PBL Netherlands Environmental Assessment Agency

GLOBIO3
State and trends of ecosystem condition on multiple levels of scale

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UN SEEA Experimental Ecosystem Accounting
18-20 November 2013
New York

PBL Netherlands Environmental Assessment Agency

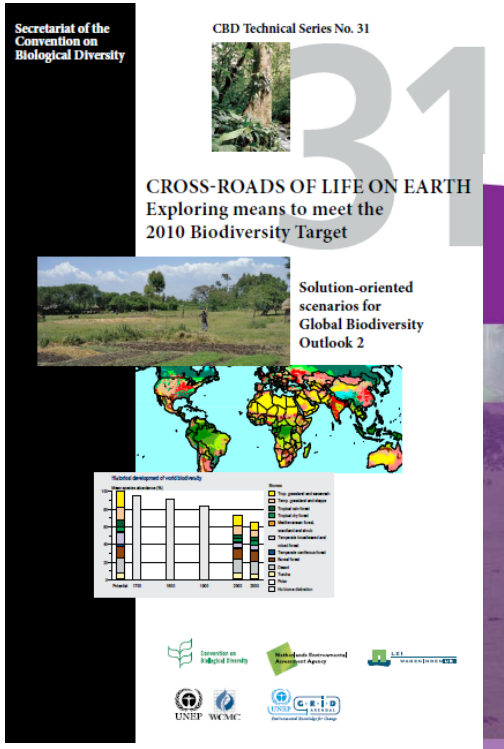
- National institute for strategic policy analysis on environment, nature and spatial planning
- Outlook studies, analysis and policy evaluations
- Always an integrated, interdisciplinary approach
- Always policy-relevant
- Solicited and unsolicited research, independent, and scientifically sound

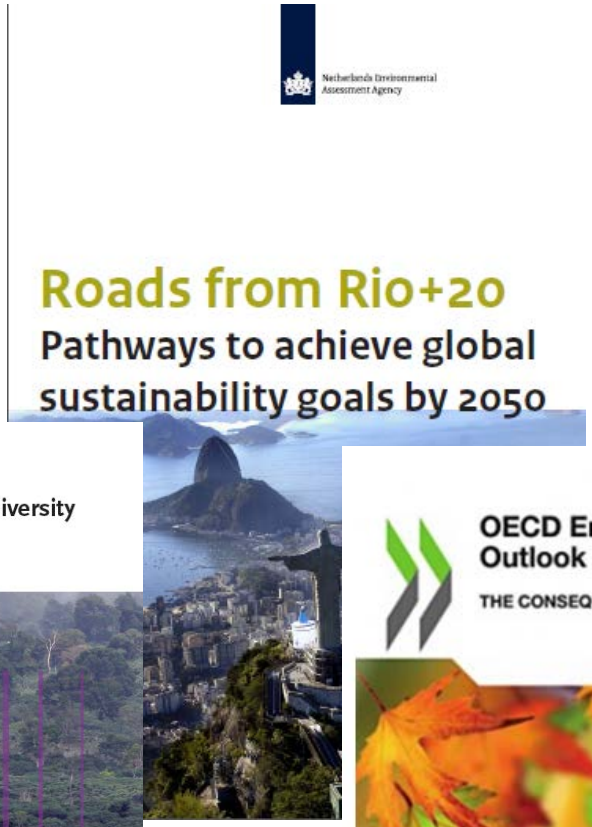
New cooperation on testing accounts

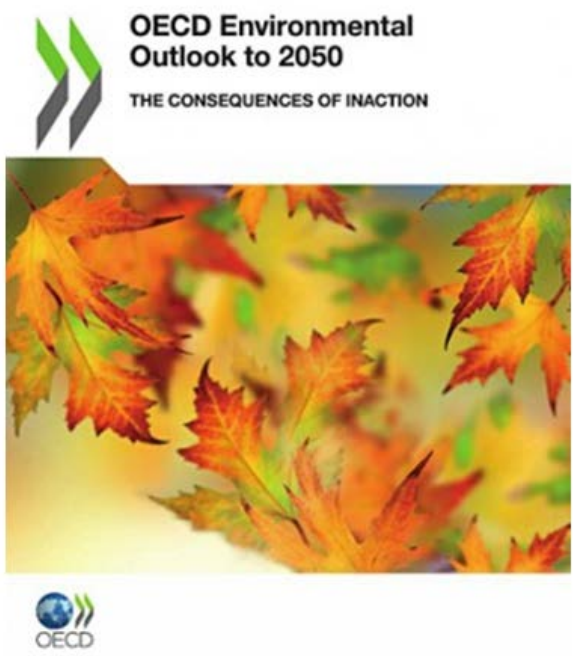
- Cooperation between UNSD, Statistics Netherlands and PBL Netherlands Environmental Assessment Agency
- Financed by Ministry of Foreign Affairs
- 2015 - 2017

- Goals:
  - Test ecosystem accounting in the Netherlands
  - Test the applicability of GLOBIO type model and metrics in ecosystem accounting

