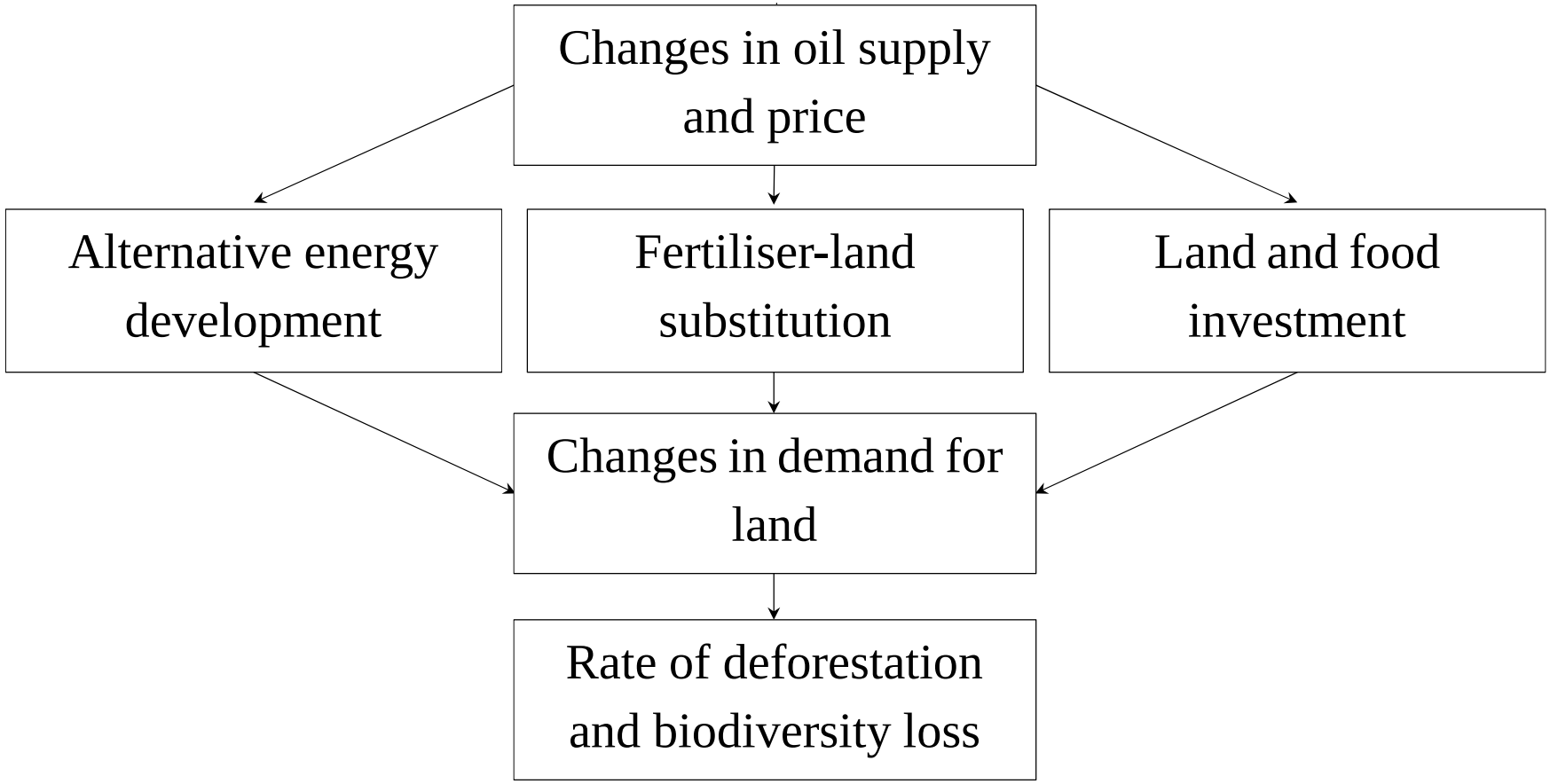
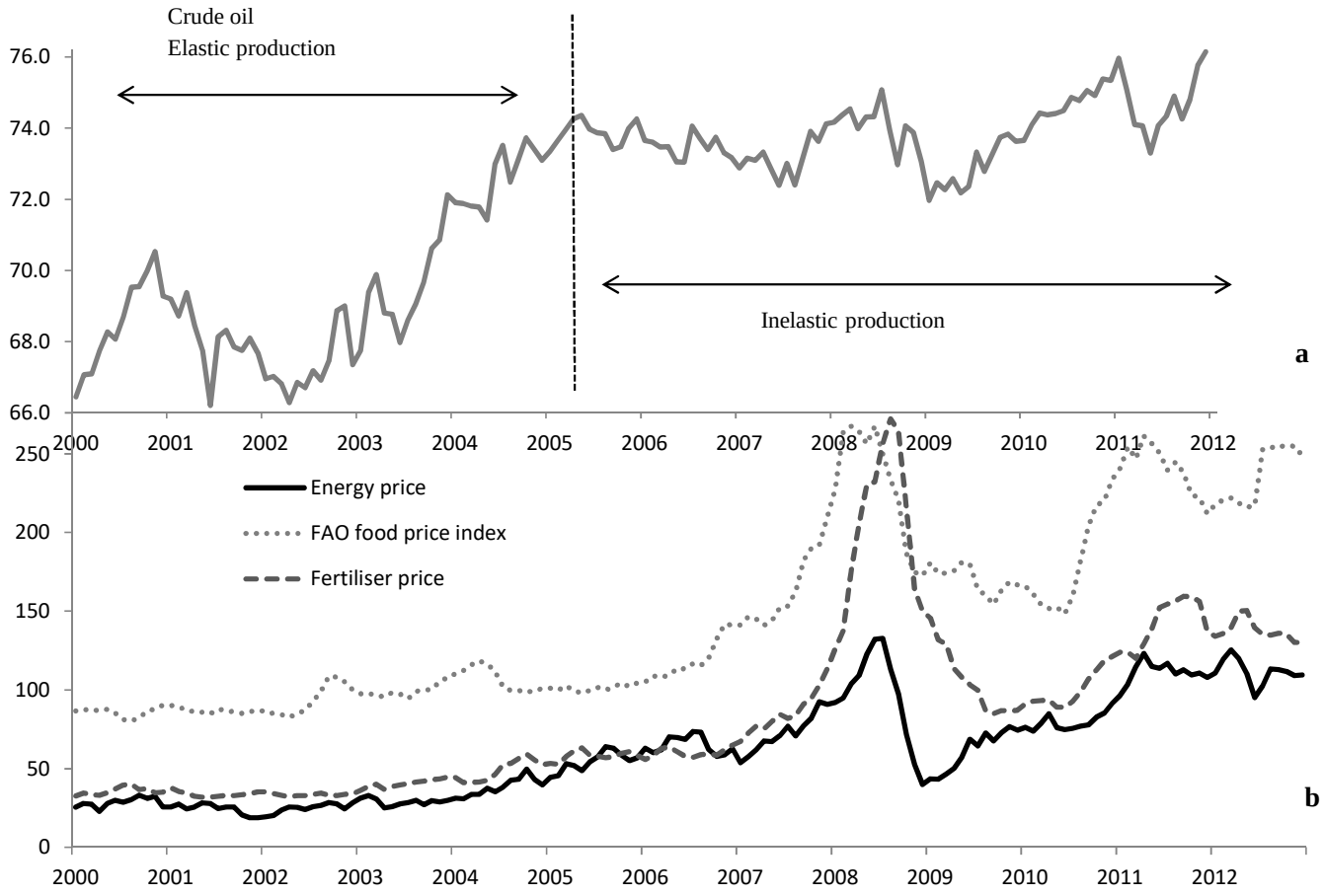
Minimising the biodiversity footprint of post-carbon agriculture

What connects petrochemical supply to biodiversity?



