Joint effort (ecology and economics)
- Need to know initial condition of Ecosystems
- Need to know the flow of ES (ecological production function) etc. etc.

But

Valuation must have a *Purpose (resolving trade off, sectoral accounting, CBA, etc.)*