www.globio.info

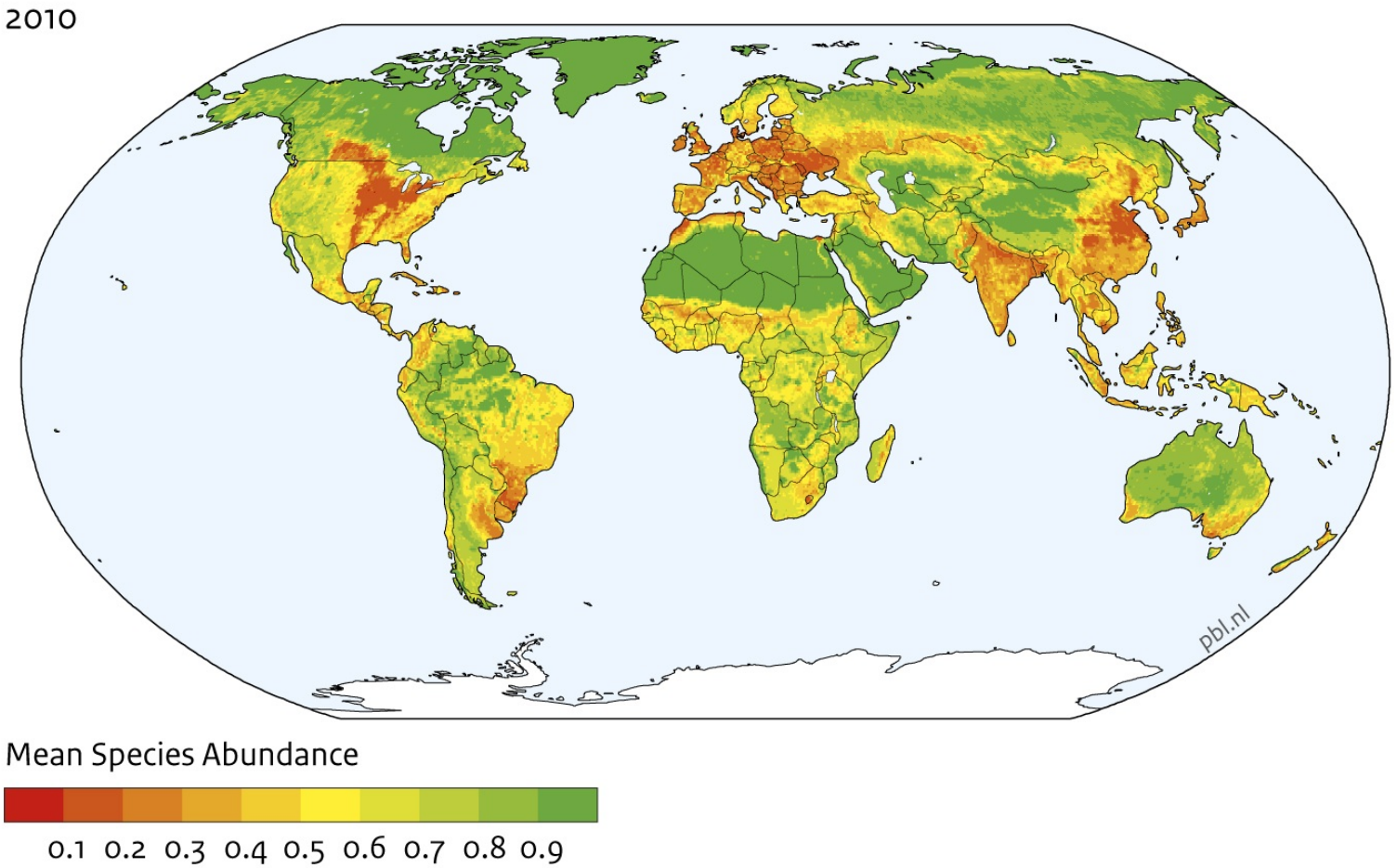






Global application

Impacts on biodiversity, 1970 – 2050



Source: PBL

Global application

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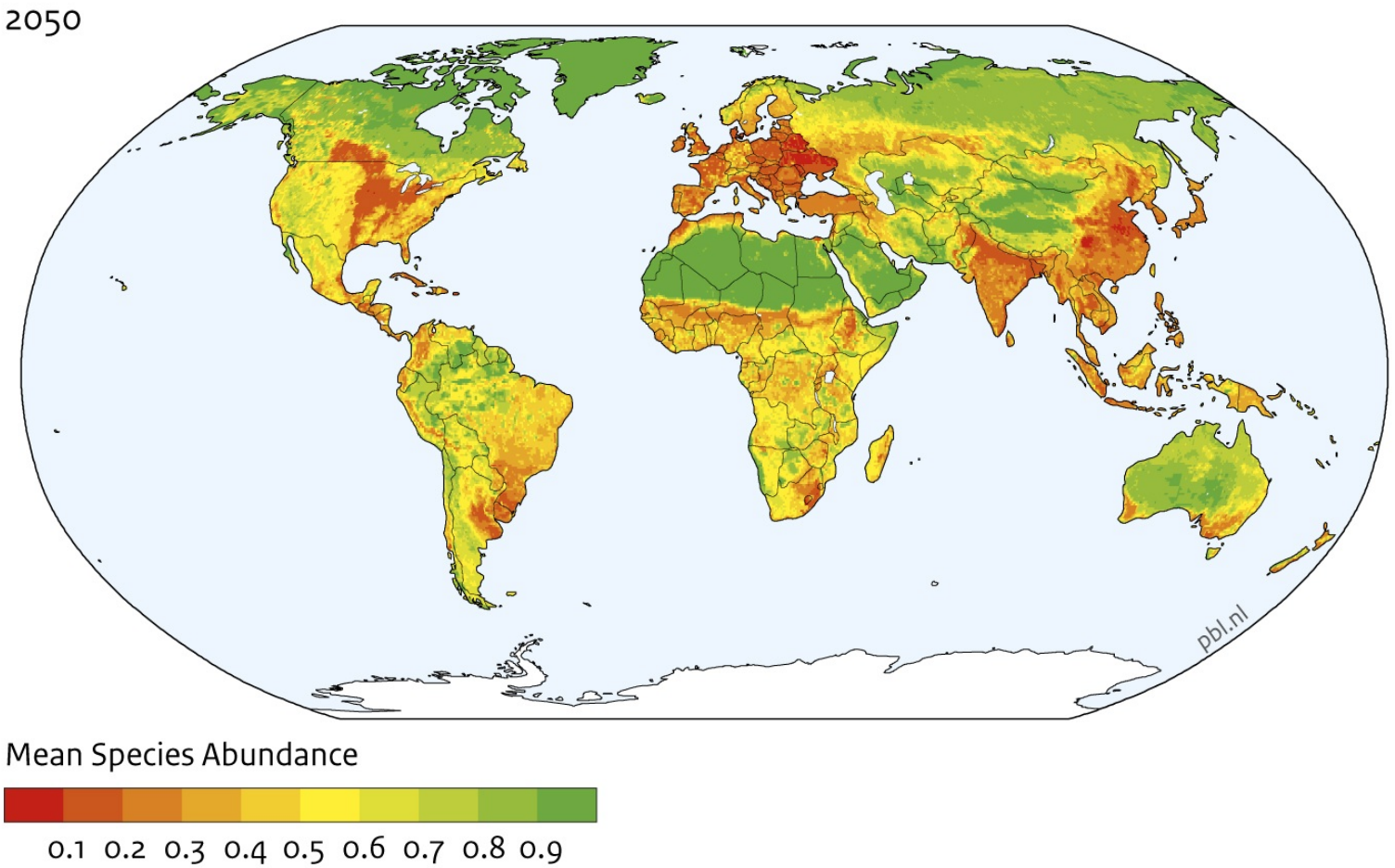
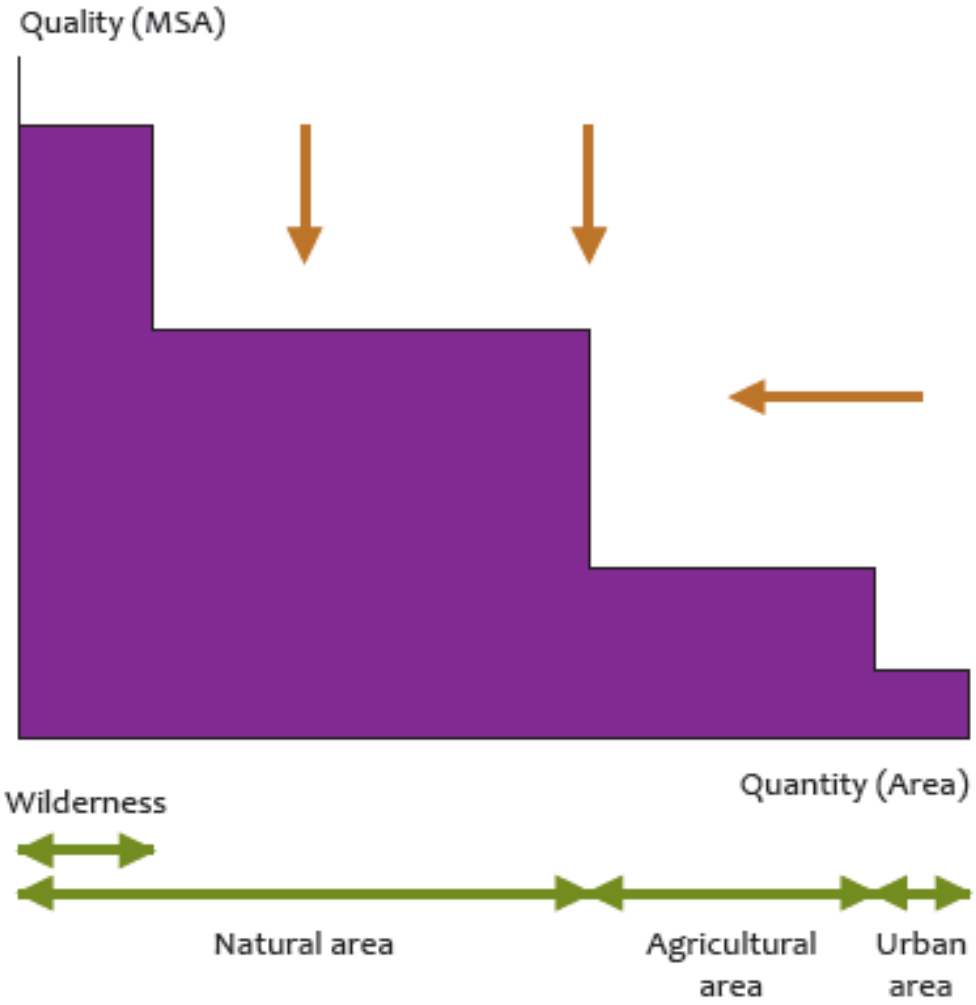
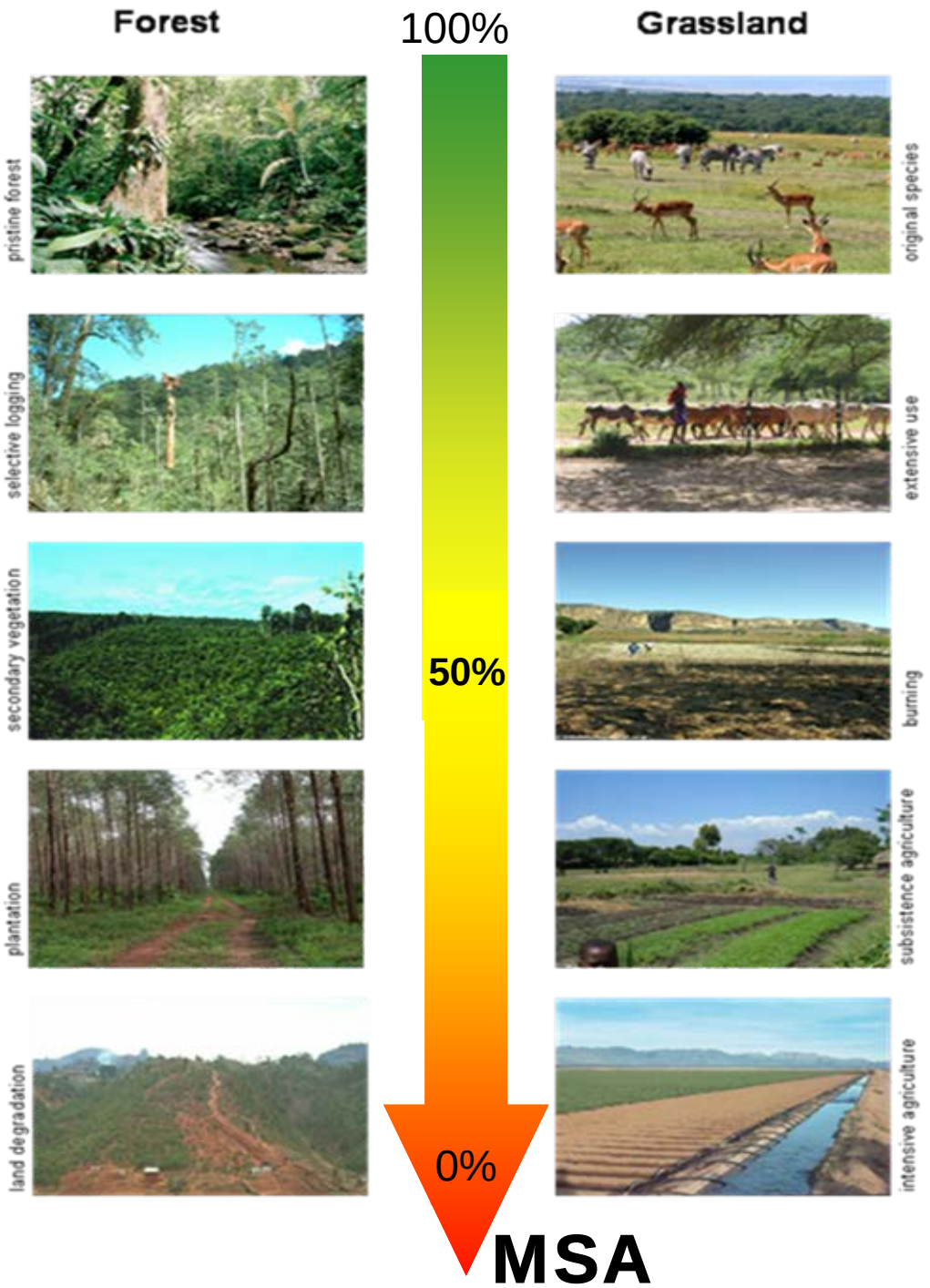


Source: PBL

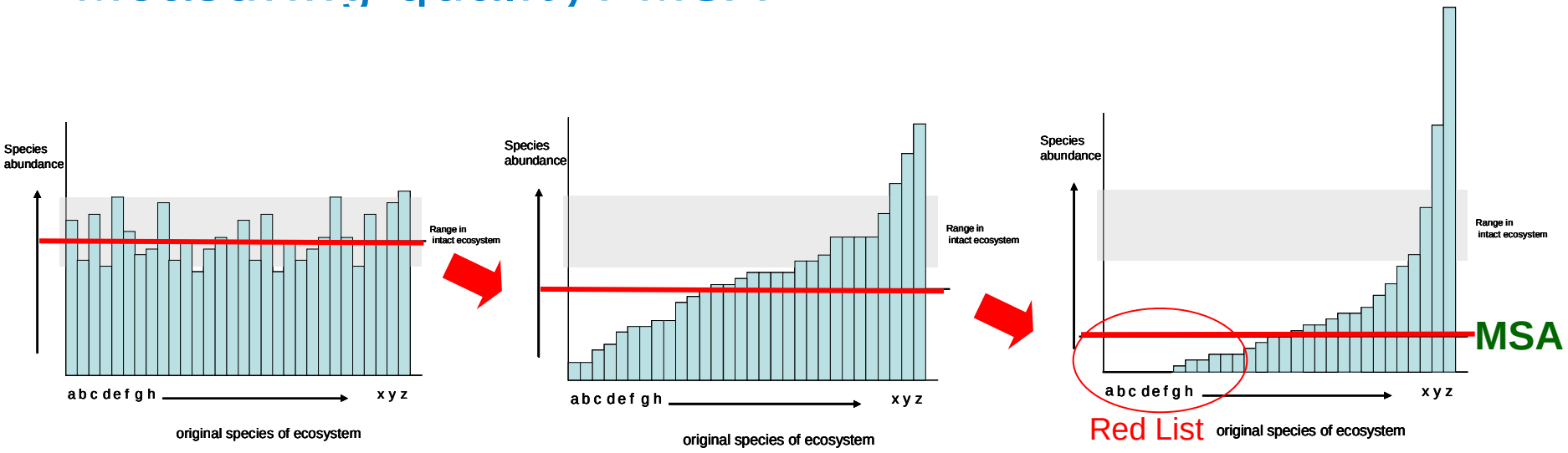
Ecosystem condition: Area * quality




1 undisturbed
Climate regulation
Energy
Freshwater
Soil protection
Food
2 extensive
Climate regulation
Energy
Freshwater
Soil protection
Food
3 intensive
Climate regulation
Energy
Freshwater
Soil protection
Food
4 degraded
Climate regulation
Energy
Freshwater
Soil protection
Food


Forest
100%
Grassland
pristine forest
original species
selective logging
extensive use
secondary vegetation
50%
burning
plantation
subsistence agriculture
land degradation
intensive agriculture
0%
MSA

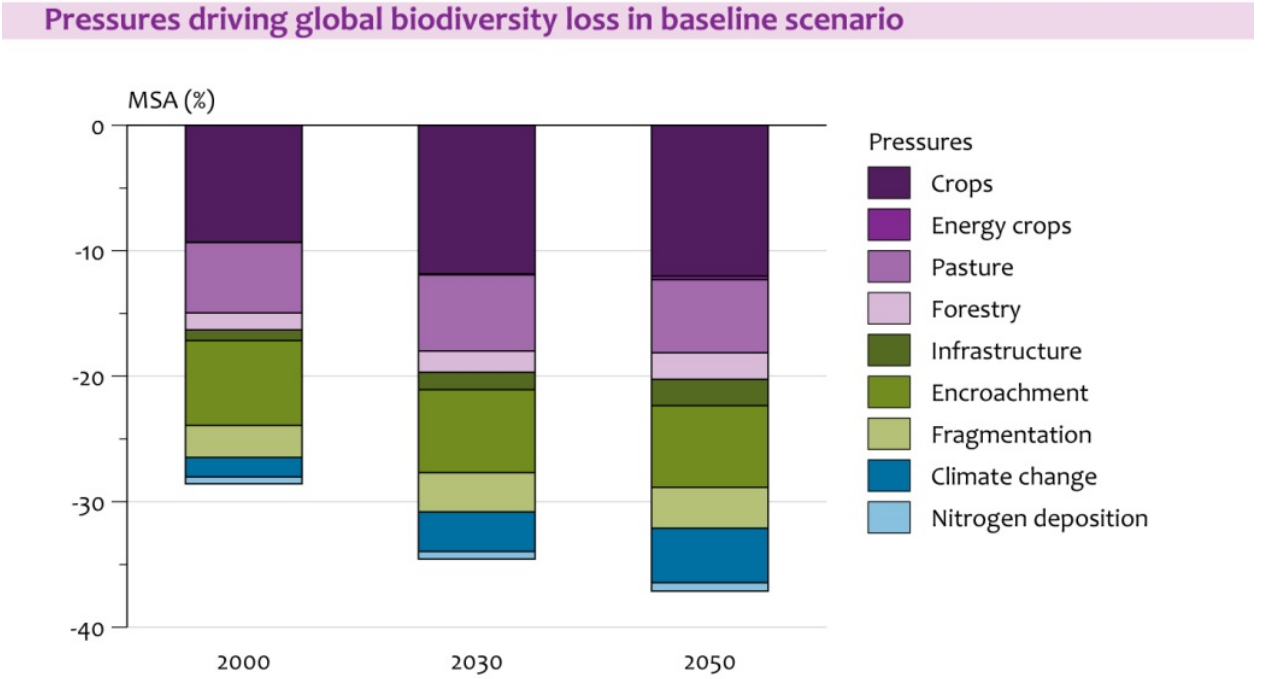
Measuring quality: MSA



- Baseline is 100%, species abundance in undisturbed situation
- Non-original species are excluded, original species topped off at 100%
- Average response of *total* set of species
- Measure of ecosystem condition (intactness)

Why driver-pressure based?

- Monitoring not everywhere available, costly to set up measurement campaigns and networks
- Interested in the process of change
- Therefore, model state of ecosystems from existing information



- MSA able to scale different pressures to common indicator

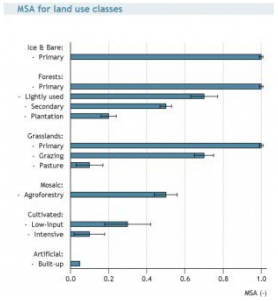
Environmental pressures included in GLOBIO3

Effect of pressures on MSA value:

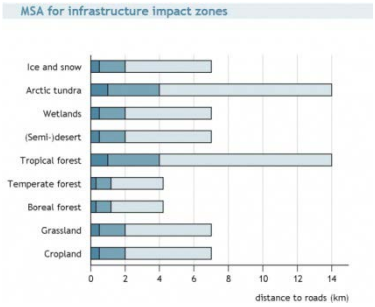
1. Land-use change (agriculture expansion, forestry)
2. Infrastructure & settlement
3. Fragmentation
4. Climate change
5. N-deposition

Cause – effect relations for each pressure based on meta-analysis of literature.