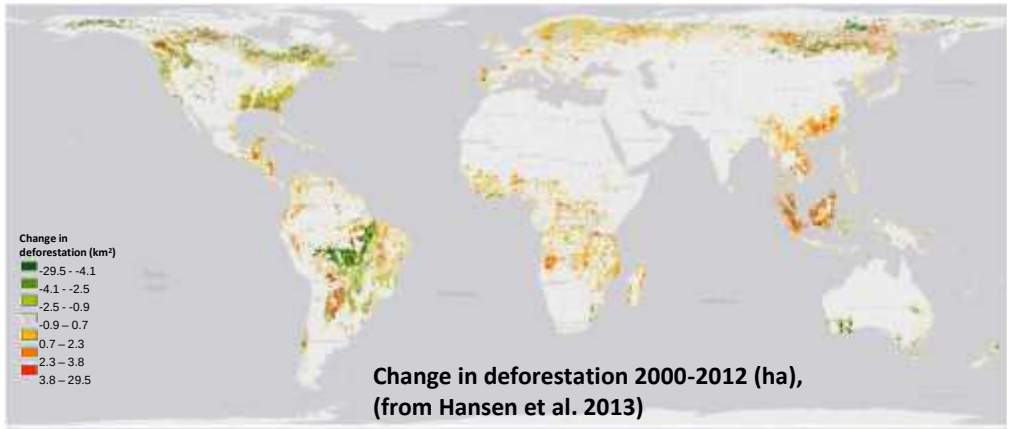
What happened to oil during the GFC?

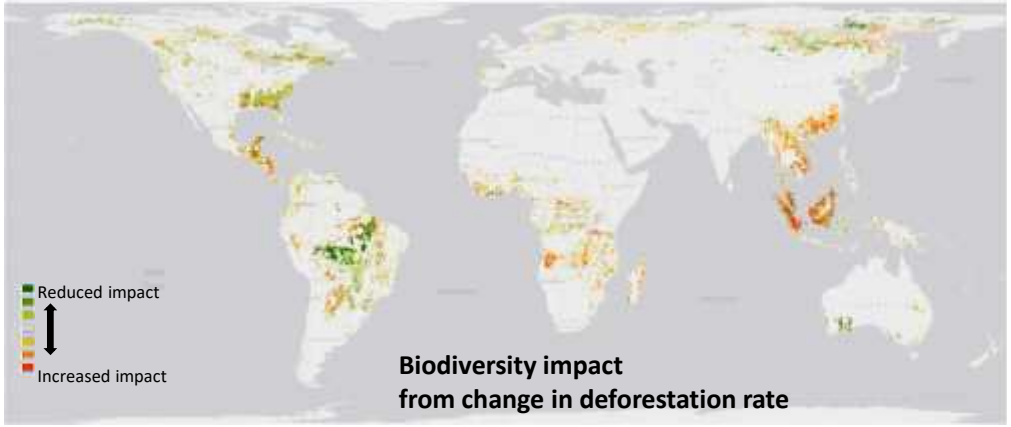


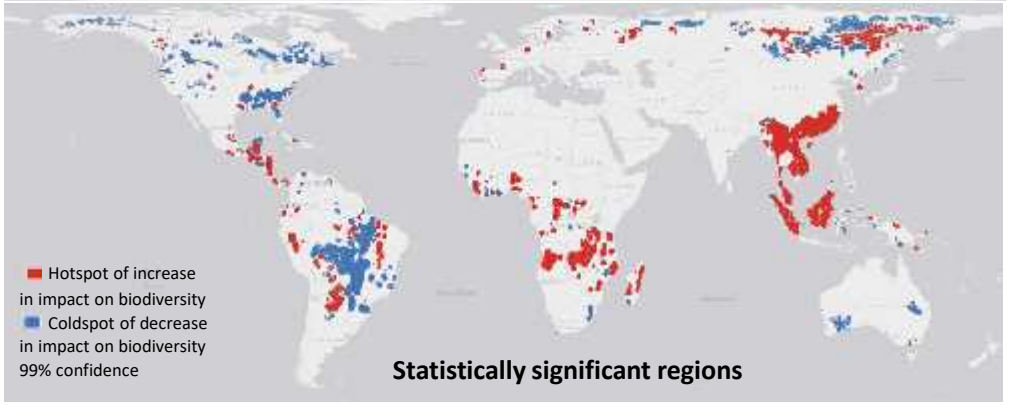
After Murray, J & King, D 2012, 'Oil's tipping point has passed', *Nature*

So what happened during the GFC?

- An additional 290,000 km^2 of forests was cleared
- 24 times the background rate of increase
- Concentrated in areas of highest biodiversity

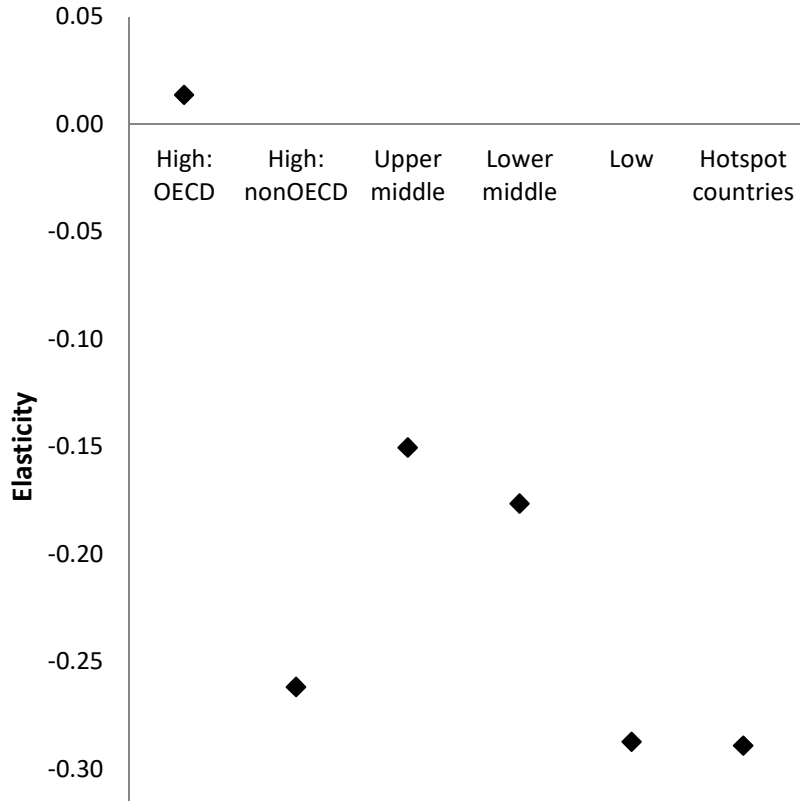






Eisner, R., Seabrook, L. M., & McAlpine, C. A. (2016). Are changes in global oil production influencing the rate of deforestation and biodiversity loss? *Biological Conservation*

What's driving the change in the hotspots?

