



Biodiversität in der Landnutzung

The Biodiversity – Production Mutualism

15.11.2019, Göttingen

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 HELMHOLTZ
CENTRE FOR
ENVIRONMENTAL
RESEARCH – UFZ

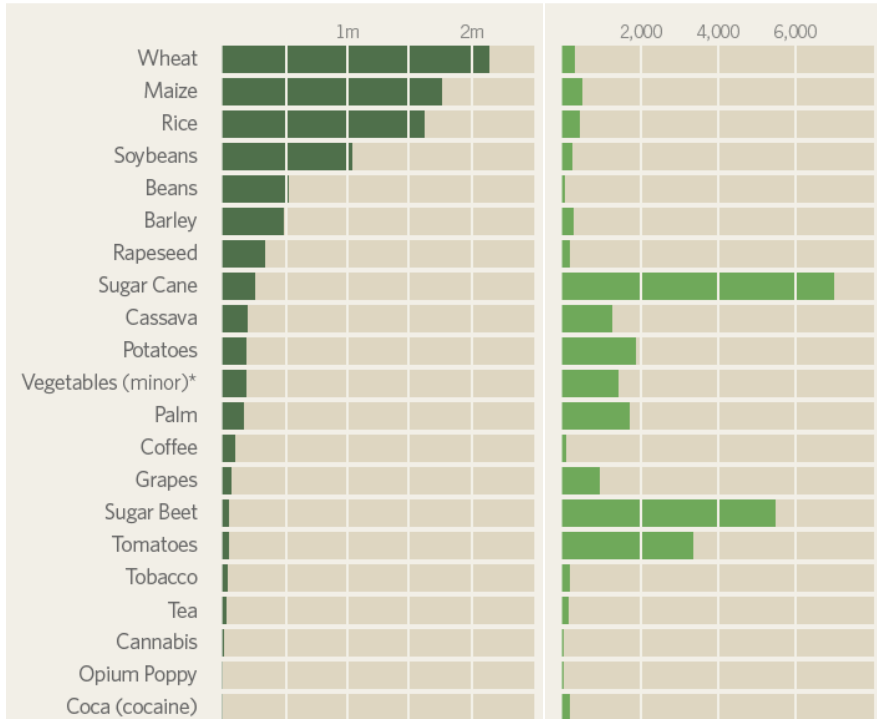
Activities in our global allotment

MOST PLANTED

Area Harvested (million km²)

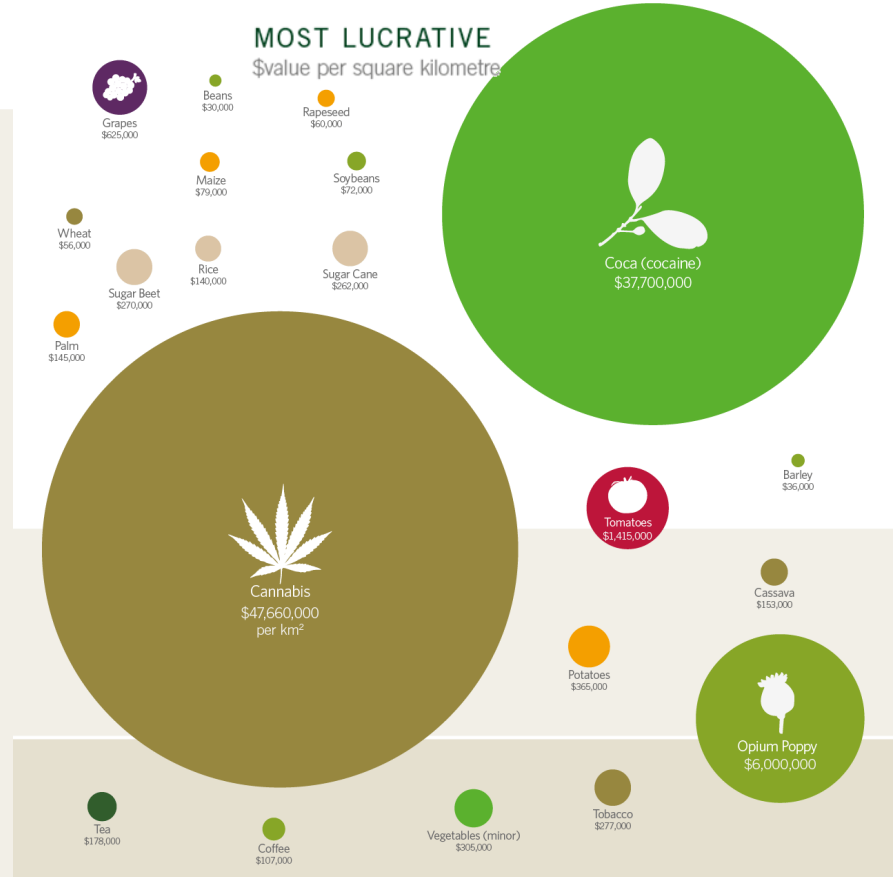
MOST FECUND

Yield per km² (tonnes)



MOST LUCRATIVE

\$value per square kilometre





From the Summary for policymakers of the IPBES Global Assessment

More food, energy and
materials than ever
before are now being
supplied to people across
distant regions

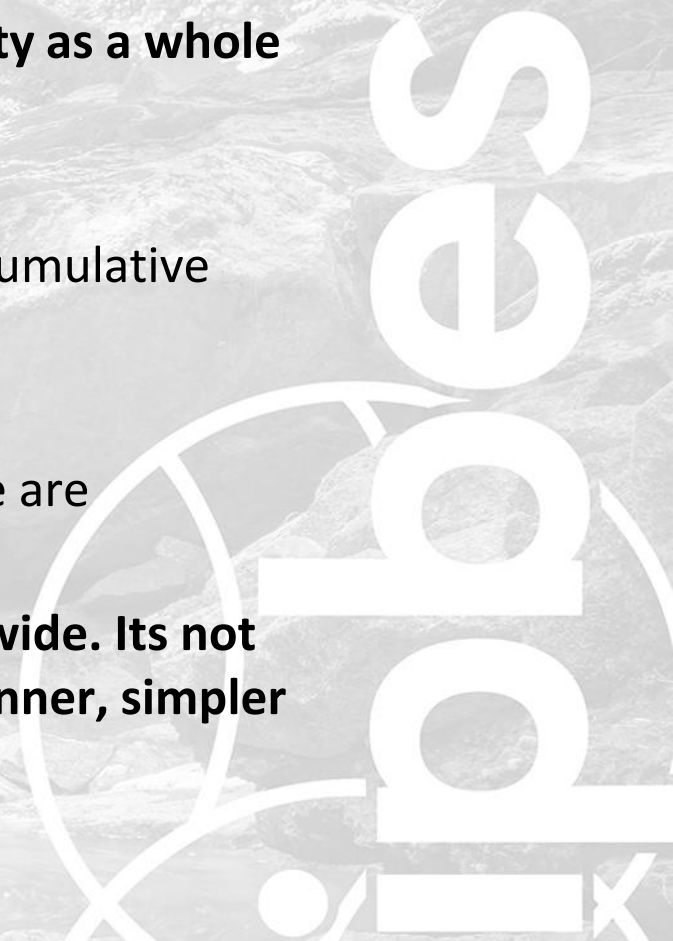
While 822 Mio. people
are mal-nourished



The biosphere and atmosphere, upon which humanity as a whole depends, have been deeply reconfigured by people.

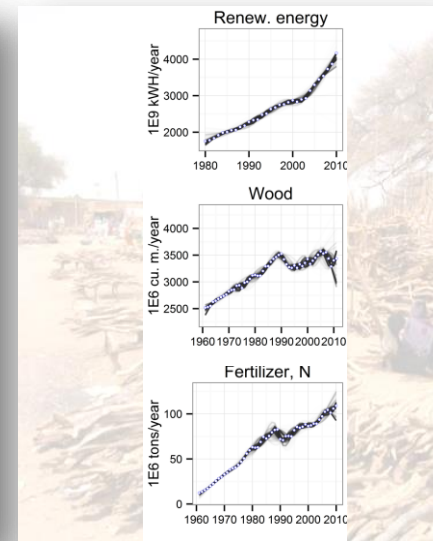
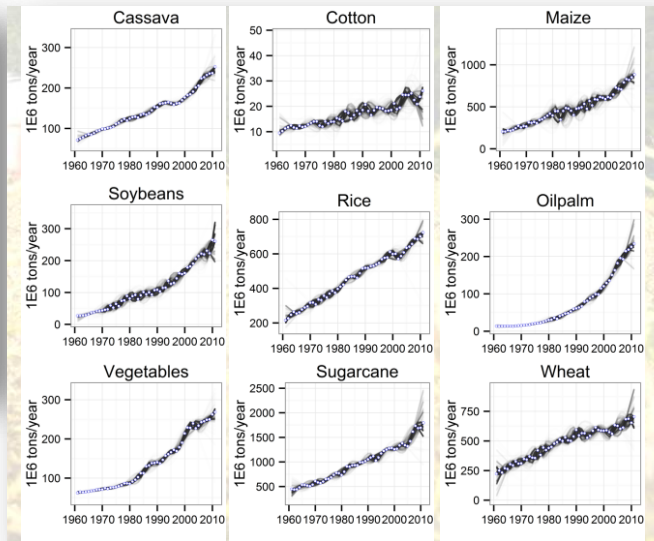
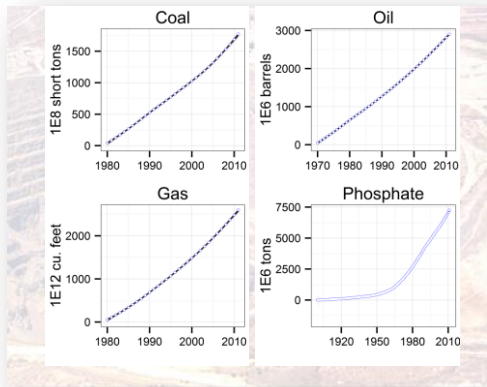
- **75%** of the land area is very significantly altered
- **66%** of the ocean area is experiencing increasing cumulative impacts
- **> 85%** of wetland area has been lost.
- Virtually all indicators of the global state of nature are decreasing

The fabric of life on Earth is deteriorating fast worldwide. Its not only getting smaller, it is also getting increasingly thinner, simpler and more frayed.

