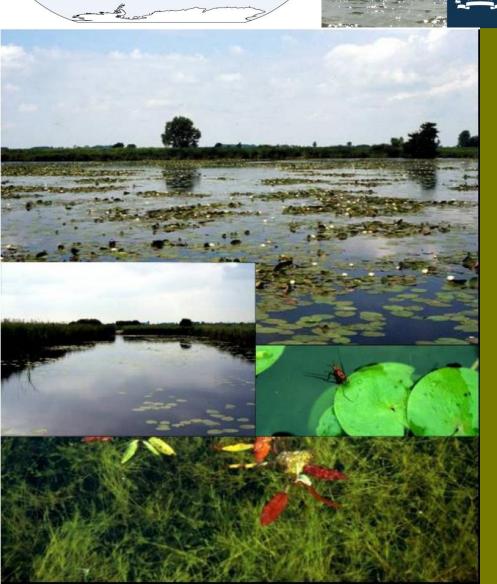


PBL Netherlands Environmental Assessment Agency

Global-scale scenarios and models for (aquatic) biodiversity and ecosystem services

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### **Scenarios**

Scenario = possible future; more or less coherent combination of drivers, policies and/or measures

- Trend scenarios; e.g. SSPs
- Target-seeking scenarios: ways to reach a certain target,
   e.g. halving biodiversity loss

Models used to estimate the impacts

DPSIR framework

Integrated assessment models

### Pressures

- DPSIR framework
- Large-scale pressures:
- -land-use
- -climate change
- -hydrology

-...

- Locally/regionally:
- Local variation in large-scale pressures
- Many additional local pressures
- Direct effects of pressures
- Indirect effects, via human adaptation; e.g. biomass energy

