The Economics of Ecosystems and Biodiversity

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The TEEB Quantitative Global Assessment: Outline

- Background to project
- Biophysical modelling
- Spatial data
- Benefit transfer
  - TEEB database
  - Value functions
- An example
  - Investment in agricultural knowledge, science and technology (AKST)

Quantitative Assessment: linking science and social science

- Biophysical policy model using GLOBIO3 model
  - Undertaken by Netherlands Environmental Assessment Agency (PBL)
  - Assessment of 8 options to counteract terrestrial biodiversity loss

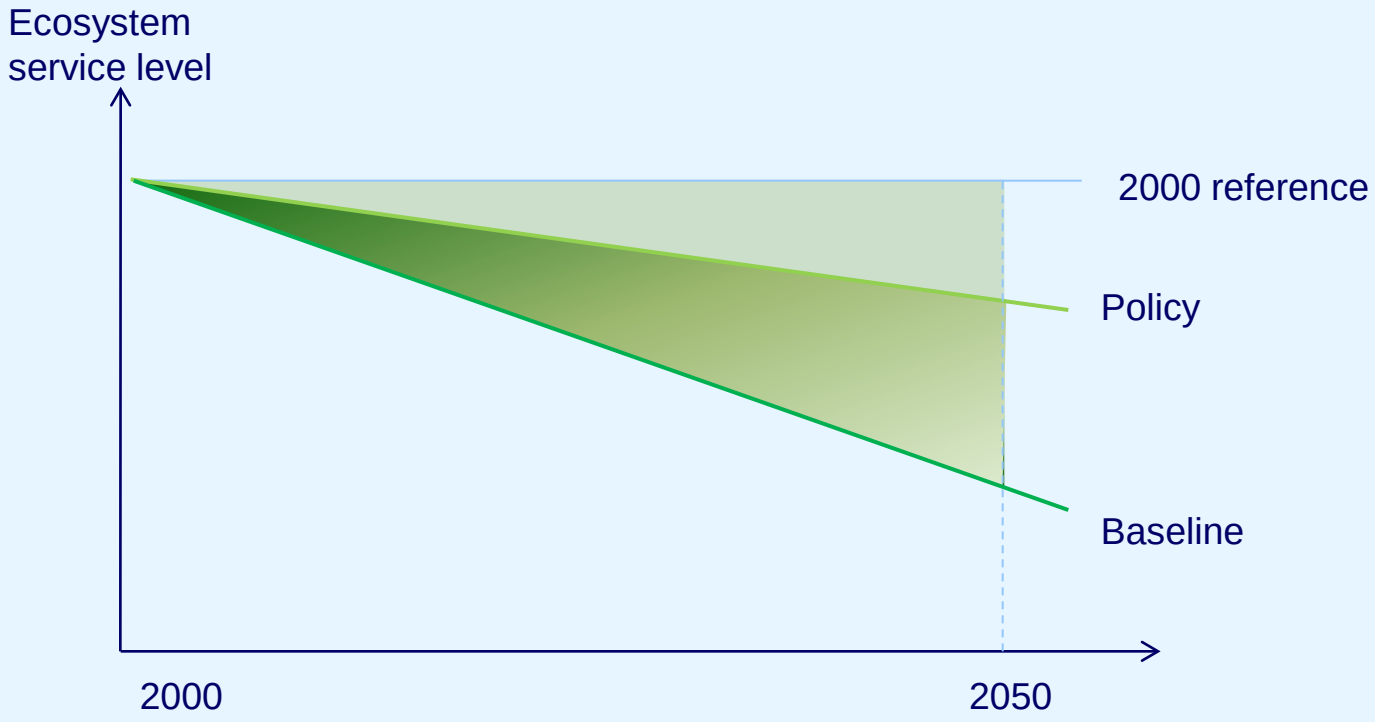
- Economic assessment
  - Valuing expected changes in ecosystem services, i.e. applying the Ecosystem Approach at global scale

Biophysical model – policy scenarios

Policy	Policy change	Time scale
Agricultural productivity: closing the yield gap	40% crop and 20% livestock productivity increase (compared to 25% baseline)	2050
Post-harvest sector	Reduce post harvest losses from 30 to 15%	2050
Global agricultural trade	Full trade liberalisation from 2020	2050
Reduced impact logging	Replacement of conventional logging with RIL	2050
Protected areas	Expansion of protected areas from 14% of total land area to: 1. 20% of each eco-region 2. 50% of each eco-region	2030
Reduced emissions from deforestation and forest degradation (REDD)	Protect from agricultural expansion: 1. All dense forest and 2. All forest and woodlands	2030
Bio-energy	Increase from 0.5 to 4 million km^2 for biomass	2050
Global dietary patterns	1. Global transition to 'healthy diet' 2. Complete substitution of meat with plant protein	2050

Quantitative assessment

- QA intends to measure costs and benefits of policy scenarios relative to baseline



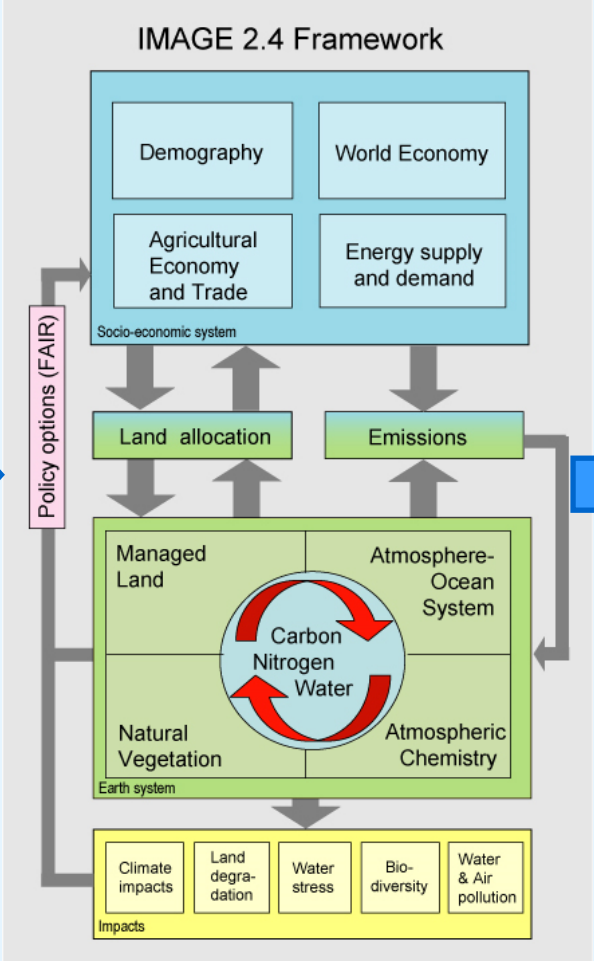
IMAGE/GLOBIO3 model framework

Indirect Drivers (scenario)