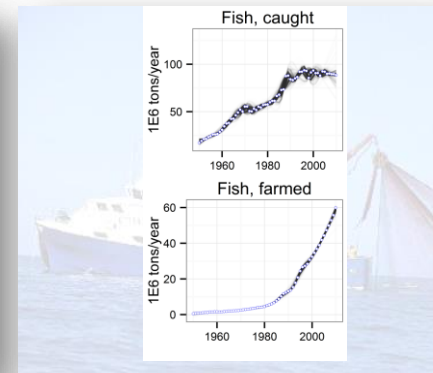
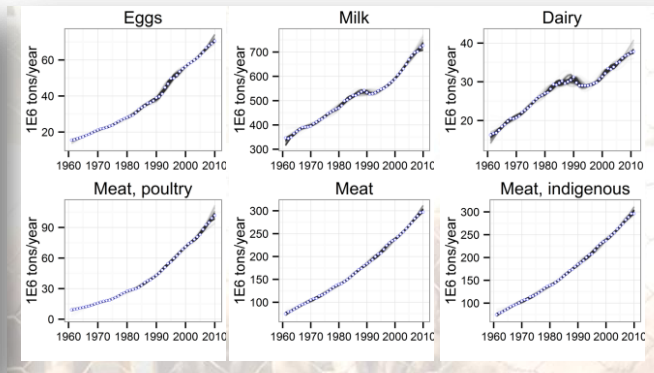
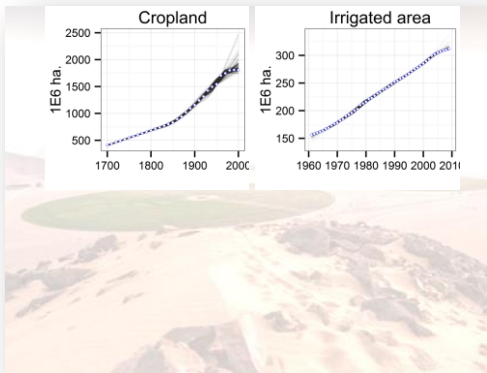


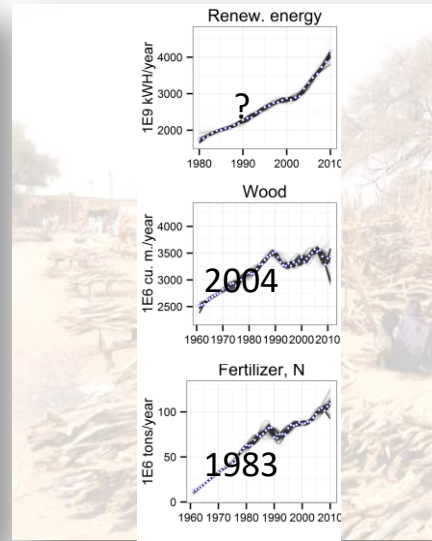
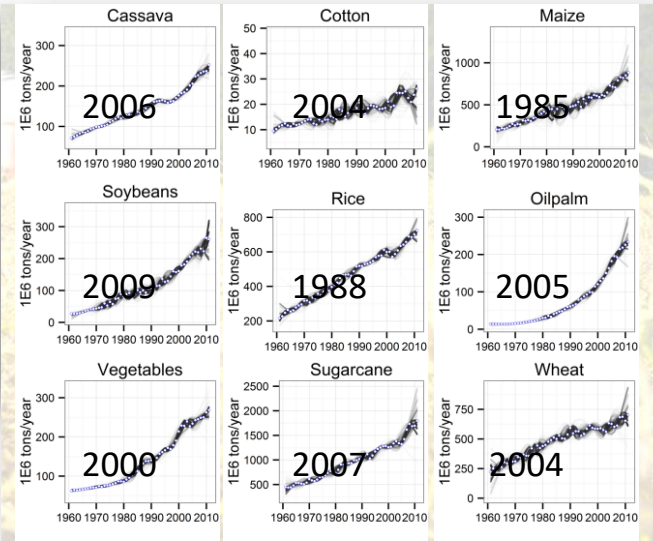
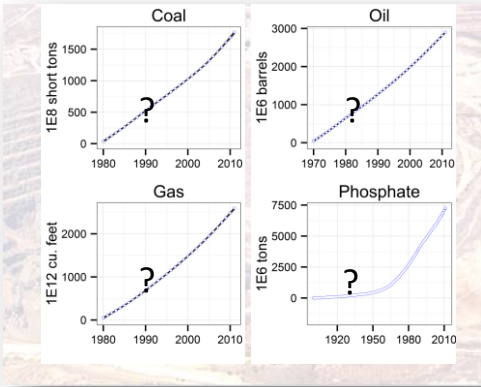


Seppelt et al., 2014

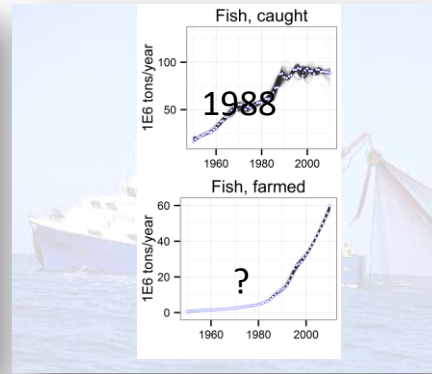
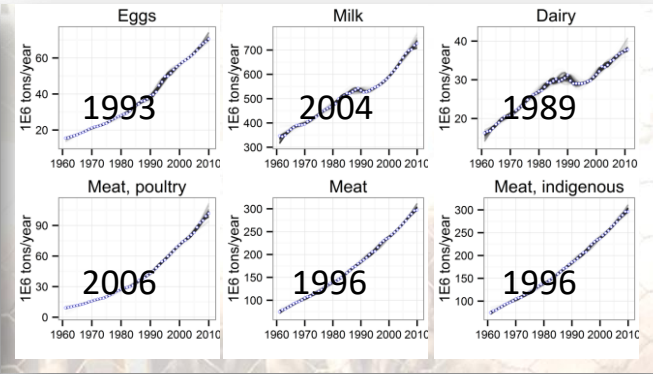
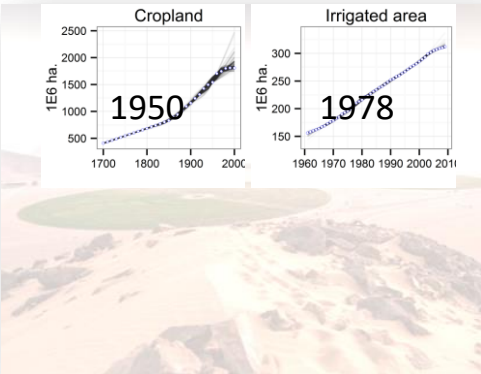


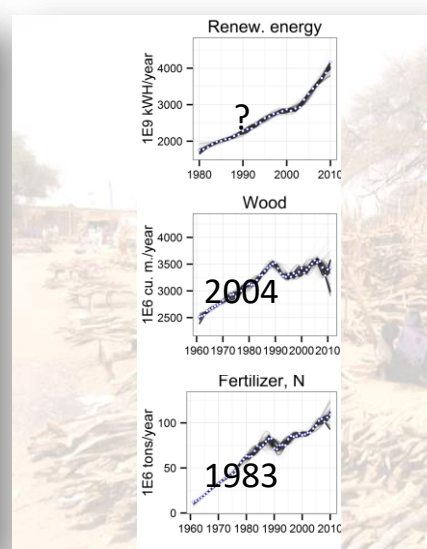
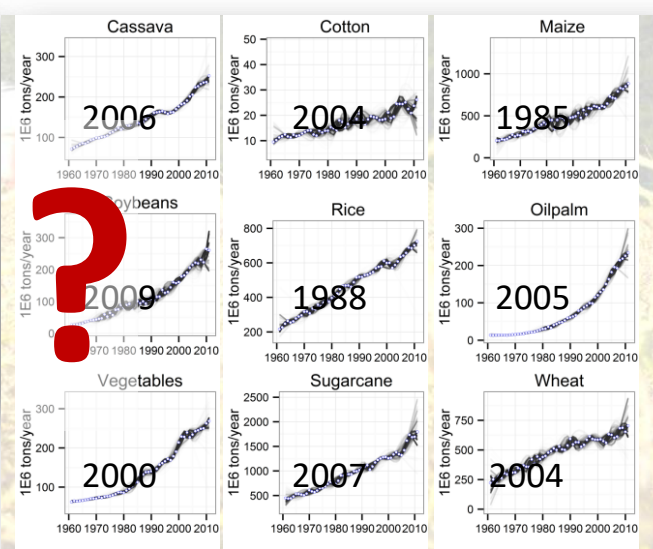
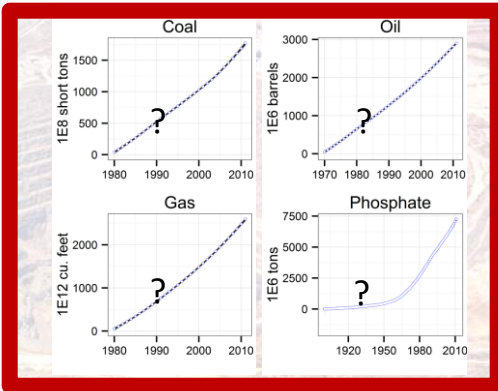
Peak year
= Year of maximum
production increase



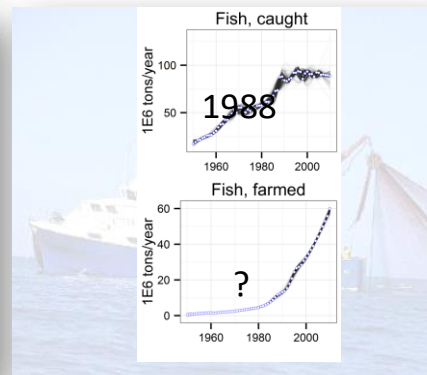
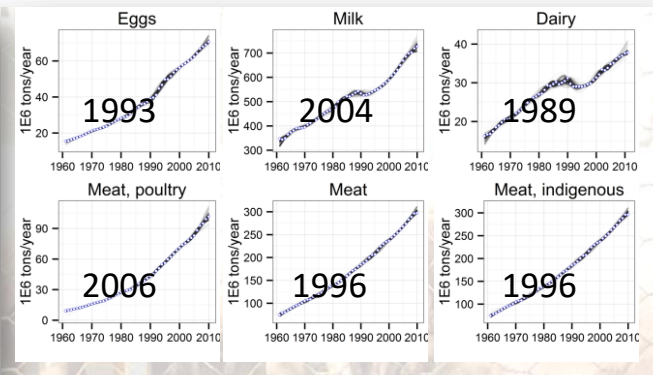
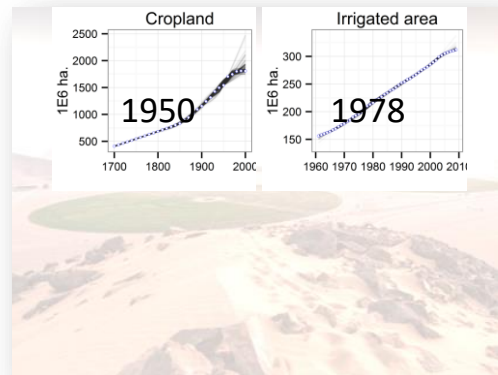