# Aquatic biodiversity











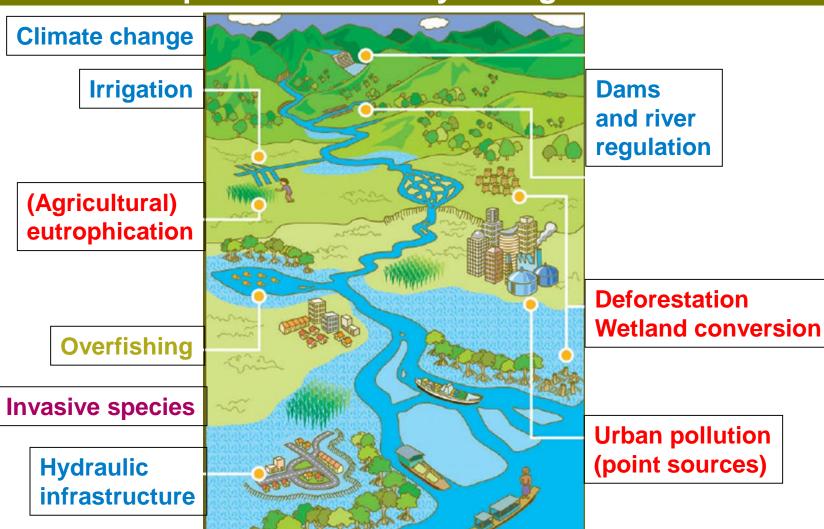








### Drivers of aquatic biodiversity change in catchments



(modified after Ratner et al, 2004; in MEA), 2005

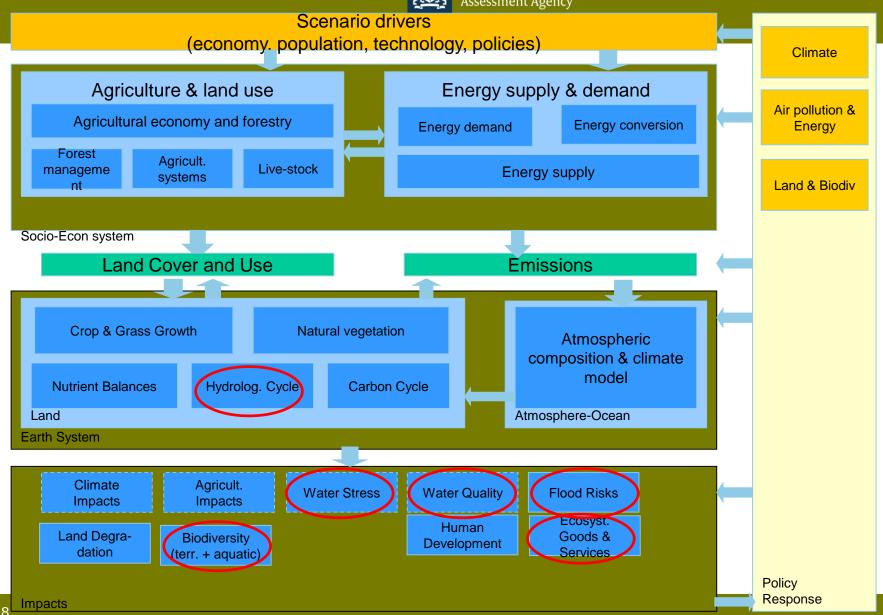
### Models at PBL: IMAGE-GLOBIO

- Integrated Assessment Model (IAM): impact of these global drivers on (terrestrial + aquatic) biodiversity and ecosystem services
- Meant for global assessments on climate/energy, land use, water, biodiversity, ecosystem services
- Support policy makers on sustainability at the global level: UNEP, CBD, OECD, EU, IPBES, Ramsar, etc.
- attainment of SDGs (sustainable development goals)
- Also as background for regional studies and assessments

## Examples of questions

- What are hotspots of environmental problems?
- - What pressures are most important where?
- Link to drivers on economic sectors and behaviour
- What are options for solutions
- - What are side-effects of solutions for other sectors?

# IMAGE-GLOBIO model framework PBL Netherlands Environmental Assessment Agency

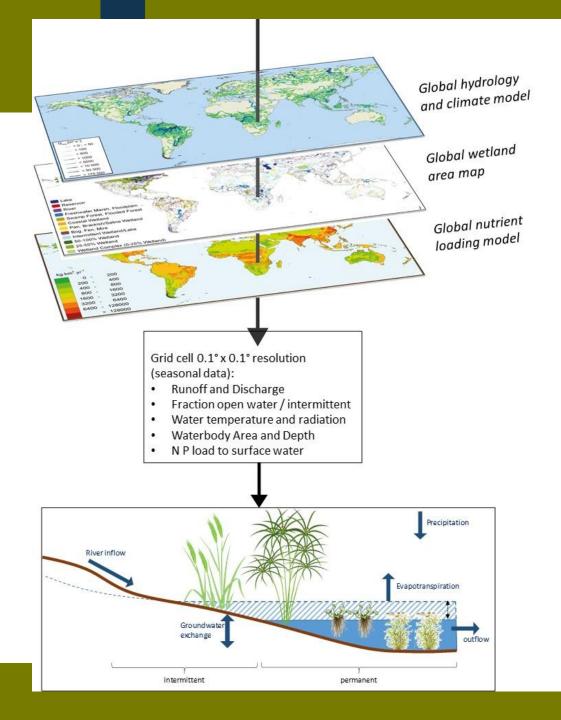


### **GLOBIO-Aquatic model chain** PBL Norbardes Environmental As IMAGE Dams and Climate and use water use (temp.,rain) Wetland Global Hydrological GlobalNutrientModel conversion Model (PCR-GLOBWB) water network (accumulation Water temp. Water quality Water, flow in catchment) (N, P) Empirical biodiv. relations (GLOBIO) Lake/wetland model (PCLake+) **GLWD** map lake depths Biodiv.of Algal blooms Biodiv.of Biodiv. of RIVERS WETLANDS LAKES in LAKES WETLAND **PURIFICATION AREA** Weighted-averaged aquatic biodiversity **SERVICES** HYDROLOGICAL DRINKING WATER:

**SERVICES** 

**HEALTH; RECREATION** 

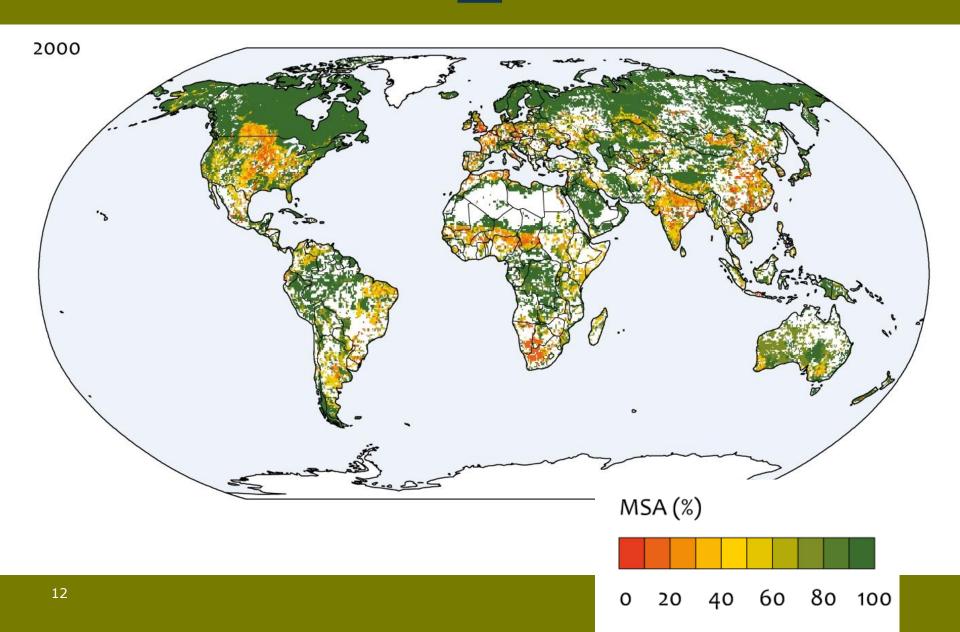
# Model set-up

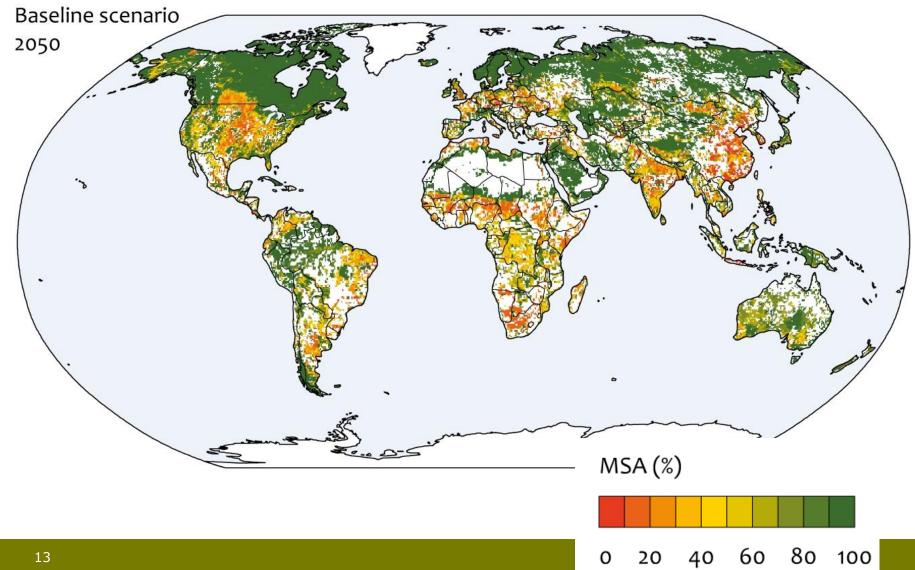


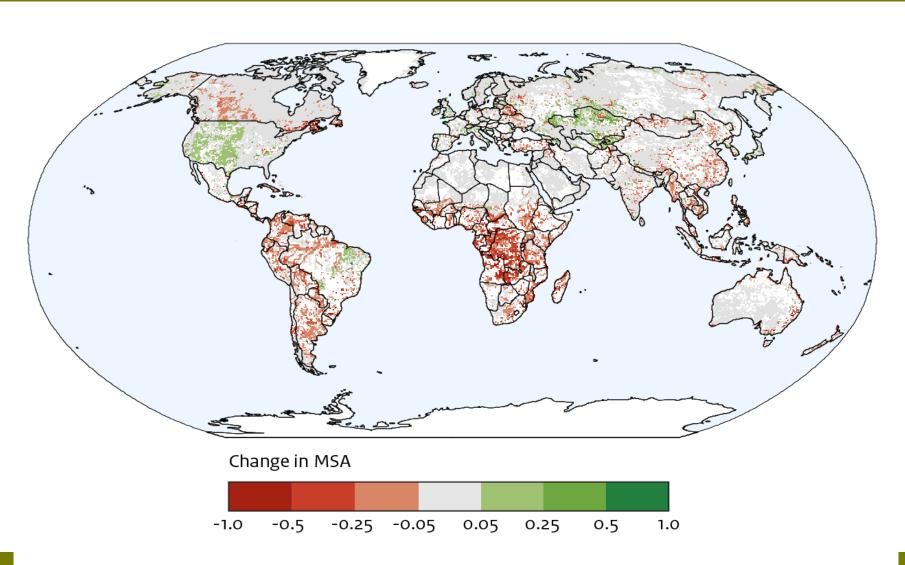
### Models

- Combination of different type of models:
- Economic models
- GIS models
- Process models
- Empirical process models
- Statistical models (species composition intactness)

# Combined results: MSA-aquatic Assessment Agency







### Global scenario initiatives

- Fourth Global Biodiversity Outlook (GBO4) 2014
- Shared Socio Economic Pathways (SSPs; IPCC) 2016-2018