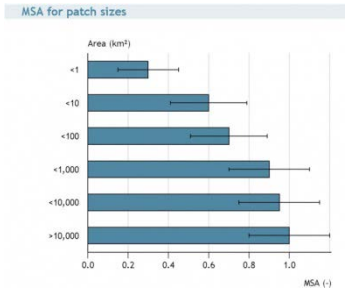
Land use change



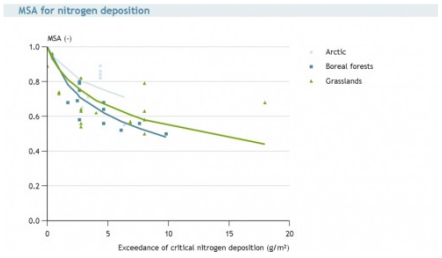
Infrastructure



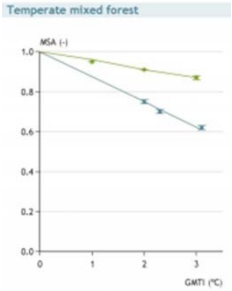
Fragmentation



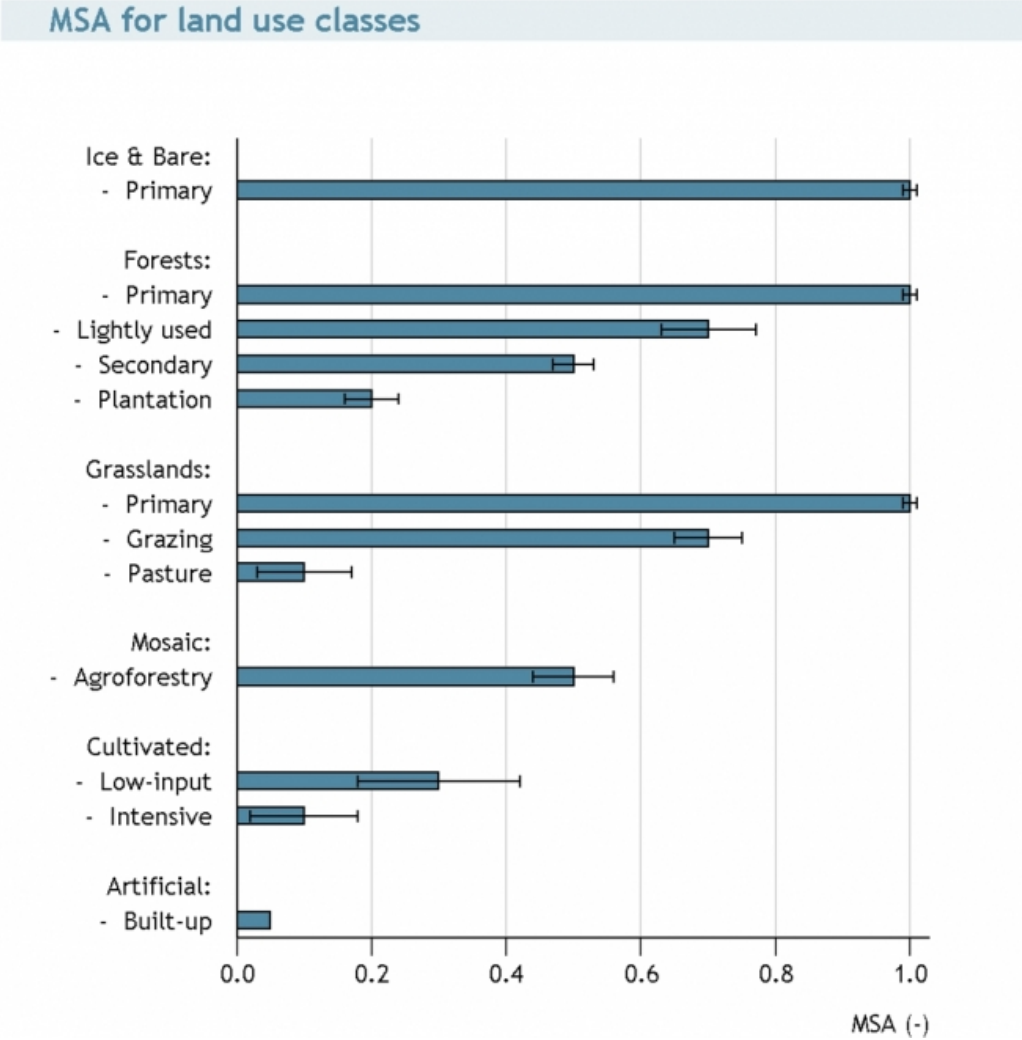
Atmosph nitrogen depos.



Climate (ex. biome)

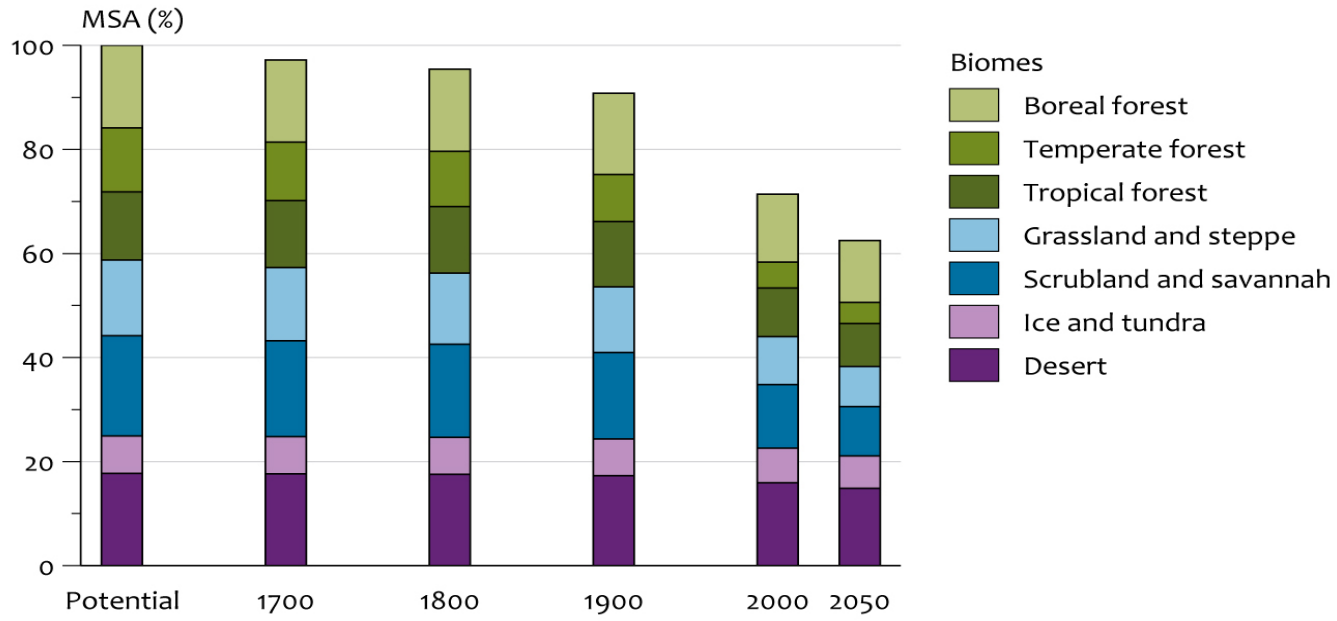


- Meta-analysis of scientific literature
- Comparisons between undisturbed state and categories of land use



Output

Global MSA in baseline scenario



- MSA values per grid cell (quality and extent)
- Per pressure contribution to change in MSA

- Beware of the interactions and double-counting
- Which are most important in linking to ESS?

Figure 1 Ecosystem condition as represented by the SEEA-EEA

Table 4.3 Measures of ecosystem condition and extent at end of accounting period for an EAU

	Ecosystem extent	Characteristics of ecosystem condition				
		Vegetation	Biodiversity	Soil	Water	Carbon
	Area	Indicators (e.g. Leaf area index, biomass, mean annual increment)	Indicators (e.g. species richness, relative abundance)	Indicators (e.g. soil organic matter content, soil carbon, groundwater table)	Indicators (e.g. river flow, water quality, fish species)	Indicators (e.g. net carbon balance, primary productivity)
Type of LCEU						
Forest tree cover						
Agricultural land*						
Urban and associated developed areas						
Open wetlands						

* Medium to large fields rainfed herbaceous cropland

Criteria for models

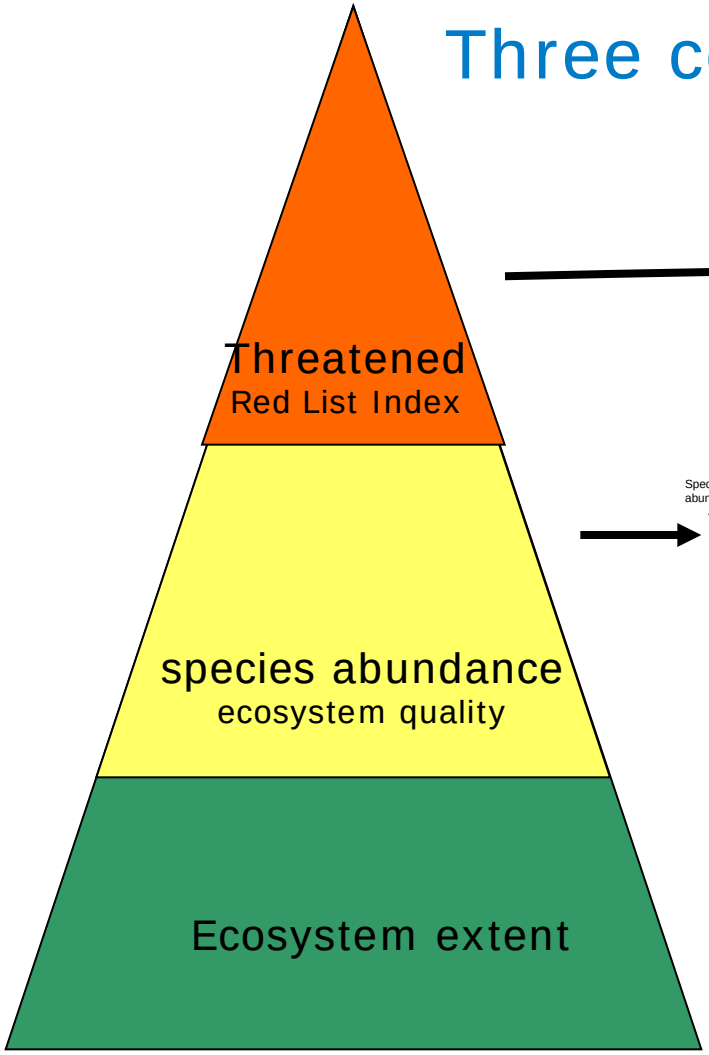
- Bagstad (2013) criteria for models to be used to measure ESS in ecosystem accounting:
  - quantification and uncertainty, time requirements, capacity for independent application, generalizability, non-monetary and cultural perspective, affordability, insights and integration with existing environmental assessment.
- Also think of criteria for the metrics and indicators:

TABLE 6: Set of headline indicators agreed on by the Conference of the Parties to the CBD through decision VII/30 and VIII/15

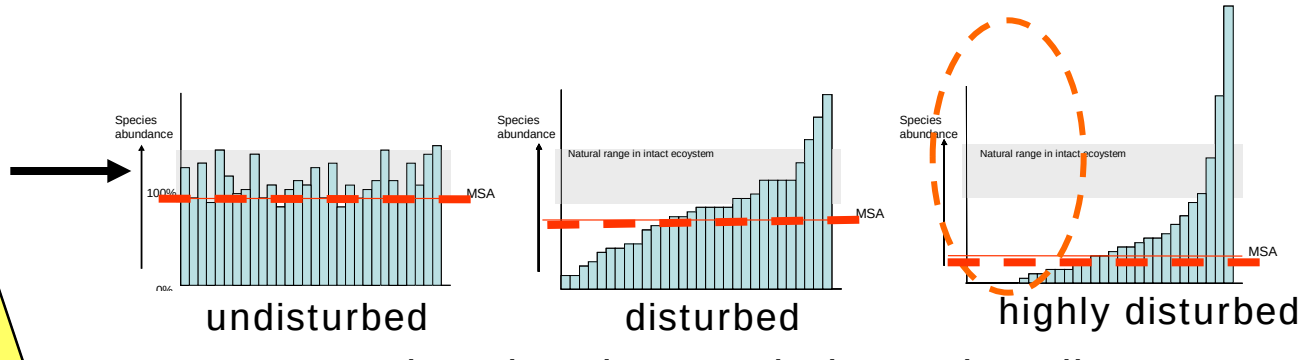
FOCAL AREA	INDICATOR
Status and trends of the components of biological diversity	• **Trends in extent of selected biomes, ecosystems, and habitats** • **Trends in abundance and distribution of selected species** • **Coverage of protected areas** • Change in status of threatened species • Trends in genetic diversity of domesticated animals, cultivated plants, and fish species of major socioeconomic importance
Sustainable use	• Area of forest, agricultural and aquaculture ecosystems under sustainable management • Proportion of products derived from sustainable sources • Ecological footprint and related concepts
Threats to biodiversity	• **Nitrogen deposition** • Trends in invasive alien species
Ecosystem integrity and ecosystem goods and services	• Marine Trophic Index • Water quality of freshwater ecosystems • Trophic integrity of other ecosystems • Connectivity / fragmentation of ecosystems • Incidence of human-induced ecosystem failure • Health and well-being of communities who depend directly on local ecosystem goods and services • Biodiversity for food and medicine
Status of traditional knowledge, innovations and Practices	• Status and trends of linguistic diversity and numbers of speakers of indigenous languages • Other indicator of the status of indigenous and traditional knowledge
Status of access and benefit-sharing	• *Indicator of access and benefit-sharing*
Status of resource transfers	• **Official development assistance provided in support of the Convention** • Indicator of technology transfer

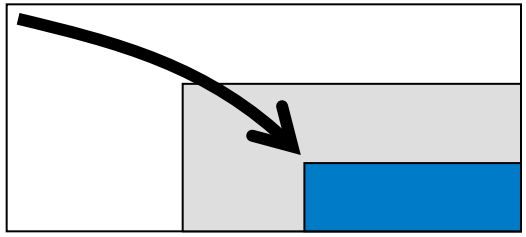
* Indicators shown in bold typeface have been assessed in this study. Indicators in italics are still in development.