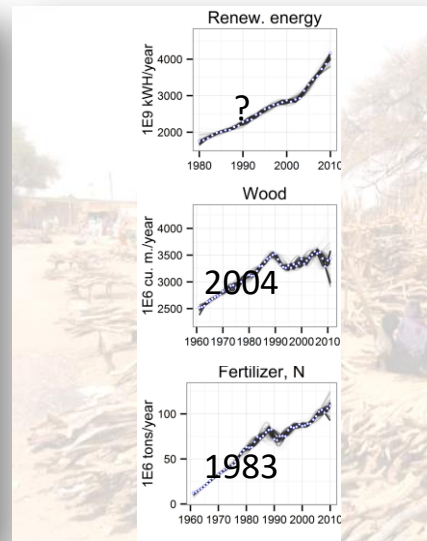
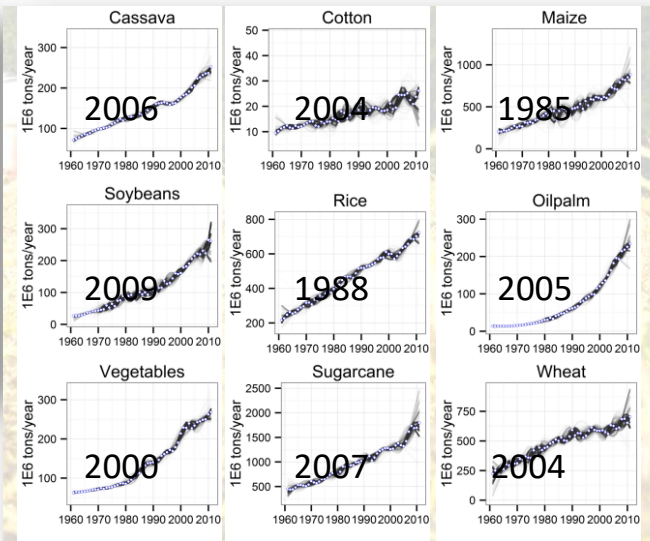
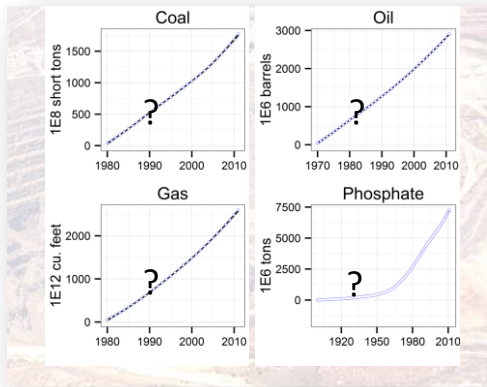
Peak year
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production increase



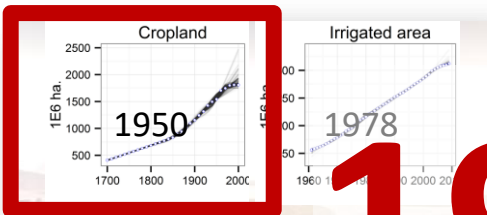


Peak year
= Year of maximum
production increase

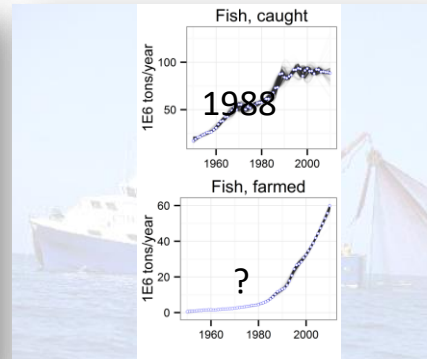
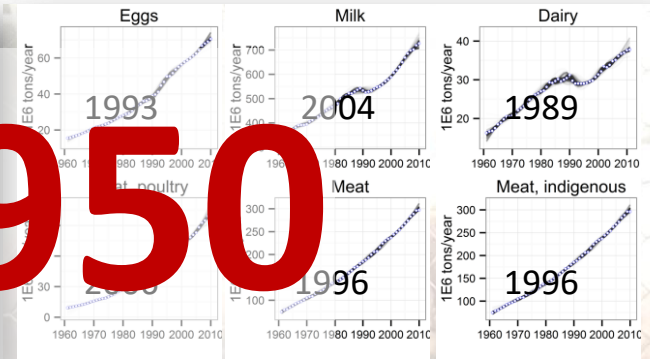


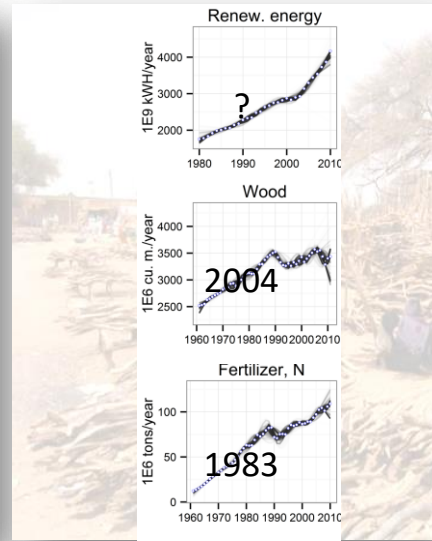
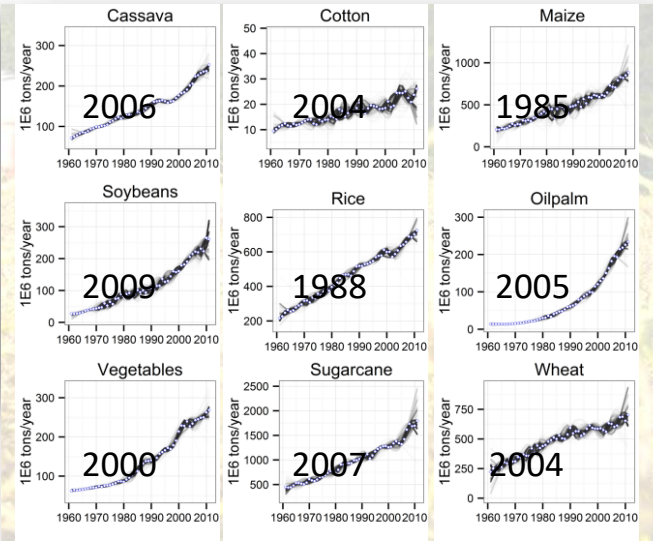
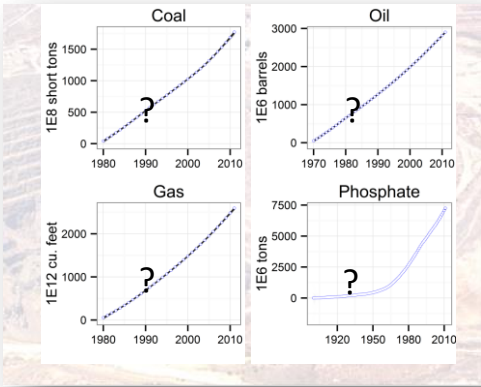


Peak year
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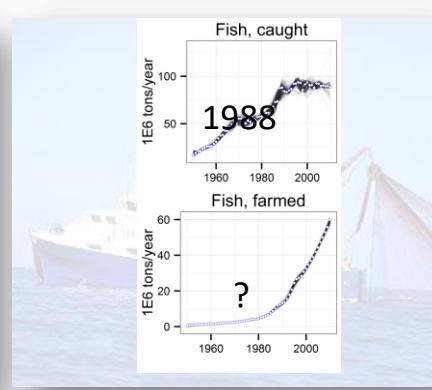
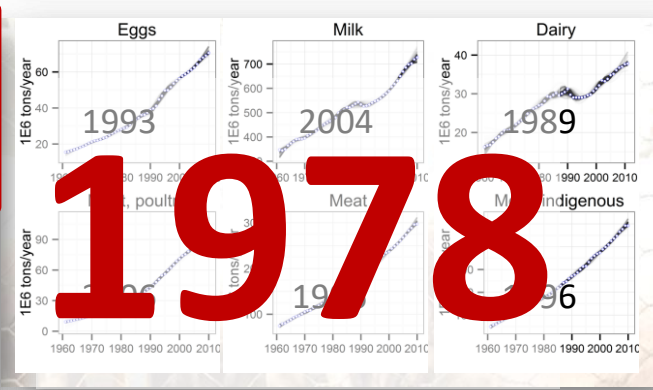
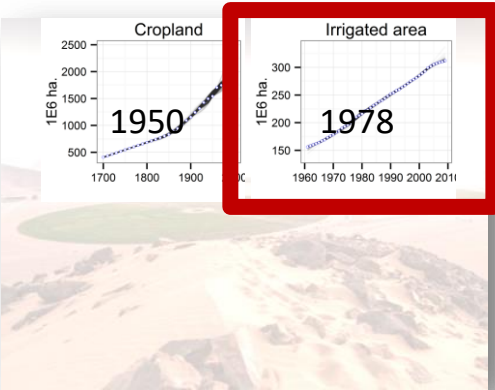


1950

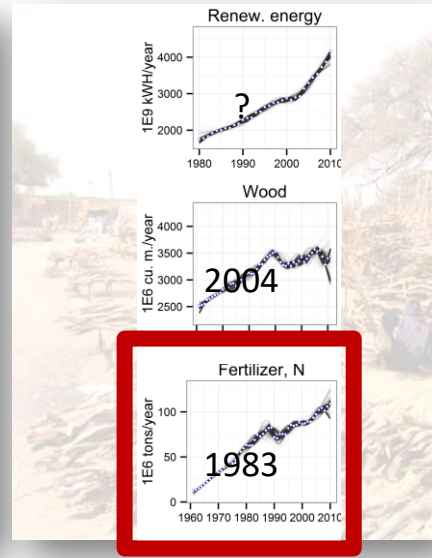
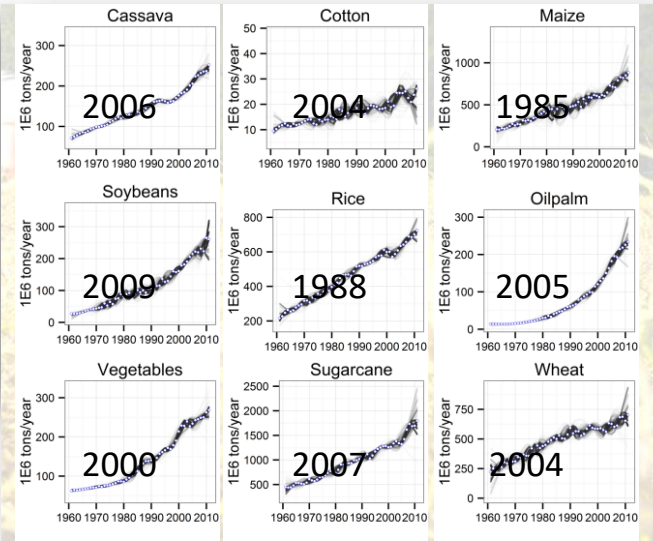
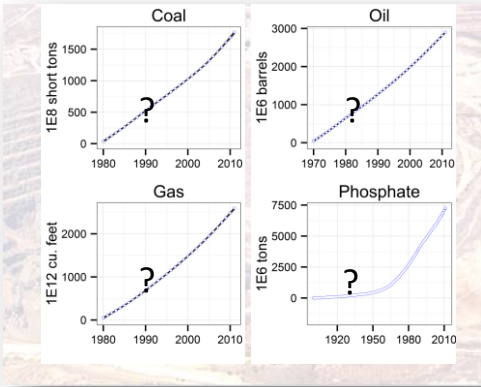




