

Agriculture: Feeding the World within Planetary Boundaries

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What do we mean when we talk about “feeding 9 billion by 2050”?

“Although it may sound straightforward, in practice the question is difficult to address...”

- **Not just a food supply issue, not just a technology issue; also involves food access and livelihoods.**
- **Cannot even be viewed only in terms of food supply and demand; environmental and social impacts of agriculture are increasingly important.**

Agrimonde: Scenarios and Challenges for Feeding the World in 2050. S. Paillard, et al. 2011 (INRA and CIRAD).



WATER FOR FOOD

7 BILLION
PEOPLE TO FEED TODAY

9 BILLION
IN 2050

= 60% more food needed

+19% increase of agricultural water consumption
(including both rainfed and irrigated) by 2050

GLOBAL WATER WITHDRAWALS



EVERY DAY 1 PERSON

DRINKS



2-4

LITRES
OF WATER

EATS



2000-5000

LITRES OF VIRTUAL WATER
EMBEDDED IN FOOD

ALL WE EAT NEEDS WATER TO GROW

1 APPLE
70
litres



150G OF BEEF
STEAK
2025
litres



100G OF
VEGETABLES
20
litres



1 SLICE
OF BREAD
40
litres



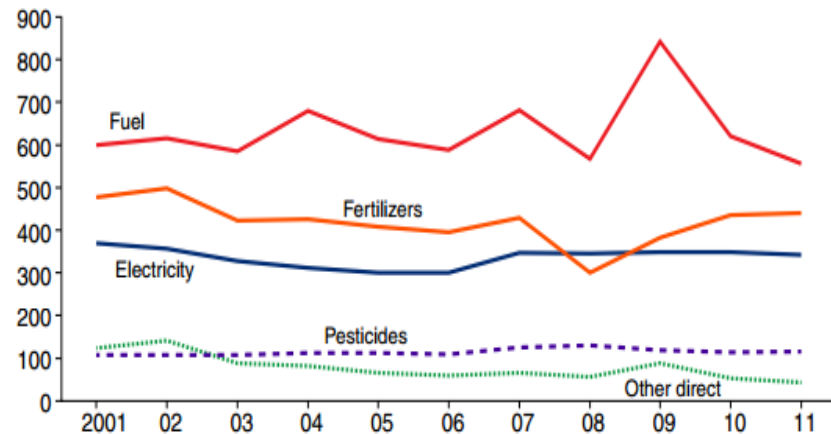
ENERGY FOR FOOD

Food production and supply chain is responsible for around 30% of total global energy

demand

Energy inputs consumed on U.S. farms, by component, 2001-11

Trillion Btu of energy



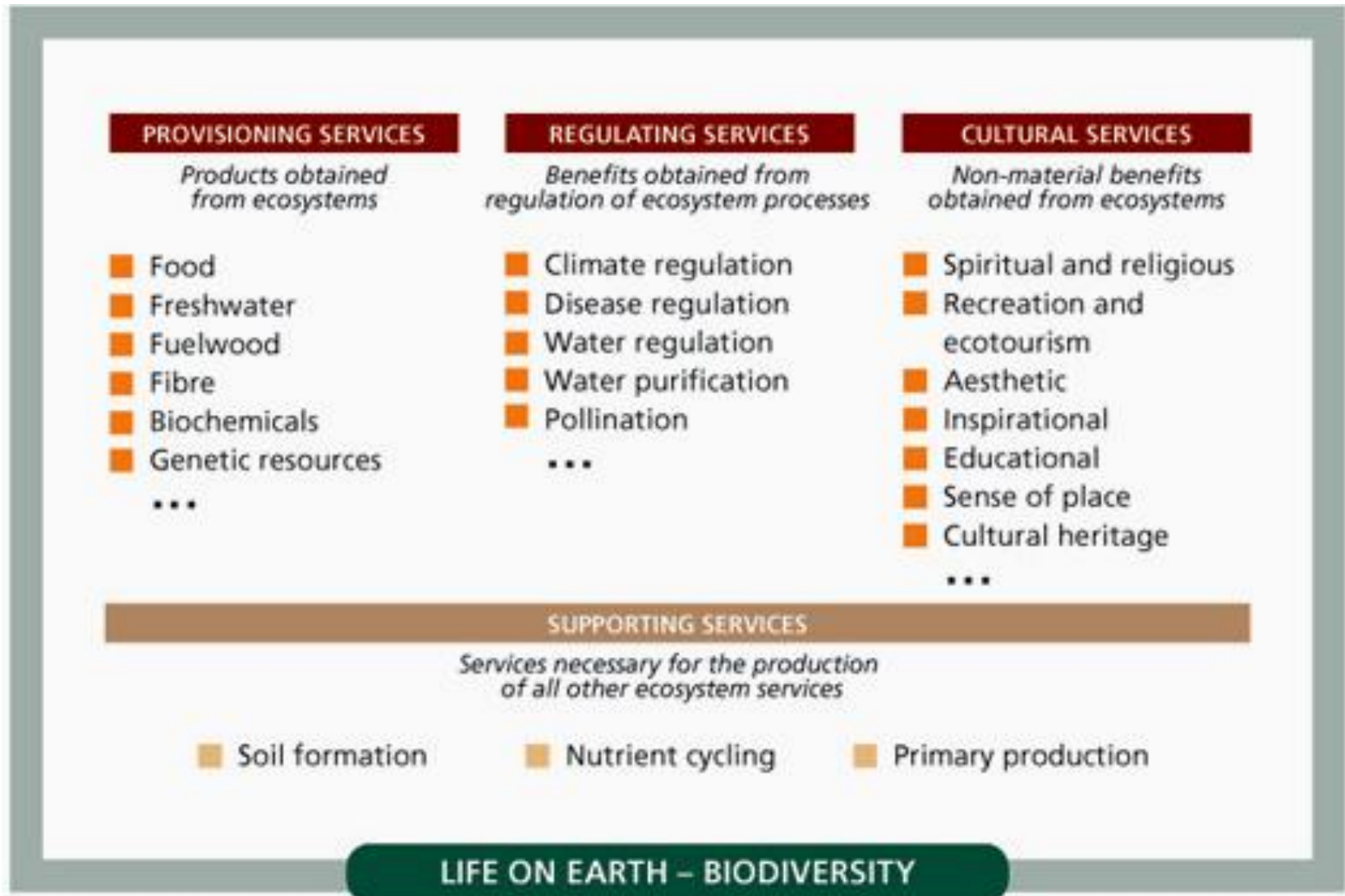
Note: "Other direct" represents liquid petroleum and natural gas. Energy consumed is calculated by taking the total yearly expenses, divided by the average yearly price, and multiplying this amount by the energy conversion ratio. Btu = British thermal units.

