Synergies between combating climate change, and the conservation and sustainable use of biodiversity

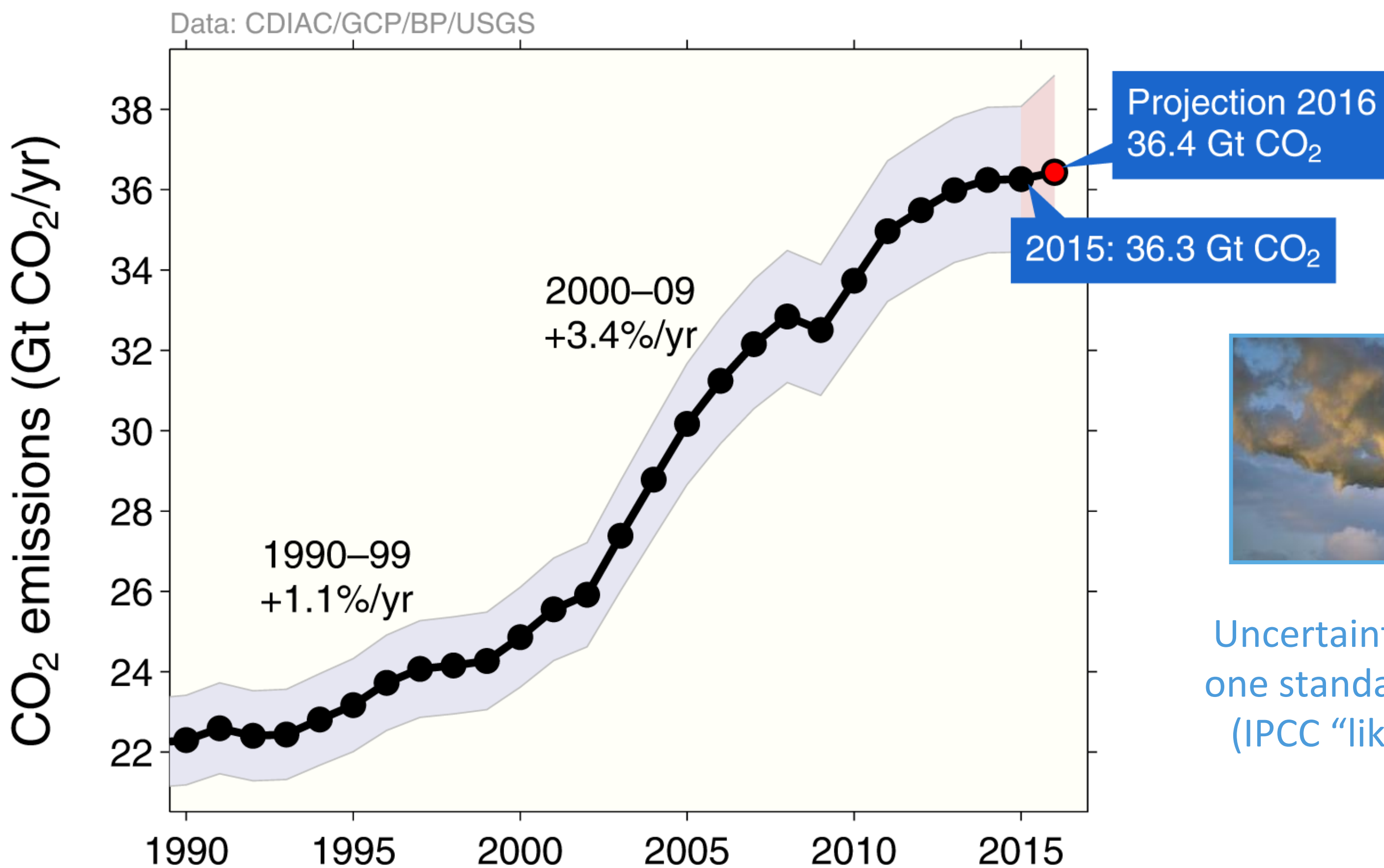
Guy Midgley, Global Change Biology Group, University of Stellenbosch, South Africa

With acknowledgements to: Paul Leadley, Rob Alkemade, Carlo Rondinini, Detlef van Vuuren, Andreas Heinimann; Thomas Hickler

Emissions from fossil fuel use and industry

Global emissions from fossil fuel and industry: 36.3 ± 1.8 GtCO_2 in 2015, 63% over 1990