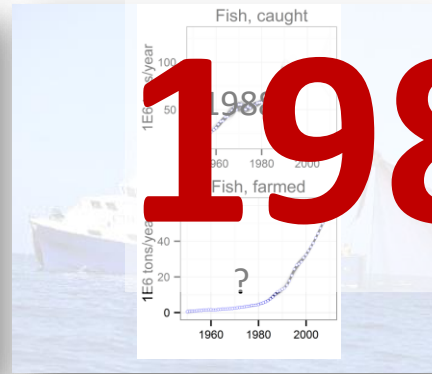
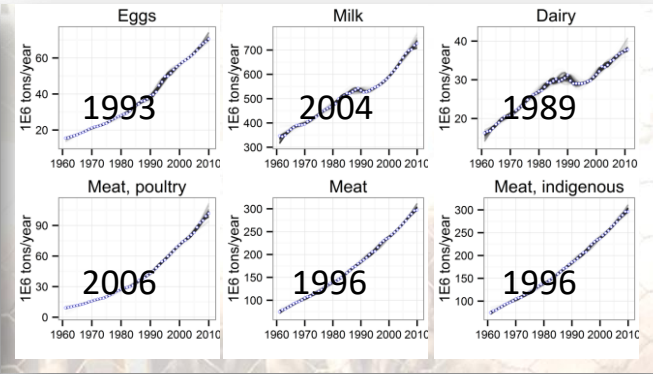
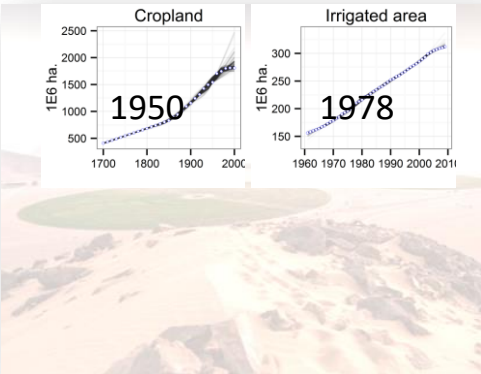
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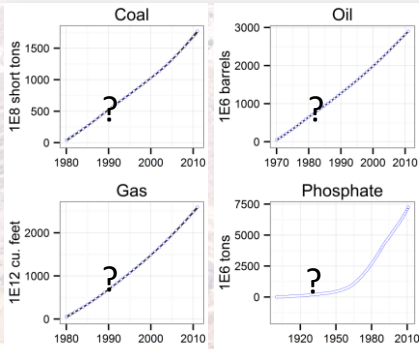
1978



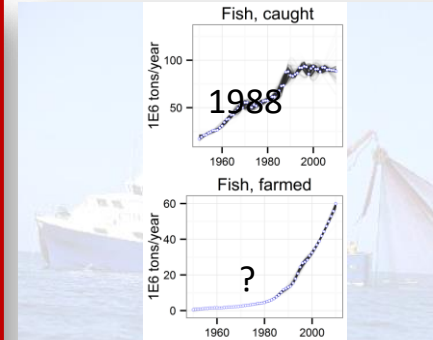
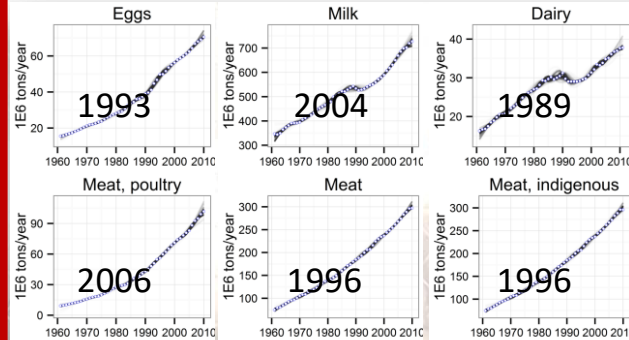
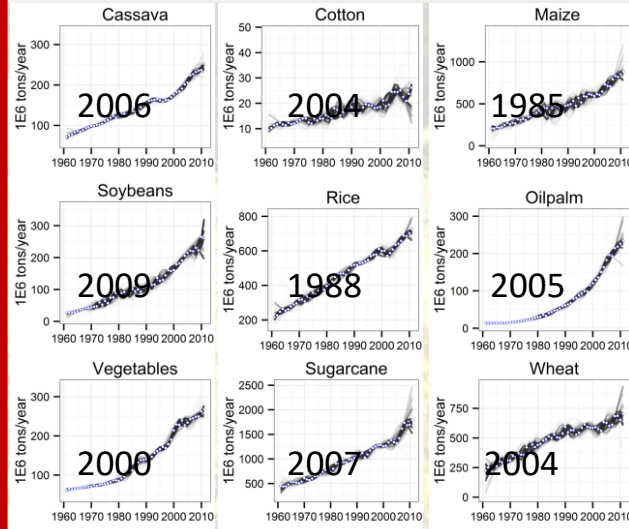
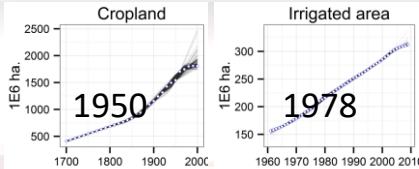
Peak year
= Year of maximum
production increase



1983



Peak year
= Year of maximum
production increase



≈ 2006
(1989-2008)

Peak years of renewable resources

- A peak year in renewables is more frequent than for non renewables
- The synchronization of peak rate years of global resource appropriation can be far more disruptive than a peak rate year for one resource
- There is potential for further increase in yields, but it will come with high efforts, unlikely in high productive regions

"We approach an "over-harvested planet", how to continue?

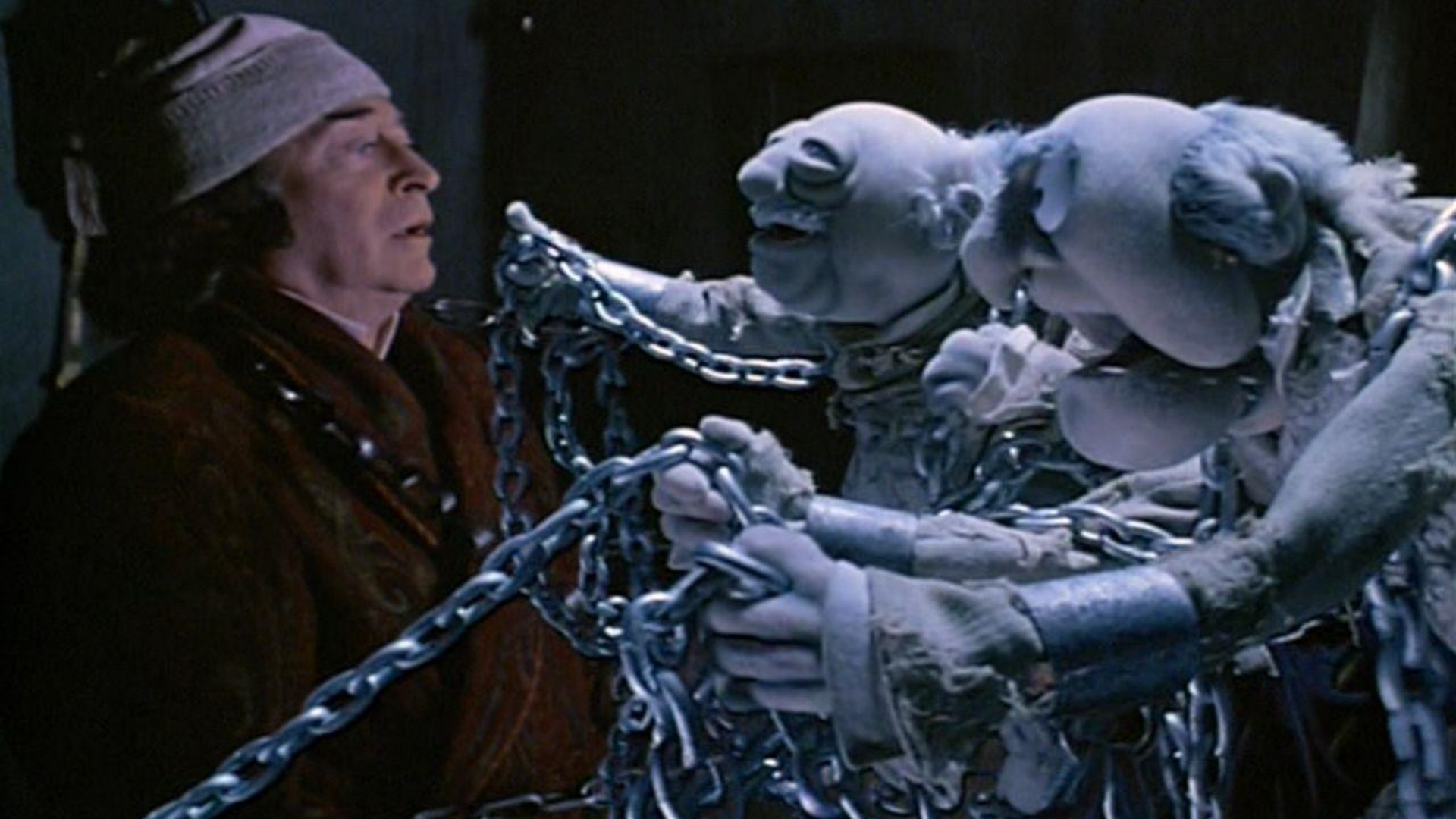


Schluss mit der Agrarromantik!

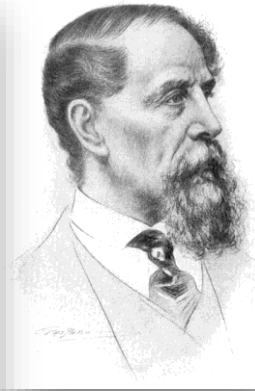
Was WISSEN schafft

Der Mensch für die Ernährung besucht, sind limitiert. Das kann nicht nur durch die Agrarproduktion noch beibehalten werden, sondern durch Konsumieren und Bewusstsein. Der wichtigste war das Anlegen neuer Ackerflächen, aber auch der sticht nicht mehr. Wilder und Grundland sollen zu Recht geschützt werden. Südlagen werden immer größer, Wissenschaftler suchen nach neuen Methoden im Norden. Die Welt ist in Deutschland gut studieren. Angeboten von Wasser, Teller und Tank zu füllen, werden die Ackerflächen immer größer. Fast 12 Millionen Hektar sind es inzwischen, das ist ein Drittel der gesamten Landesfläche. Doch das reicht bei Weitem nicht aus. Bislang man importierte Pflanzen mit ein, die unter anderem für Futtermittel verwendet werden, kommen rund 5 Millionen Hektar im Ausland hinzu. Das kann nicht nur durch, sondern durch beitragen, ebenso wie mauler Einsatz von Schädlingbekämpfungsmitteln. Wer die besten Erträge will, sollte bedenken, dass Ökologischer Landbau pro Fläche im Schnitt 30 Prozent weniger Ertrag bringt. Das zeigt eine Metaanalyse mit Daten aus aller Welt, die niederländische Forscher ausgewertet haben.