Three complementary state indicators



RLI

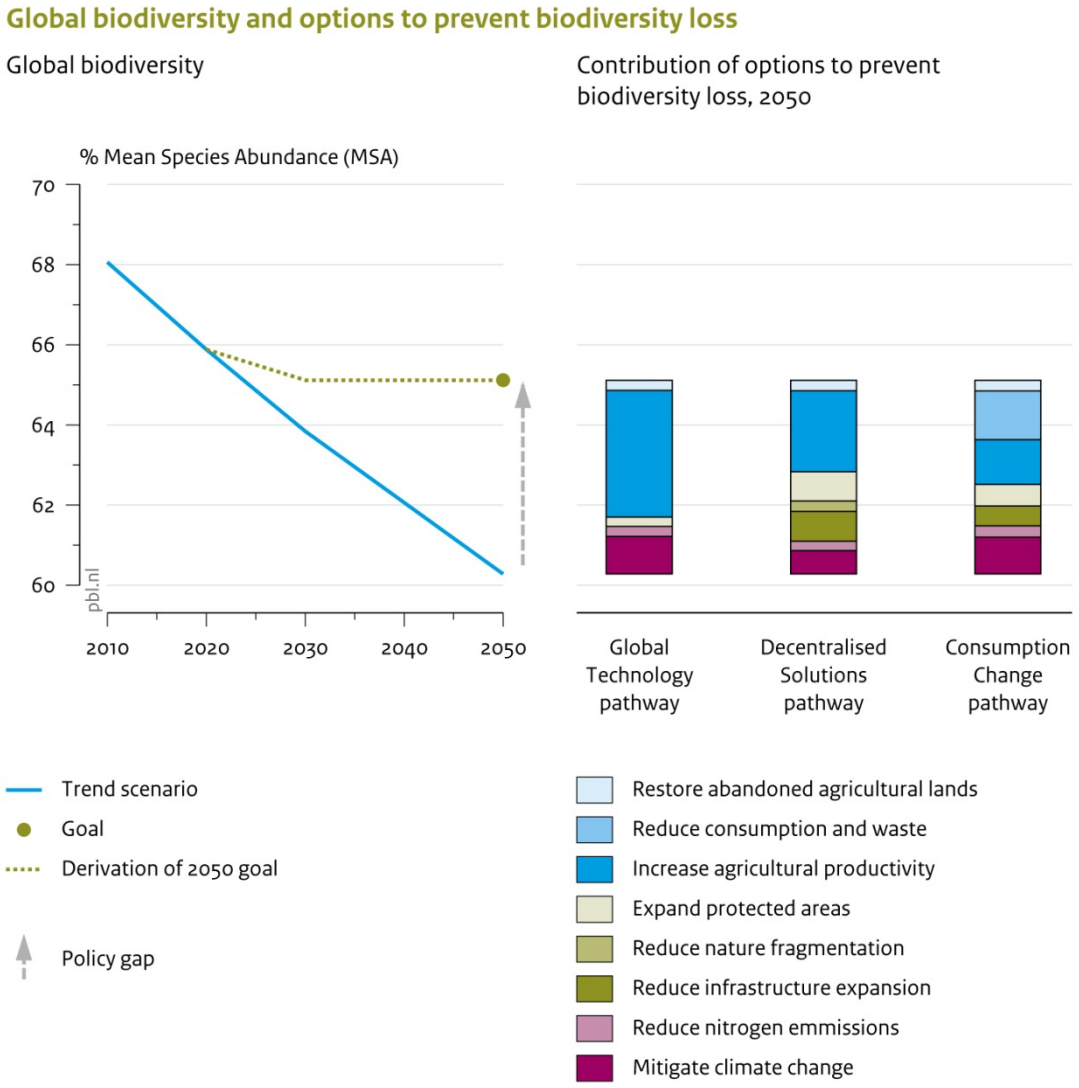




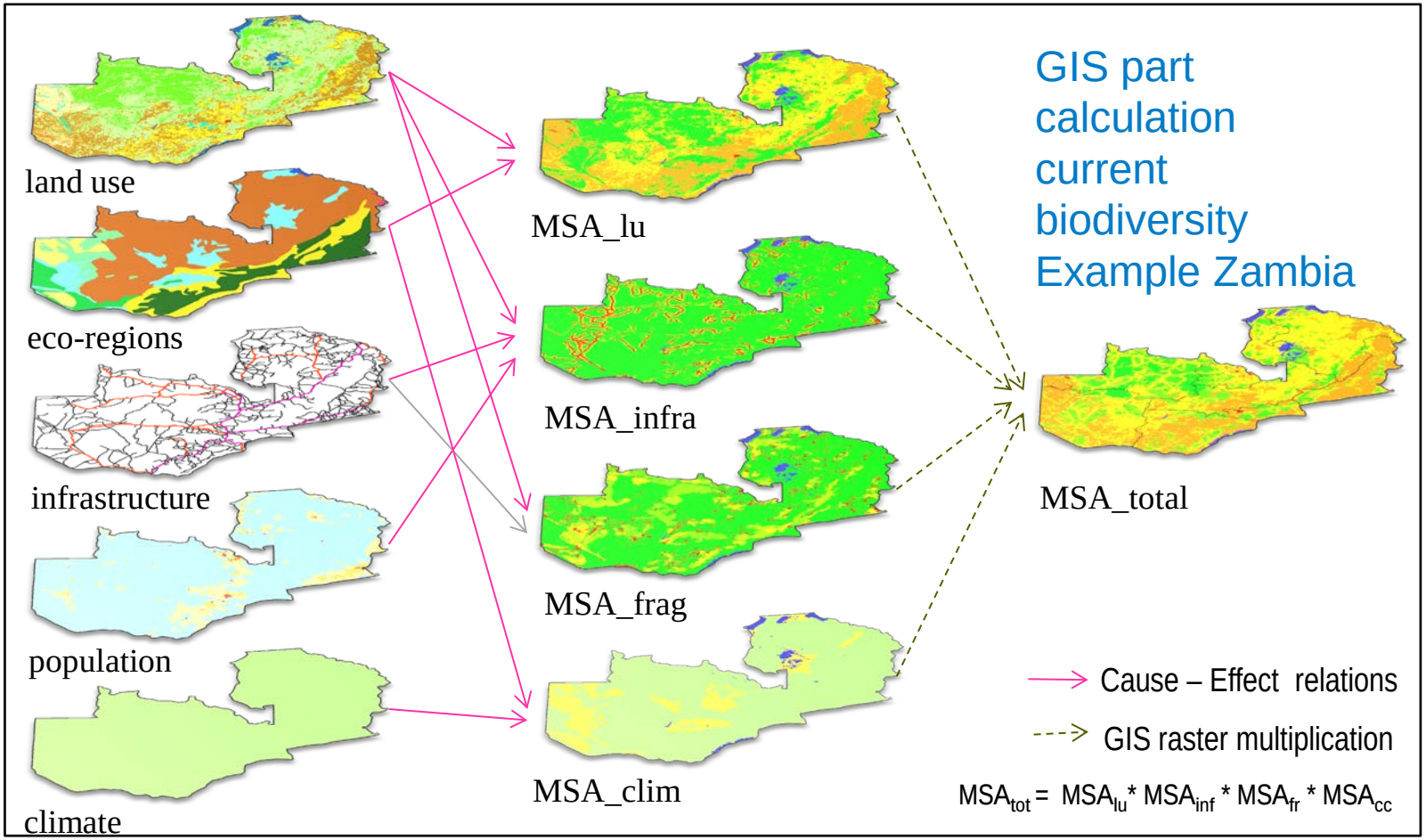
Habitat loss

Policy relevance

- Future projections (baseline)
- Provide order-of magnitude perception, and interactions between drivers
- Policy options based on changing drivers of loss



National applications

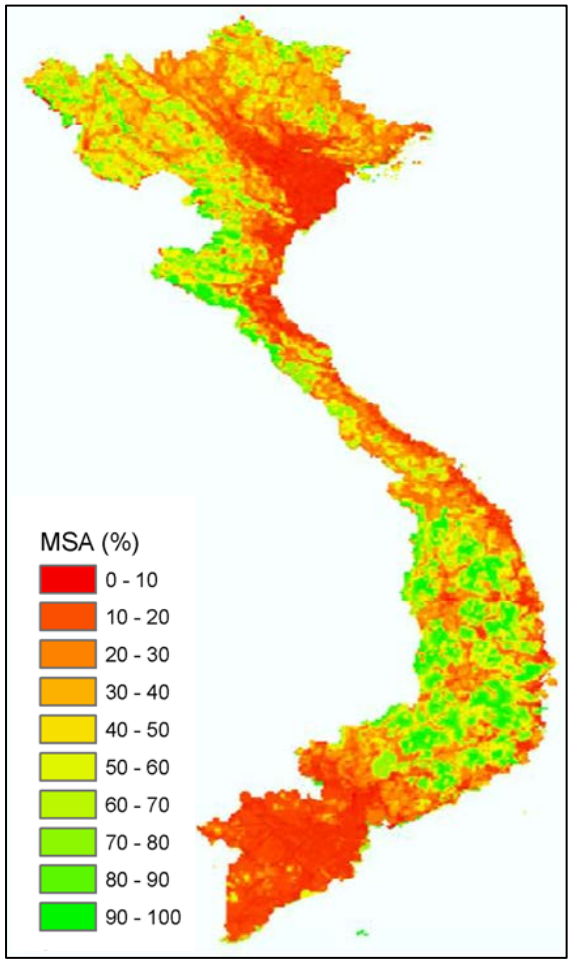


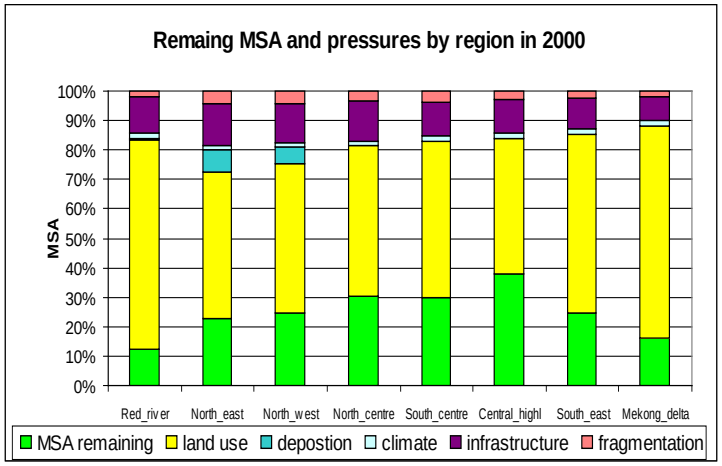
Input layers
(drivers / pressures)