Source: Miranowski (2005) and USDA, Economic Research Service calculations.

Also must take into account transport, storage, processing and other energy costs for food.

Ecosystem Services

Food is just one service that people obtain from ecosystems



Are we approaching “Planetary Boundaries”?

What is the “*Safe Operating Space for Humanity*”?

- Climate change
- Biodiversity loss
- Nitrogen loading
- Phosphorous loading
- Ozone depletion
- Ocean acidification
- Freshwater use
- Land use change
- Atmospheric aerosols
- Chemical pollution

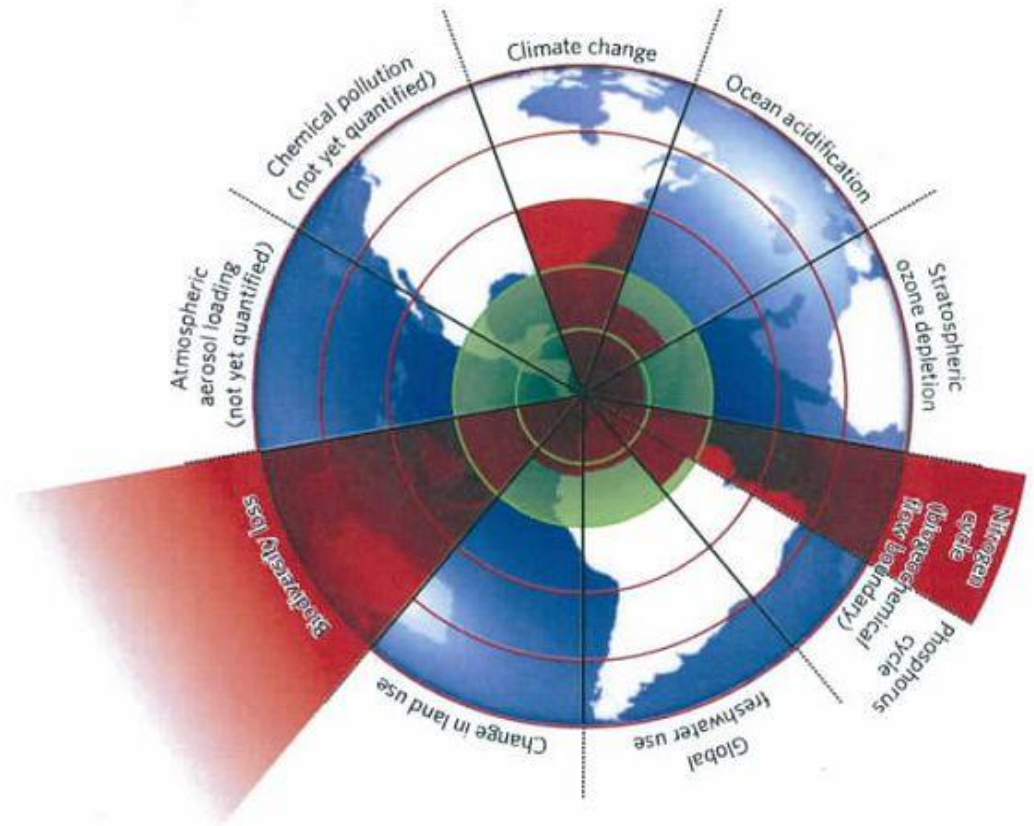


Figure 1 | Beyond the boundary. The inner green shading represents the proposed safe operating space for nine planetary systems. The red wedges represent an estimate of the current position for each variable. The boundaries in three systems (rate of biodiversity loss, climate change and human interference with the nitrogen cycle), have already been exceeded.

