

# Exploring the impacts of agriculture on biodiversity

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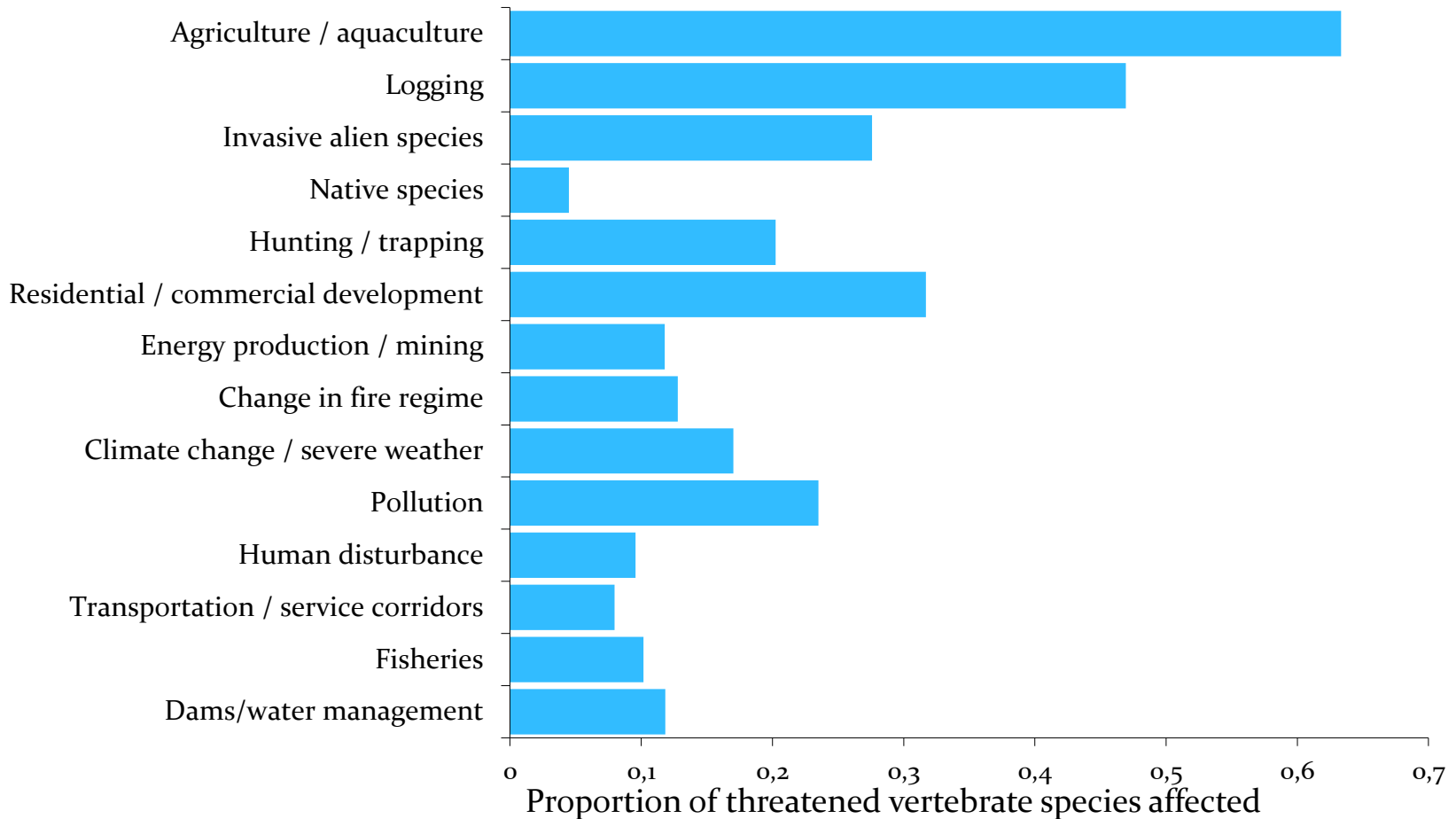
# Agriculture has had the greatest impact on the planet of any human activity.