Nicht zuletzt sind landwirtschaftliche Pflanzen vornehmlich, die gegenwärtlich auch mit schlechter Wasserversorgung, und widrigen Klima zurecht kommen oder besonders nahrhaft sind. Die Grüne Technik kann dabei helfen. Auch wenn viele Wissenschaftler das Gegenteil behaupten: Genetisch veränderte Pflanzen sind weder eine große Gefahr für die Umwelt noch für die Gesundheit.



A Christmas Carol: Eine Geistergeschichte zum Christfest



Charles John
Huffam
Dickens

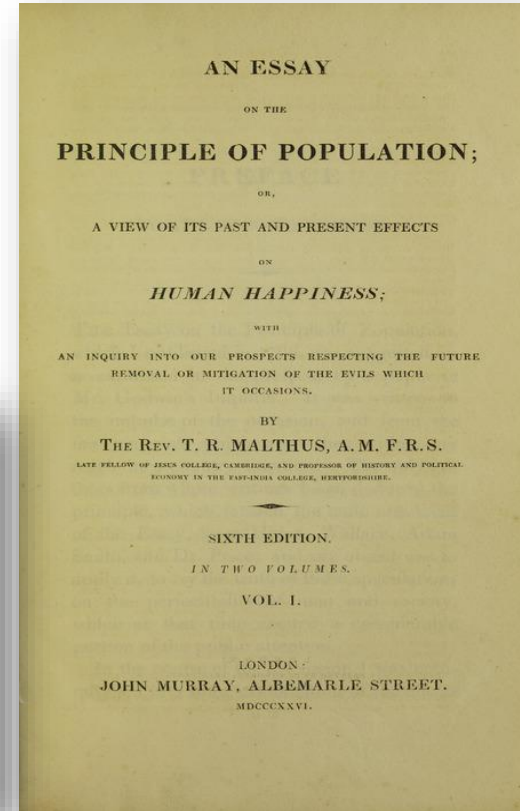
*7.2.1812

†9.6.1870

Thomas
Robert
Malthus

*13.2.1766

†29.12.1834



The Optimistic View: Trust in innovations?



home > environment

climate change

write

Land rights George Monbiot's blog

Meet the ecomodernists: ignorant of history and paradoxically old-fashioned

George Monbiot

The people behind technology are

the guardian

home > environment > climate change

wildlife energy pollution

UK work all

Farming
George Monbiot is wrong to suggest small farms are better for humans and nature

the guardian

home > science

UK world sport football opinion culture business lifes all

Environment Political science
We can only save nature by using it - Responding to Ecomodernism

Peak in innovation? Cost per invention are increasing

(Huebner 2005, Fenichel & Zhao 2014)

Further increase in photosynthetic efficiency is expected to be hard to achieve

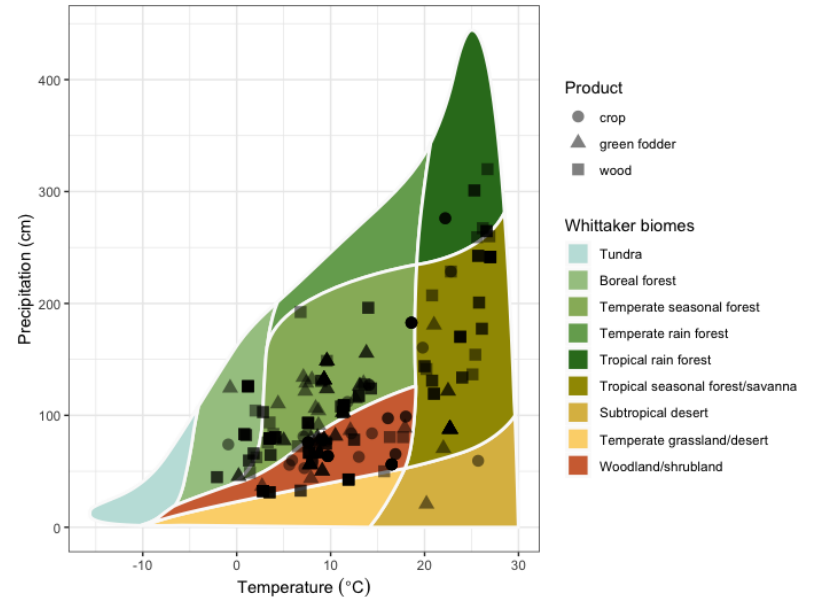
(Zhu et al. 2010)

A basic constraint on breeding is biological diversity: Peak rate years of species domesticating: 2600 B.C. (3600-1500 B.C.)

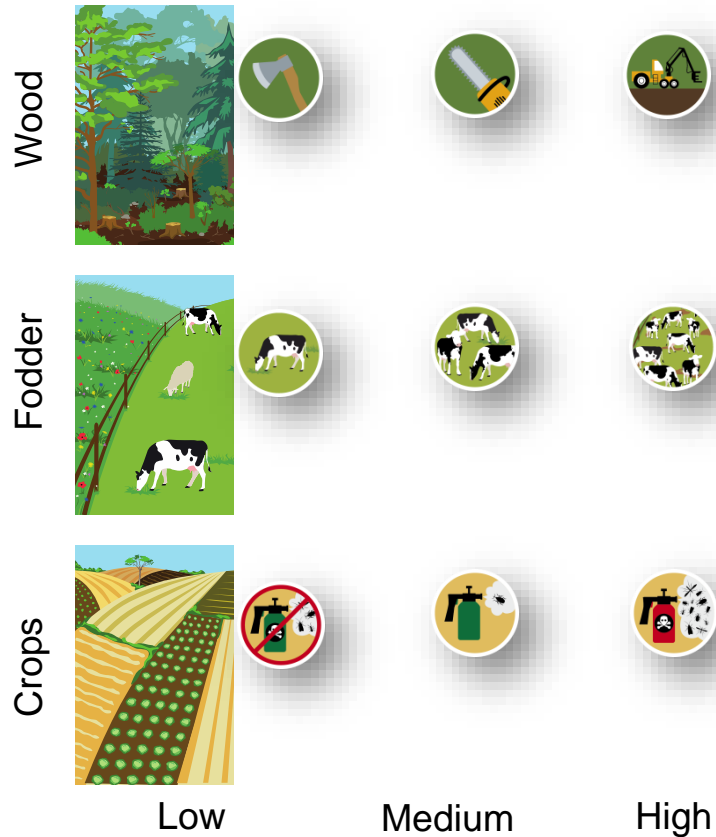
How are farmland biodiversity and yields
affected by intensification?

Relationship between biodiversity and production

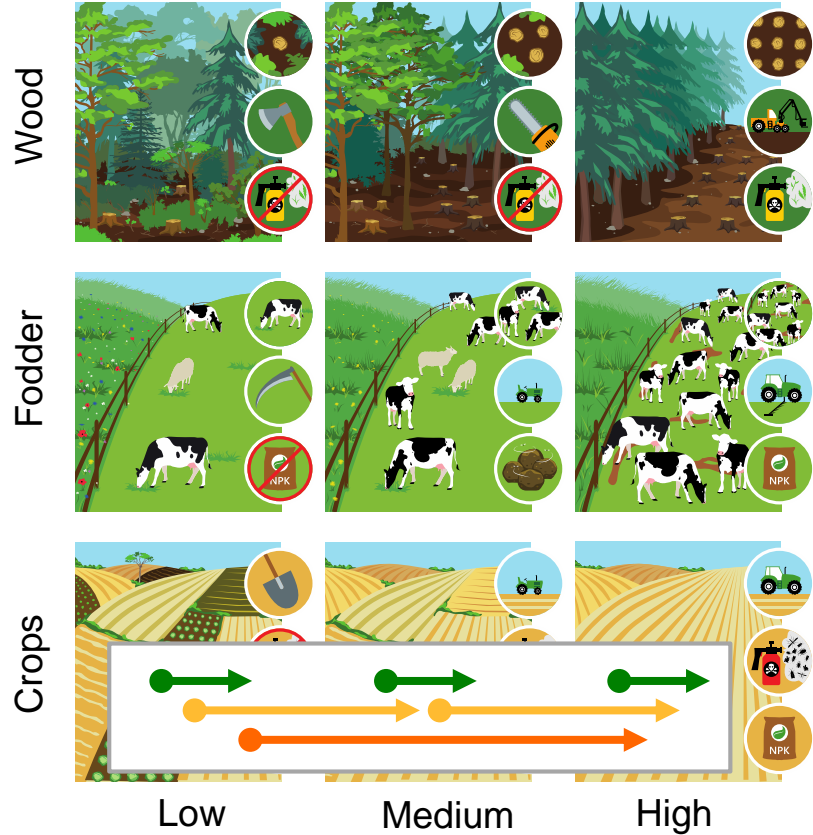
- Studies measuring the **simultaneous effects** of **land-use intensification** on both biodiversity and yield **at the same locations**
- Global meta-analysis synthesizing (115 studies, 449 cases)
- 1.6% or 9909 screened papers contained useful information