- Population growth
- Economic growth

Policy response options

For example:
- Protected areas
- Agricultural yields



GLOBIO3

Environmental drivers

- Land use
- N deposition
- Infrastructure
- Fragmentation
- Climate change

Cause-effect relationships

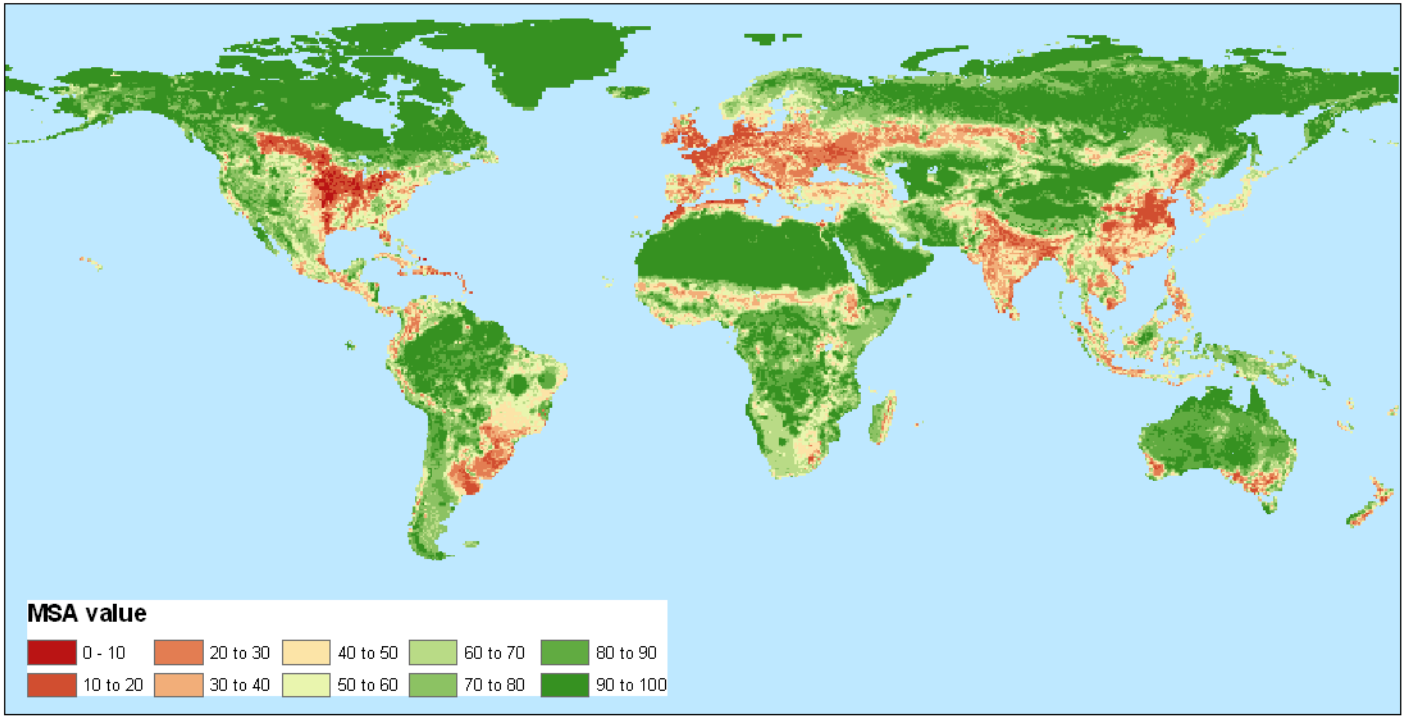
Biodiversity indicators

- MSA
- Ecosystem extent

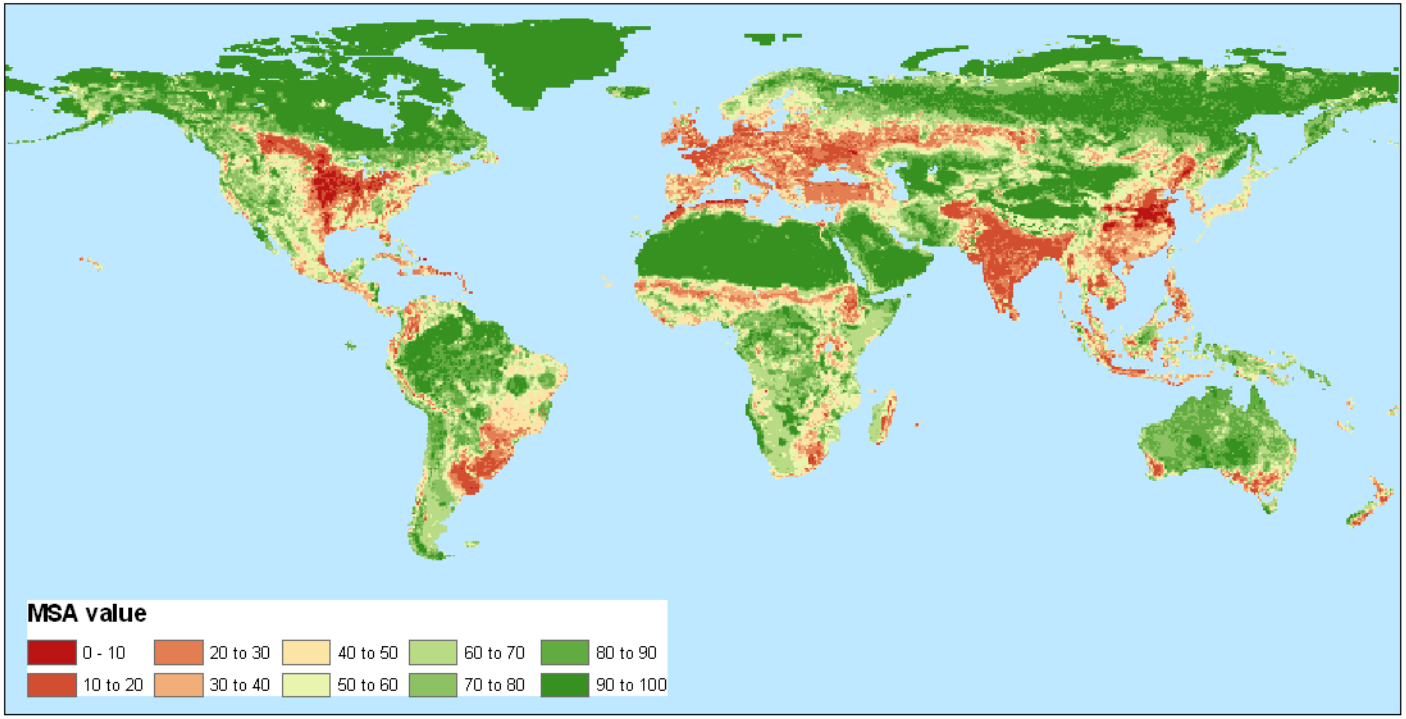
Biophysical model - baseline scenario

- Baseline developed from OECD projections:
  - World population grows from 6 to 9 billion
  - Fourfold increase in economic output (~ 2.8% per annum)
  - Per capita incomes grow particularly in BRIC countries
  - Agricultural productivity increases at 1.8% per annum – does not keep pace with population or consumption patterns
  - No change in environmental or trade legislation
  - Timber demand increases with population and incomes
  - Global mean temperature increases to 1.6ºC above pre-industrial level
  - No change in protected areas (14%)