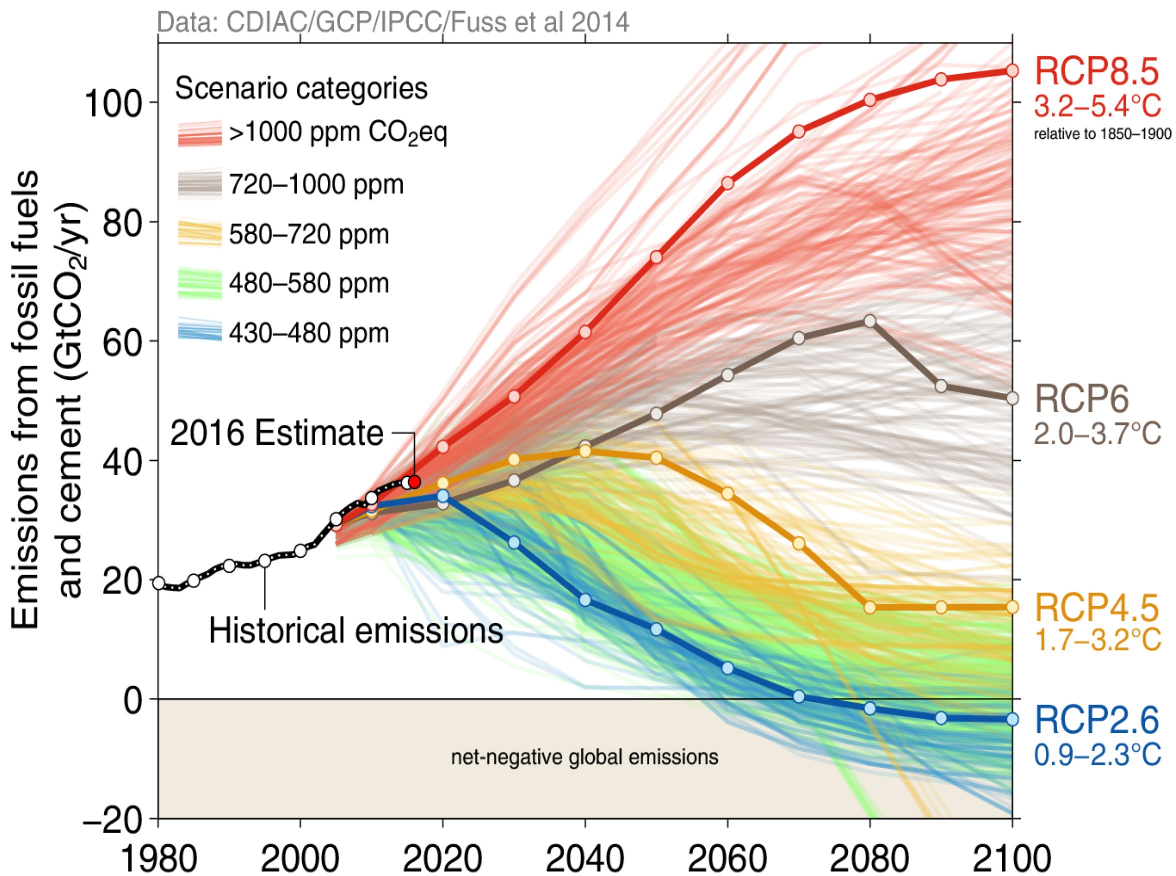
- Projection for 2016: 36.4 ± 2.3 GtCO_2, 0.2% higher than 2015



Uncertainty is ±5% for one standard deviation (IPCC "likely" range)

Estimates for 2014 and 2015 are preliminary. Growth rate is adjusted for the leap year in 2016.
Source: CDIAC; Le Quéré et al 2016; Global Carbon Budget 2016

Emissions scenarios: Representative conc. pathways



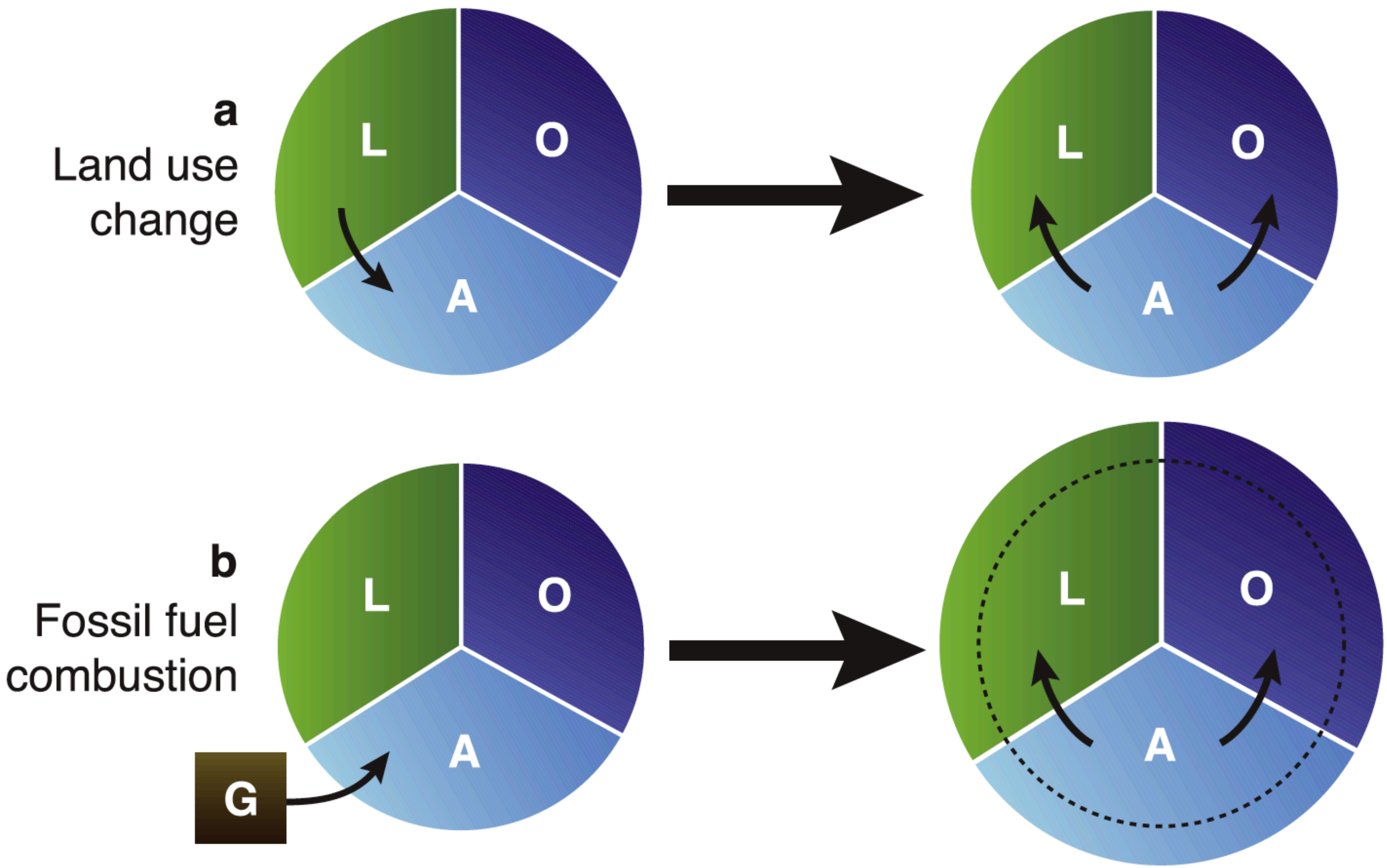
- Paris Agreement target paraphrased: "Keep global ΔT below 2°C this century, as close to 1.5°C as possible"
- Current pledges not sufficient, most studies suggest likely ΔT ± 3°C by2100

The IPCC Fifth Assessment Report assessed about 1200 scenarios with detailed climate modelling on four Representative Concentration Pathways (RCPs)
Source: Fuss et al 2014; CDIAC; IIASA AR5 Scenario Database; Global Carbon Budget 2016

What are the important synergies with conservation and biodiversity?