- Bending the Curve initiative (IIASA, WWF) 2018
- IPBES Nature's Futures, ongoing
- Scenarios for the CBD post-2020 Biodiversity Agenda, ongoing
- SIM4Nexus, EU project 2016-2020

### Some recent assessments with IMAGE-GLOBIO

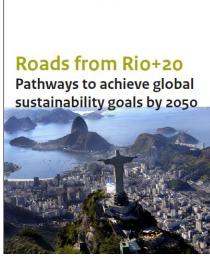
2010 (COP CBD, Nagoya) OECD-EO, 2012

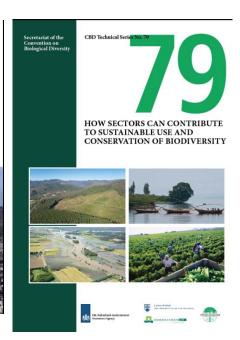
2012 (Rio Conference)

GBO4, 2014





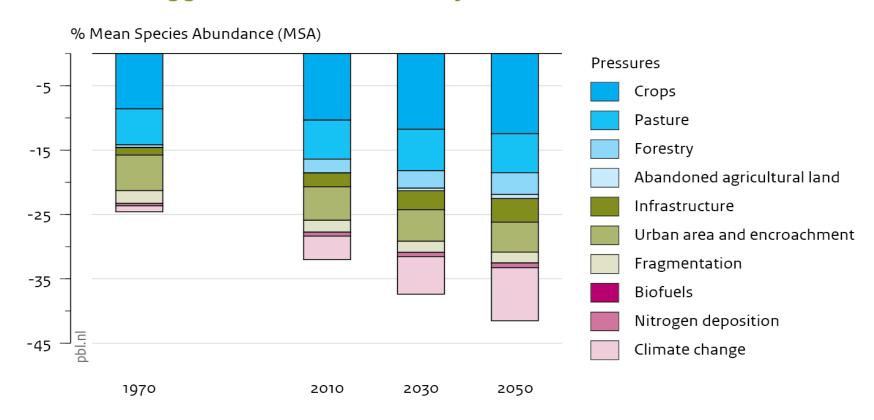




## Pressures on terrestria Trend scenario



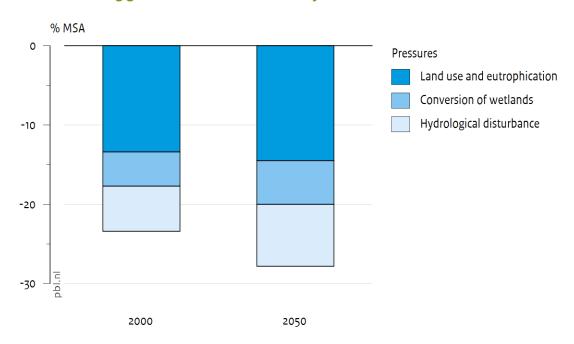
### Pressures driving global terrestrial biodiversity loss under the Trend scenario