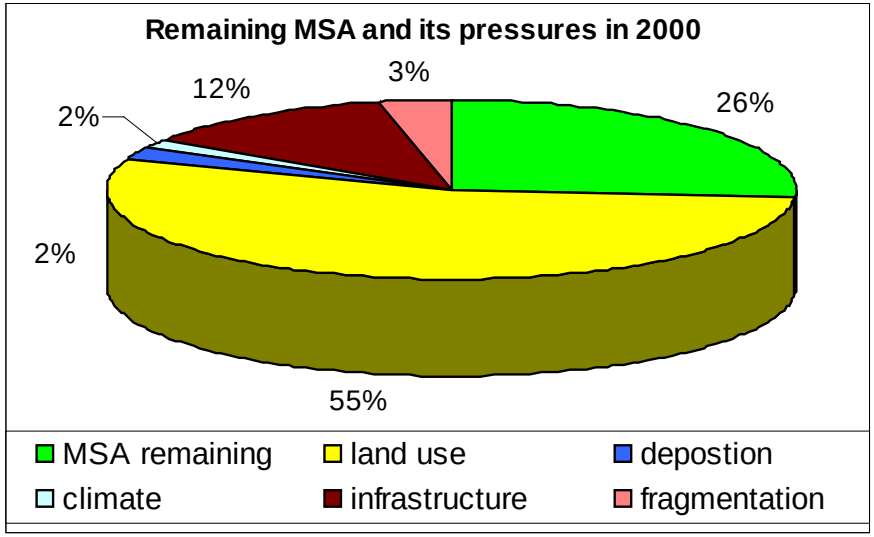
Intermediate output
Pressure impact

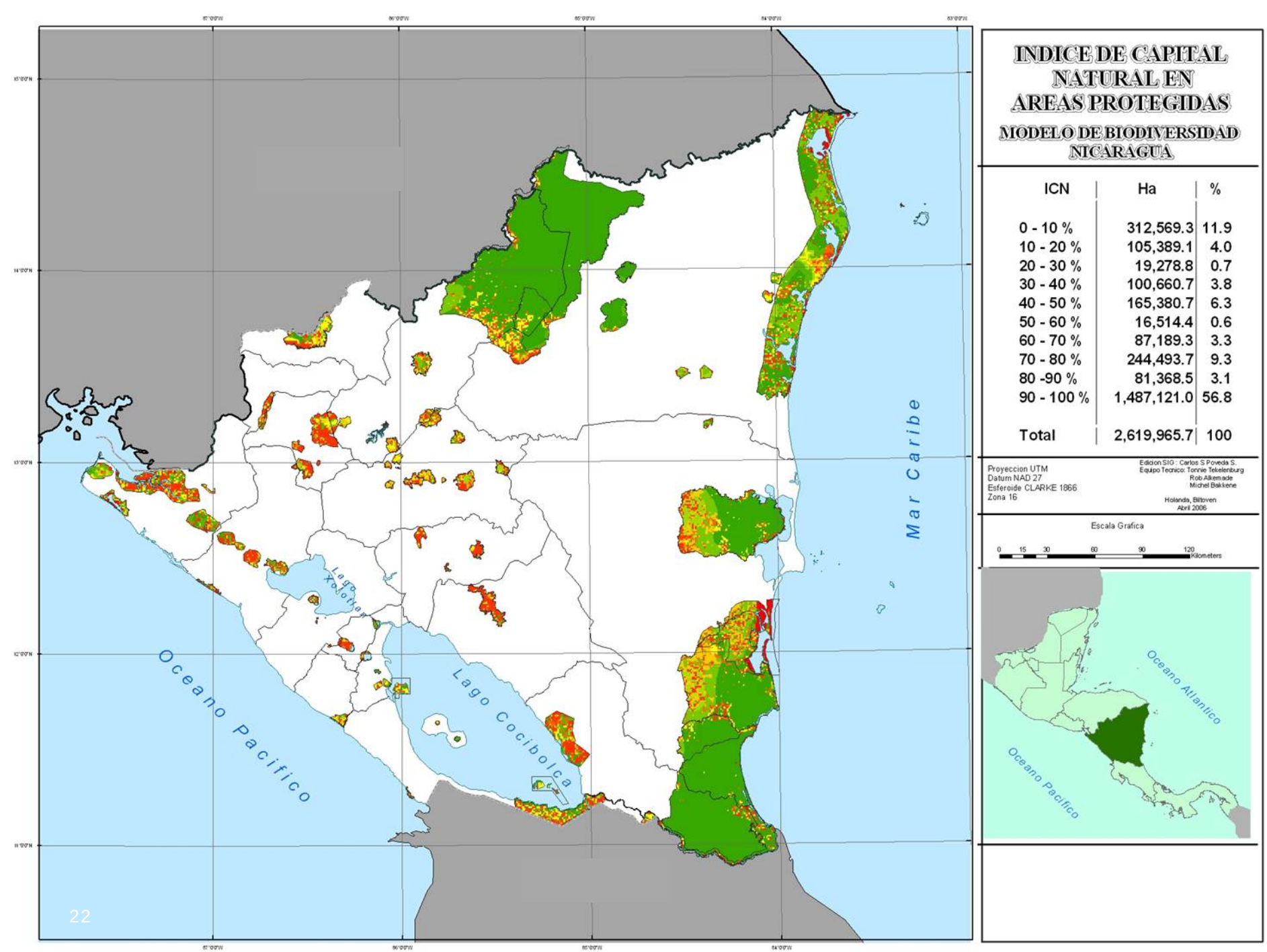
Output
Overall impact pressures

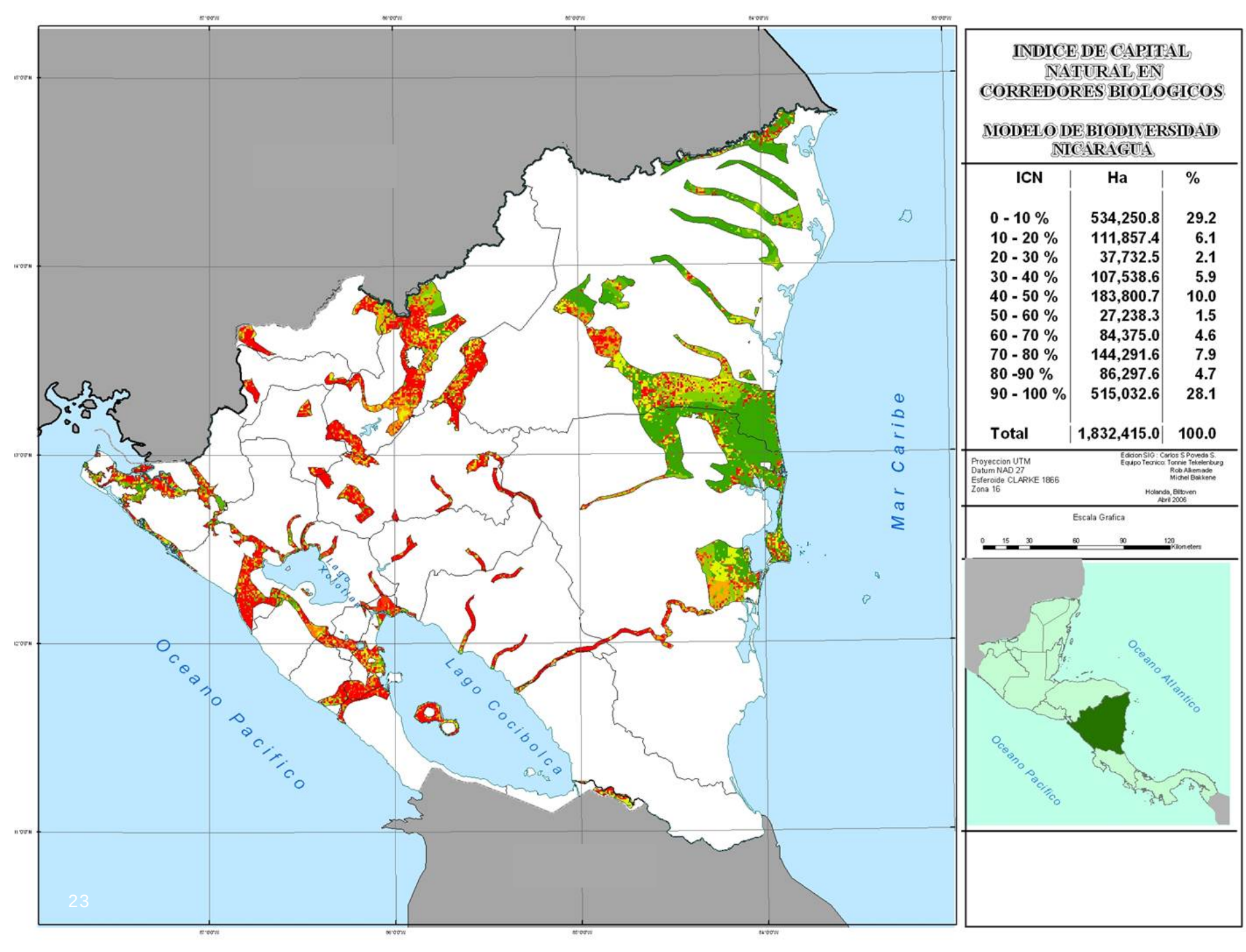
National applications








INDICE DE CAPITAL NATURAL EN AREAS PROTEGIDAS
MODELO DE BIODIVERSIDAD NICARAGUA
ICN | Ha | %
0 - 10 % | 312,569.3 | 11.9
10 - 20 % | 105,389.1 | 4.0
20 - 30 % | 19,278.8 | 0.7
30 - 40 % | 100,660.7 | 3.8
40 - 50 % | 165,380.7 | 6.3
50 - 60 % | 16,514.4 | 0.6
60 - 70 % | 87,189.3 | 3.3
70 - 80 % | 244,493.7 | 9.3
80 -90 % | 81,368.5 | 3.1
90 - 100 % | 1,487,121.0 | 56.8
Total | 2,619,965.7 | 100
Proyeccion UTM
Datum NAD 27
Esferoide CLARKE 1866
Zona 16
Edicion SIG : Carlos S Poveda S.
Equipo Tecnico: Tonnie Tekelenburg
Rob Alkemade
Michel Bakkene
Holanda, Biltoven
Abril 2006
Escala Grafica
0 15 30 60 90 120
Kilometers
Mar Caribe
Oceano Pacifico
Lago Xolotlan
Lago Cocibolca
Oceano Atlantico
Oceano Pacifico


INDICE DE CAPITAL NATURAL EN CORREDORES BIOLOGICOS
MODELO DE BIODIVERSIDAD NICARAGUA
ICN | Ha | %
0 - 10 % | 534,250.8 | 29.2
10 - 20 % | 111,857.4 | 6.1
20 - 30 % | 37,732.5 | 2.1
30 - 40 % | 107,538.6 | 5.9
40 - 50 % | 183,800.7 | 10.0
50 - 60 % | 27,238.3 | 1.5
60 - 70 % | 84,375.0 | 4.6
70 - 80 % | 144,291.6 | 7.9
80 -90 % | 86,297.6 | 4.7
90 - 100 % | 515,032.6 | 28.1
Total | 1,832,415.0 | 100.0
Proyeccion UTM
Datum NAD 27
Esferoide CLARKE 1866
Zona 16
Edicion SIG : Carlos S Poveda S.
Equipo Tecnico: Tonnie Tekelenburg
Rob Alkemade
Michel Bakkene
Holanda, Biltoven
Abril 2006
Escala Grafica
0 15 30 60 90 120 Kilometers
Oceano Atlantico
Oceano Pacifico
Mar Caribe
Oceano Pacifico
Lago Cocibolca
Lago Xolotlan

National application: Adjusting MSA values of land use classes with the help of expert knowledge

Original GLOBIO 3 Land Use MSA value table

Biodiv class name	MSA value
Primary forests	1.0
Forest plantations	0.2
Secondary forests	0.5
Light used primary forests	0.7
Agro forestry	0.5
Extensive agriculture	0.3
Irrigated intensive agriculture	0.05
Intensive agriculture	0.1
Perennials & bio fuels	0.2
Natural grass & shrub lands	1.0
Man made pastures	0.1
Livestock grazing	0.7
Natural Bare, rock & snow	1.0
Natural inland water	null
Artificial water	null
River/stream	null
Built up areas	0.05

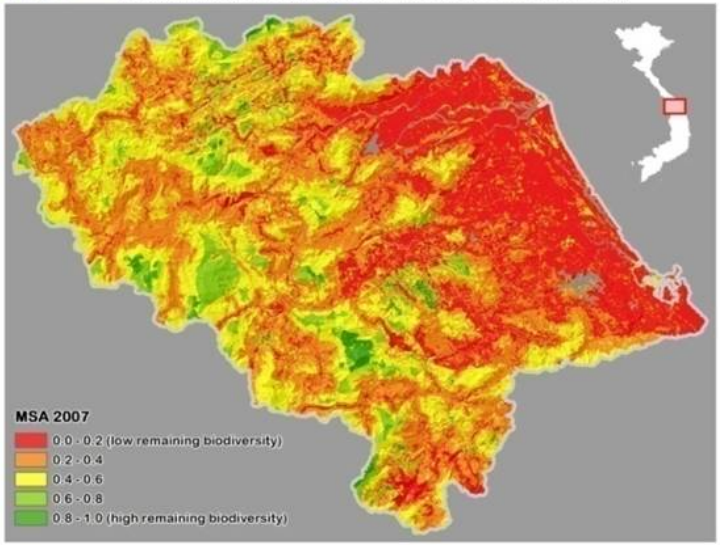
Adjustment of values

Based on local expertise

Vietnam adapted Land Use MSA value table

Code	Lu original (2002)	Local MSA value
10	Natural Timber Forest	0.9
11	Rich Forest	1
12	Medium Forest	0.8
13	Poor Forest	0.6
20	Young Forest	0.55
21	Reforestation Rich	0.45
22	Reforestation Medium	0.4
23	Young forest with volume	0.55
24	Young forest with no volume	0.45
31	Dipterocarp forest (deciduous)	0.95
32	Semi- deciduous forest	0.95
41	Natural conifer forest	0.95
42	Mix forest (Broad leaf and conifer forest)	0.8
51	Bamboo forest	0.45
52	Mix forest (Timber+bamboo forest)	0.55
60	Mangrove forest	0.8
70	Plantation forest	0.2
71	Speciality forest	0.9

BIODIVERSITY PRESSURE MODELLING
QUANG NAM, VIET NAM: MEAN SPECIES ABUNDANCE 2007 (BASELINE)



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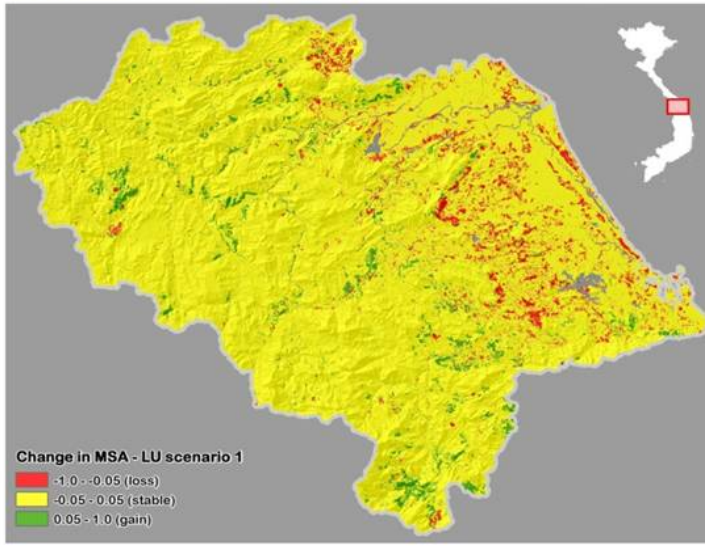
BIODIVERSITY PRESSURE MODELLING
QUANG NAM, VIET NAM: CHANGE IN MSA 2007-2020 (SCENARIO 1)



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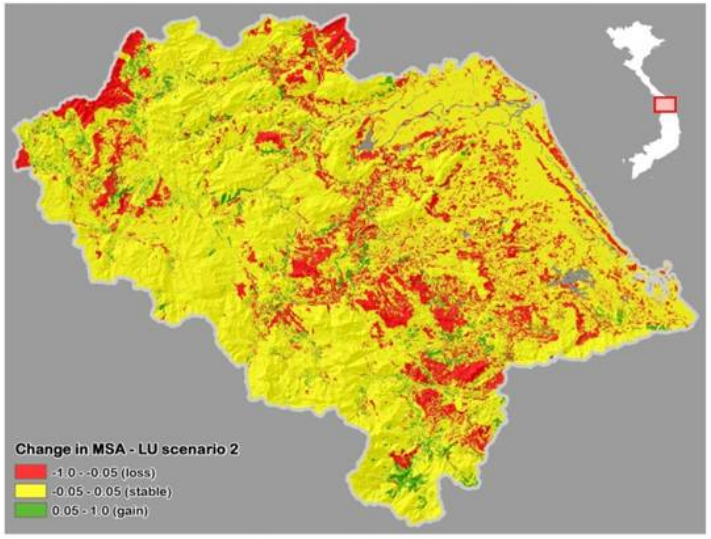
BIODIVERSITY PRESSURE MODELLING
QUANG NAM, VIET NAM: CHANGE IN MSA 2007-2020 (SCENARIO 2)