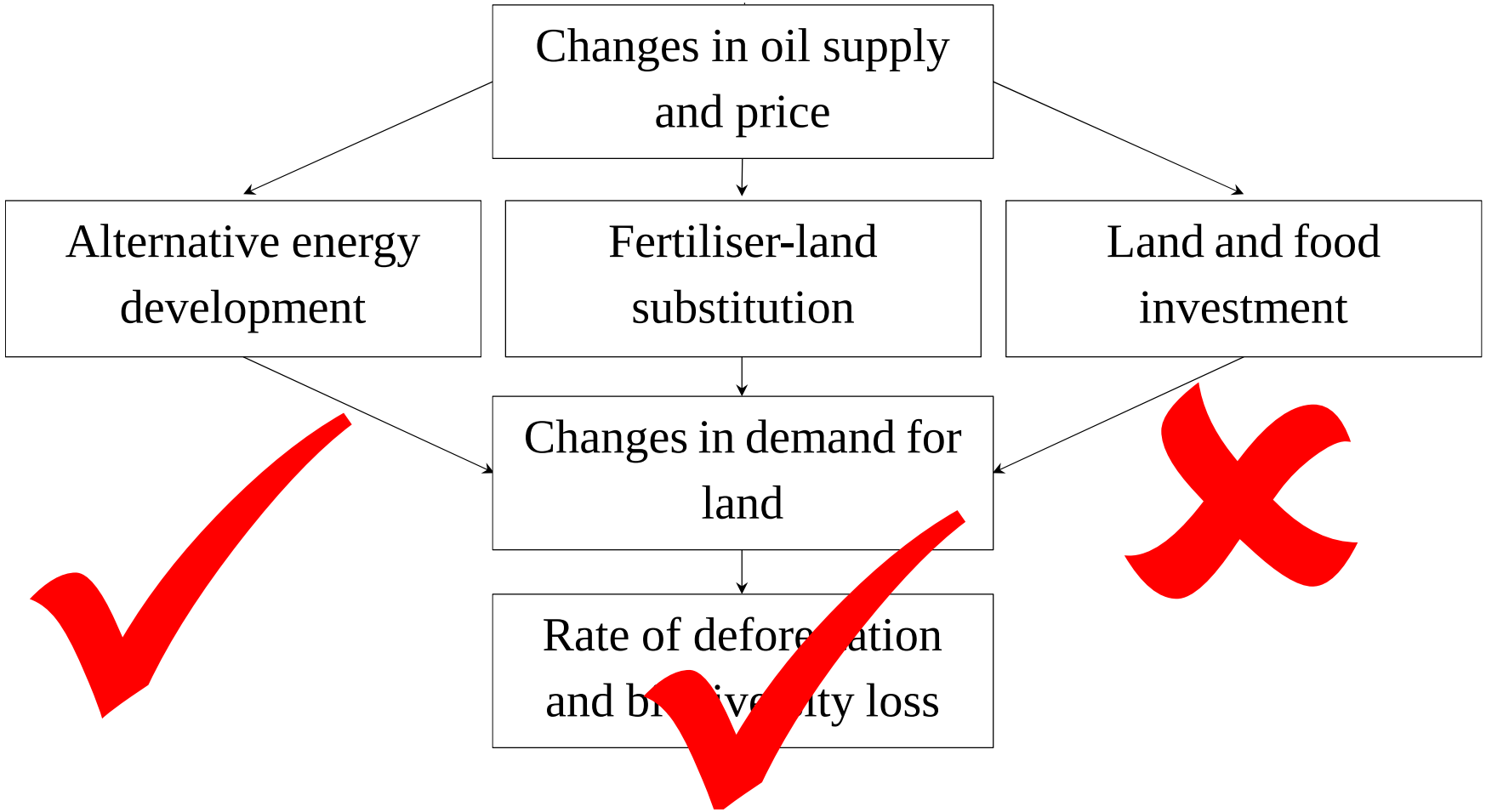


The hotspots:

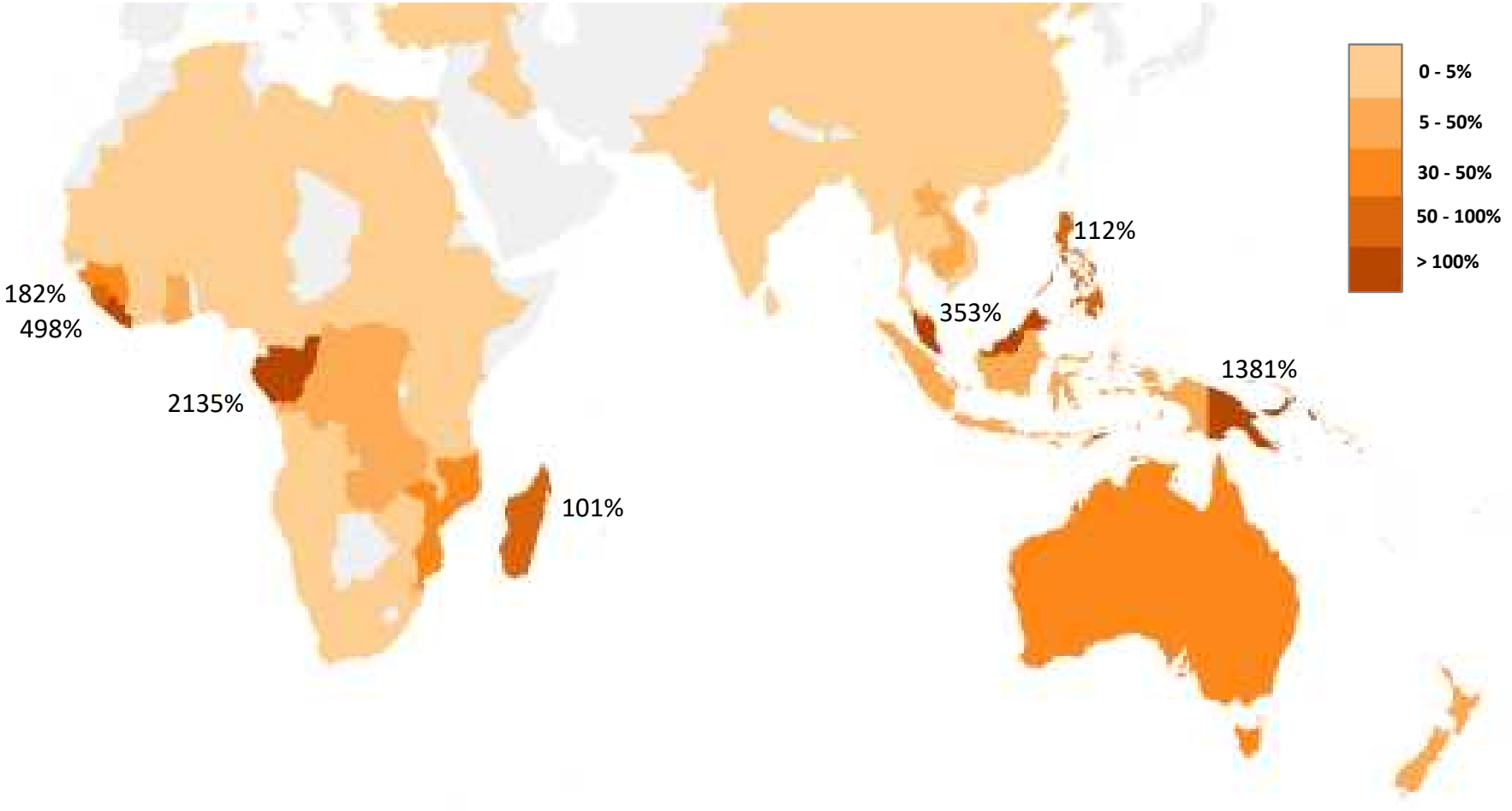
- Commercial agriculture was driving the change
- They were particularly sensitive to the price of N

Eisner, R., Seabrook, L. M., & McAlpine, C. A. (2016). Are changes in global oil production influencing the rate of deforestation and biodiversity loss? *Biological Conservation*

What connects petrochemical supply to biodiversity?