Source: PBL

## Global average MSA loss and contribution of drivers

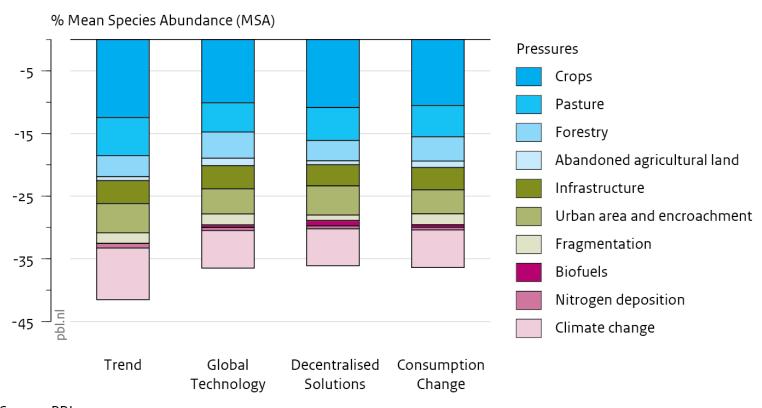
### Pressures driving global freshwater biodiversity loss in the Trend scenario



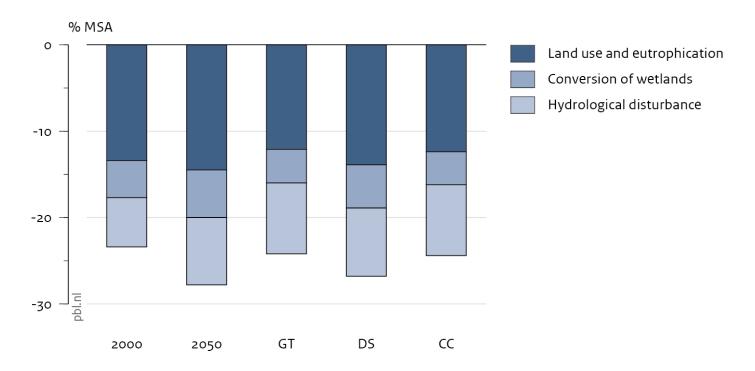
Source: PBL

# 3 'pathways' to reduce biodiversity loss: Pressures on terrestr. biodiversity loss:

### Pressures driving global terrestrial biodiversity loss in 2050



# Pressure on aquatic biodiv. in 3 'pathways' Assessment Agency PBL Netherlands Environmental Assessment Agency



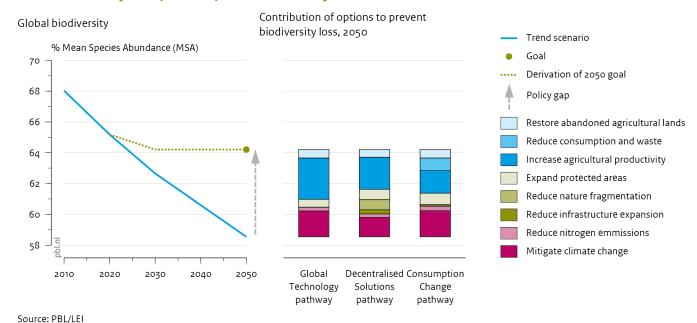
**Figure 1.** Pressures driving global-averaged freshwater biodiversity loss under the Trend scenario (2050) and three development pathways (GT: global technology, DS: decentralized solutions, CC: consumption change). Source: PBL (Kok et al., 2014)

Note: for hydropower, assumptions equal to Trend in all pathways

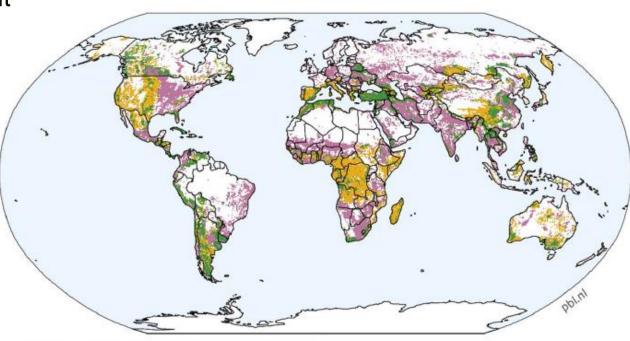
=> All 'pathways' can reduce but not stop further biodiversity decline.