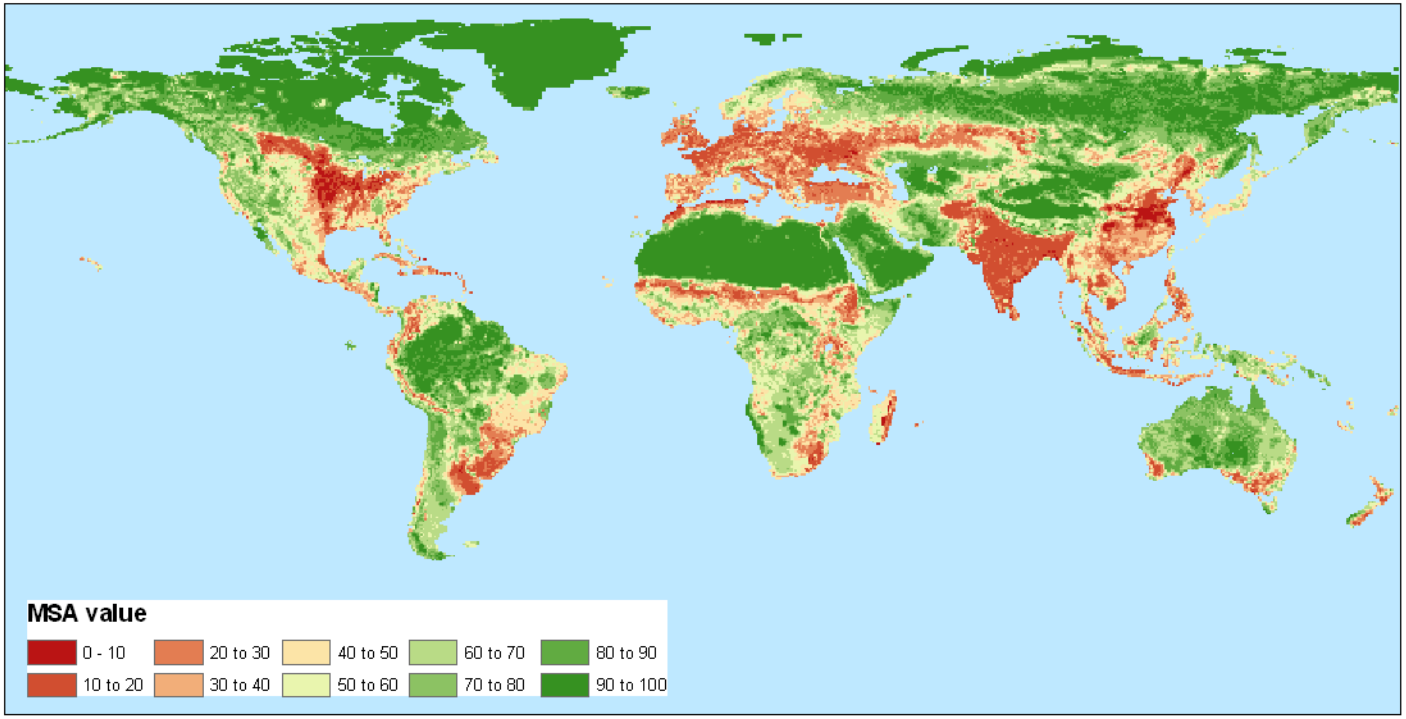
Mean Species Abundance 2000



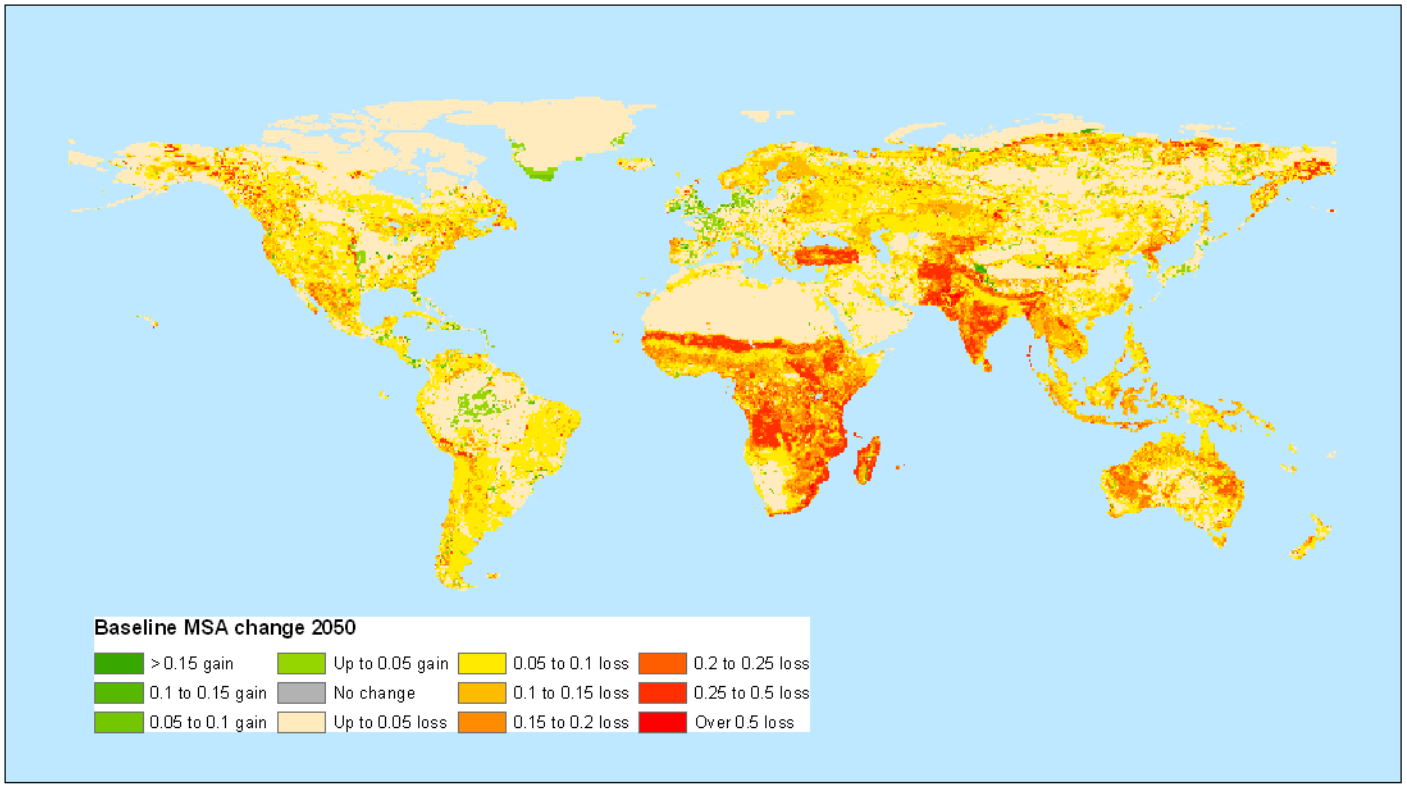
Mean Species Abundance 2030



Mean Species Abundance 2050

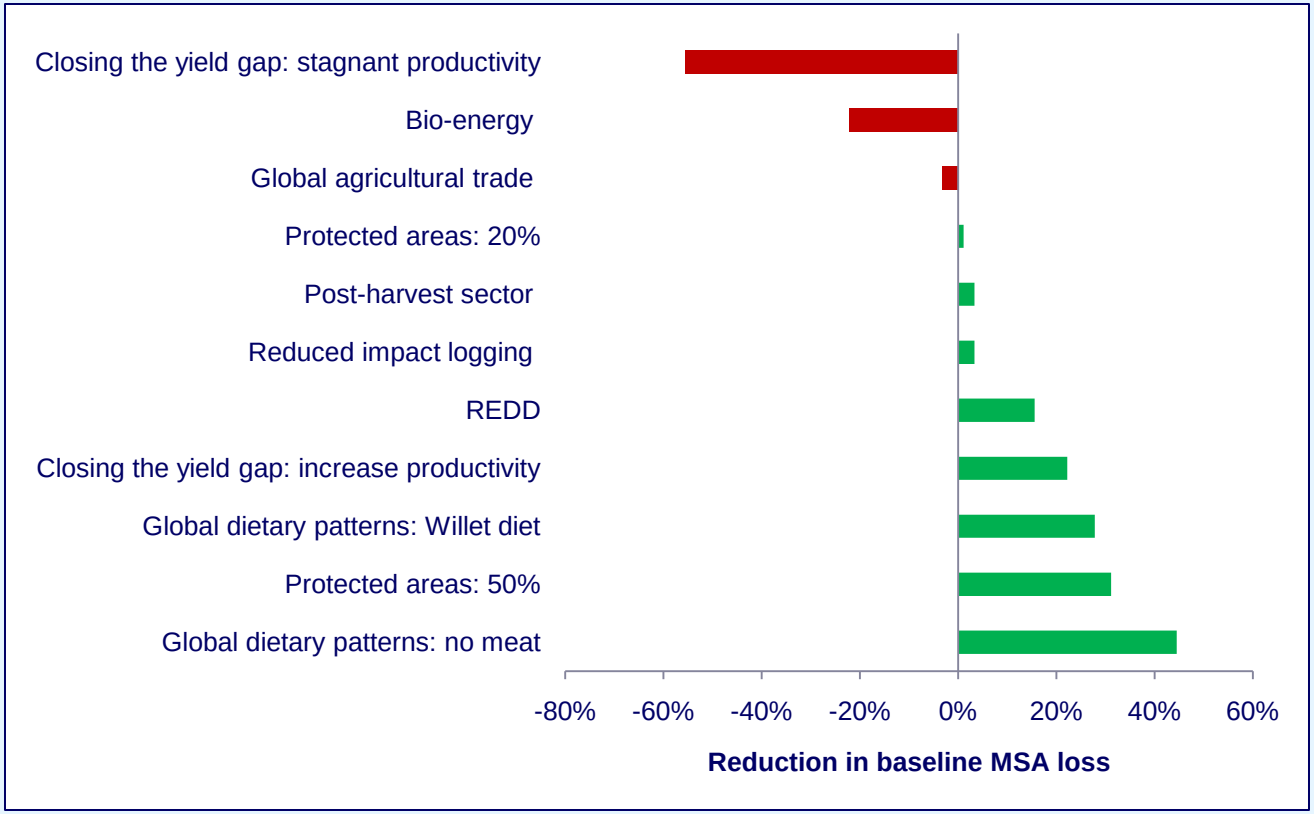