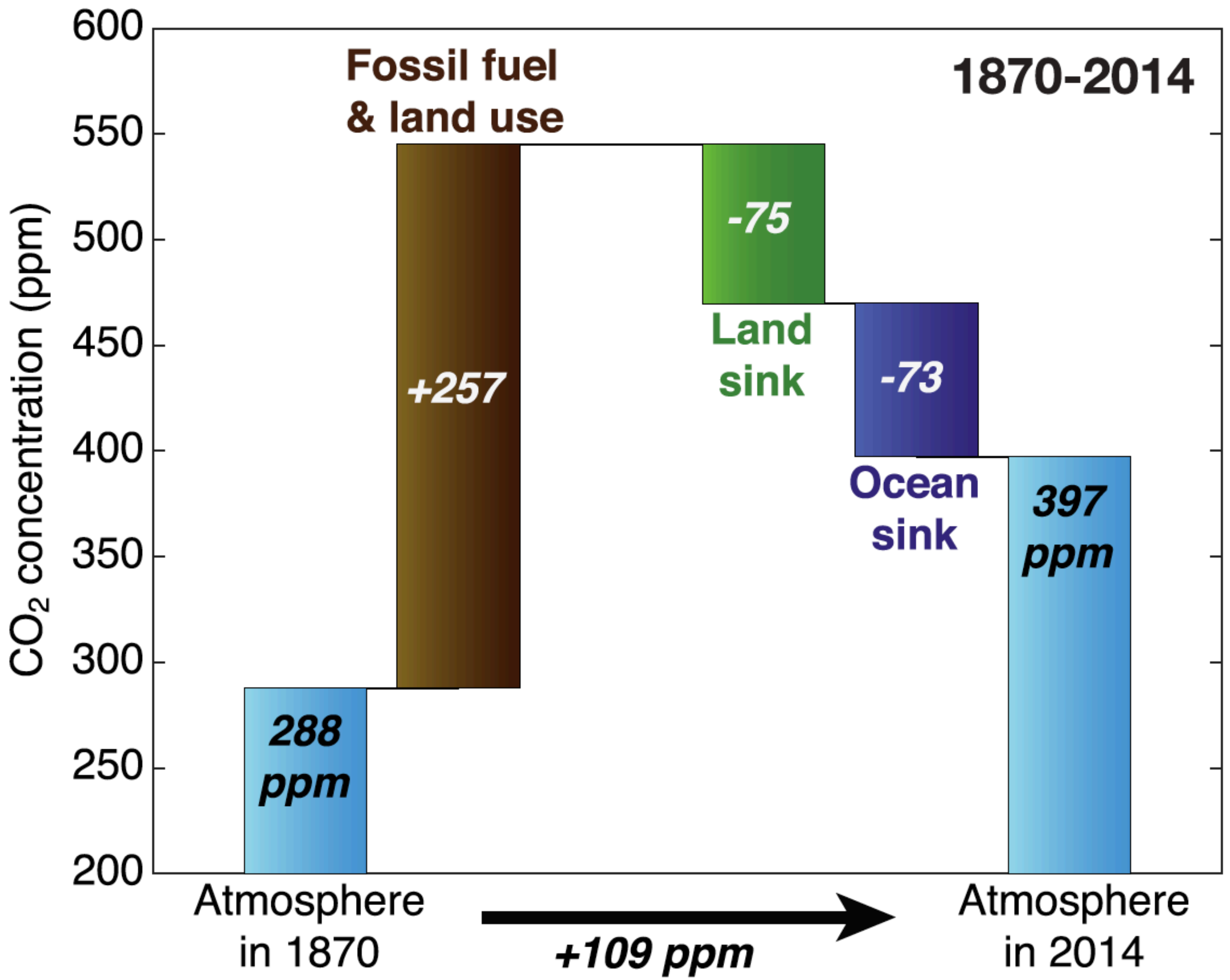
- Mitigation
  - Ecosystem roles in mitigation
  - Unintended consequences for biodiversity
- Adaptation
  - Adaptation strategies for nature conservation
  - Biodiversity/ecosystem support for people's resilience

Human perturbation of carbon cycle



Jones et al. (2016) Environ. Res. Lett. 11 095012 doi10.1088/1748-9326/11/9/095012