Land use intensity across production systems

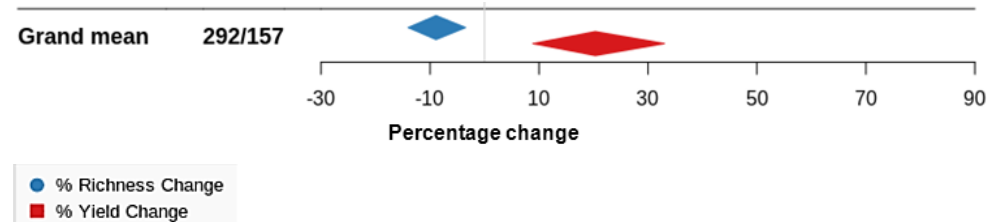


Land use intensity across production systems

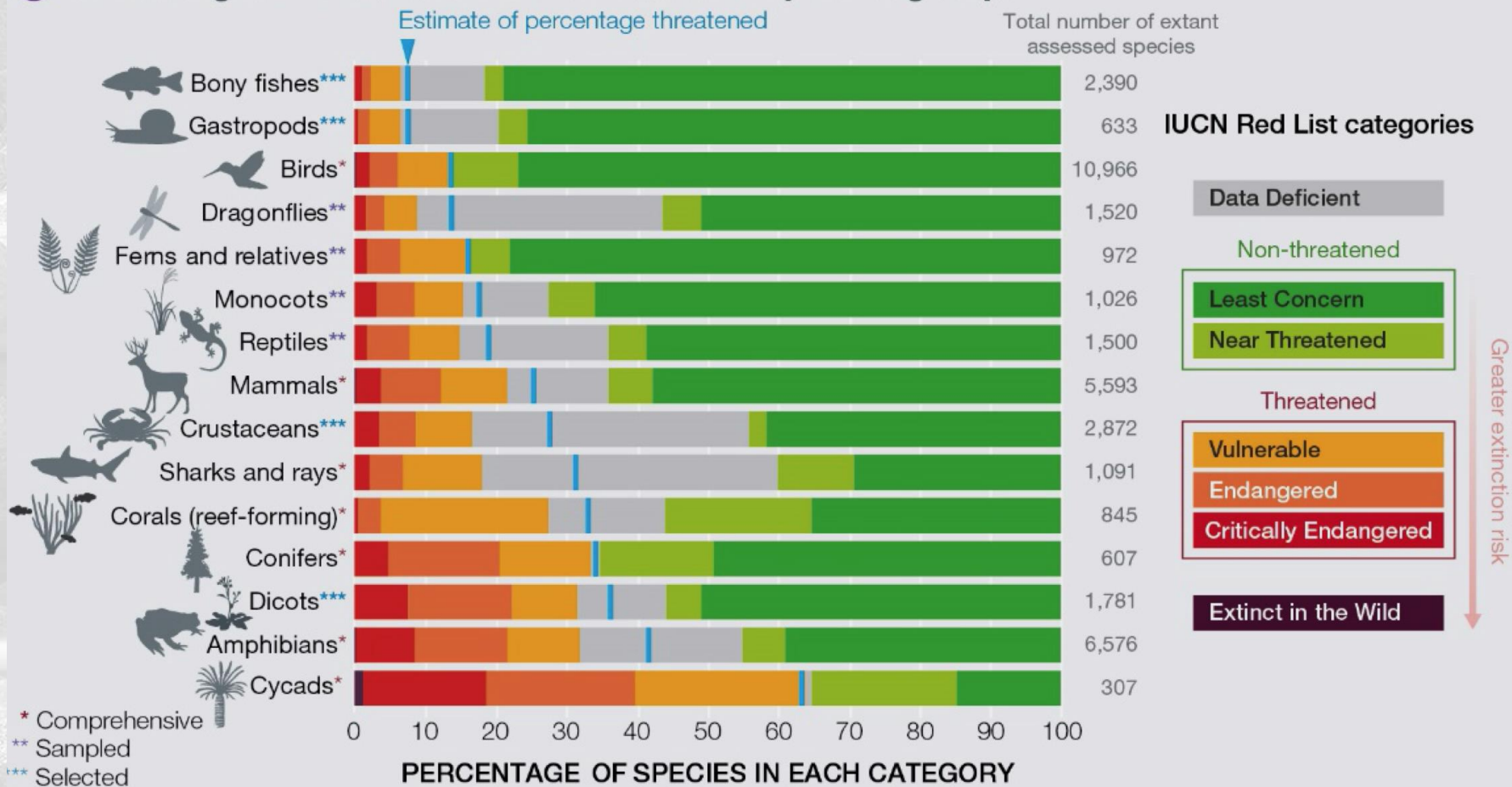


Biodiversity ~ Production Relationship: Results

- The higher the increase in yield, the greater the loss of biodiversity: **No “win-win” situation**
- **Largest effect in medium-medium systems:** suitable for “closing the yield gap” strategies, BUT with highest risk for biodiversity
- Biodiversity loss **even in high-intensity systems**



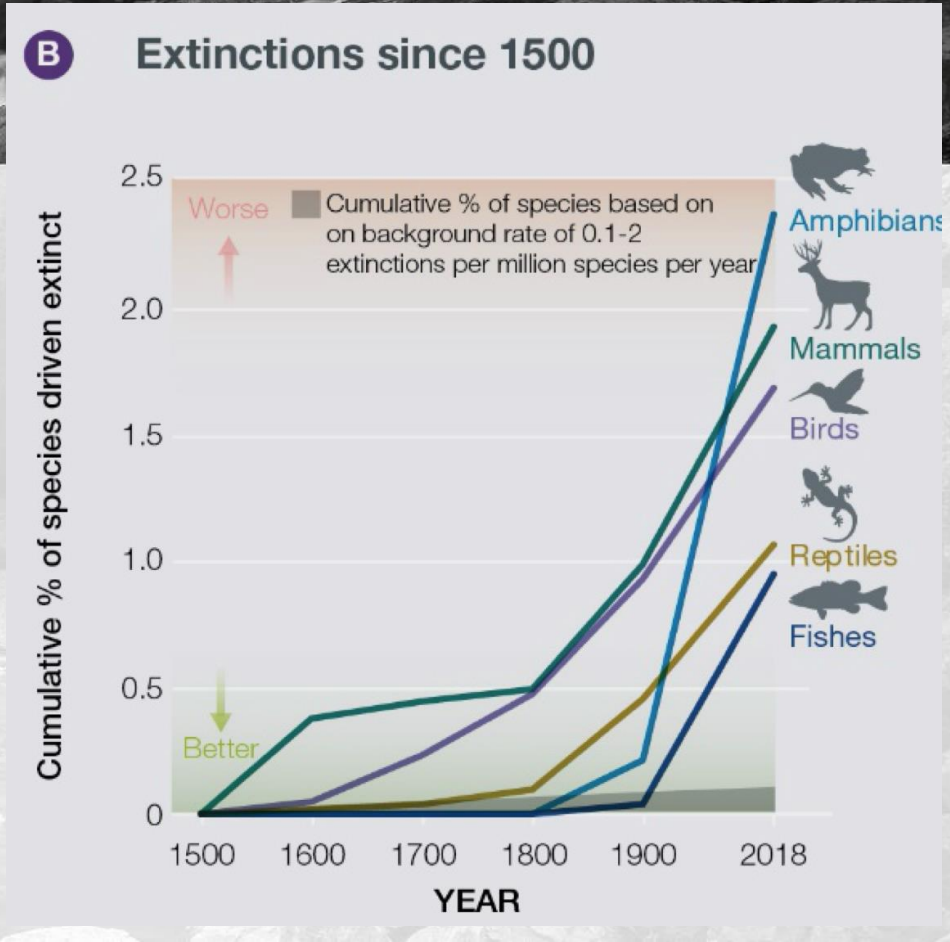
A Current global extinction risk in different species groups





Global extinction rates are at least 10 to 100 times higher than it has been on average the last 10 million years

On 23% of the agricultural areas yields losses are documented through decay of ecosystem function

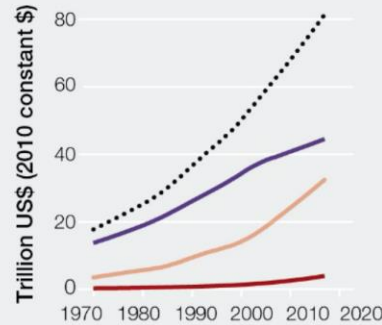


How do future scenarios consider the trade-off
between production and biodiversity?

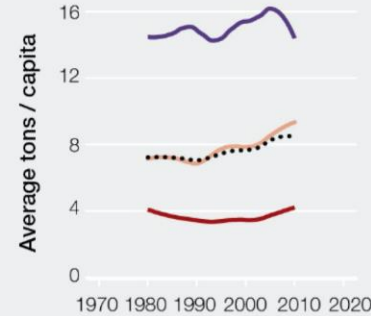
Global trends and regional asymmetries in development, production and consumption

- 4 fold increase in global economy
- 10 fold increase in global trade

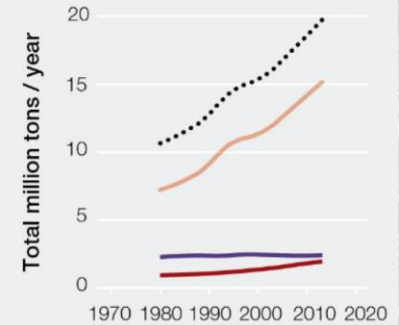
A Gross domestic product (GDP)



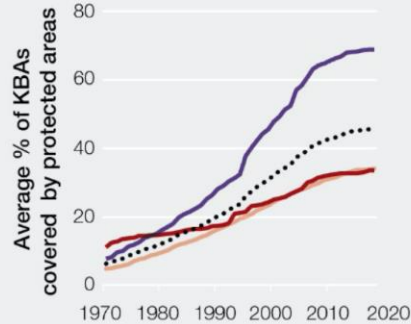
B Domestic material consumption



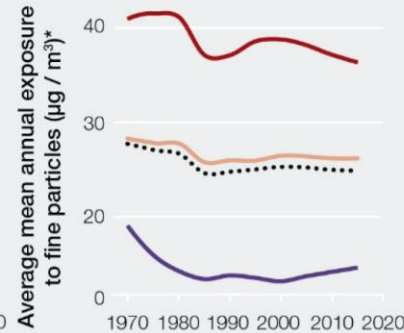
C Extraction of living biomass (domestic consumption and exports)



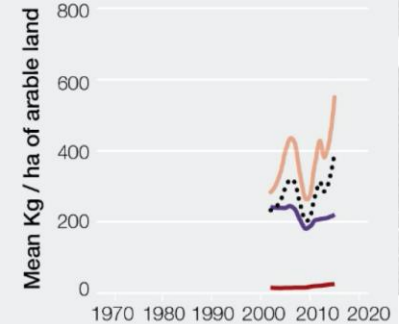
D Protection of Key Biodiversity Areas (KBAs)