Baseline MSA change 2050



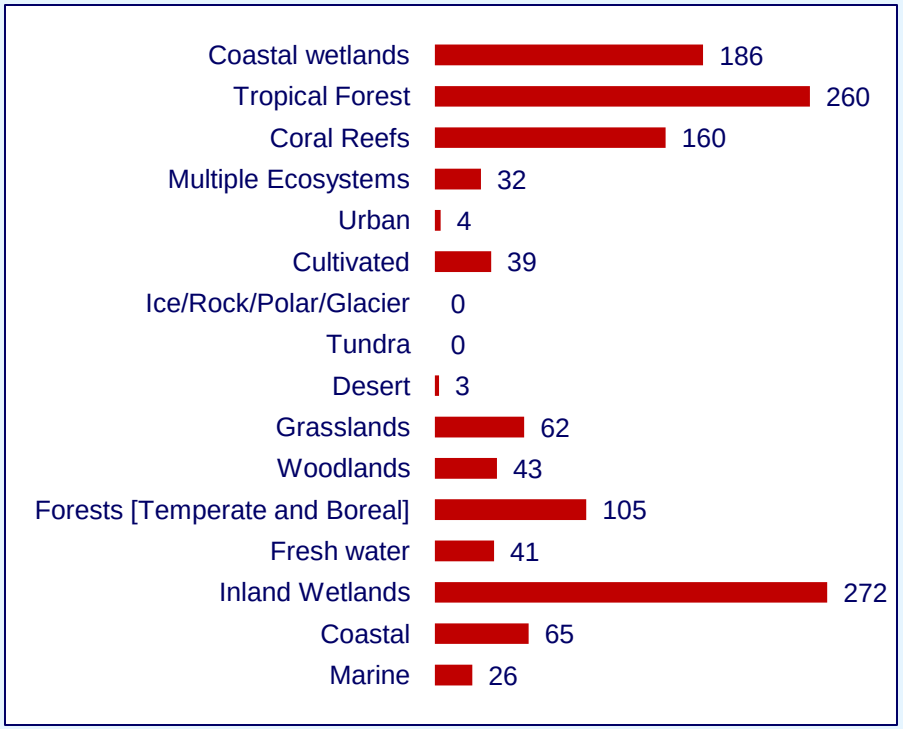
Policy scenario outcomes

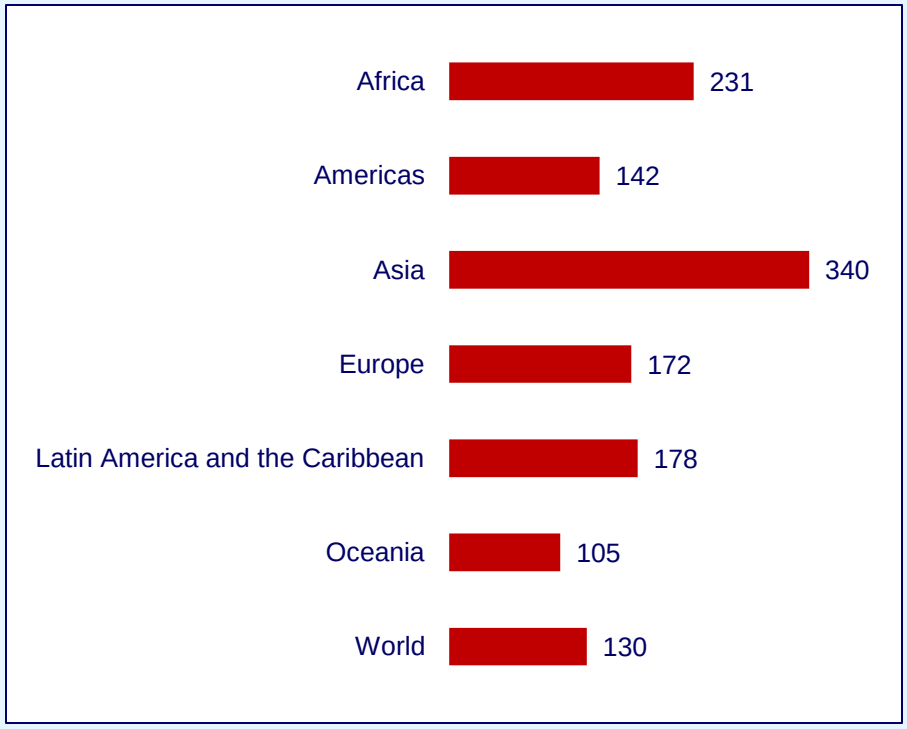
- Baseline global MSA loss is estimated to be 9% (71 to 62) between 2000 and 2050