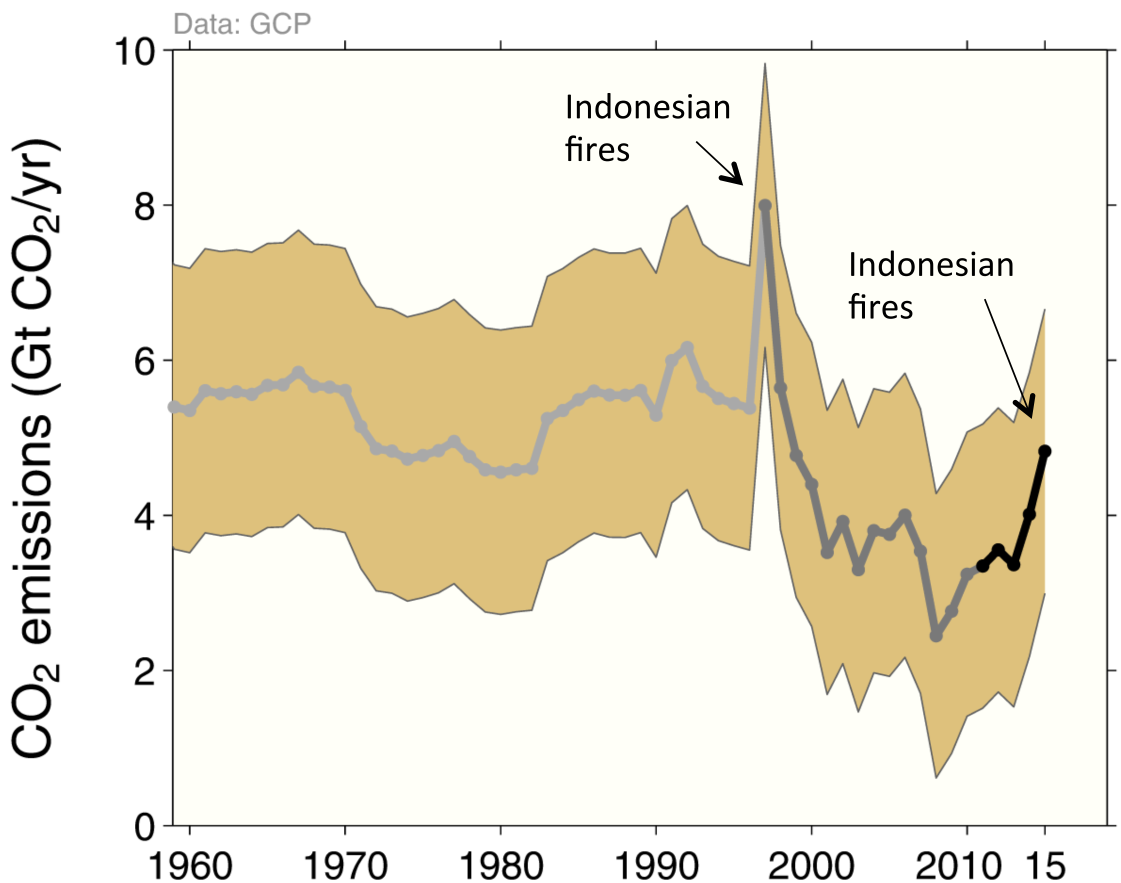
Ecosystems have absorbed ± 50% of the carbon released to atmosphere



Jones et al. (2016) Environ. Res. Lett. 11 095012 doi10.1088/1748-9326/11/9/095012

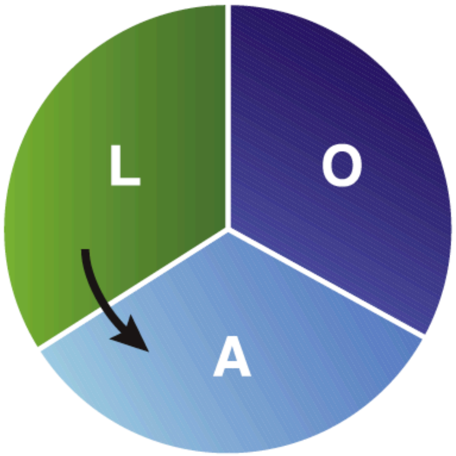
Land-use change emissions

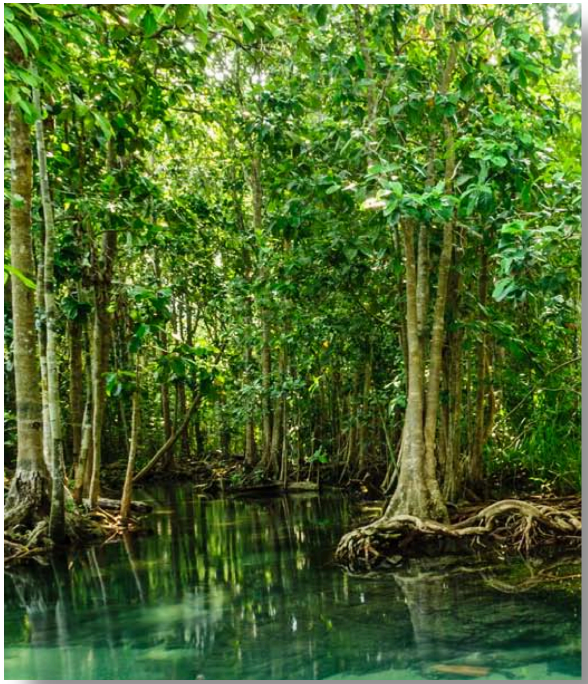
Emissions in the 2000s were lower than earlier decades, but highly uncertain
Higher emissions in 2015 are linked to increased fires during dry El Niño conditions in Asia



Three different estimation methods have been used, indicated here by different shades of grey
Land-use change also emits CH_4 and N_2O which are not shown here
Source: [Houghton et al 2012](); [Giglio et al 2013](); [Le Quéré et al 2016](); [Global Carbon Budget 2016]()

Reducing emissions from deforestation and forest degradation





Best practice policies to curb deforestation:

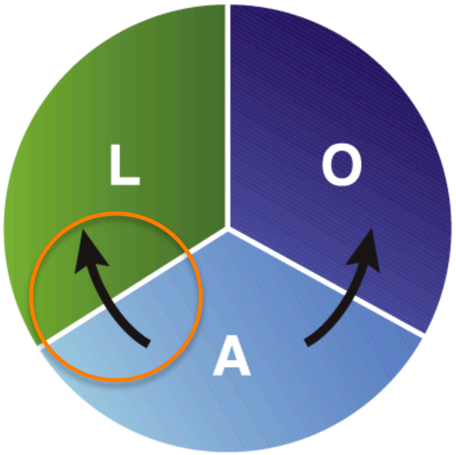
- Establishing new protected areas
- Using command-and-control measures (regulations on forest conversion, investing in protected areas (Scharlemann et al., 2010))
- Using economic instruments (taxes, subsidies, payments for ecosystem services)
- Creating policies affecting drivers and contexts that currently promote deforestation

Benefits (tropics):

- C-sequestration (by 2030) 1.8-4.7 GtCO_2 reducing deforestation; 0.3-1.7 GtCO_2 forest management and reduced degradation

UNEP (2015). The Emissions Gap Report 2015. United Nations Environment Programme (UNEP), Nairobi