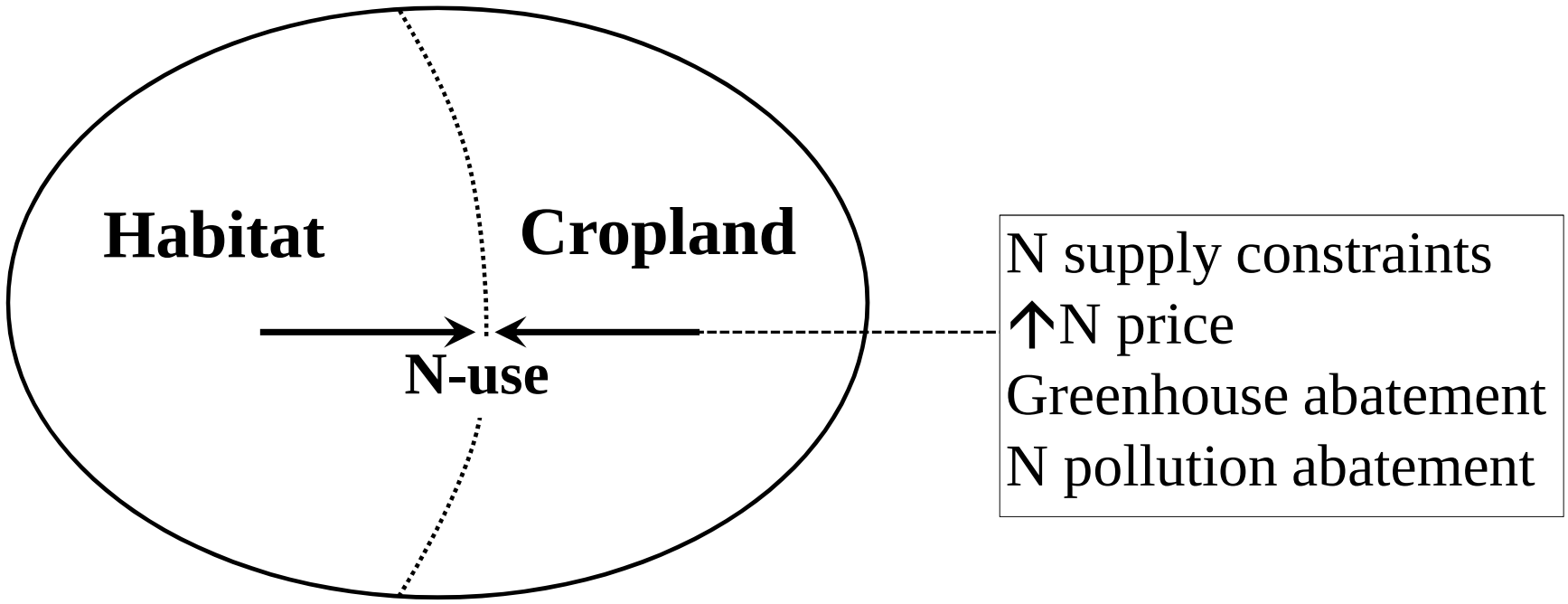


Land grabbing as % of agricultural land



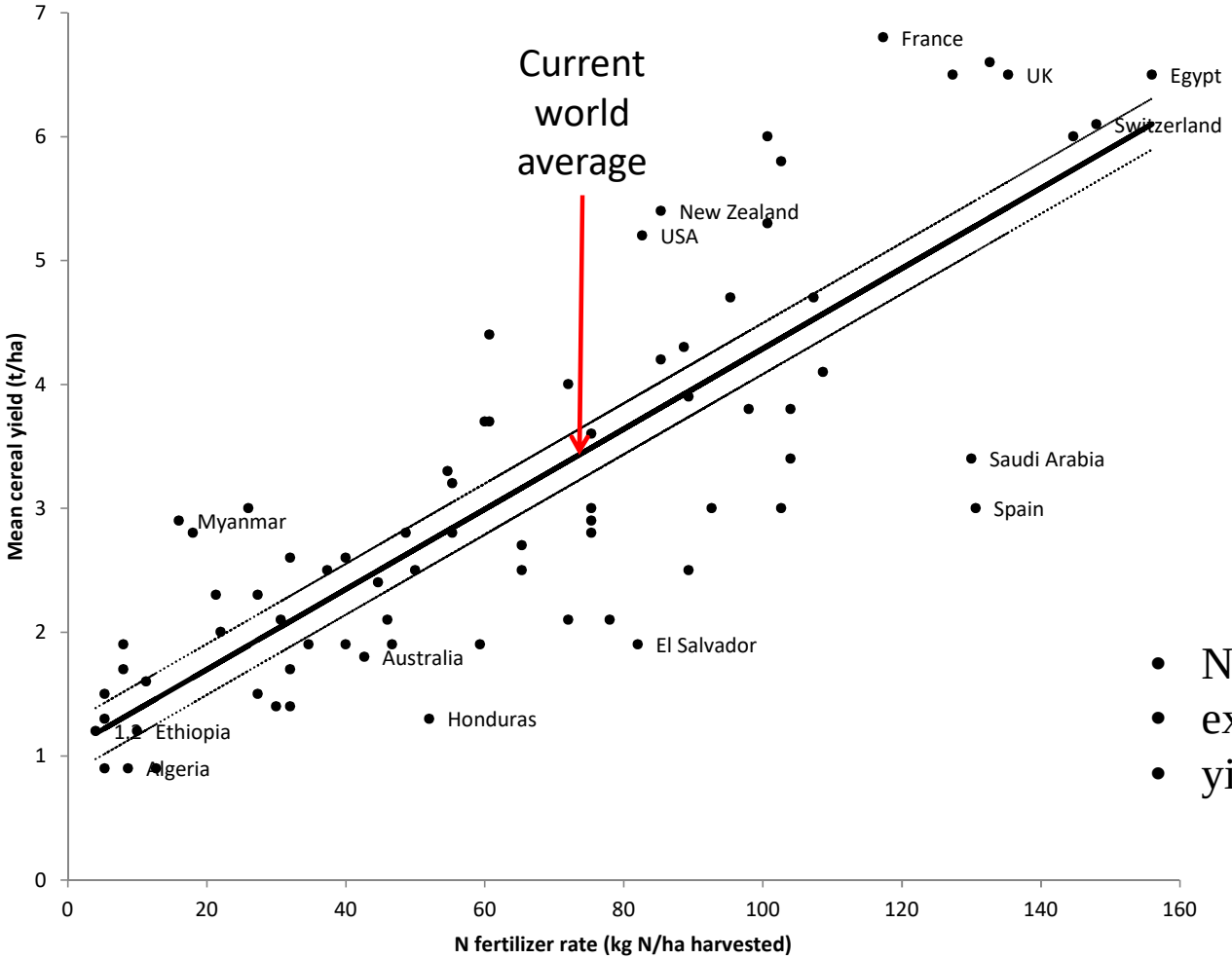
Eisner, R., Seabrook, L. M., & McAlpine, C. A. (2016). Are changes in global oil production influencing the rate of deforestation and biodiversity loss? *Biological Conservation*

Worst-case scenario: no petrochemical fertiliser



Conceptual model. N-use influences the boundary between cropland and habitat

Linear model of N-use



- N to yield relationship is linear, with $R^2 = 0.68$
- extrapolation to yields with zero N (1.05 t/ha)
- yield = 0.032 N + 1.053

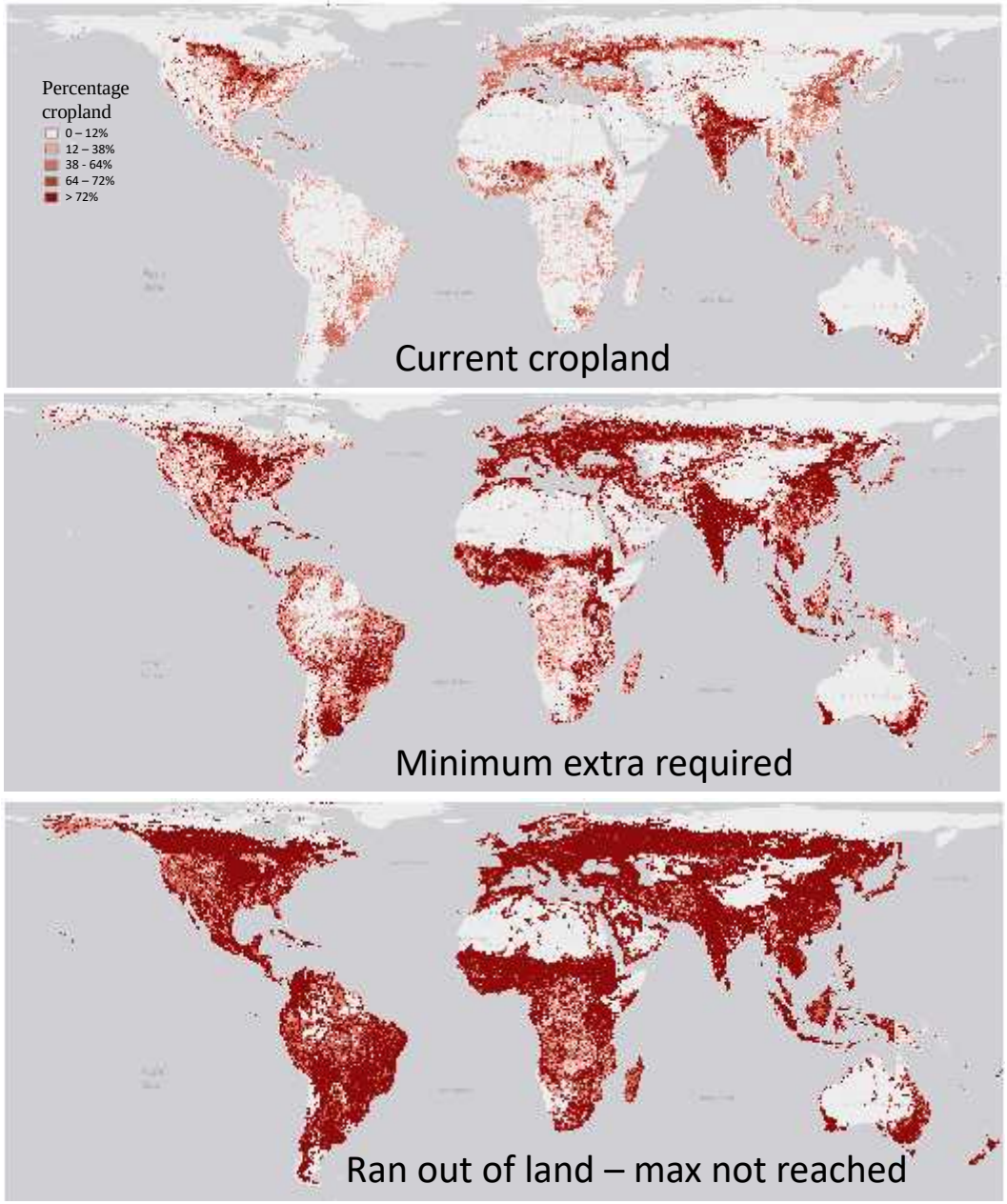
Dobermann, A. 2006. Invited paper: Nitrogen Use Efficiency in Cereal Systems. Europe, 21