E Air pollution



F Fertilizer use



*Fine particles: < 2.5 micrograms

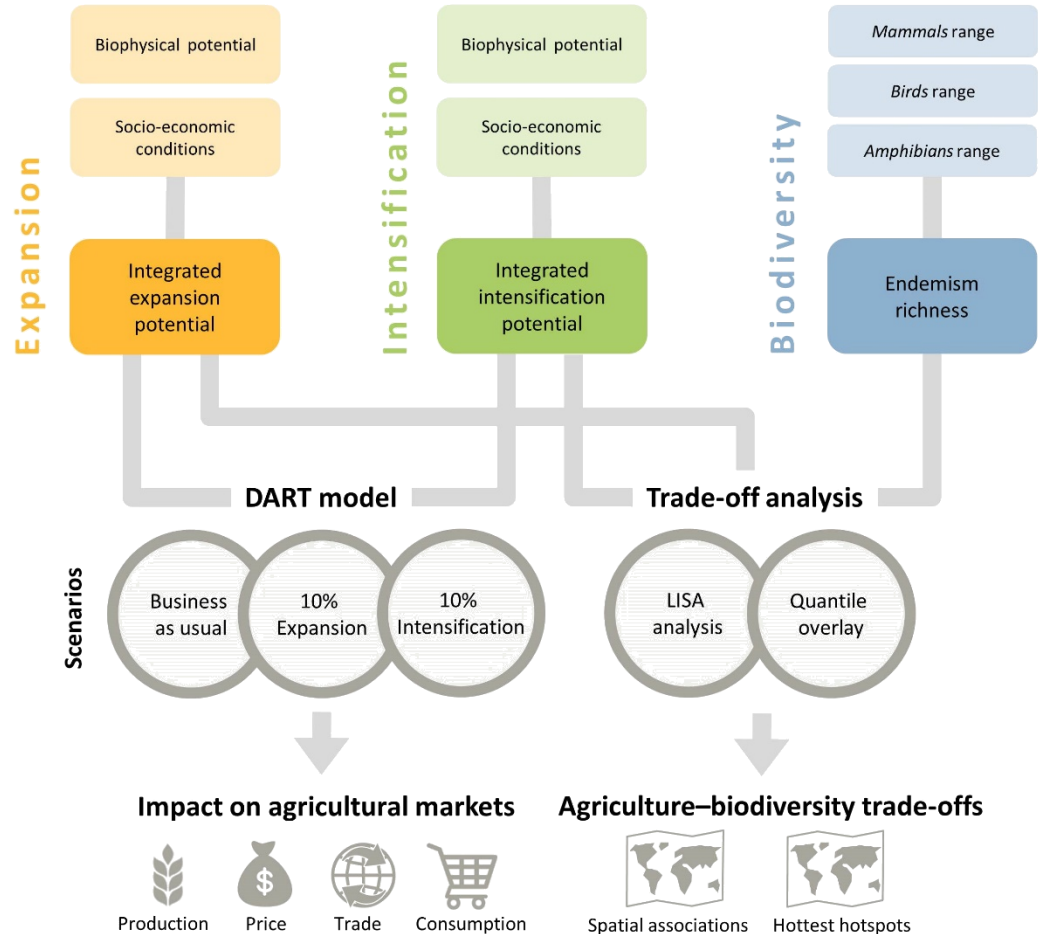
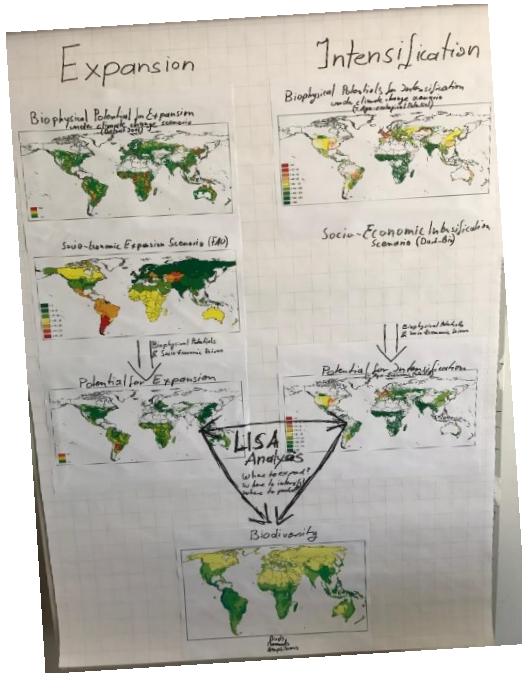
— Developed

— Developing

— Least developed

..... World

Comparing Land Use Expansion and Intensification (globally)

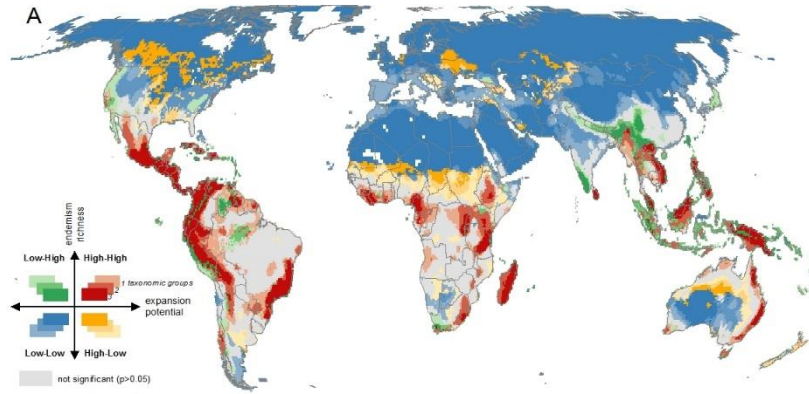


Global Scenarios for 2030: Expansion vs. Intensification

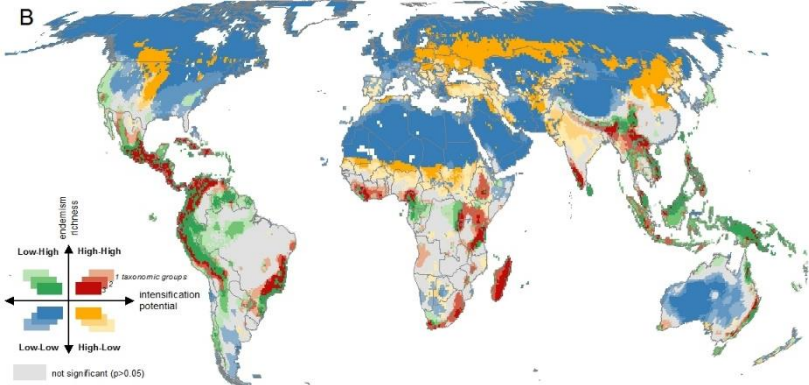


Spatial association of endemism richness, cropland expansion and intensification

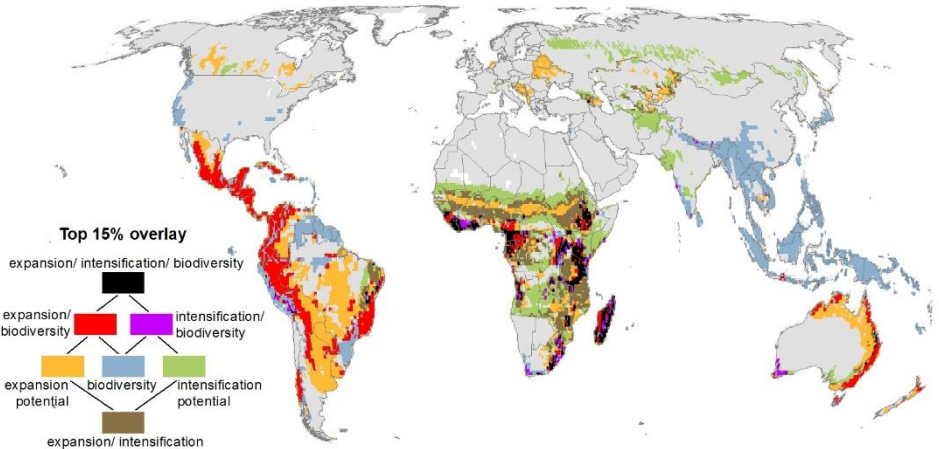
(A) Potential cropland expansion



(B) Potential intensification



(C) Hottest Hot spots: Expansion potential, intensification potential and endemism richness



Synthesis of Global Scenarios on Biodiversity and Natures contributions to People

Economic optimism

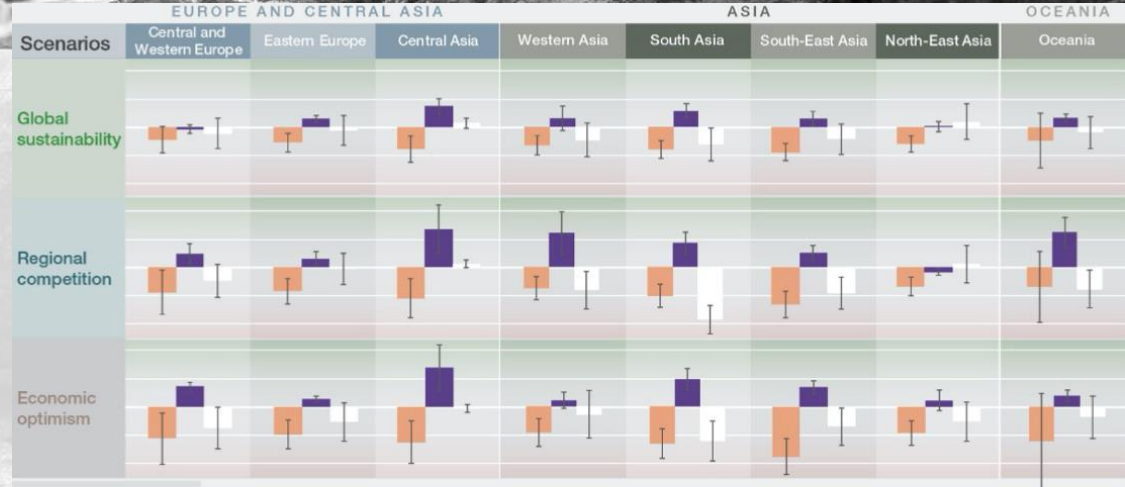
- rapid economic growth
- low regulation

Regional competition

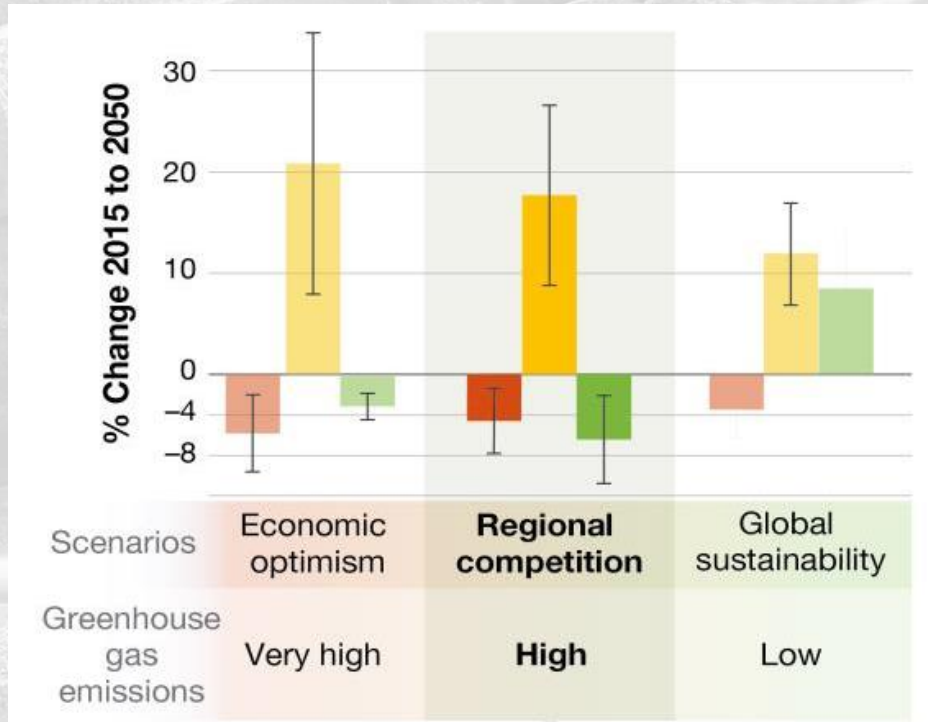
- strong trade and other barriers
- growing gap between rich and poor