Increasing carbon sequestration through ecosystem restoration, reforestation and afforestation



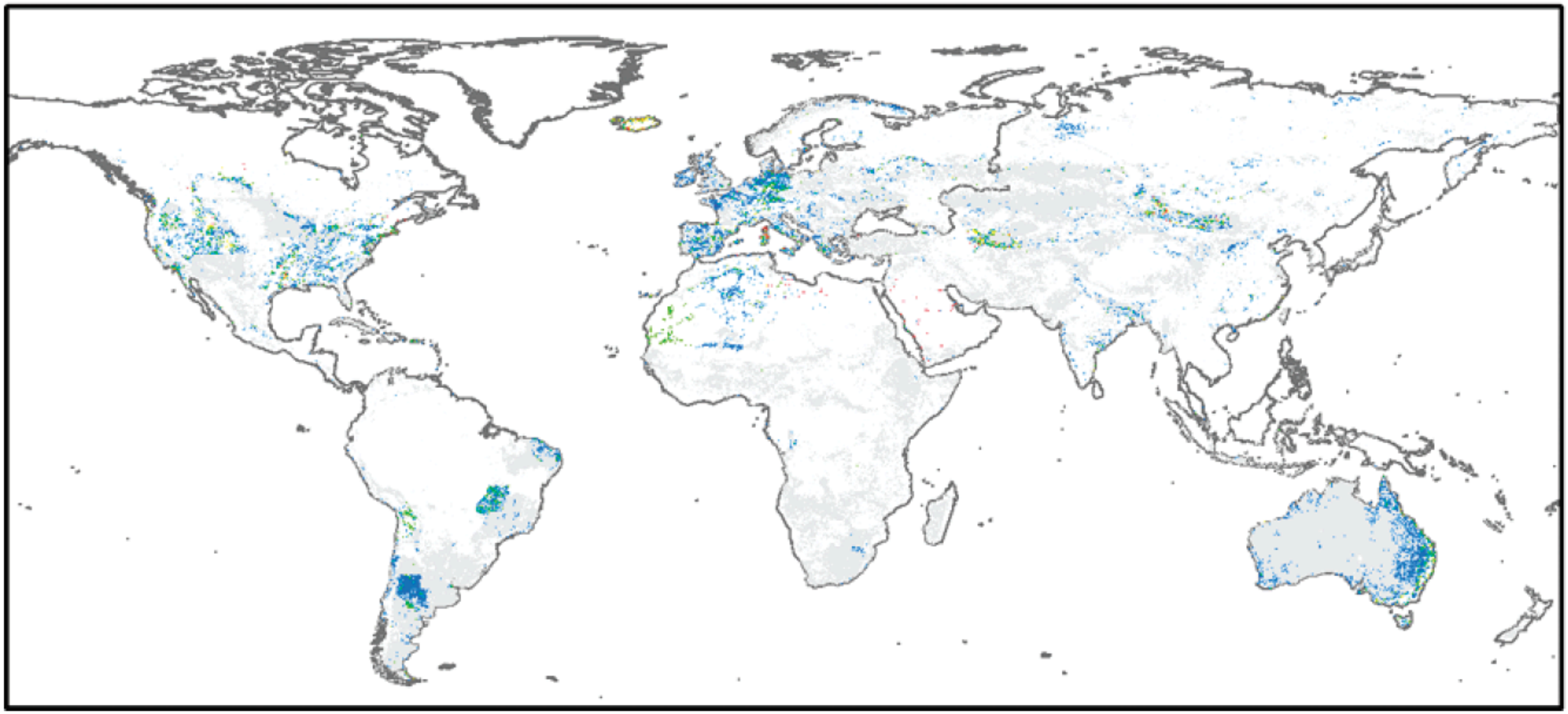
http://www.grida.no/publications/et/ep5/page/2363.aspx

- Reforestation can be implemented at different scales, from small areas within a mosaic of other land uses to "wide-scale"
- Global potential for 'wide-scale' restoration of closed-canopy forest is up to 0.5 billion ha, with mosaic restoration up to 1.5 billion (WRI, 2011)
- Mitigation potential est 3.8 $GtCO_2$ by 2030 (UNEP 2015)
- Many other ecosystem restoration opportunities exist with significant co-benefits

Increasing carbon sequestration through ecosystem restoration, reforestation and afforestation

Estimated global area of abandoned agriculture = 385-472 million ha with production 4.3 t ha^{-1} y^{-1}