- **Multiple direct and indirect impact pathways:**
  1. Habitat conversion and fragmentation
  2. Climate change
  3. Pollution.
  4. Exotic/modified species

# Agriculture and land use/cover change

- 38% of Earth's ice-free land surface under crop production and permanent pasture
- Half of all former temperate deciduous forests and savannas
- Three quarters of the world's natural grasslands.
- Leading cause of tropical deforestation.
- 70% of human use of fresh water
- Approx half of total fish consumption now from aquaculture

# The most important threat to wild vertebrates



(Baillie et al 2010)

## Forest



## Grassland



100%

Abundance of original species

0%

# Declines in mean abundance of original species

# GHG emissions from agriculture ~ 1/3 of total emissions

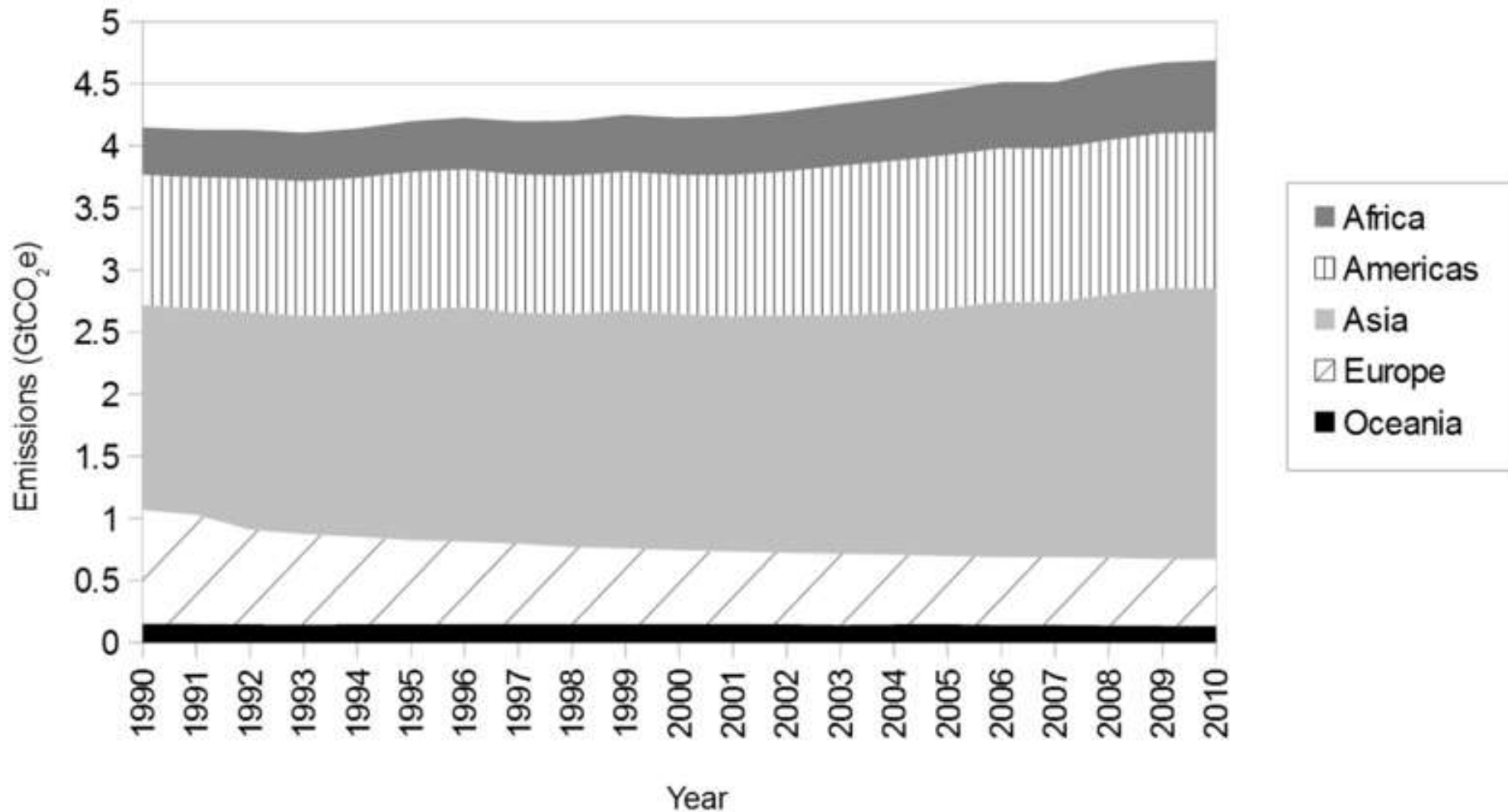
- CO<sub>2</sub> releases linked to deforestation
- Methane releases from rice cultivation
- Methane releases from enteric fermentation in cattle
- Nitrous oxide releases from fertilizer application