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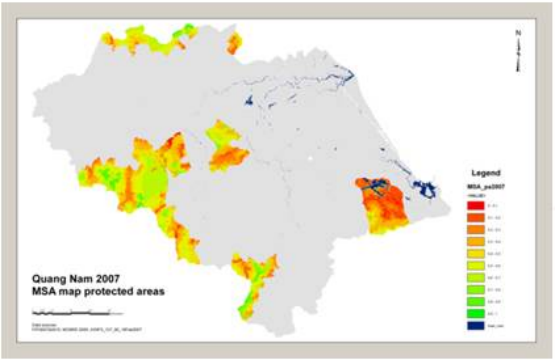
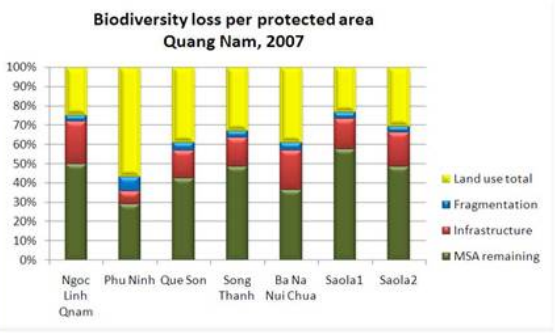
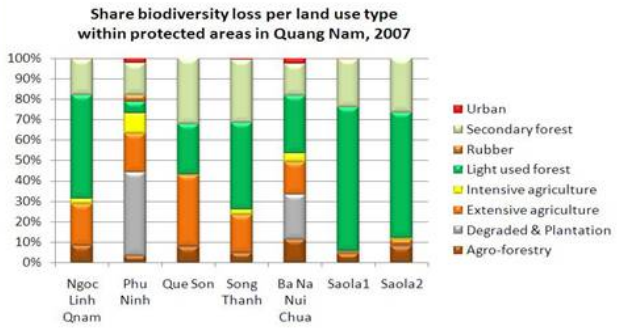
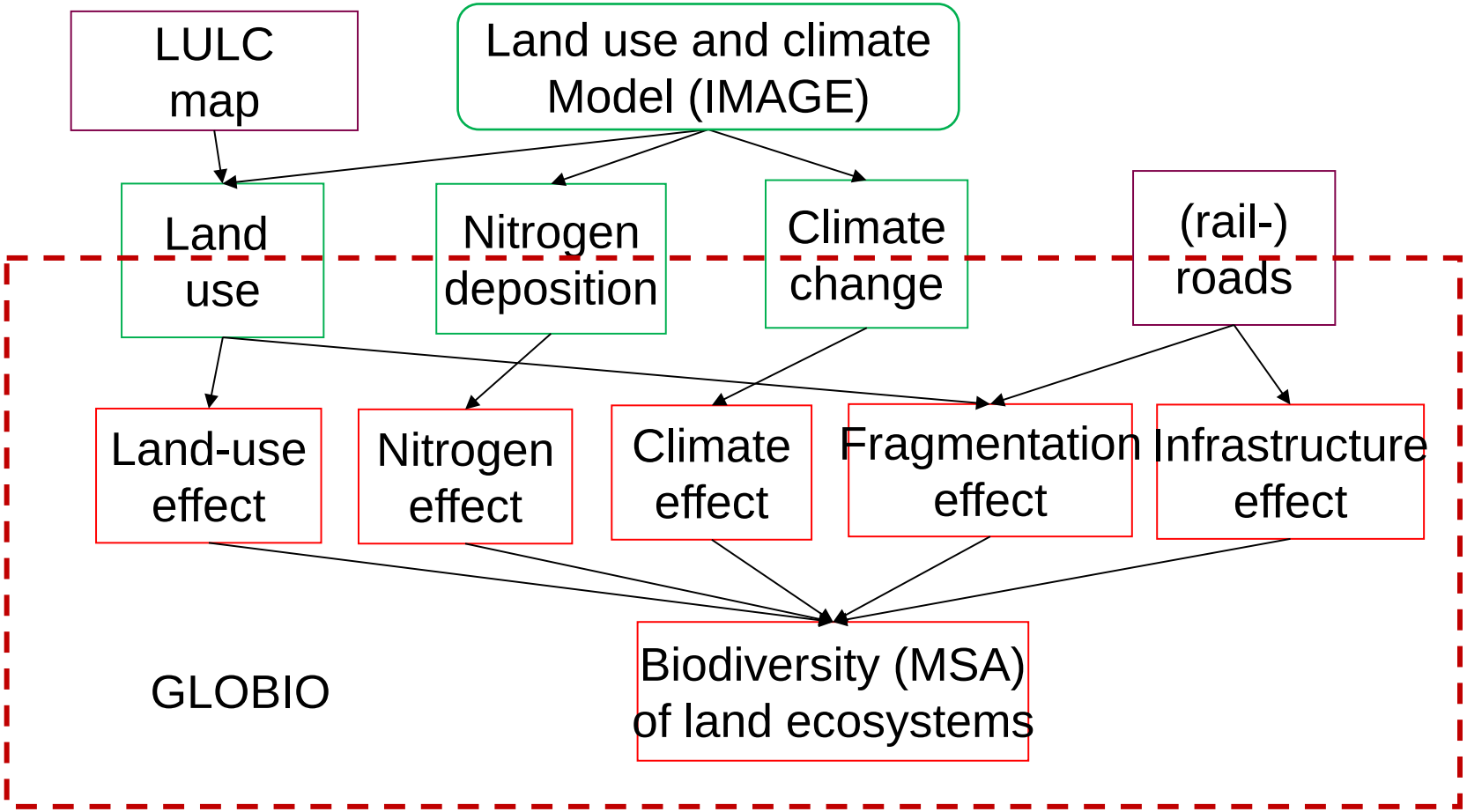






Input data required for GLOBIO3



Applied on different scales of analysis

- Assessments using GLOBIO3:
  - UNEP's Global Environment Outlook
  - CBD's Global Biodiversity Outlooks
  - OECD Environmental Outlook
  - TEEB (Rethinking and Quantitative Assessment)
  - 25 countries trained to use GLOBIO3
  - In 2013 three workshops (~60 countries total), sponsored by Japan and the Netherlands, capacity building GLOBIO3 application on national scale for 5th national report to CBD
- Model available for anyone (number of countries use own adaptations)
- Main work comes from creating the input (LULC maps mainly)
- Complications in use come with future projections; current state is not complicated

Creating a global baseline

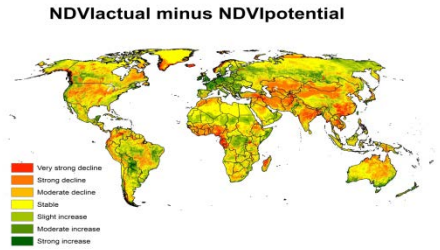
- Two ways to improve on our current global baseline:
  - More precise land use maps (country level) that use globally nested LULC categories (to maintain projection ability)
  - Improve and add MSA estimates for different LULC with regional experts
- Adaptable to national ambition levels; always zero-order available (current baseline)

Example Vietnam case

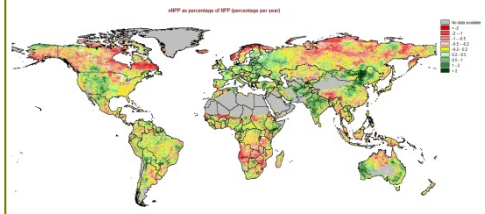
- Split the model into the parts per pressure type
- Resolution in GLOBIO set to 1*1 km
- National land use map with > 43 land classes, MSA values per land use class based on local expert knowledge

PBL workplan on Ecosystem services

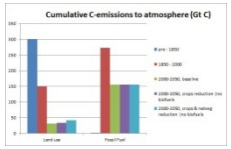
Degraded

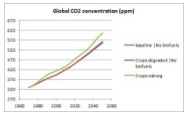


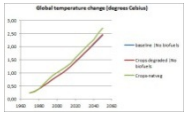
Degrading



Cstorage & climate







Water retention & floods

- Km3 soil water prist, LU, degra, to 2050
- Change in waterstress days
- Figure: Nr days/km2 flooded
- Map all year / seasonal rivers

Agri area & food

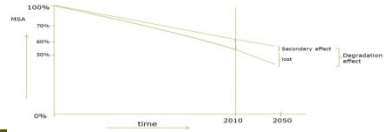
- Mln km2 arable / grazing
  good condition & degraded & abandoned & reserve, tot 2050 Stapel diagram
- Lost food production former & current agri land in Kcal & kg proteins tov potential, tot 2050

Forestry area & fiber

- Mln km2 forestry
  good condition & degraded & lost & reserve, tot 2050 Stapeldiagram
- Lost timber & fiber production
  former & current forestry land in m3 & tons per Y tov potential, tot 2050

Biodiversity

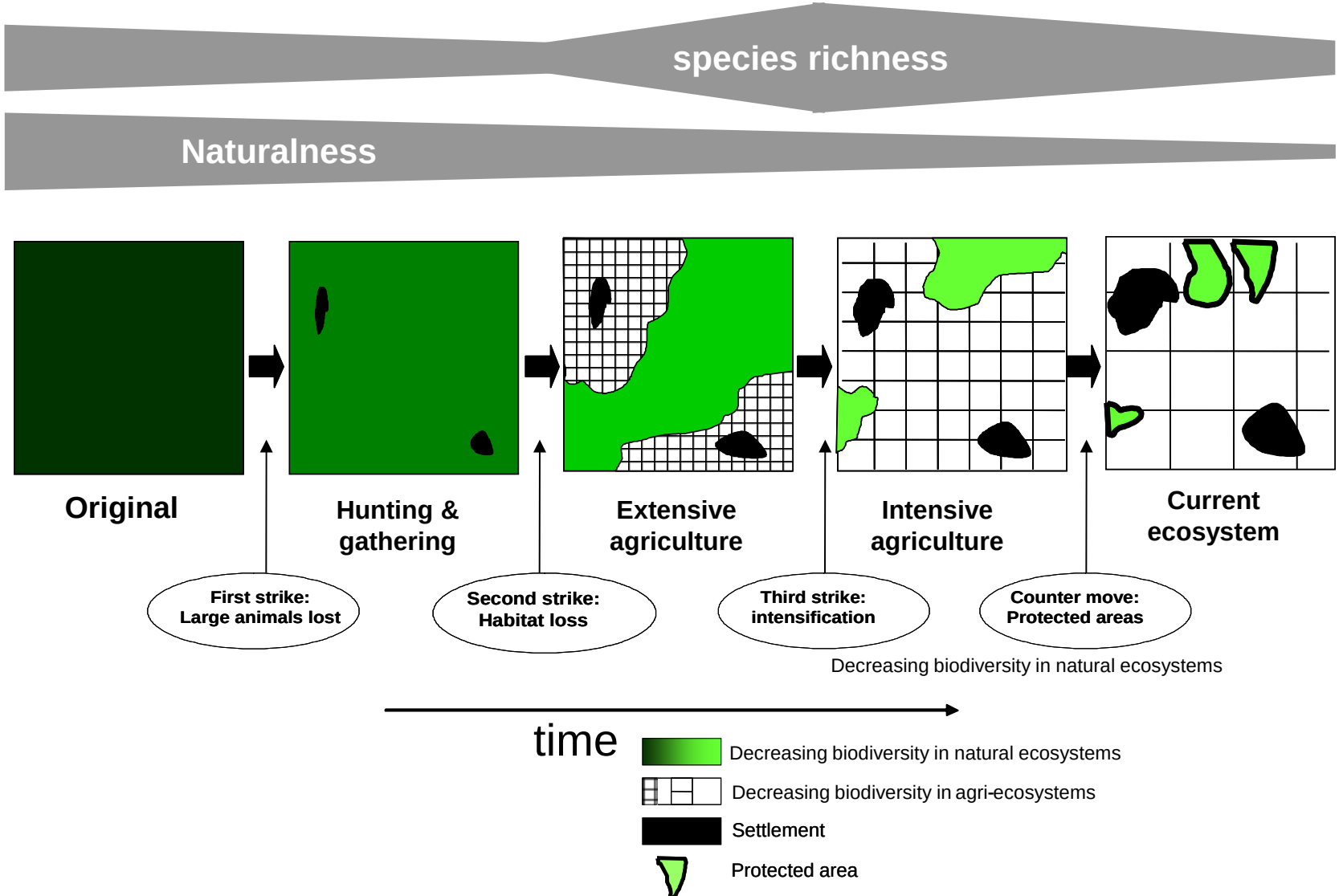
- Remaining MSA & loss due to agri, forestry, climate, infra/urban, Ndep, degradation from former LU & indirect from degradation from current LU



Environm dependency

- Map % prim sector/GDP
- Lost GDP due to degradation Map
- Figure: x-as 100- 0% env income
  y-as Nr people
- Nr of high env dependent people in degrading areas tot 205