D) HYDE Abandoned Agriculture



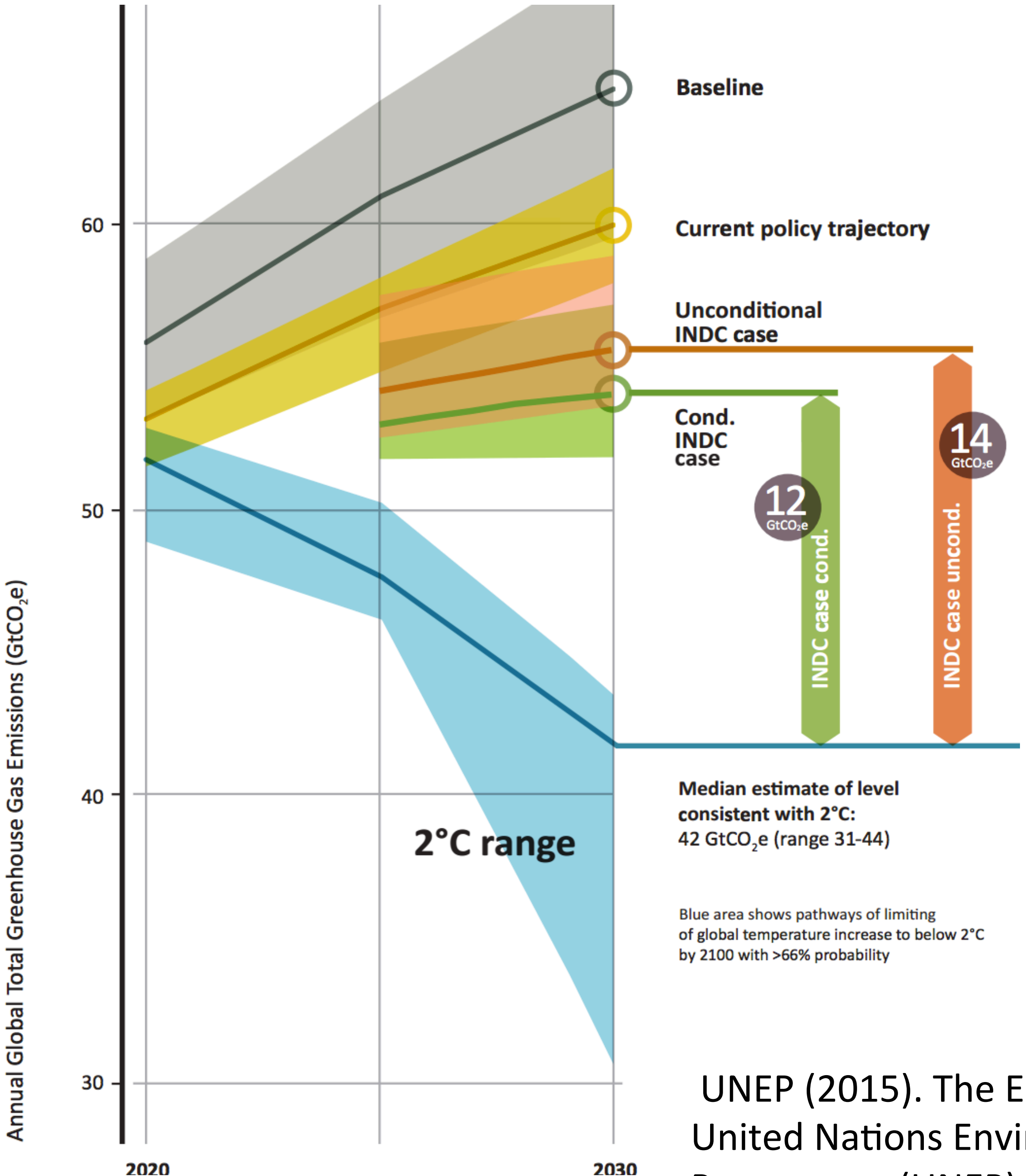
Elliot Campbell et al. 2008 Environmental science and technology

Risks to biodiversity and ecosystem services from afforestation

- Non-forest "marginal" ecosystems identified as potential targets for afforestation may have significant carbon stocks – grasslands and savannas store significant amounts carbon, including below ground

- They also harbour significant biodiversity – Madagascan grasslands have endemic grass genera evidence of ancient origins (Bond et al 2008); Southern African grasslands and shrublands are amongst richest in the world

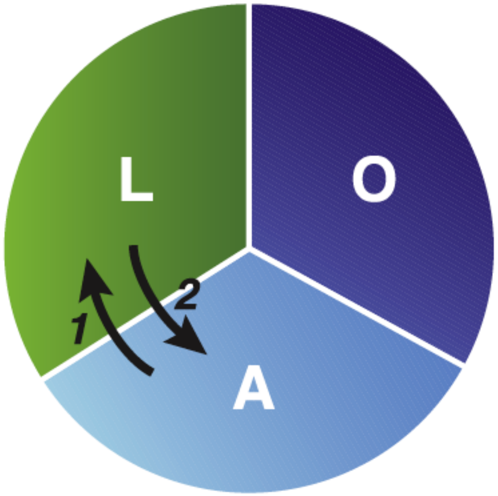
- Careful decision making taking biodiversity and ecosystem service impacts would reduce these risks



- **There is a significant gap between INDC and remaining below 2°C**
- **Most scenarios that remain below this target assume significant biofuel and bioenergy with carbon capture and storage (BECCS)**

UNEP (2015). The Emissions Gap Report 2015. United Nations Environment Programme (UNEP), Nairobi

Biofuel and land-use considerations



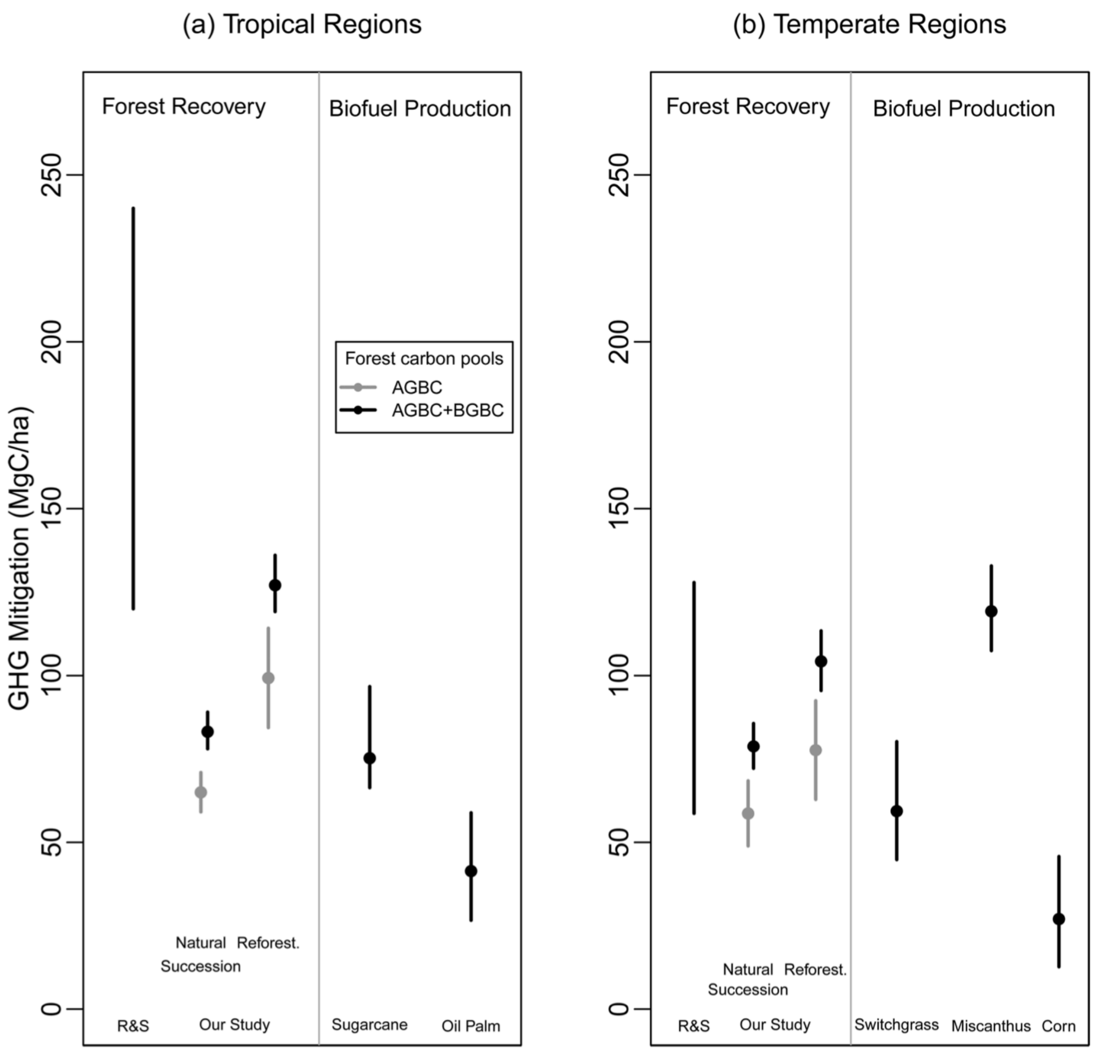
- 10% substitution of liquid fuel by biofuel requires ± 40% of cropland in USA and Europe *(Righelato and Spracklen 2007)*