Together, comprising

- 54% of methane emissions,
- 80% of nitrous oxide emissions,
- Almost all carbon dioxide emissions resulting from land use change

# Greenhouse gas emissions from agriculture, by region, 1990-2010.

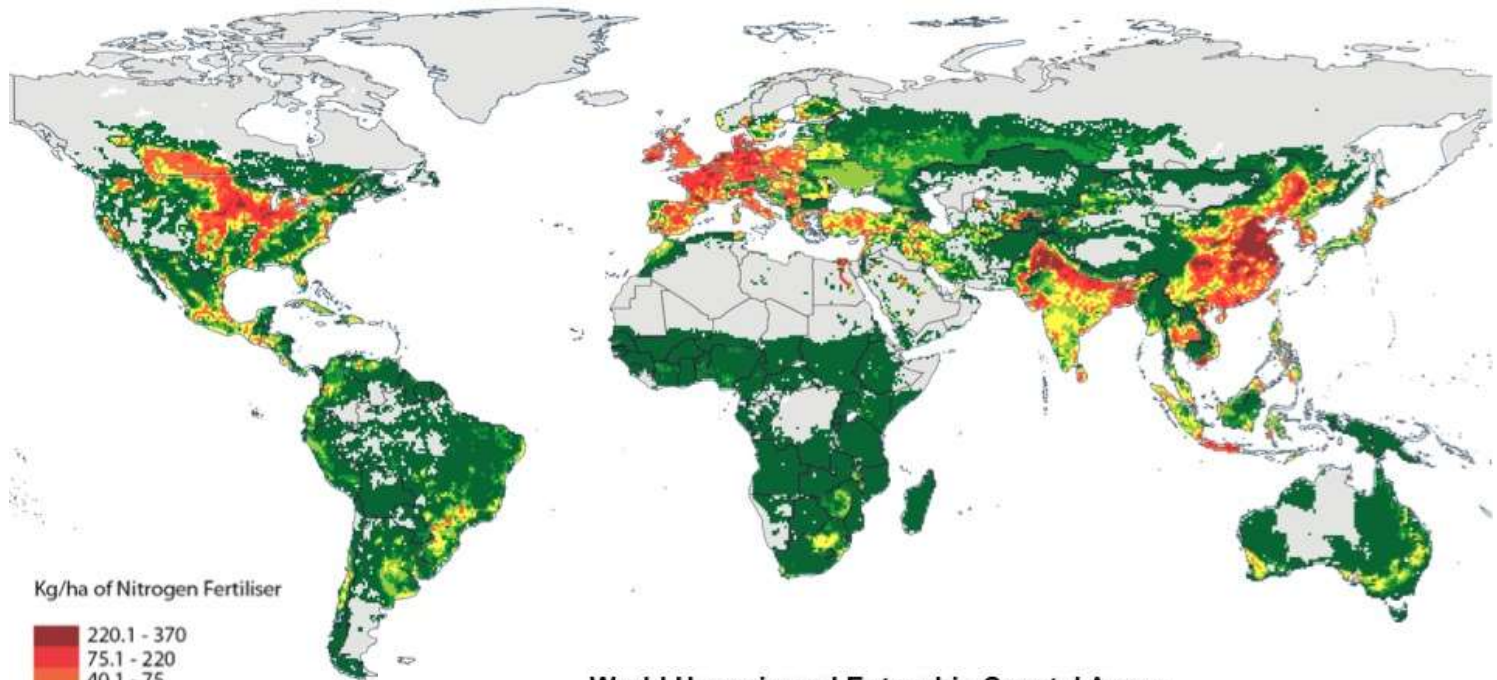


# Agricultural Pollution

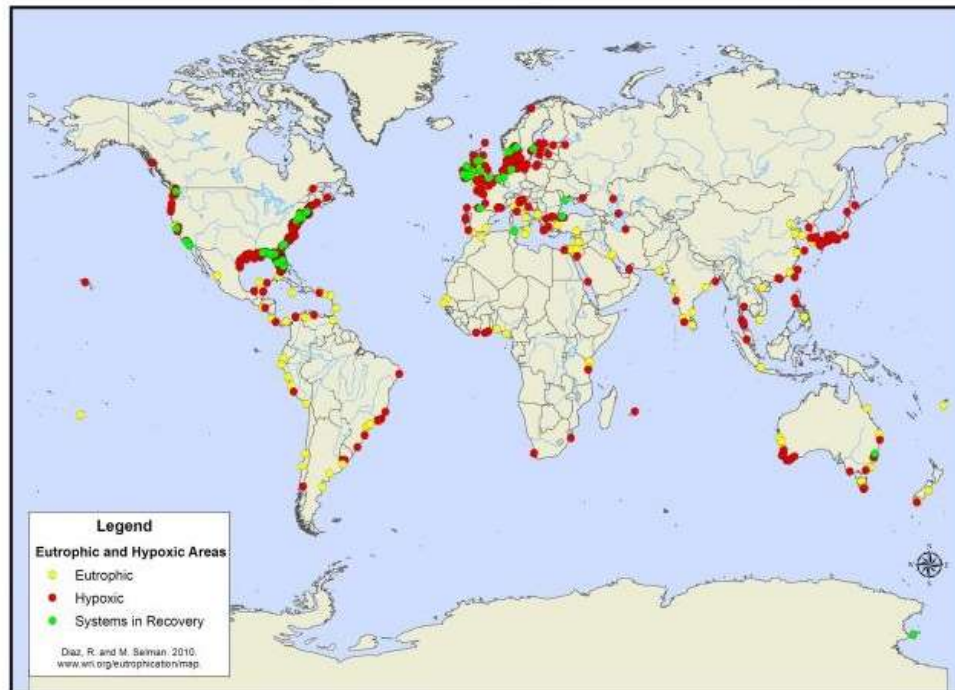
Leading cause of water quality impacts in inland waters

- Leaching, runoff and eutrophication
- Heavy metals
- Organic contaminants
- Pharmaceuticals
- Sedimentation (25-40B tons/yr)





### World Hypoxic and Eutrophic Coastal Areas



# Pesticides

“Pesticides, particularly insecticides, have been demonstrated to have a broad range of lethal and sublethal effects on pollinators”

“It is currently unresolved how sublethal effects of pesticide exposure recorded for individual insects affect colonies and populations of wild pollinators.”

“Recent research focusing on neonicotinoid insecticides shows evidence of lethal and sublethal effects on bees.”

“Pollinator decline is primarily due to changes in land use, intensive agricultural practices and pesticide use...”