Species richness vs. naturalness

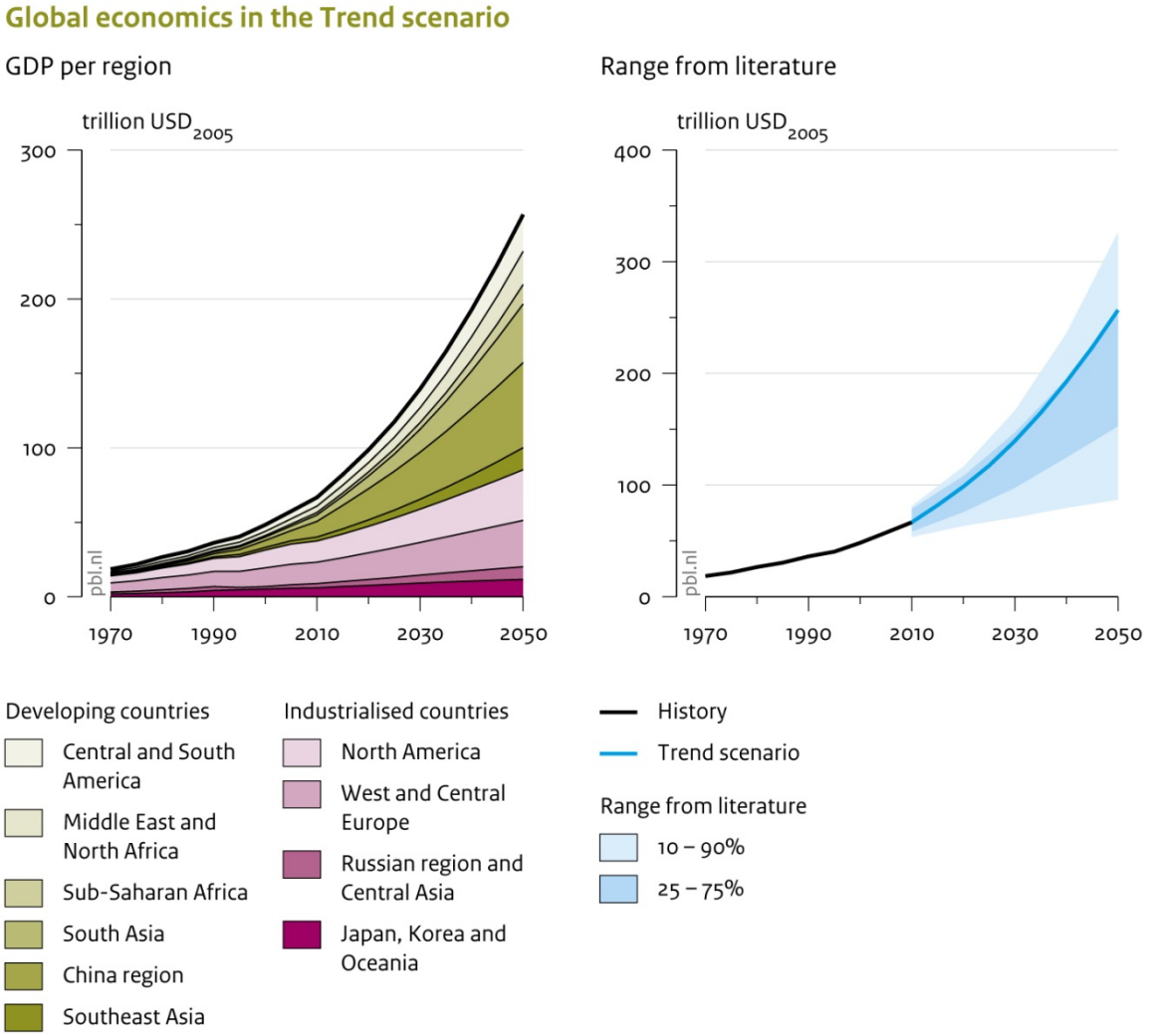


Recent PBL global assessments

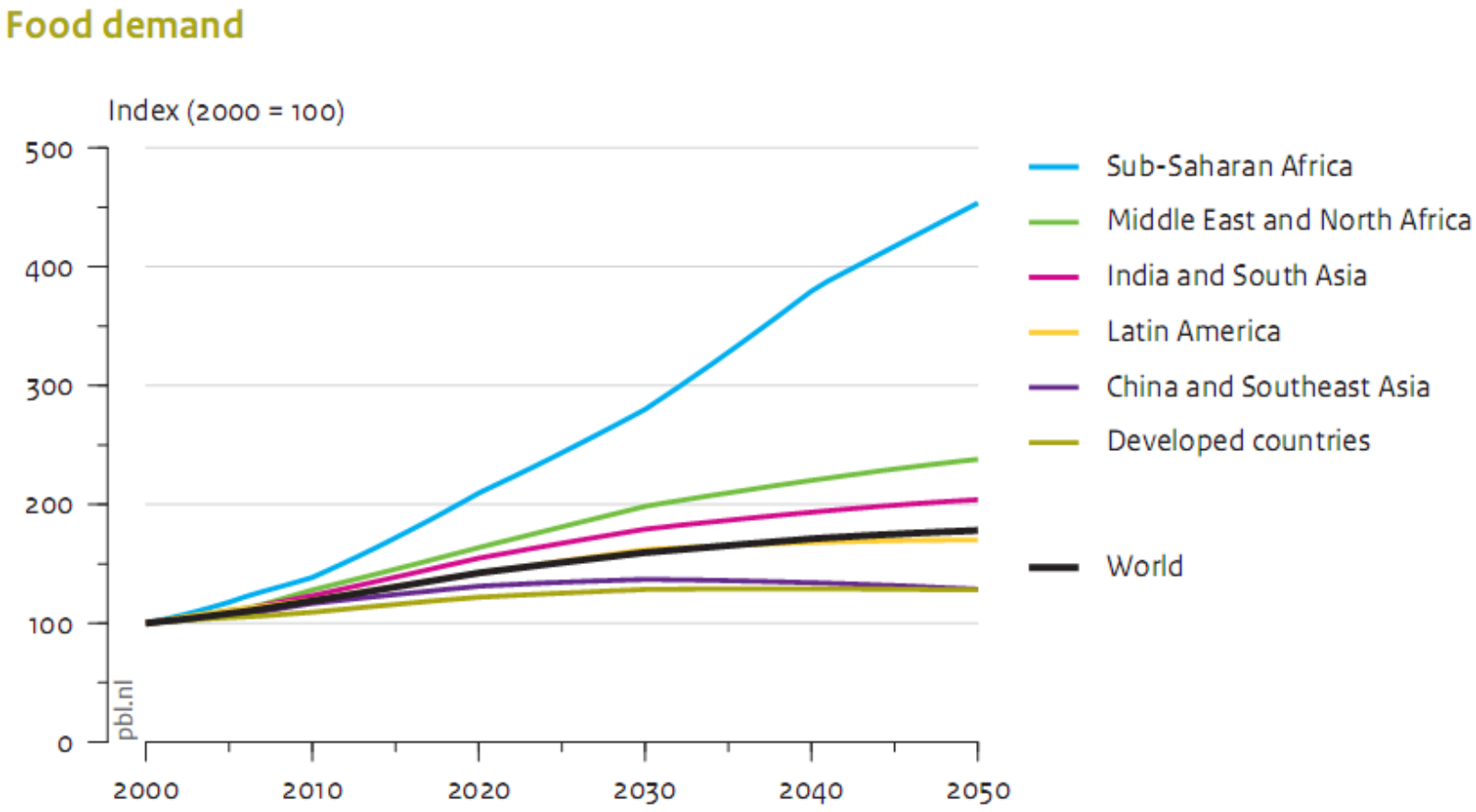
PBL global assessments aim to:

- Identify socio-economic and environmental trends
- Show interactions between trends
- Provide order-of-magnitude estimates of potential change
- Assess effects of alternative ‘options’ or system changes

Projections of accelerating economic growth

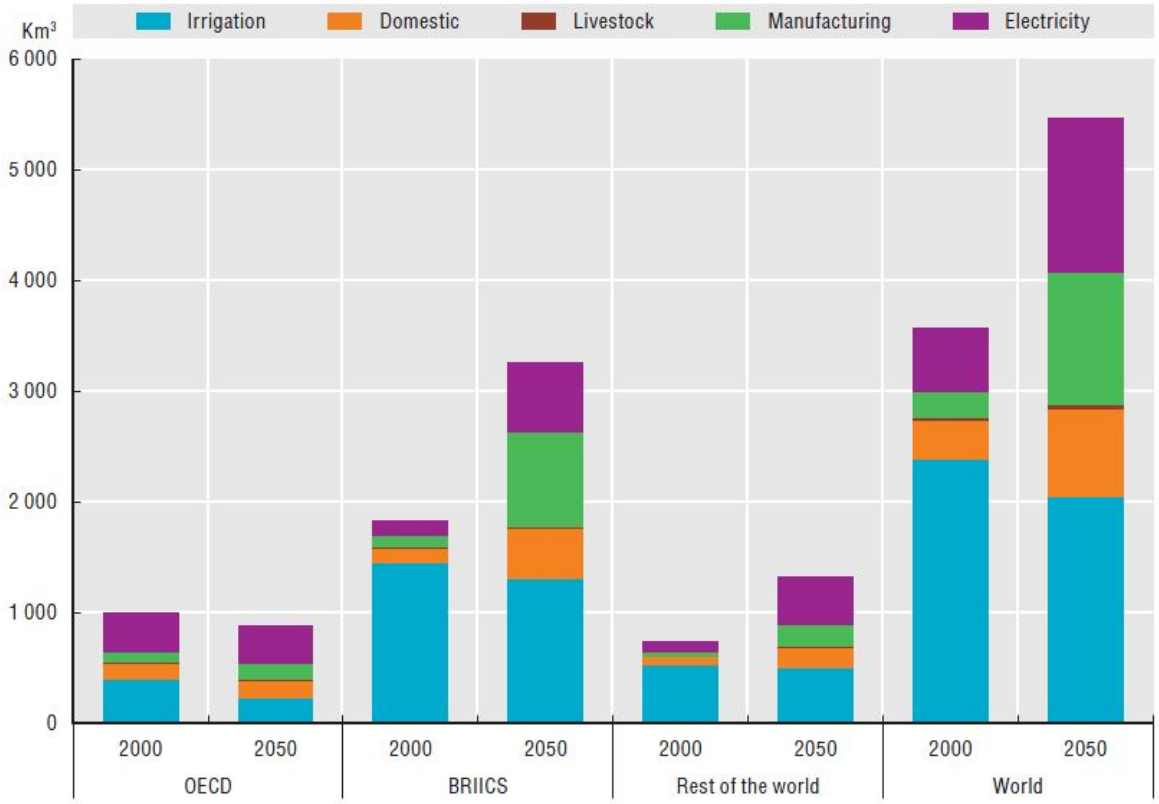


Projections of increased demands of food ....



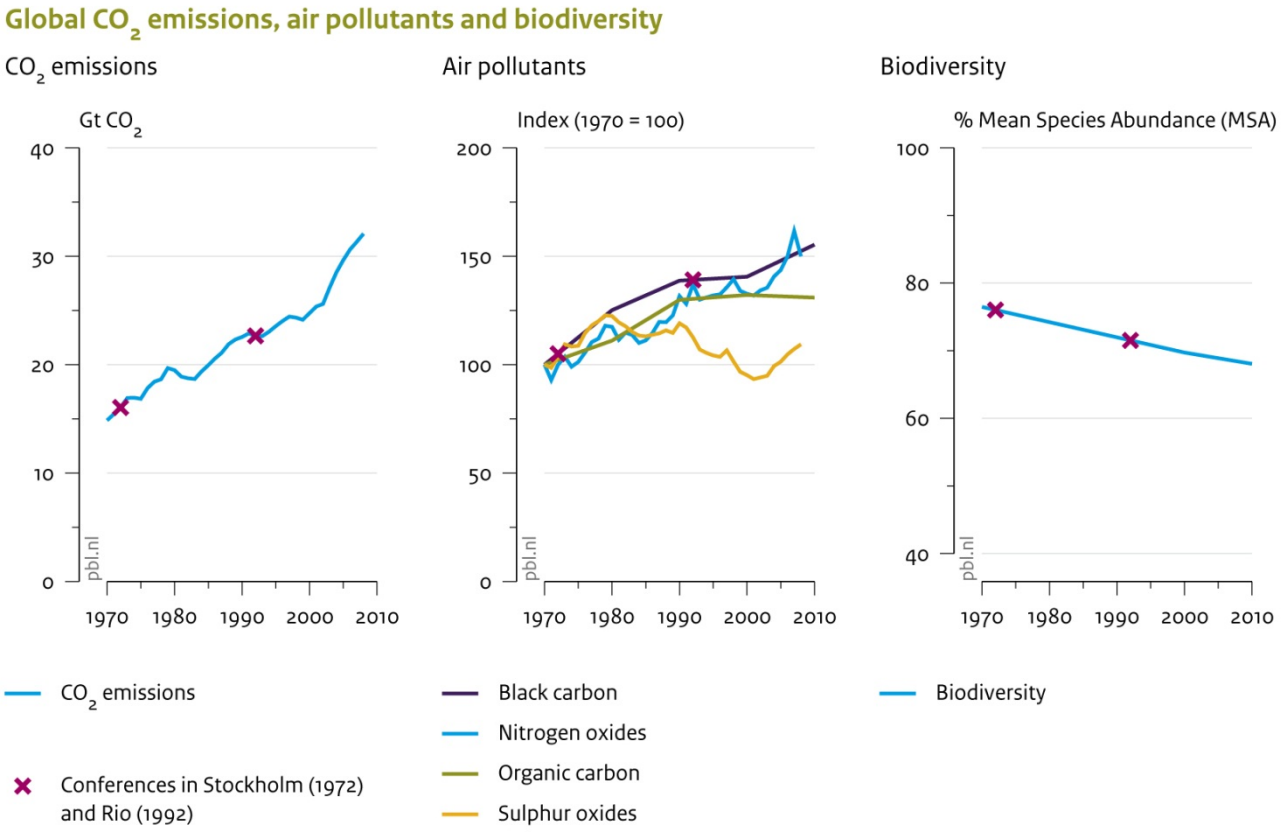
… and water

Figure 5.4. **Global water demand: *Baseline*, 2000 and 2050**



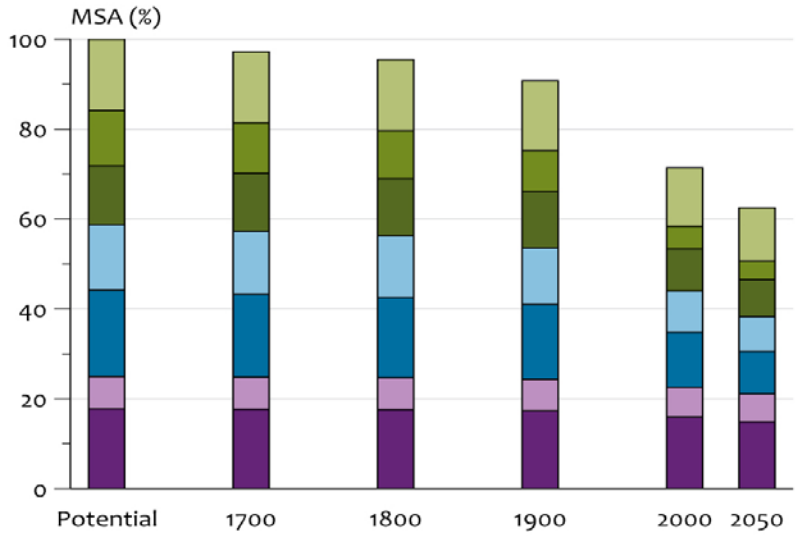
Notes: This graph only measures "blue water" demand (see Box 5.1) and does not consider rainfed agriculture.
Source: *OECD Environmental Outlook Baseline*; output from IMAGE.