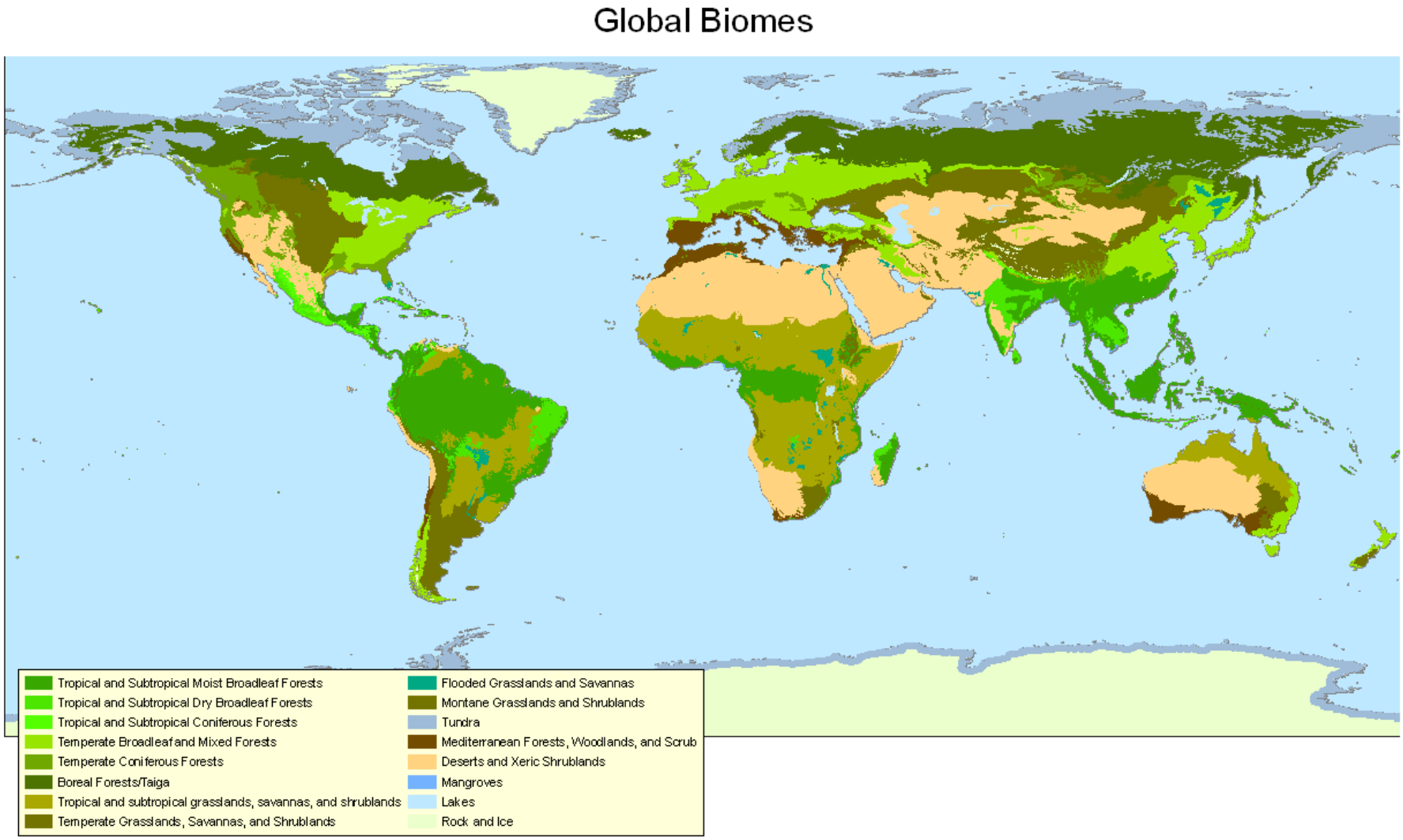
TEEB valuation database

- Developed at Wageningen University
  - 1298 individual value estimates

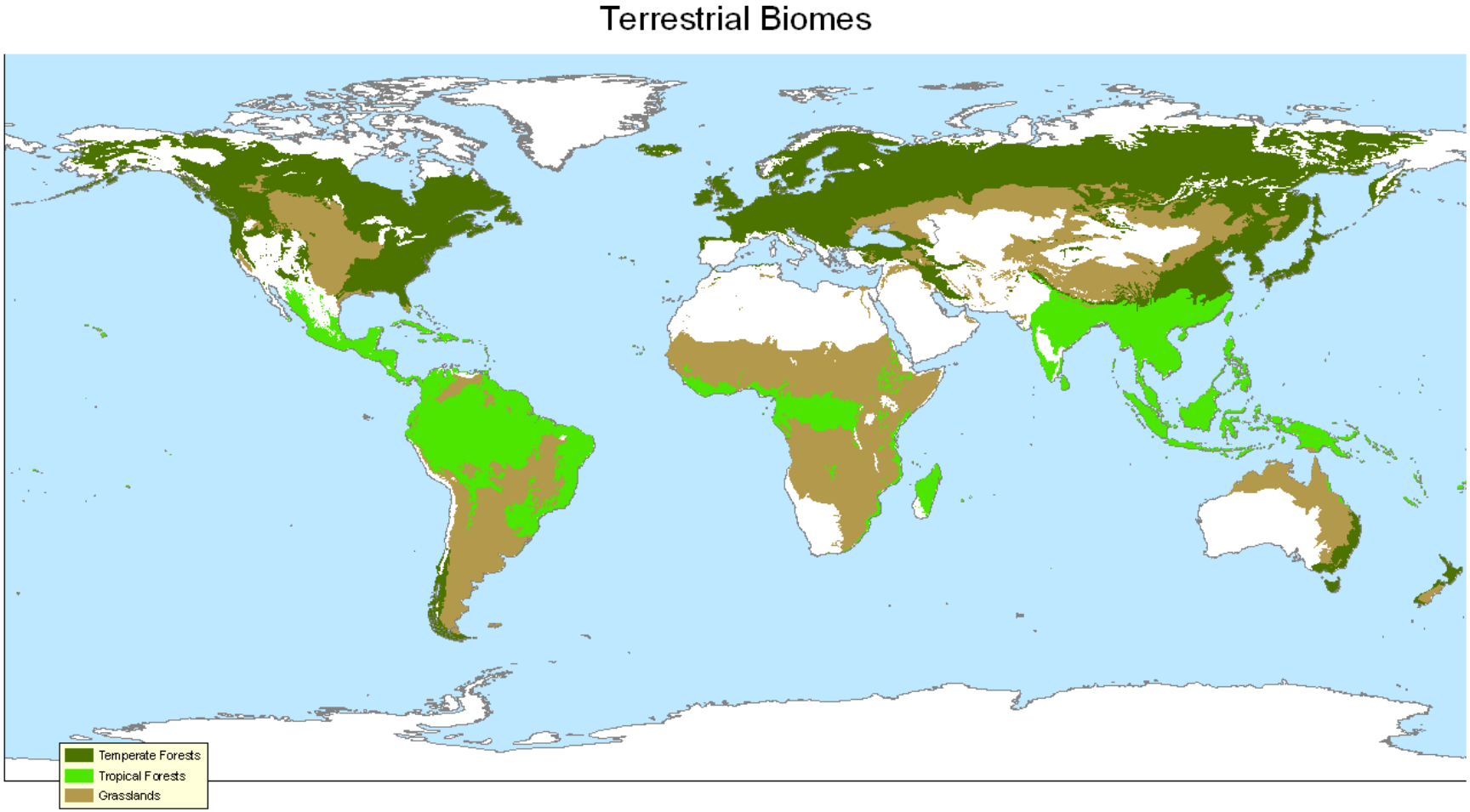




Global biome map



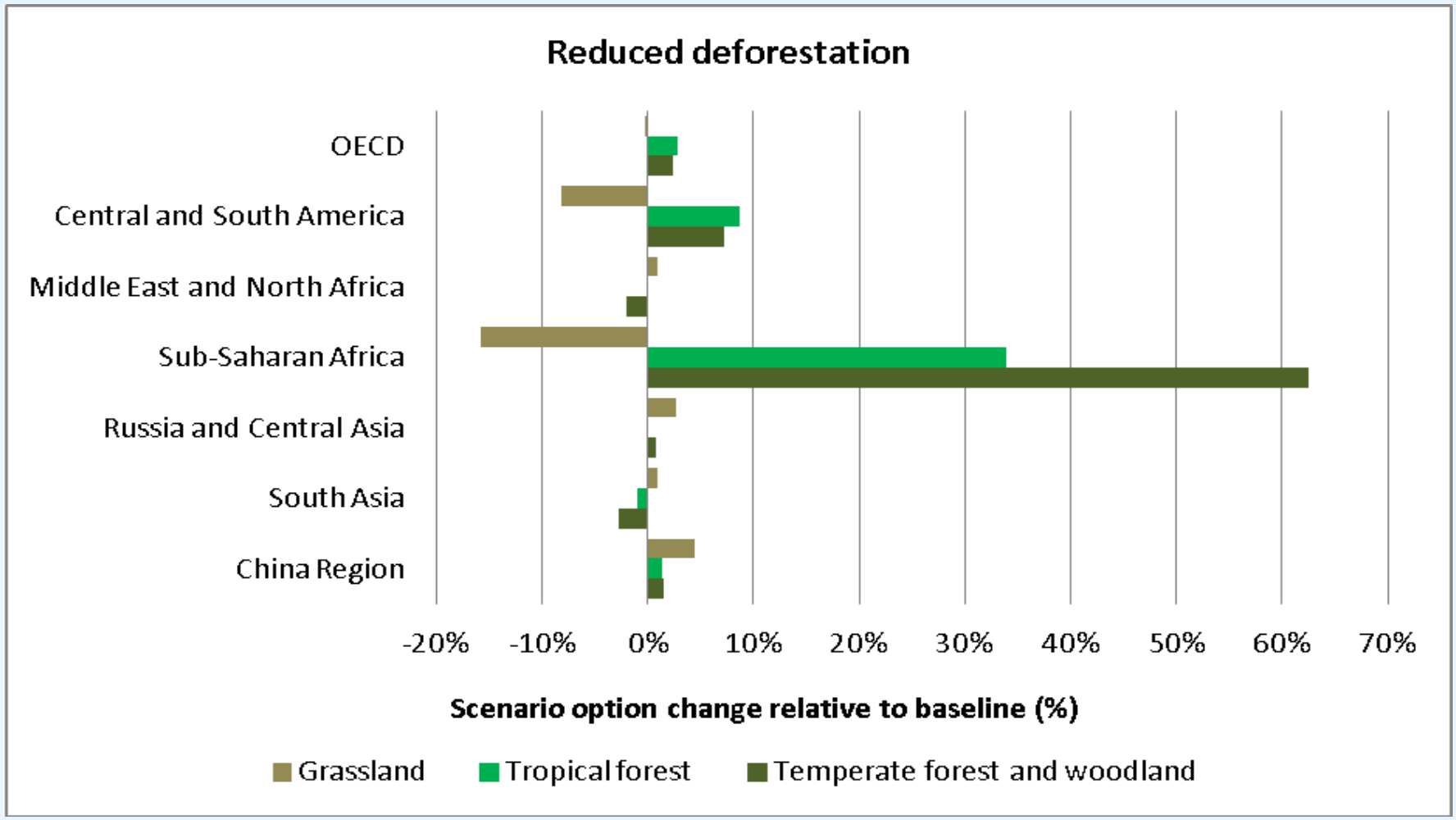
Terrestrial biome coverage



The economic valuation appraisal

1. There will be an expected change in land cover in 2030/2050 compared to 2000: *Business As Usual*
2. Compare this to the land cover projection *with the policy intervention* at 2030/2050
3. The bio-physical analysis estimates how much more or less of each biome there will be per IMAGE-GLOBIO region