IPBES 2016

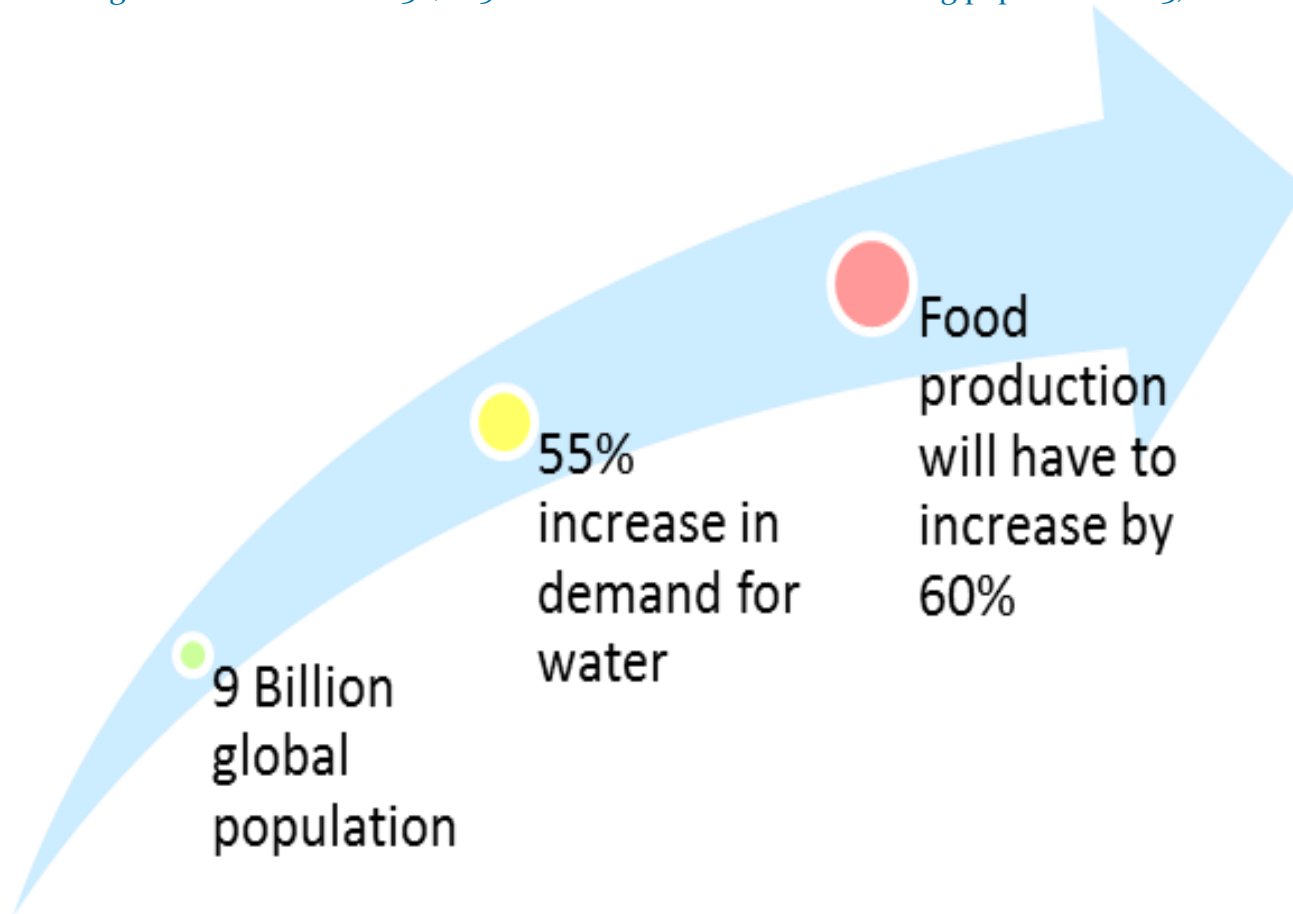
# Exotic/modified species

- Deliberate introductions
  - eg biological pest control
- Accidental introductions
  - eg pollinator parasites
- Hybridization and genetic decline
- Facilitated spread from agricultural practices



# Expected demand for food and water by 2050

Alexandratos, World agriculture towards 2030/2050: the 2012 revision. ESA Working paper No. 12-03, 2012.