# GBO4 outcome: Large potential for biodiversity-friendly production methods and nature-based solutions exist to realise 2050 vision

#### Global biodiversity and options to prevent biodiversity loss



Pathways play out differently among regions



MSA at least five percentage points higher than Trend Scenario in 2050

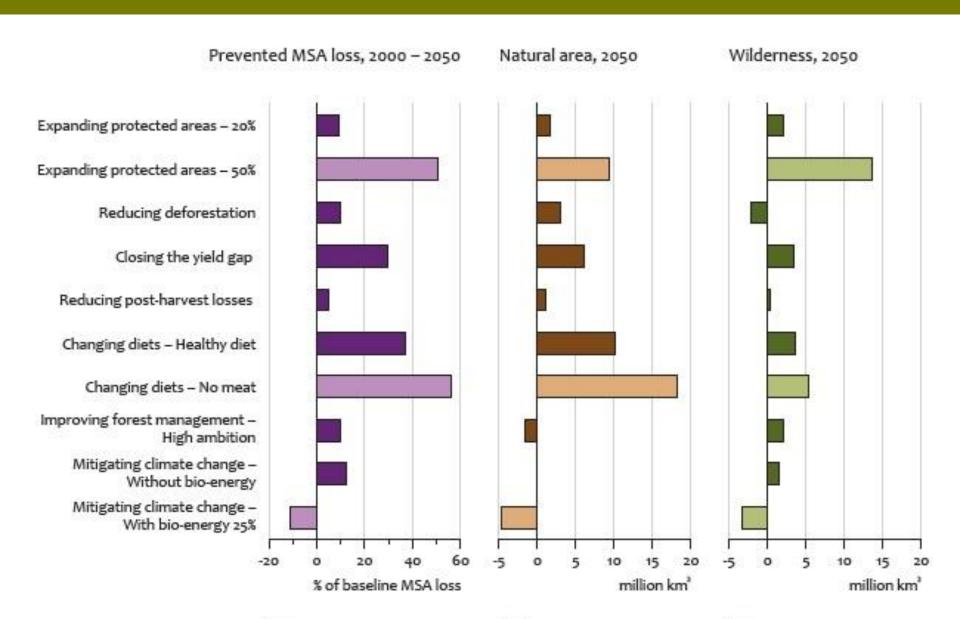
Higher MSA in the Global Technology pathway

Higher MSA in the Decentralised Solutions pathway

Higher MSA in both pathways

Fig. 5. Areas with at least 5% avoided loss in pathways, compared to the Trend scenario.

# Effects of options compared to baseline



# Conclusions from GBO4: Strategies to stepup, scale-up and speed-up efforts to mainstream biodiversity

- Apply integrated land-, water- and seascape approaches
- Better integrate biodiversity in voluntary sustainability initiatives along supply chain
- Further develop consumption perspective on biodiversity, including food security and sustainable, healthy diets
- Shift investment flows in key sectors towards more biodiversity-friendly alternatives

# Shared Socio-Economic Scenarios (IPCC)

### SSP5: Fossil fuel-ed development

- Rapid growth, free trade
- High technology development,
- Environment and social goals not a priority: adaptive, technology-fix
- Focus on economic growth

### SSP1:Sustainability

- Global cooperation
- Rapid technology dev.
- Strong env. policy
- Low population growth
- Low inequity
- Focus on renewables and
- efficiency
- Dietary shifts
- Forest protection



UN world



Clash of civilisations.