- Biofuel expansion may come at a considerable cost for biodiversity, e.g. as croplands expand to meet food production needs

- Careful decision making informed by full mitigation effects and ecosystem service and biodiversity costs would reduce these risks

- There is a critical role for conservation science in assessing risks and informing decisions relating to implementing biofuel implementation

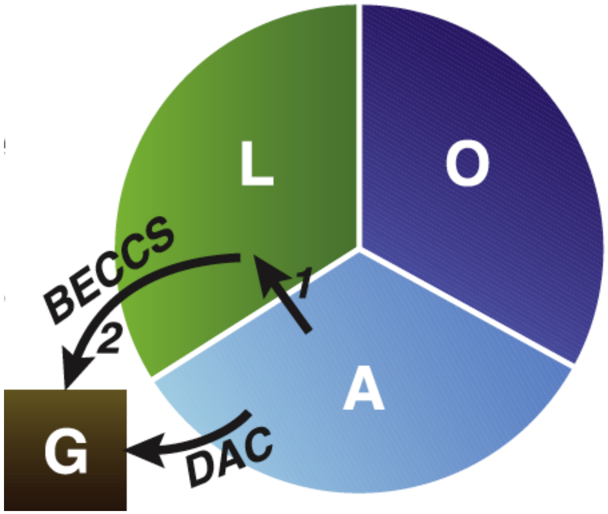
Bioenergy and ecosystem-based strategies: Comparative analysis



Evans et al. 2015

- Avoiding deforestation and restoring ecosystems may currently be more effective than bioenergy as a climate mitigation strategy
- There are significant biodiversity conservation and ecosystem services co-benefits associated with such approaches, plus avoided impacts due to intensive agricultural practices
- Scientific capacity in estimating the relative benefits and co-benefits is increasing and provides important evidentiary support for policy decisions

Bioenergy with carbon capture and storage (BECCS)



- Negative emission technologies (NETs)

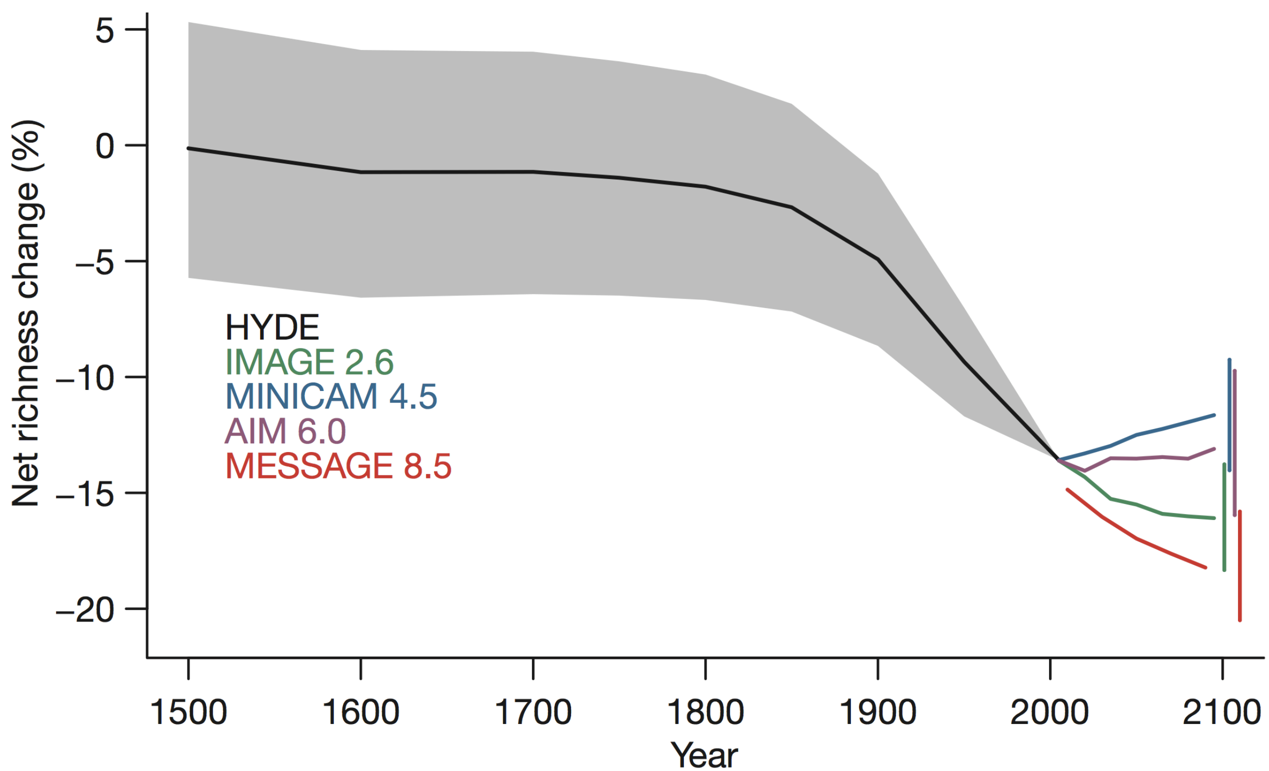
- Bioenergy may identify "marginal" land as appropriate for implementation, with associated risks for currently less threatened ecosystems and biodiversity