# Synergies and Challenges in the SDGs



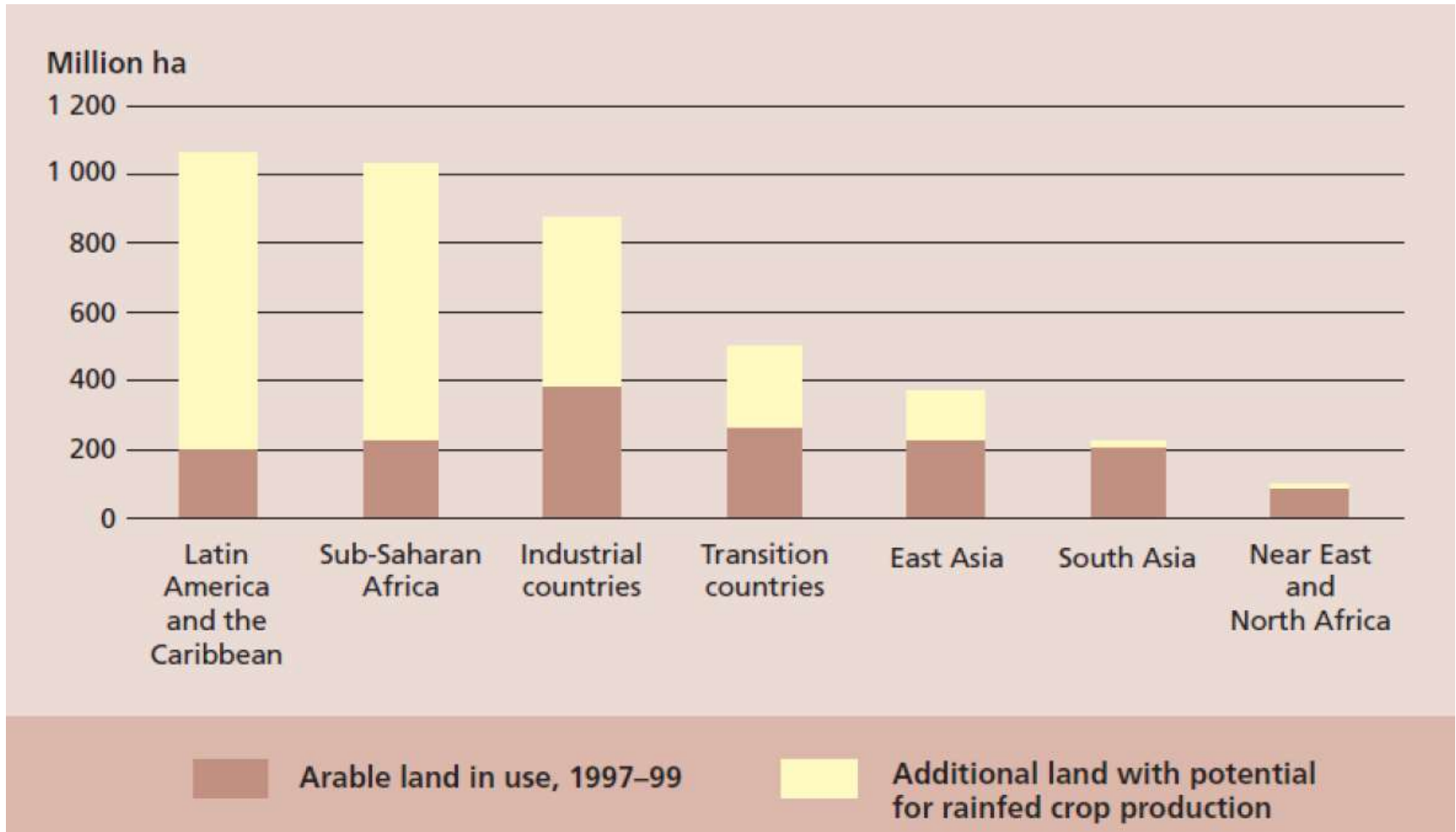
Goal 2.3 By 2030, double the agricultural productivity and incomes of small-scale food producers... including through secure and equal access to land, other productive resources and inputs