Land requirements of reduced N

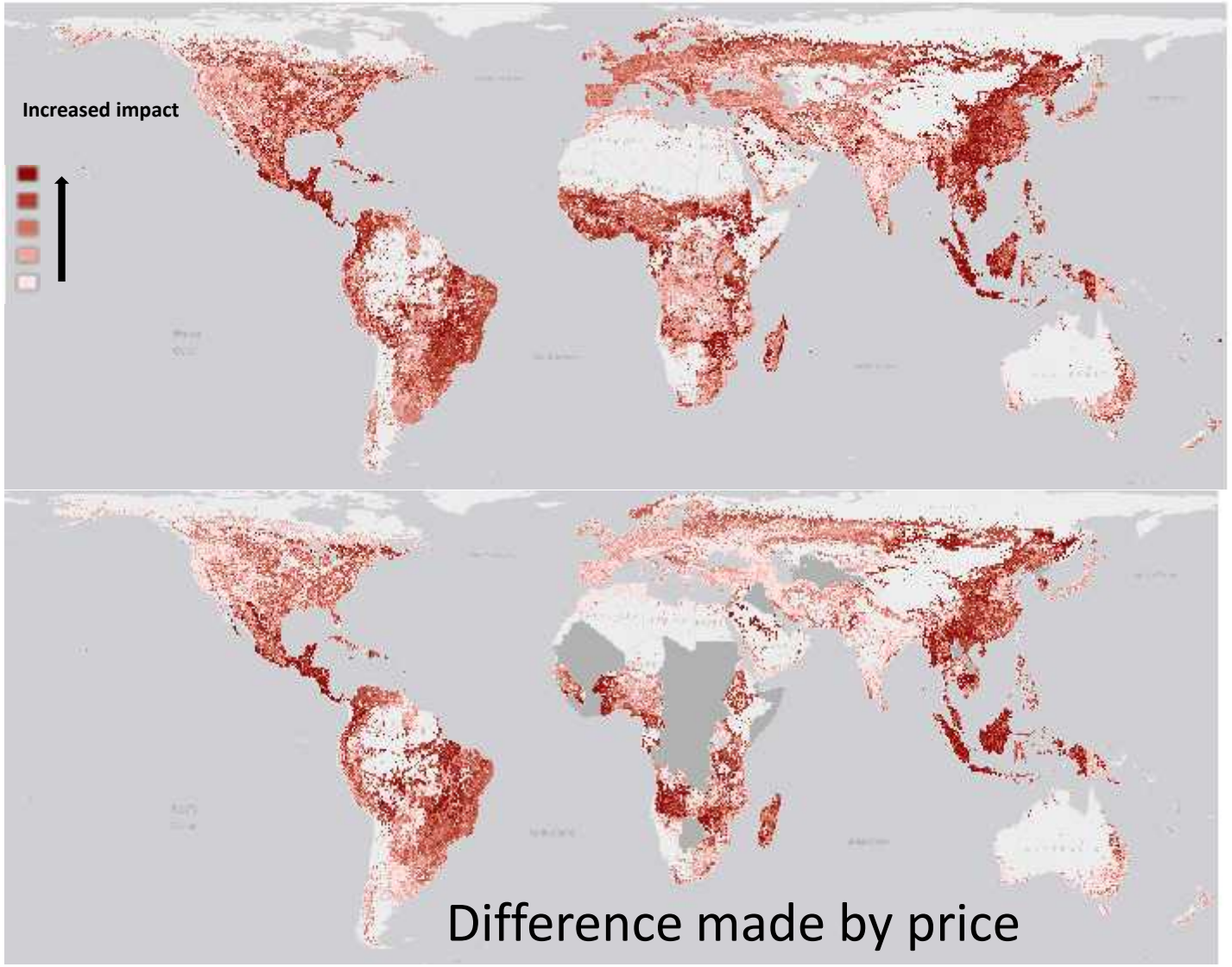
- Yield (tonnes) = 0.032 N (kg) + 1.053
- 32 kg of grain for every kg of N applied
- 100 m^2 of extra land needed for every kg of N reduced

Cropland required without mineral N

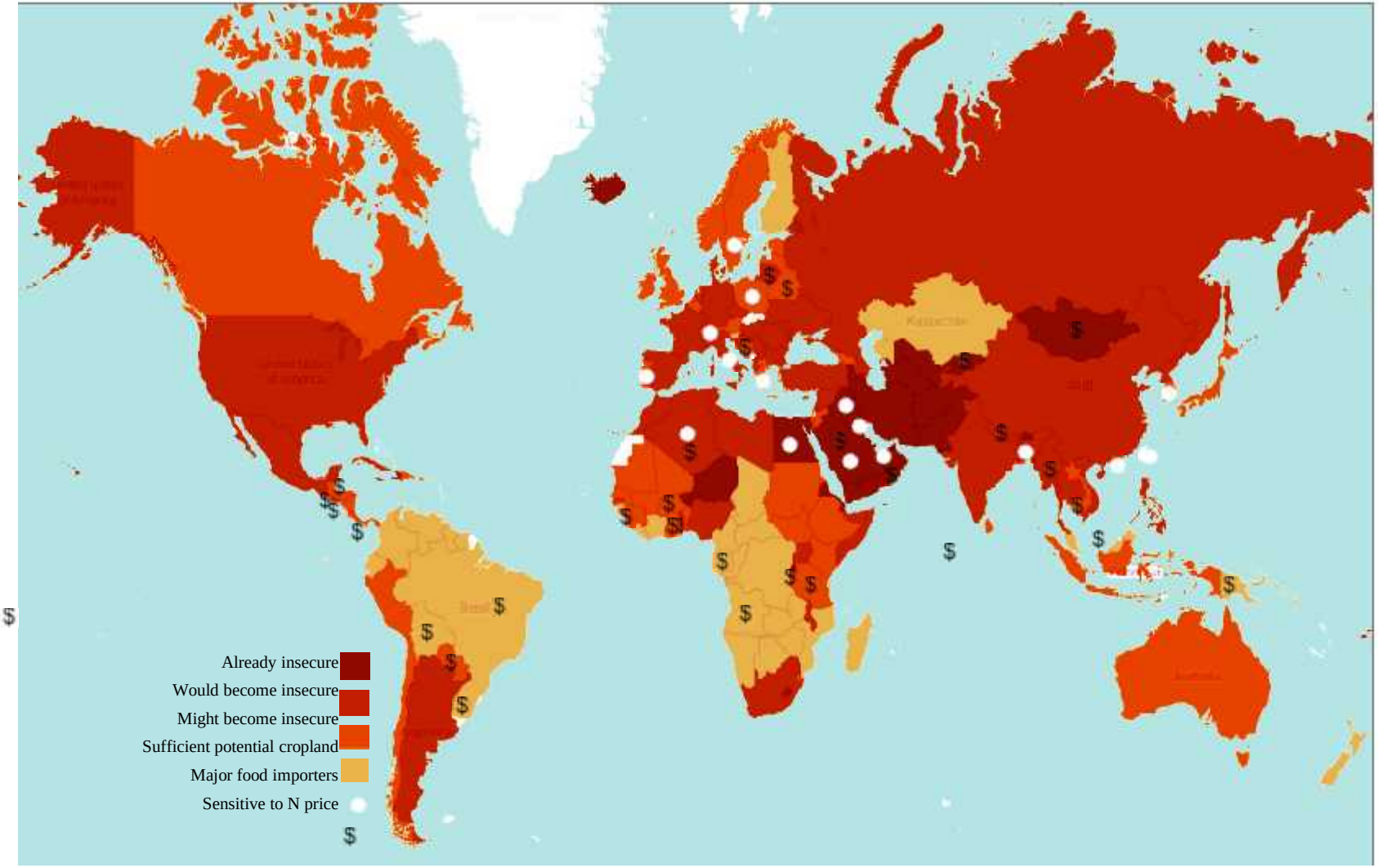
Biodiversity loss and food insecurity would become universal even with the minimum land requirements