   - temperate forest, tropical forest and grassland biomes
4. For every patch of temperate forest in the OECD (243,491 patches) we assume the same percentage change.
   - e.g. +2.4% for ‘reduced deforestation’
5. Given this assumed change, what is the expected value of the change in ecosystem services provided by each of these 243,491 patches?
   - For OECD temperate forests, $36.3 billion 2007 USD/annum to 2030

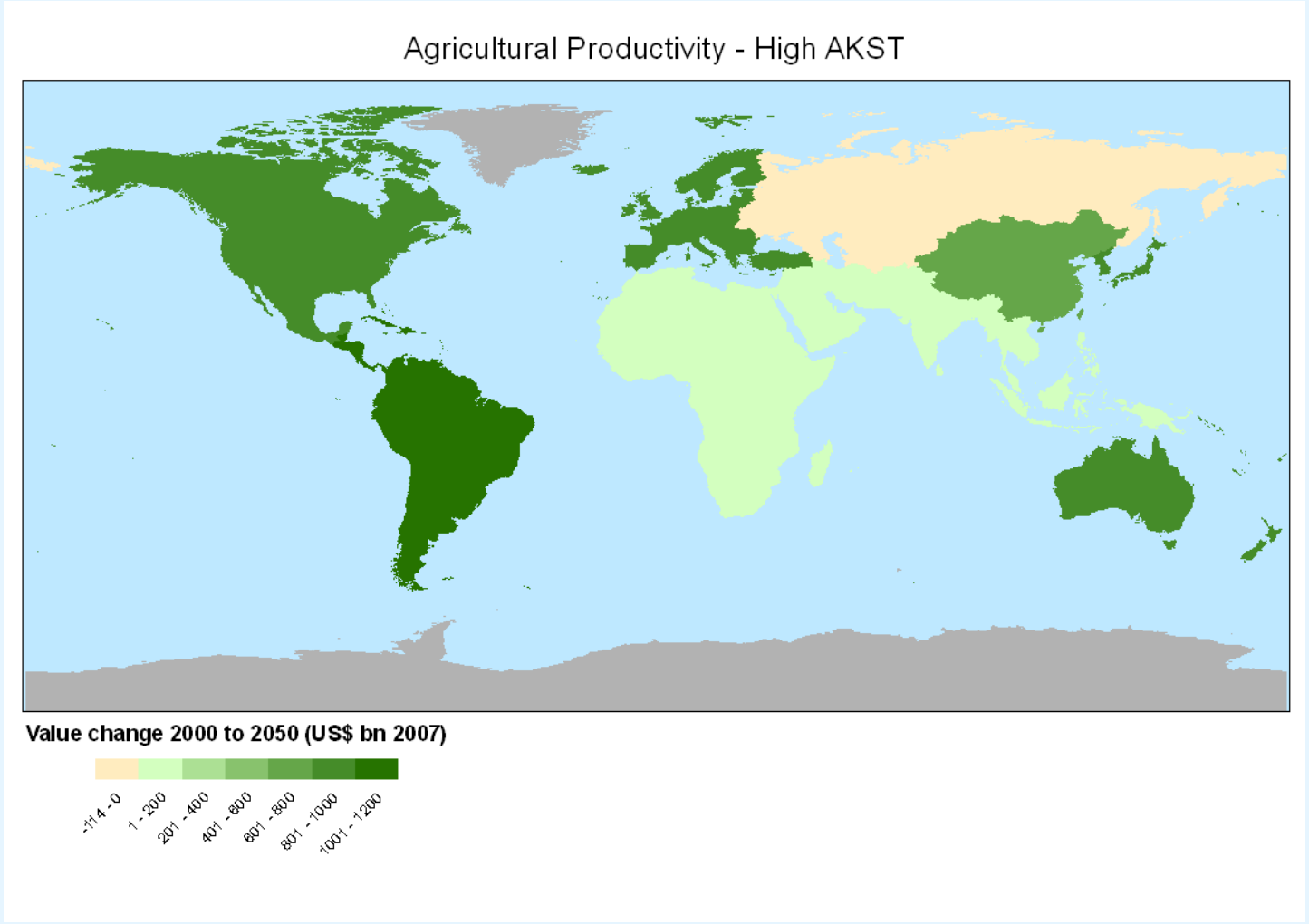
Bio-physical changes example: ‘reduced deforestation’ example