- Certain implementations (e.g. biochar) may contribute to increasing soil carbon stores with related co-benefits *(Smith 2016)*

- There is a need for scientific assessment of these still novel technologies to reduce risks, inform decisions relating to implementation and assess the conservation and biodiversity implications

Integrated projections of land-based mitigation impacts

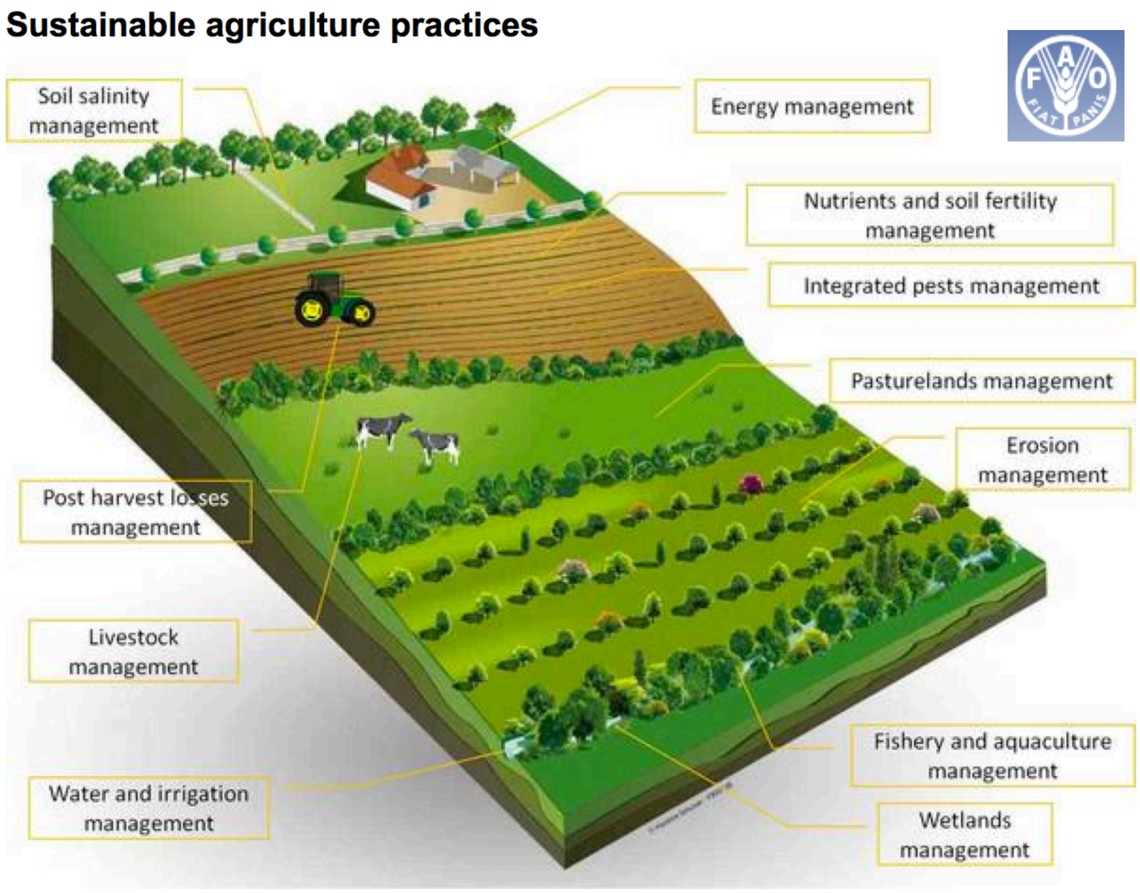
Many current scenarios anticipate large-scale bioenergy and corresponding land use changes and/or high rates of greenhouse gas emissions: Analysis would help to inform implementation that could reduce/avoid adverse effects on biodiversity



Projected effects of RCP land use change scenarios on local species richness

Newbold et al. 2015

Sustainable agricultural intensification



- Sustainable agricultural practices, including promoting soil carbon sequestration, could contribute to climate mitigation while reducing impacts on biodiversity

- Ecosystem based approaches to adaptation can also help to build societal resilience, including through supporting more climate resilient land use practices

Conclusions

- Global CO_2 emissions have stabilized; but significant efforts in renewables and land based approaches will be needed as part of a portfolio to maintain this trend and then strengthen it to achieve even the 2°C global goal
- The land sink plays significant role in mitigating warming for at least a century – ecosystem approaches will be critical for maintaining and enhancing the land sink, and there are many conservation synergies
- Negative Emissions Technologies (such as BECCS), afforestation and biofuels appear necessary to achieve 2.6 Representative Concentration Pathway, with significant implications for biodiversity – decisions could have a wide range of impacts on biodiversity, and conservation would benefit by exploring the implications quantitatively and with rigor
- Conservation related analytical efforts informed by the growing databases and tools available are increasingly playing a role in informing sustainable implementation towards the global goal, but intensifying these efforts will help to reduce many uncertainties