Global sustainability

- Proactive environmental policy
- Sustainable production and consumption



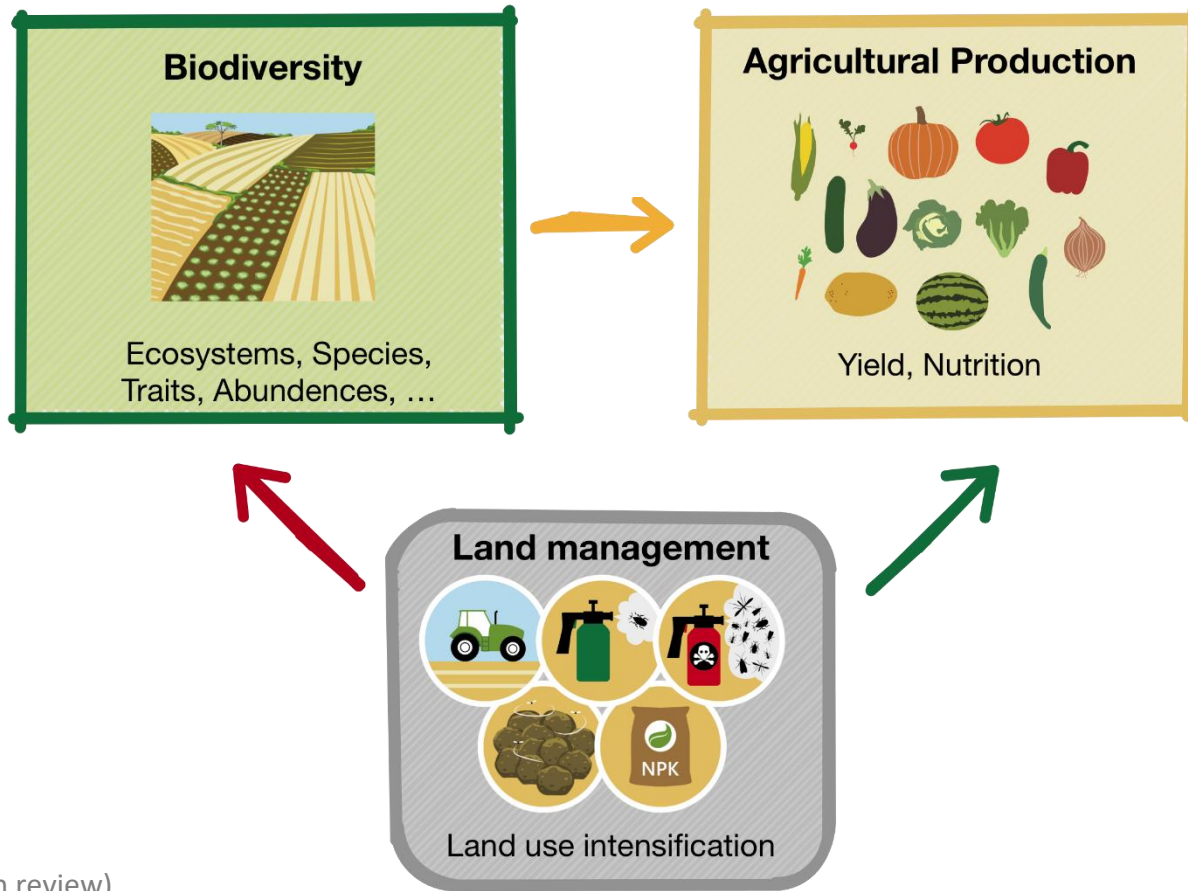
Projected changes in biodiversity and nature's material and regulating benefits, due to climate & land use change by 2050



- Species richness
- Material NCP
- Regulating NCP

Sorry, but why is there no feedback considered?

The Biodiversity ~ Production Mutualism











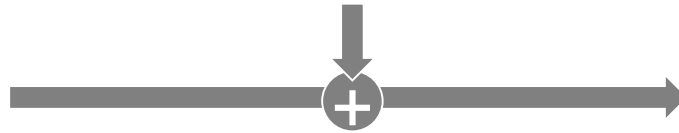
Outlook: What would be needed?

Point-based yield estimates

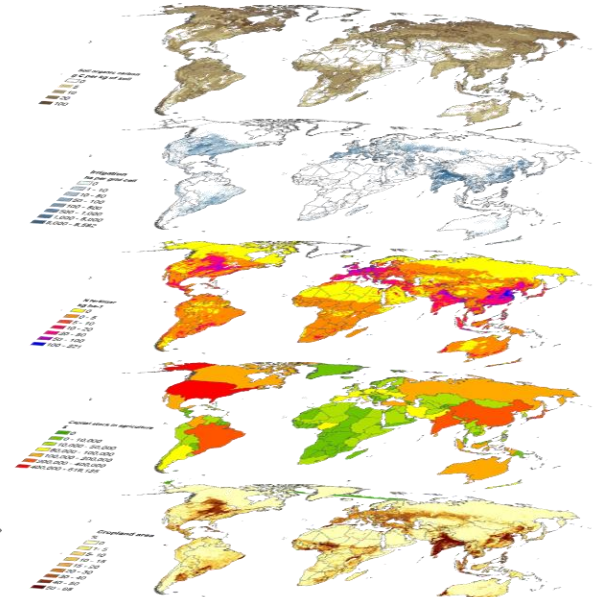


Fields in landscape with varying structure

-  Bunds
-  Rice fields
-  Plantations
-  Artificial areas
-  Bare Soil/Grasslands
-  Woodlands
-  Hydrographic network
-  Ponds



Synthesis of socio-environmental conditions to homogeneous units



Conclusions & Outstanding Future Research Questions

"Solutions for a cultivated planet" have to consider biodiversity and context in multifunctional land use

Paradigm shift overcoming "protection" vs. "use"

- Where are tipping-points after which yields start declining?
- How can high intensity farming systems be restructured to foster and re-establish farmland biodiversity?
- What are the aspects of intensification in regions of lower land use intensity that boost yields and at the same time utilize biodiversity?





Transformative Change

Selected key points
from the Summary
for Policy Makers
(SPM) Section D



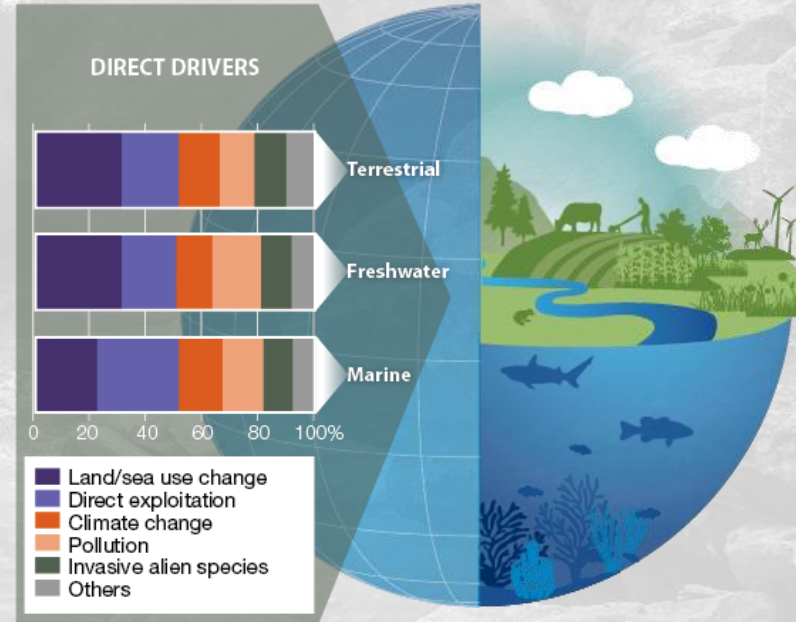
Food and Agriculture
Organization of the
United Nations





Drivers of change have accelerated during the past 50 years to levels unprecedented in human history

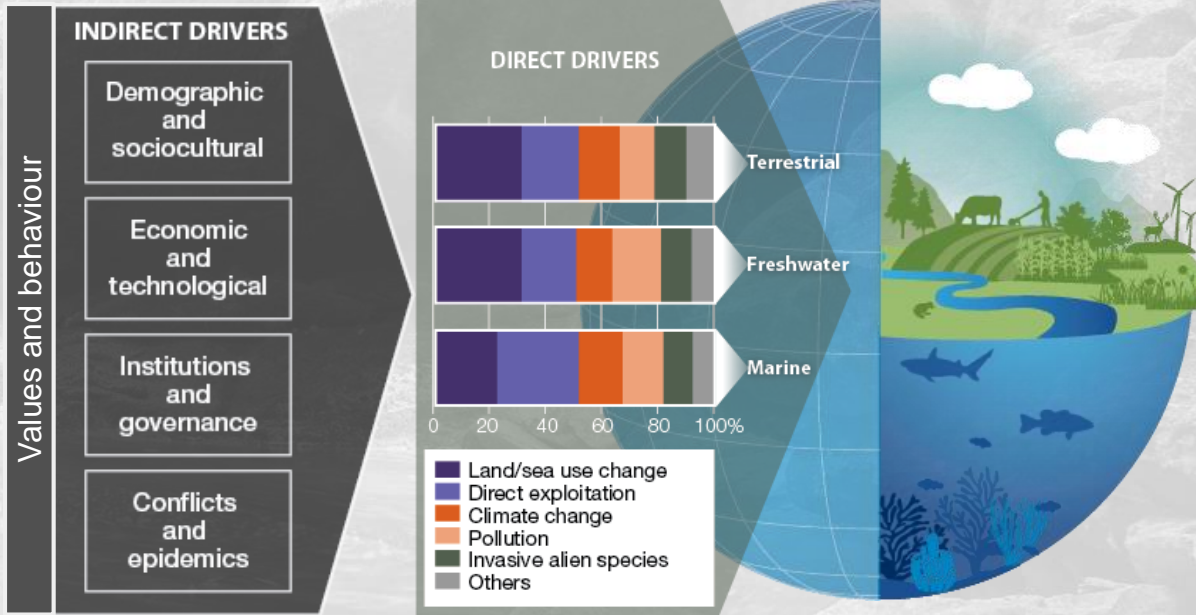
Meeting global societal goals through urgent and concerted efforts addressing **direct drivers** of change, which have accelerated during the past 50 years to levels unprecedented in human history





Drivers of change have accelerated during the past 50 years to levels unprecedented in human history

Meeting global societal goals through urgent and concerted efforts addressing direct drivers and especially the root causes (**indirect drivers**) of nature deterioration



D10 *A key component of sustainable pathways is the evolution of global financial and economic systems to build a global sustainable economy, steering away from the current, limited paradigm of economic growth.*

- 68% of the capital in the soy and beef production and 70% of the capital in the illegal fishing flows through tax havens
- OECD countries subsidize US \$ 100 billion in agricultural production that is not environmentally friendly



Global Assessment

Most comprehensive global picture of the links between nature and people in recent times ever produced.

Trends worrying and clearly unsustainable

An urgent call for action:

- Prompt action
- Tackling the roots causes of nature's deterioration
- Coordinated and integrated across sectors and scales



Historical Garden
1850-1900

MUSEUMGARTEN
Historical Garden
1850-1900

*Anyone who believes in indefinite growth in anything physical,
on a physically finite planet, is either mad or an economist.*

Kenneth E. Boulding