Biodiversity impact of cropland expansion

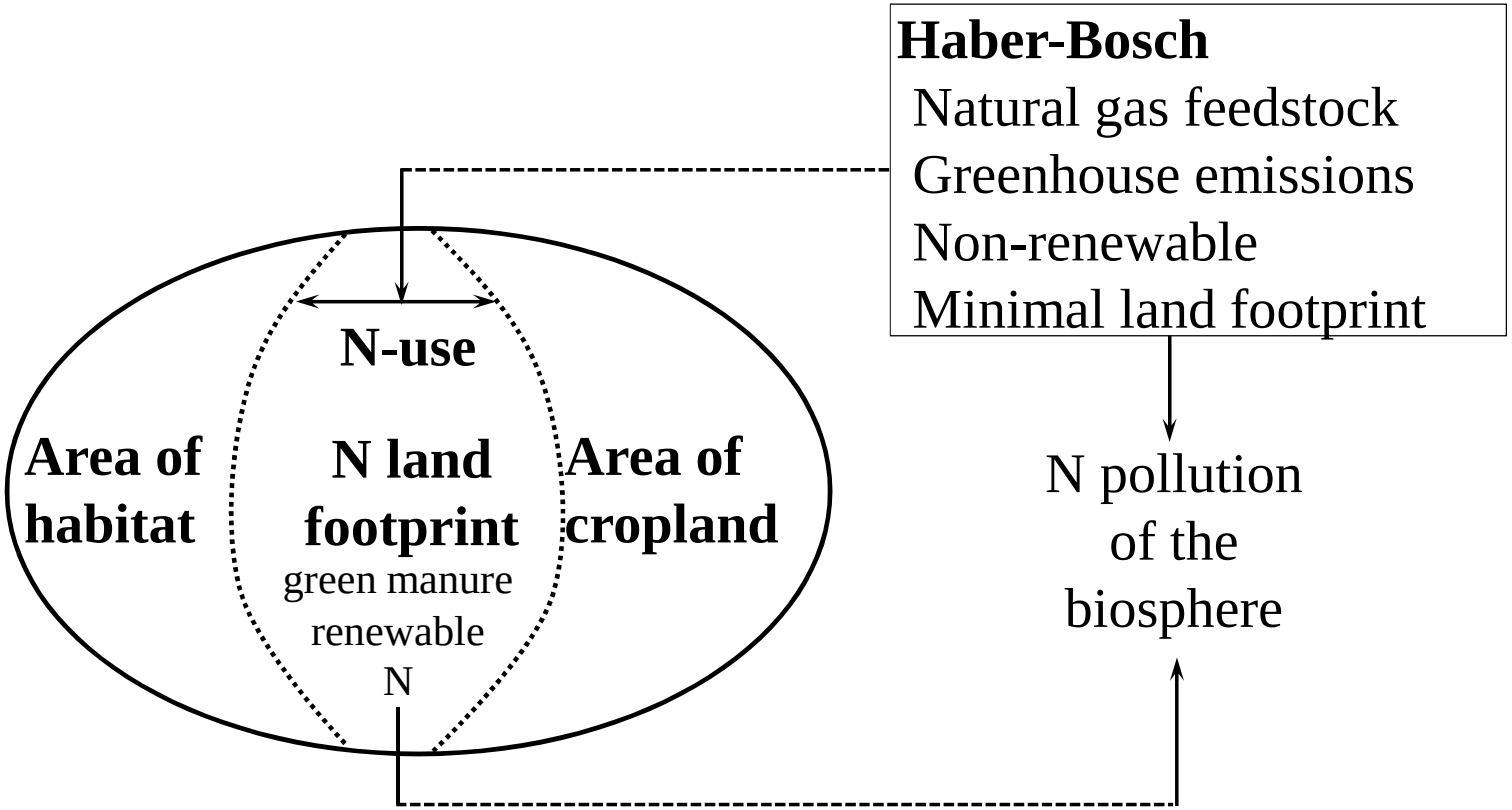


Land suitability – food security

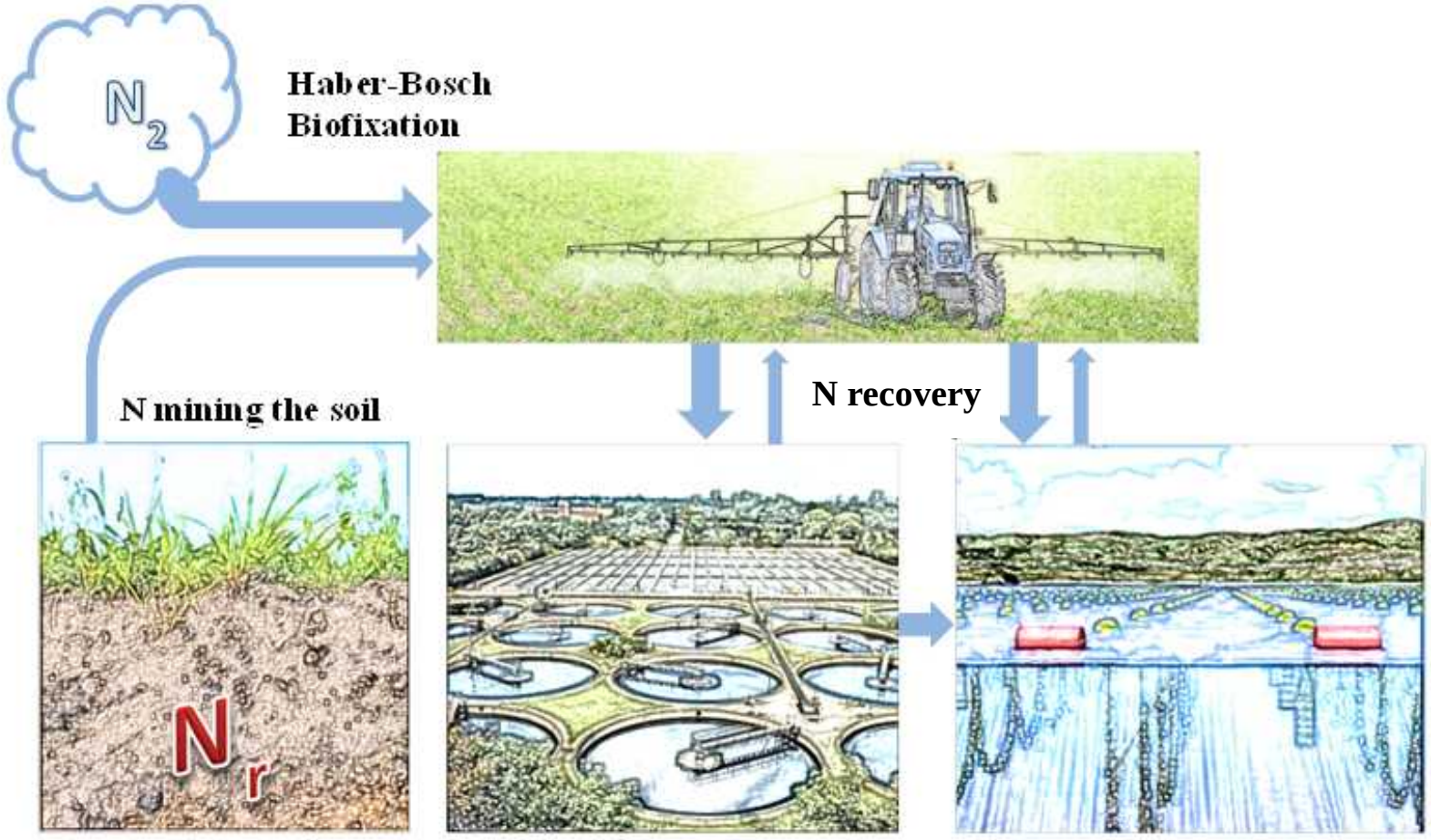


Few countries have sufficient arable land to be food secure without mineral N

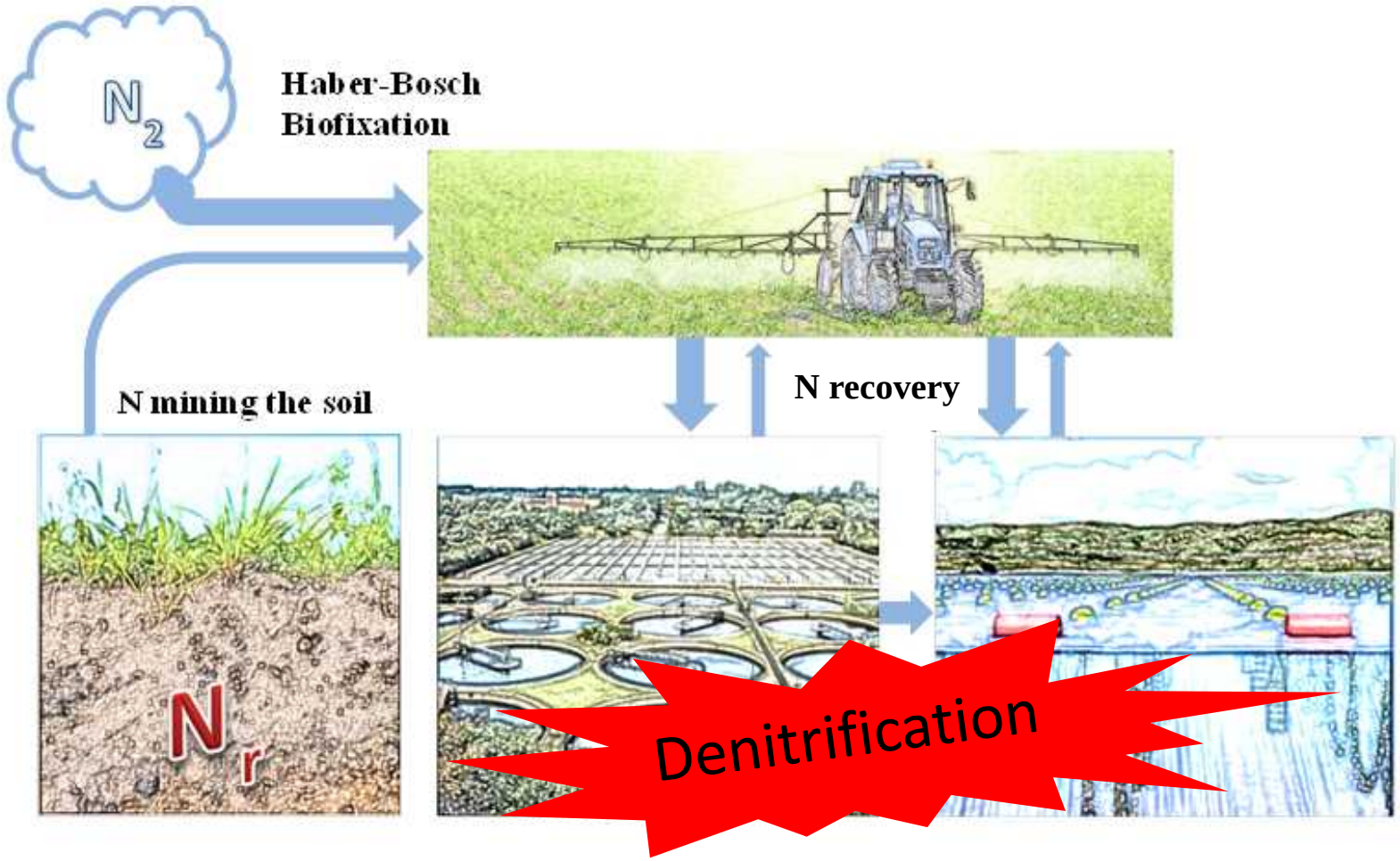
Footprint/biodiversity impact of nitrogen production