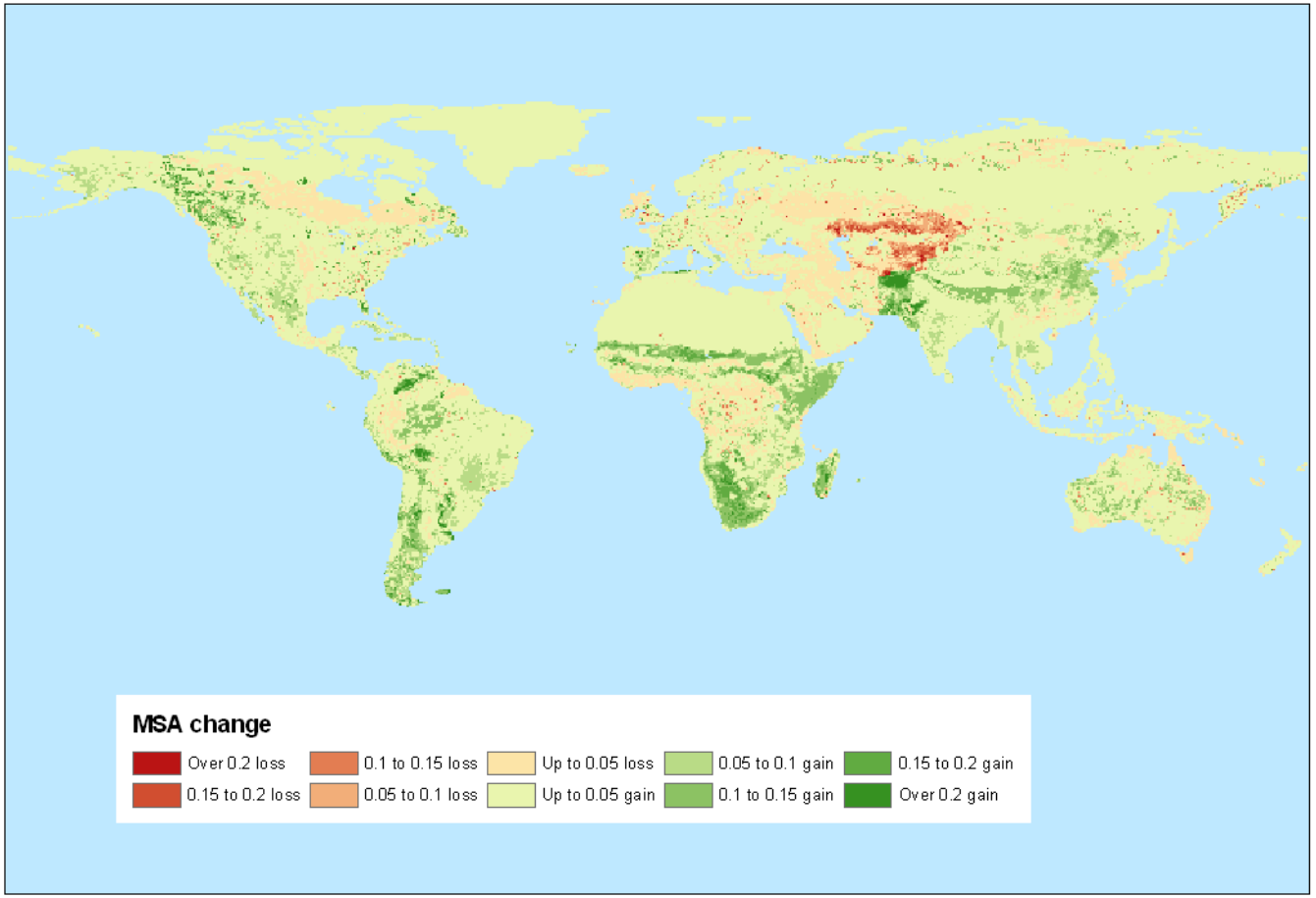
Spatial variables

- Additional spatial data within 10, 20 and 50 km radii of each site:
  - Area (ha) of forest, lakes and rivers, mangrove, wetland, grassland, coral reef
  - Population density (person/km^2)
  - Gross cell product (2005$US) – measure of economic output
  - Urban area (ha)
  - Roads (km)
  - Human appropriation of NPP (gC/m^2/yr)
  - Accessibility index - travel time to urban centres