### SSP2: Middle of the Road





Have's and have not's

### SSP3: Regional rivalry

- Competition among regions Low technology development
- Environment and social goals
- not a priority Focus on domestic resources
- High population growth
- Slow economic growth dev. countries

### SSP4: Inequality

- · Inequality across and within regions
- Low technology development
- Environment priority for those that can afford
- Limited trade







































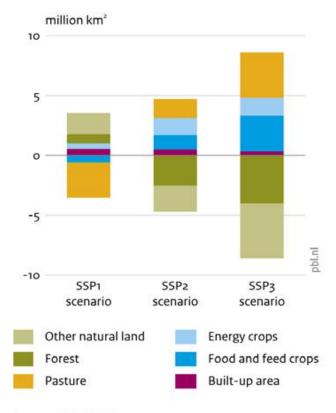


Challenge to adaptation

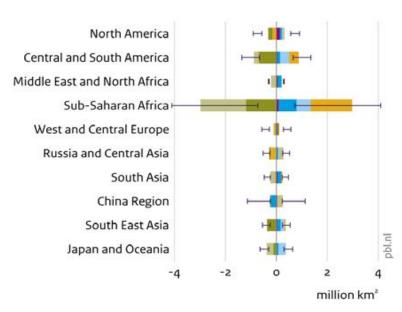
## SSP scenarios: land-use changes 2010-2050

### Land-use change, 2010 - 2050

Global per scenario



Regional change under the SSP2 scenario

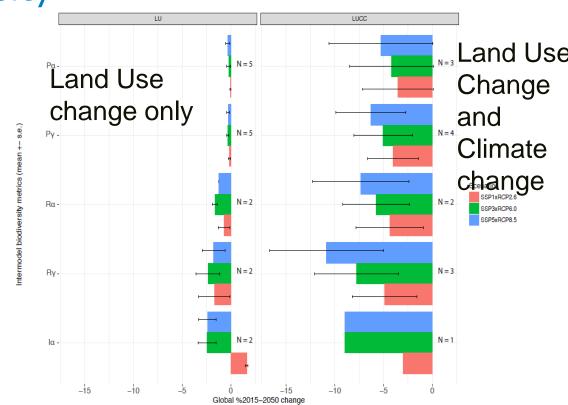


 Range between SSP1 and SSP3 scenario

Source: PBL/IMAGE

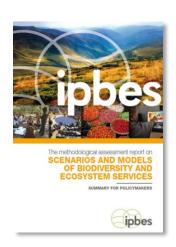
### Results on biodiversity

- three SSP variants
- 10 biodiversity models
- biodiversity measured by
- species richness at local, regional and global levels,
  - Intactness and
  - habitat change



# IPBES scenarios: Conclusions from the IPBES scenario assessment (2016) scenarios

- Most global scenarios are limited to assessing the impact of drivers on Biodiversity and Ecosystem Services
- Most global scenarios are developed for other purposes, e.g. climate change and its impacts
- Most global scenarios lack a participatory approach.



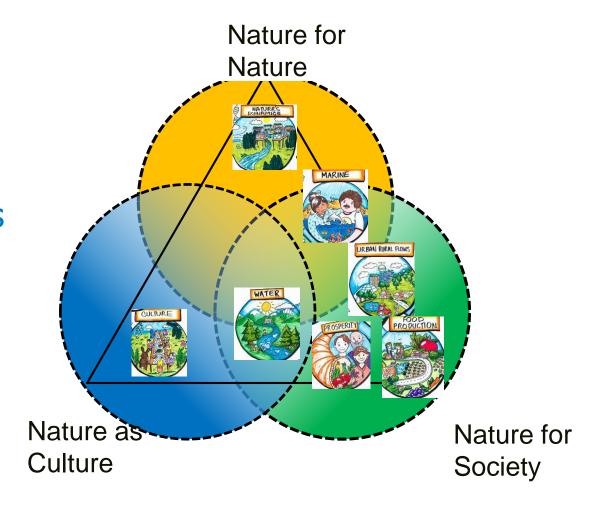
Visioning workshop: from seeds to visions