Goal 15.3 By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world

Goal 15.5 Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species

# Potential for cropland expansion



(FAO, 2008).

# Modelled land use change - Great Lakes Region

Scenario

*GEO4*

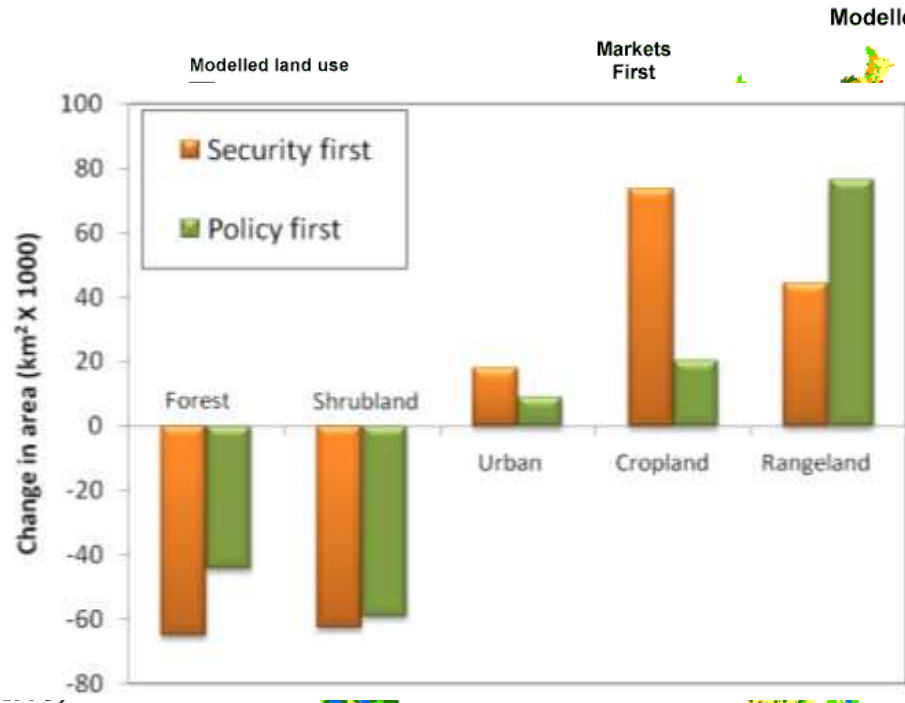
Time Frames

*Scenarios ~*

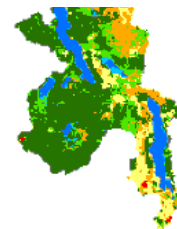
Resolution

*5 arc-minut*

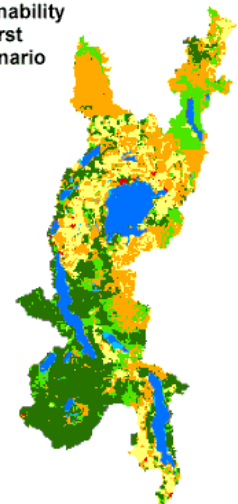
*(~ 9km x 9km)*



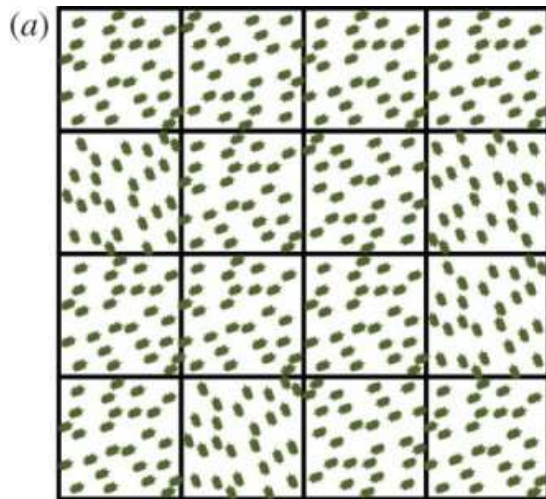
Projected changes in major land use types between now and 2050 for Great Lakes region in Africa for two GEO-4 scenarios



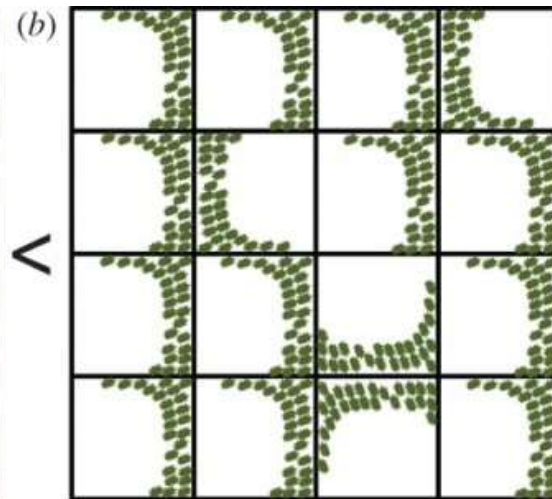
Sustainability First Scenario



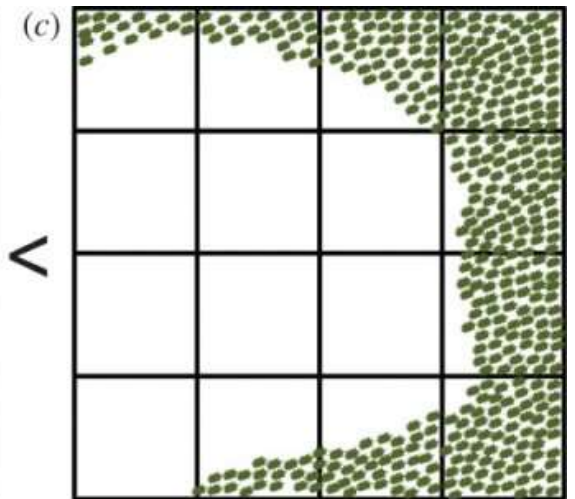
# Choices to be made



land sharing



land sparing within each farm



land sparing across multiple farms



# Land sparing benefits biodiversity

- Across taxa, regions, and agricultural/ecological systems, land sparing results in fewer and less severe declines in populations of species.
- Most species are specialists - highly sensitive to substantial habitat modification.
- Understanding needed from a greater range of regions, biomes, and taxonomic groups
- Other considerations important – hybrid/optimising approach

# Significant policy implications of an integrated agenda for food and biodiversity

- Billions of dollars spent in support of land sharing.
- Not all yield increases are equal
- Interacting variables and other considerations – Ecosystem services, equity etc
- Scale of application important – national and sub-national
- Linking yield increases with sparing:  
Land use zoning; Subsidies; infrastructure; Standards/certification
- Alongside demand and waste strategies.
- Intensification practices must be sustainable!

- **Both the impacts of agriculture on biodiversity, and the role of biodiversity in supporting agricultural productivity, demonstrate the need for better integration of biodiversity and agricultural policies to ensure Food Systems for a Sustainable Future.**
- **We can not conserve biodiversity or feed the world without making significant progress in this endeavour.**