Projections of increased pressure on the environment



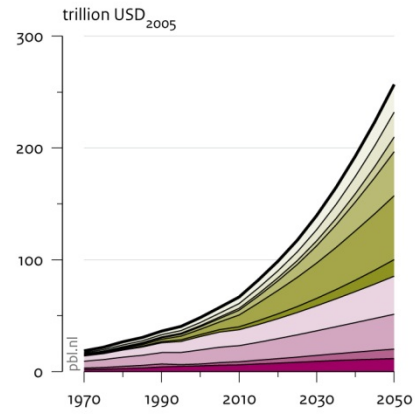
No projections of feedback from environmental degradaton on economy

Global MSA in baseline scenario

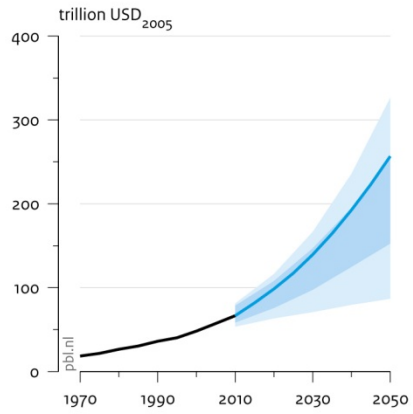


Global economics in the Trend scenario

GDP per region



Range from literature



Developing countries
- Central and South America
- Middle East and North Africa
- Sub-Saharan Africa
- South Asia
- China region
- Southeast Asia

Industrialised countries
- North America
- West and Central Europe
- Russian region and Central Asia
- Japan, Korea and Oceania

- History
- Trend scenario

Range from literature
- 10 – 90%
- 25 – 75%

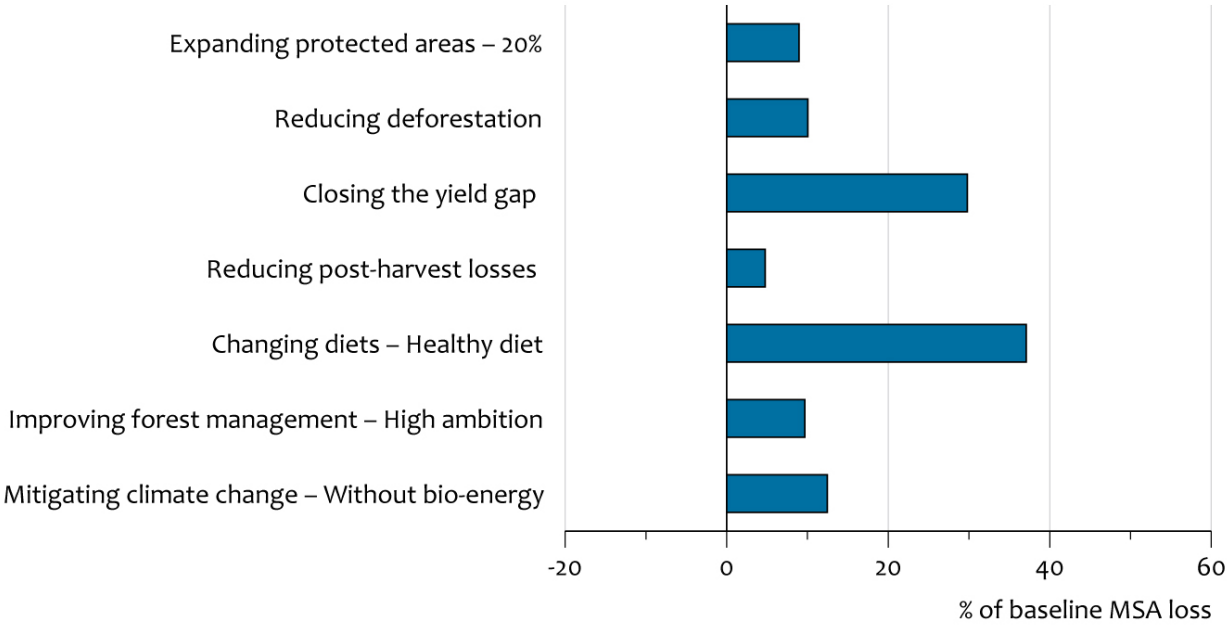
Different approaches

- Different policy options

Rethinking global biodiversity strategies (2010)

Prevented global MSA loss compared to baseline scenario, 2000 – 2050

Per option

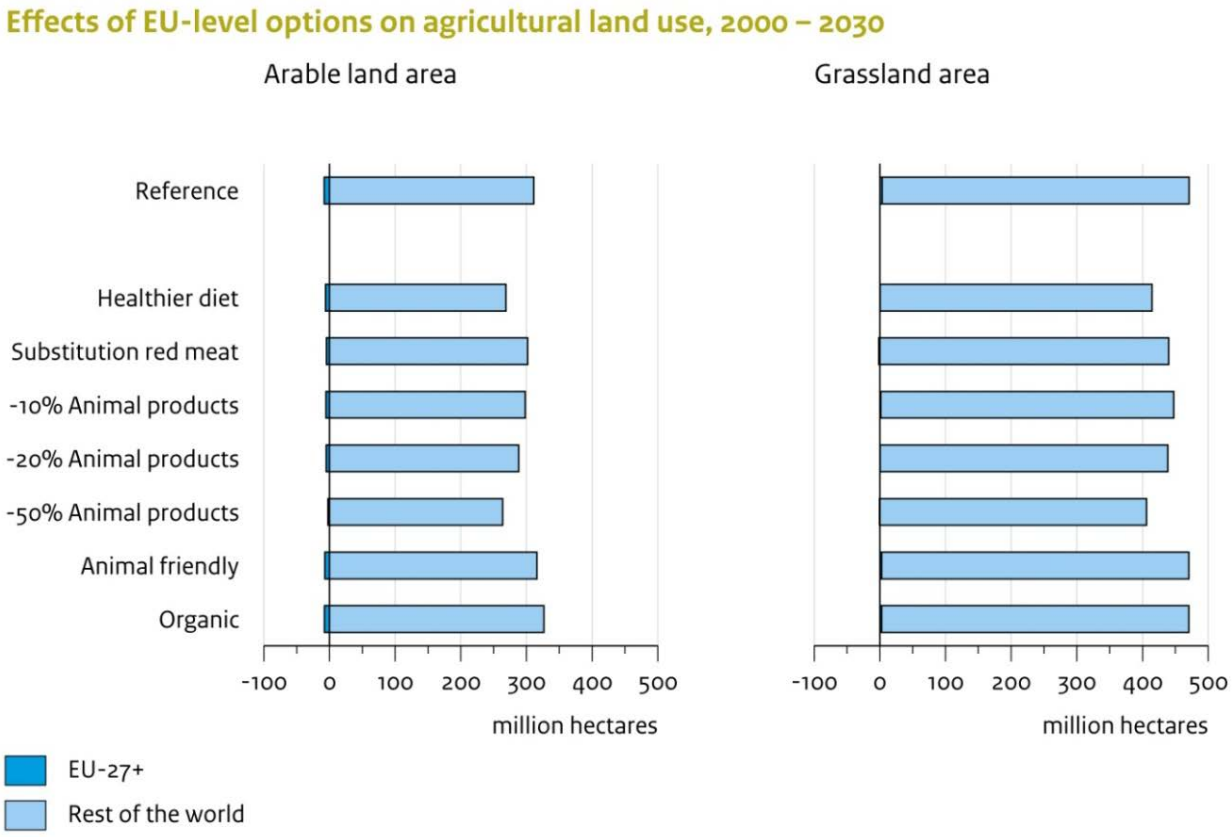


Prevented global MSA loss of options expanding protected areas and reducing deforestation by 2030

Different approaches

- Sector-oriented

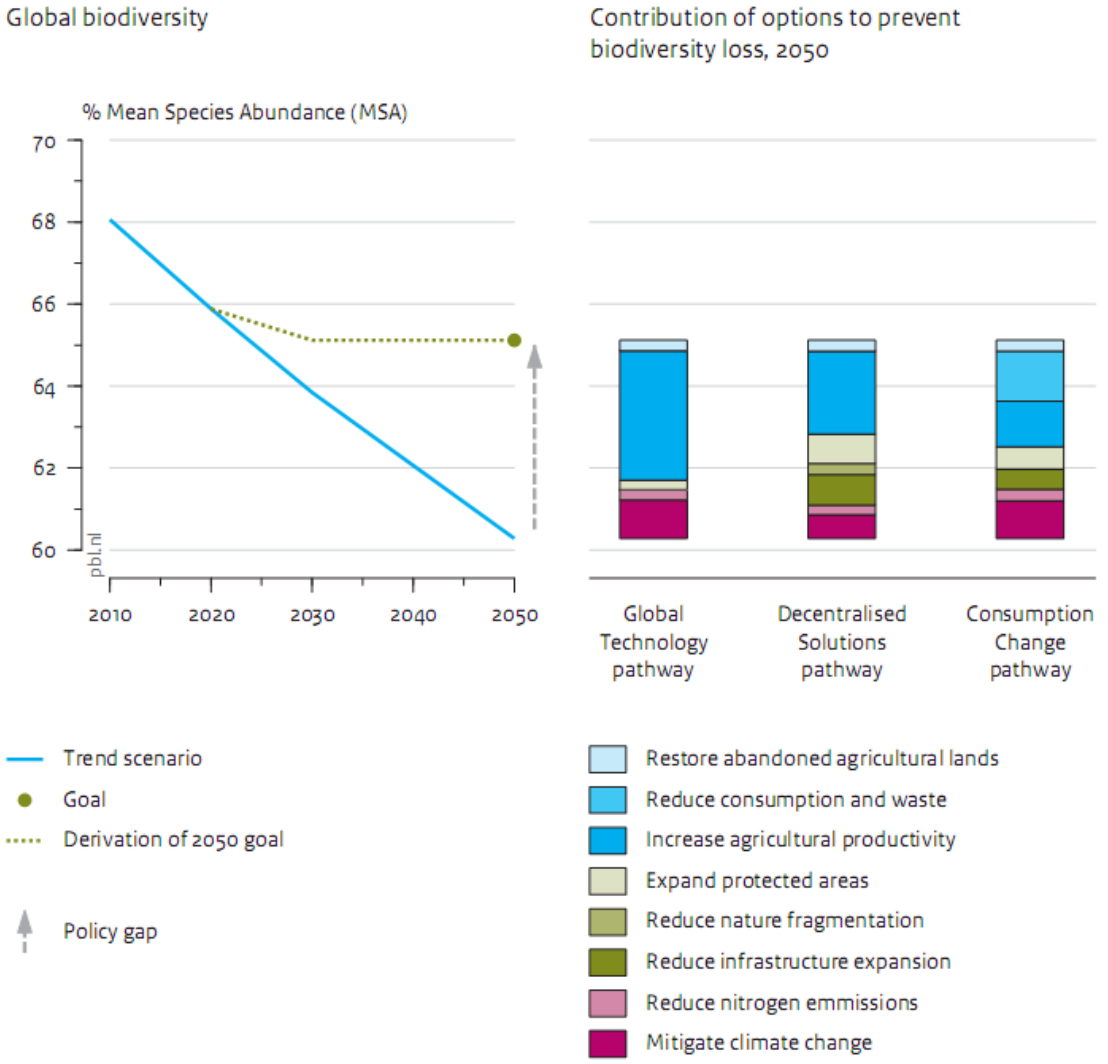
Protein Puzzle, (2011)



Different approaches

- Backcasting from global policy goals

Roads from Rio+20 (2012)



Work on biodiversity and ecosystems

- Biodiversity (GLOBIO 3)
- Aquatic biodiversity (GLOBIO Aquatic)
- Global land degradation (current and ongoing)
- Functions: SOC & carbon storage, water retention
- Water demand, drought and flood models
- Ecosystem services (production from IMAGE)
- Environmental dependency