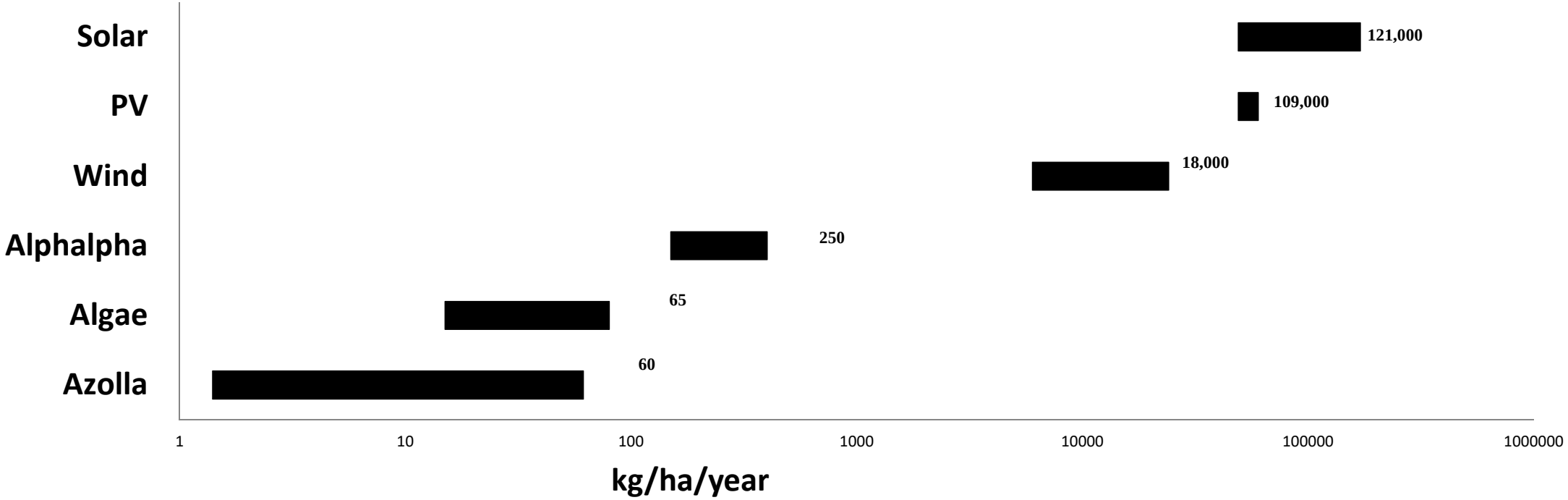
Potential N sources for agriculture



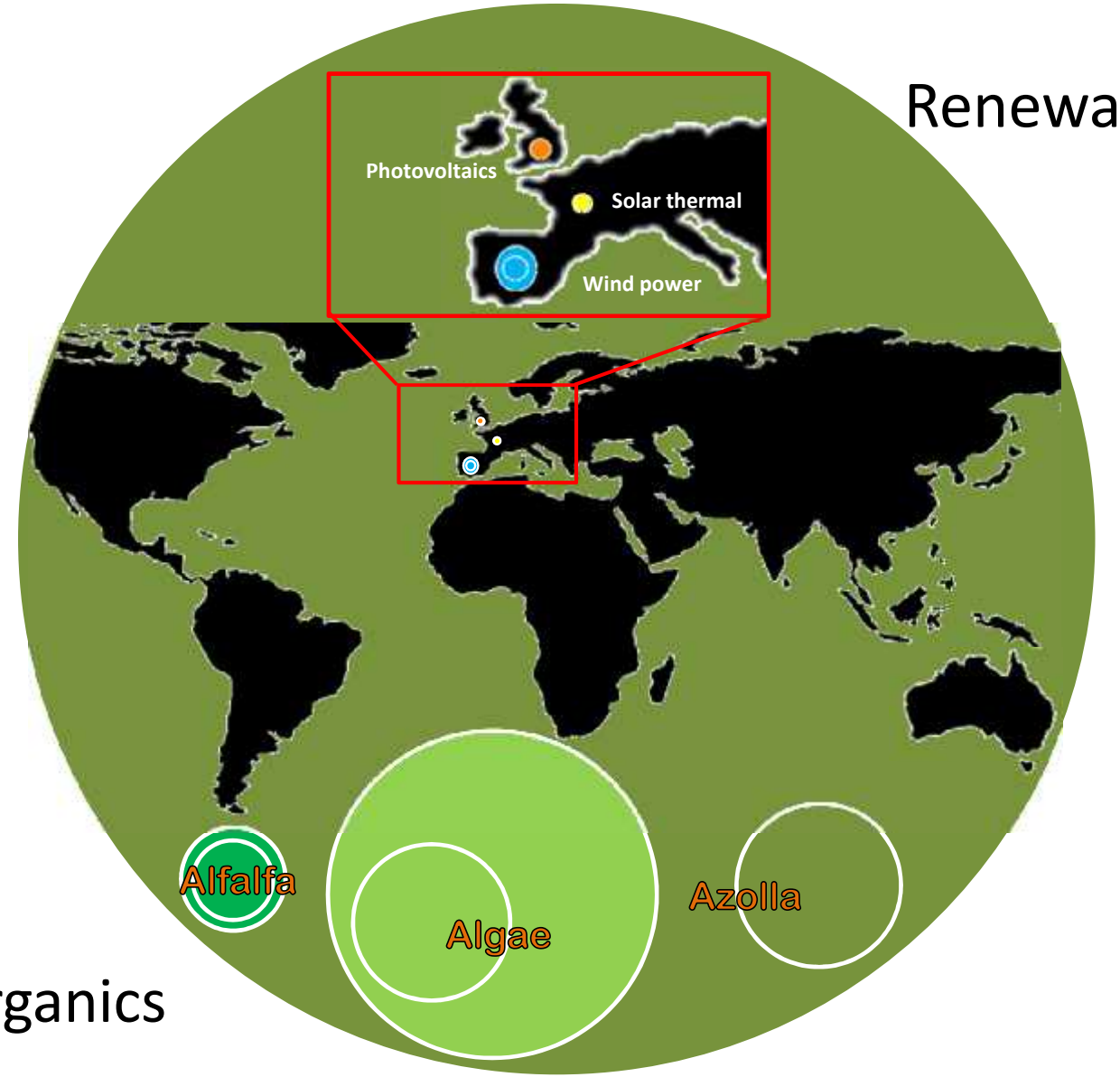
Potential N sources for agriculture



Yield of nitrogen sources



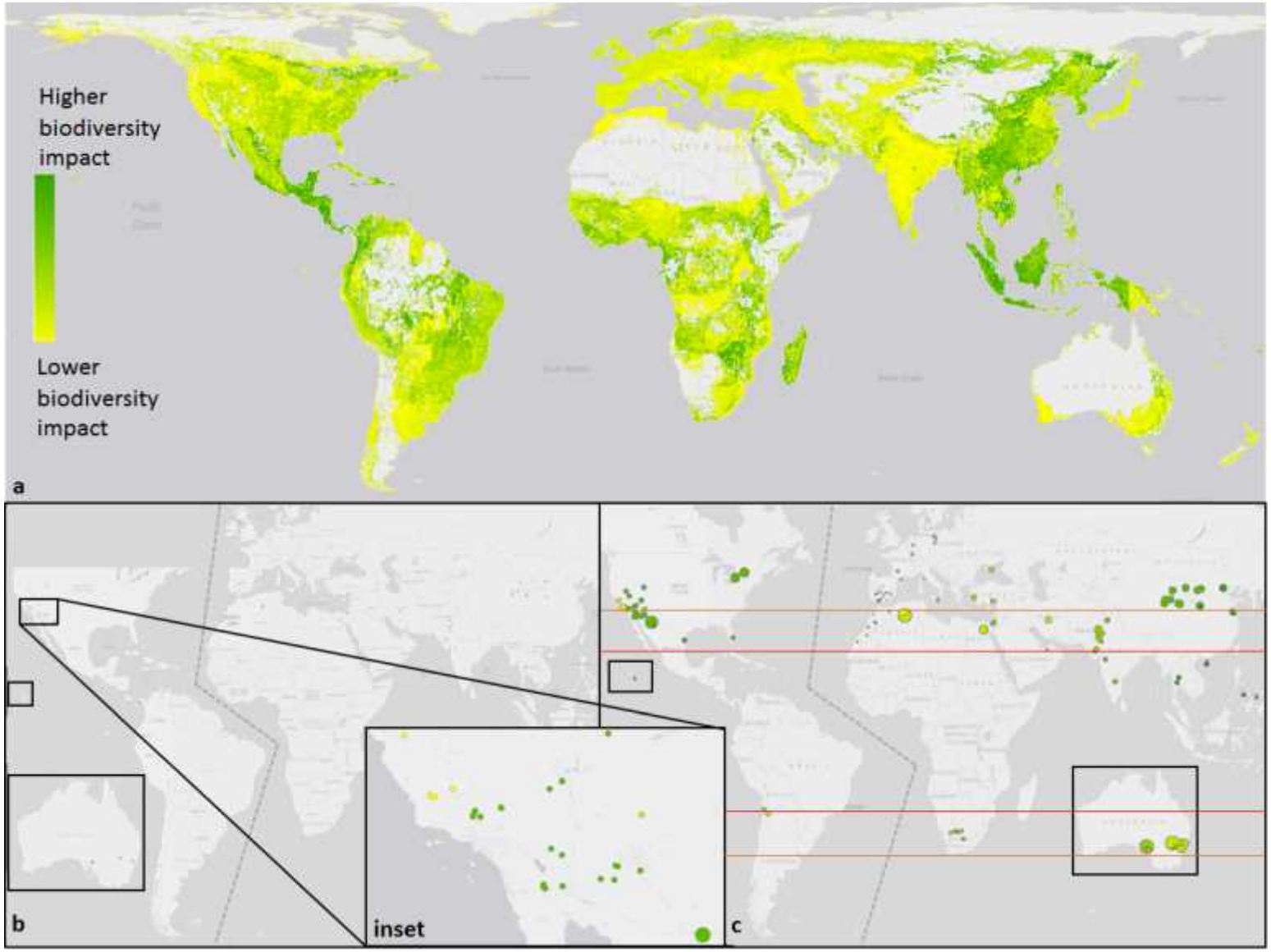
Footprint of nitrogen sources



Renewables

Organics

Biodiversity impact of solar powering our N supply

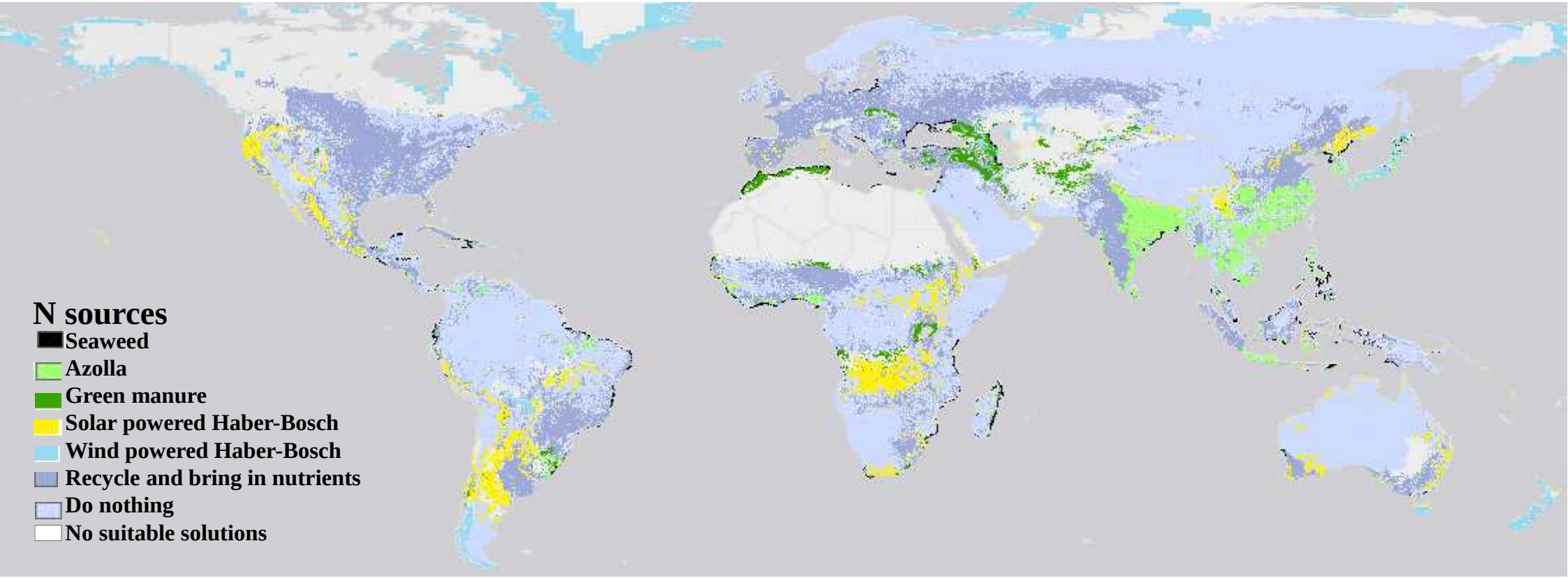


Which N source to use where

minimising impact on food security and biodiversity

And taking into account

- Affordability to the world's poorest people
- Subsistence agriculture spreading into areas of high biodiversity
- Solar and wind power's footprint and the resource available
- Yield gap
- Transport
- Albedo



Take homes

- N supply is a biodiversity conservation issue
- Using solar energy to power N production currently has lowest biodiversity footprint
- Relatively few places are highly suitable for N production
- People will use less land-efficient N sources for other reasons
- The International Nitrogen Initiative is seeking to N reduce pollution – risk to land efficiency
- Intervention is needed to prevent land-fertiliser substitution becoming global biodiversity threat as we decarbonise