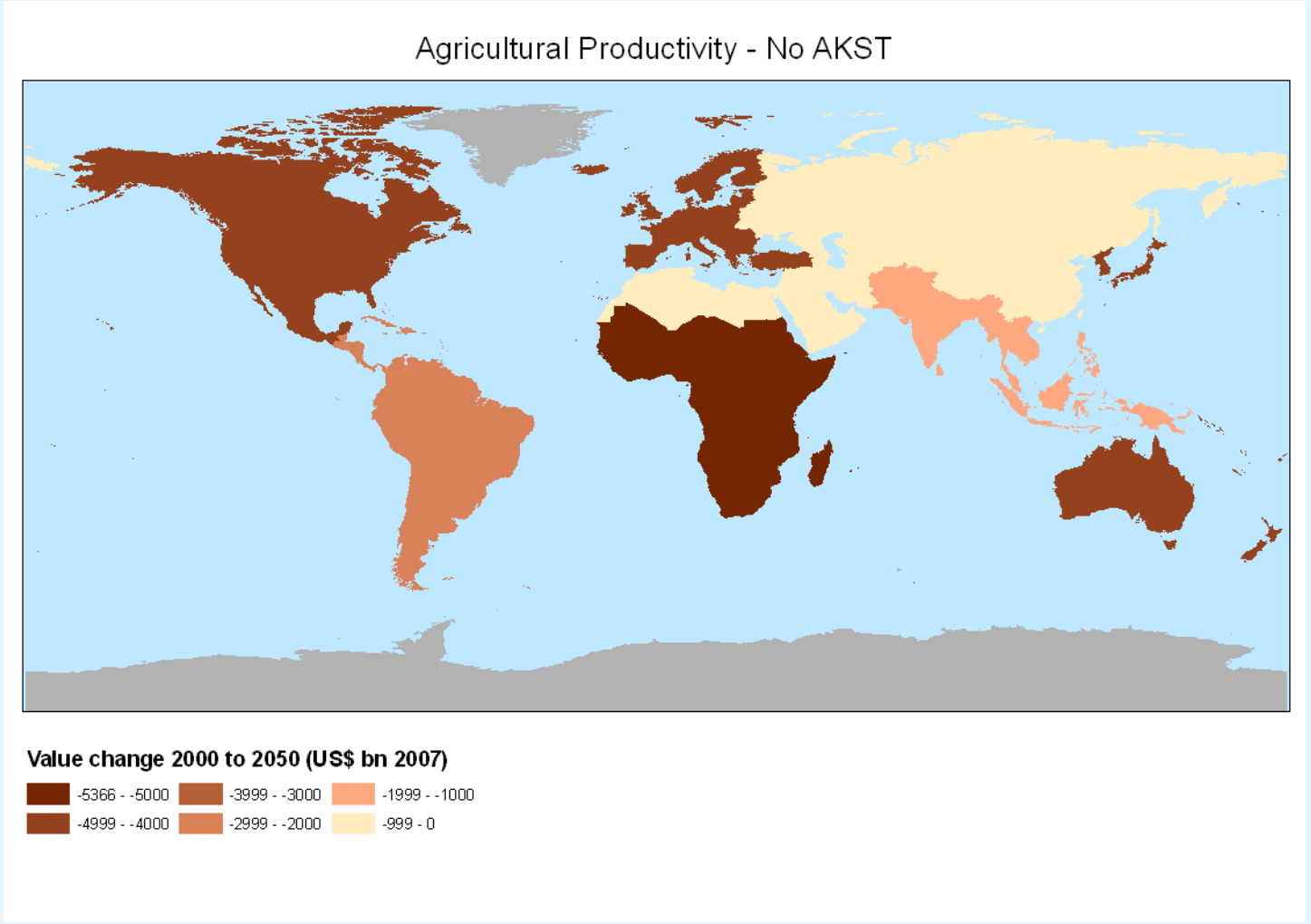
Example: Investment in AKST



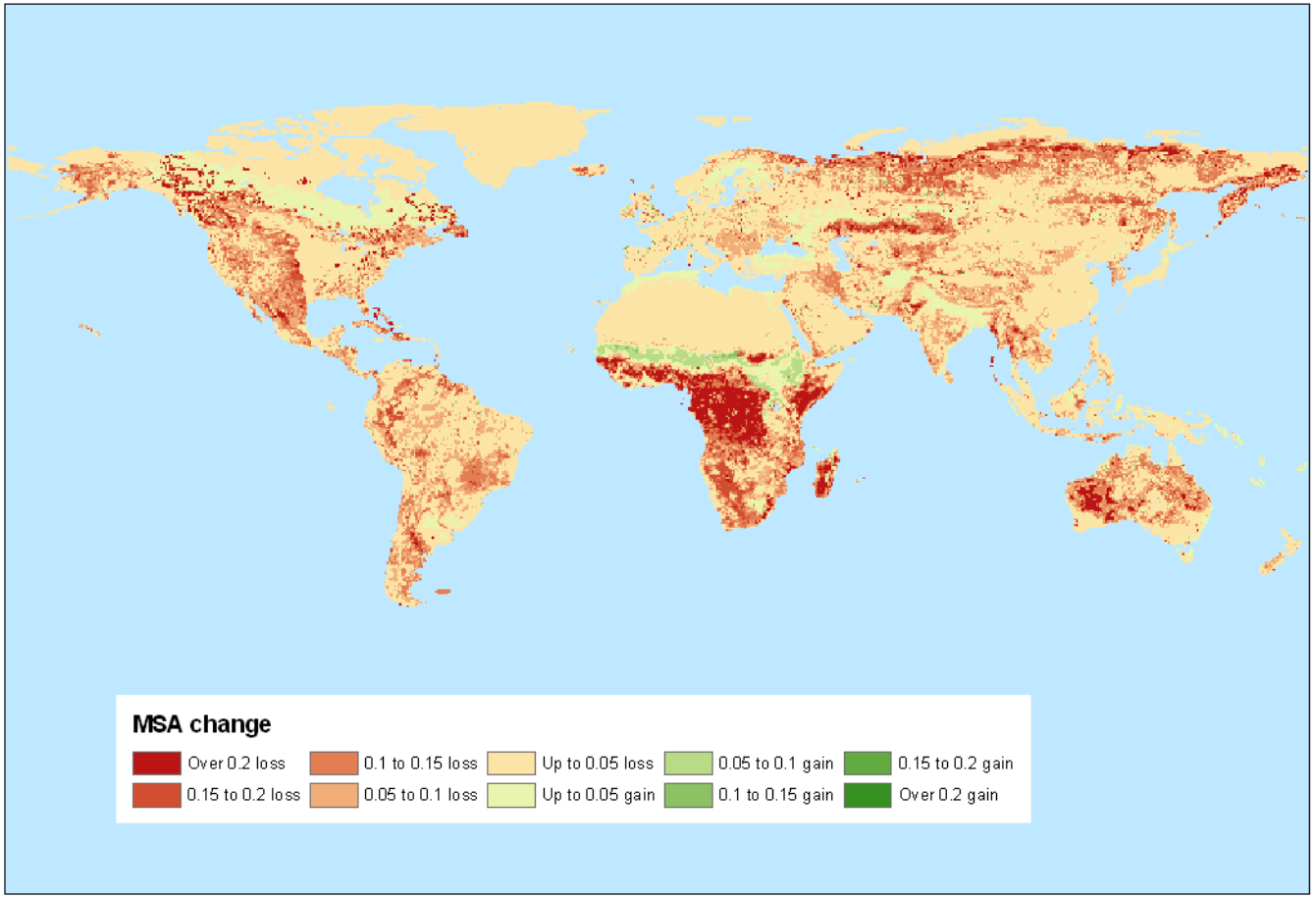
MSA change High AKST



No investment in AKST

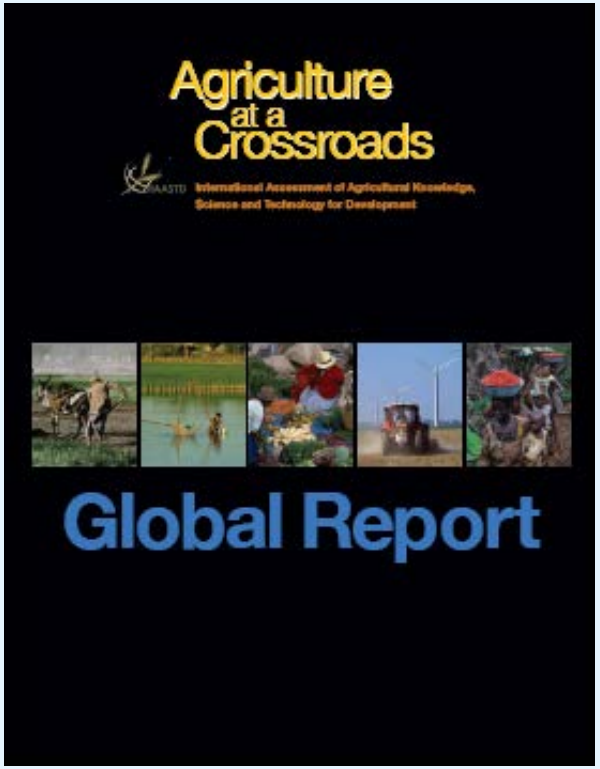


MSA change: No AKST



Summary results AKST

- Annual land use change benefits 2050 = **$161 billion**
  - Central and South America = $63.2 bn
  - Russia and Central Asia = -$6.2 bn
- Aggregate 2000 to 2050 = **$2964 bn**
- Cost 2000 to 2050 = **$568 bn**
- Benefit/Cost ratio = **5.2**
- Carbon benefits = **$6343 billion**
- B/C ratio including carbon = **16.4**
  - **1% Discount Rate, UK Social Cost of Carbon**
  - **4% DR, POLES model carbon values BC ratio is 63.1**



Conclusions and looking forward

- Summary:
  - AKST/REDD/PA to 20% of eco-regions provides significant net benefits in land cover change impacts
  - Important regional impacts
- Next steps:
  - Intermediate points (e.g. 2010) to improve trajectory
  - Compare MSA change profile with value changes
  - Isolate values by type of ecosystem service
  - TEEB III national level analysis
  - Presentation at Copenhagen Consensus