J Rockstrom, et al.

Ecology and Society 14(2) 2009

Nature 2009

Millennium Assessment Framework to evaluate food production system: social drivers dominate choices and outcomes

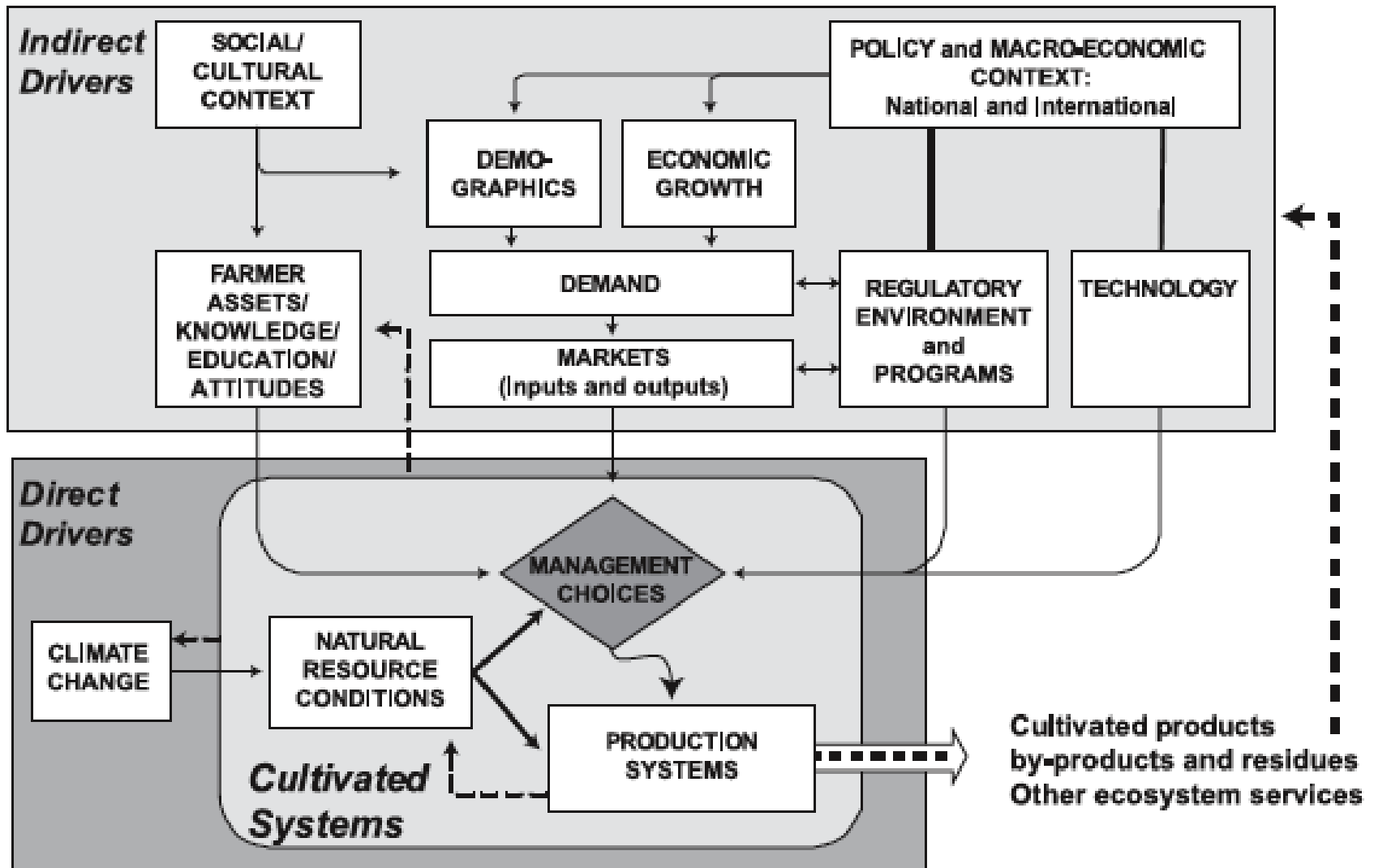


Figure 26.7. Interactions between Drivers of Cultivated Systems