# Resulting 7 visions

MARINE URBAN RURAL FLOWS HEALTHY OCENNS = HAPPY COMMUNITIES SUSTAINABLE GLOBAL OCEAN A NATURE INTO THE CITY & DE LOCAL & INDIGENOUS MANAGEMENT REWILDING COUNTRYSIDE OF DECISION-MAKING RE: COASTLINES RE-THINK GOVERNANCE INT'L COLLABORATIVE HIGH SEAS & SOCIETAL SYSTEMS MANAGEMENT A CONSCIOUS CONSUMPTION OF FOOD WITH LINKAGES TO/ FROM CONSUMERS / PRODUCERS CULTURE DEDUCATION RECONNECTS WITH NATURE WATER HARMONIOUS BIODIVERSE FOOD RIVERS ARE RECOGNISED DIVERSITY OF KNOWLEDGE & CULTURAL INSTITUTIONS IS AS LIVING SYSTEMS SHARED & RESPECTED MICRO WATER MANAGEMENT NO HYDRO/ FOSSIL FUELS O CIRCULAR ECONOMY PRINCIPLES PRODUCTION PROSPERIT AWARE, INFORMED CONSUMERS WITH LOCAL FOCUS OMMUNITY BASED NATURAL ECOLOGICAL OPTIMISATION RESOURCE MANAGEMENT NATURES SUPPORTED BY TECHNOLOGY DEPLACE "GDP GROWTH" GOVERNANCE, REGULATION & WITH A NEW SYSTEM EDUCATION CONNECTION! HOUSTIC, INCLUSIVE, EQUITABLE 6 RECOGNITION THAT NATURE IS CONSTANTLY MOUNG - SPACE/TIME FOR NATURE 6 DYNAMIC DANCE WITH NATURE ON AN EVOWTIONARY STAGE ENGINEERED NATURE

Lundquist et al., 2018, NIWA Relation between visions and perspectives



## Use of scenarios and models in policy making

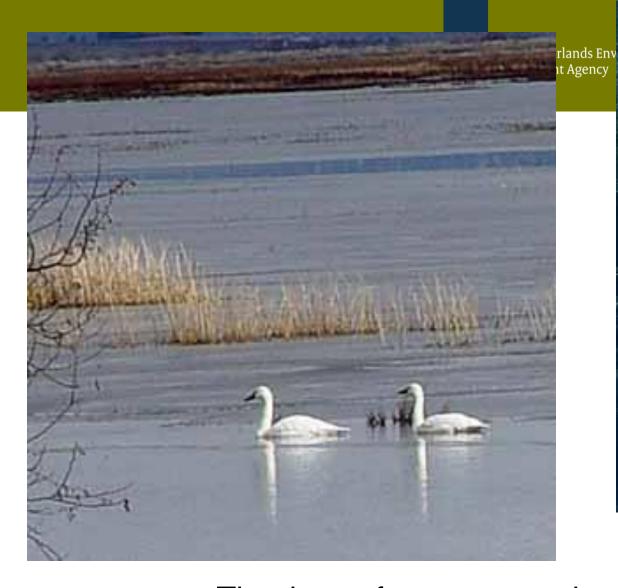
- Land in reports
- Awareness building
- Promote integrated policy (Nexus approach)
- Cooperation between countries
- Playing (e.g. serious game)

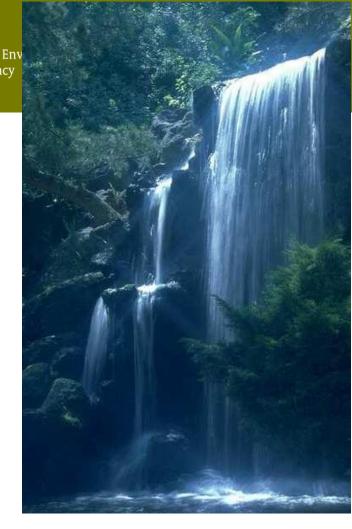
## Conclusions on biodiversity

- Land-use, climate and hydological changes can be translated into water quality, ecological functions and biodiversity
- Already considerable decrease in Europe,
   N.America, China, India
- Africa and S.America will follow
- Biodiv. decrease can be reduced by 50%, but this will require fundamental societal changes

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- Boelee, E. et al. (2016). Overcoming water challenges by naturebased solutions.





Thank you for your attention

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