Environmental aspects of Agriculture

Food security

X

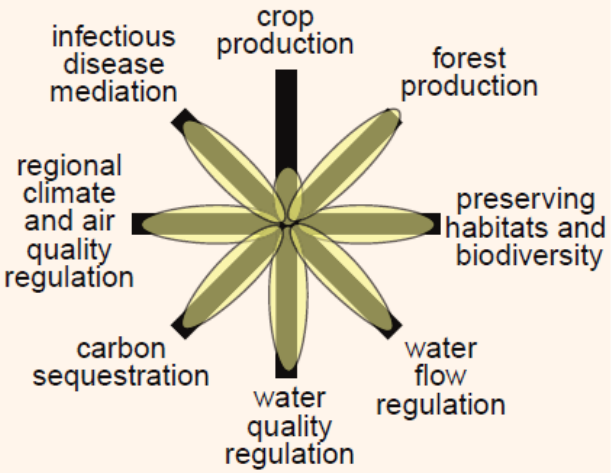
Biodiversity

Food security

Intensive agriculture + and - χ Extensive agriculture + and -

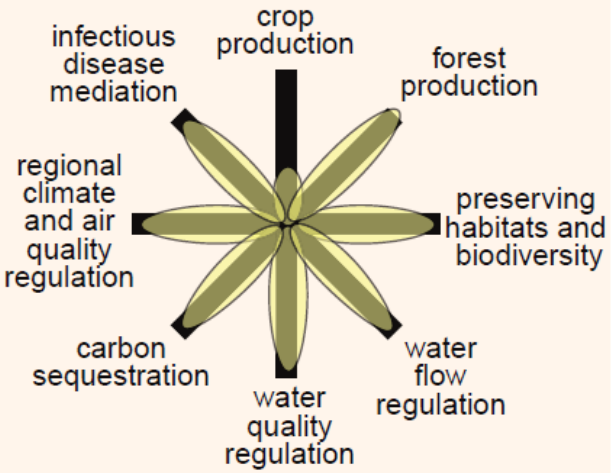
Biodiversity

Biodiversity



natural ecosystem

Biodiversity



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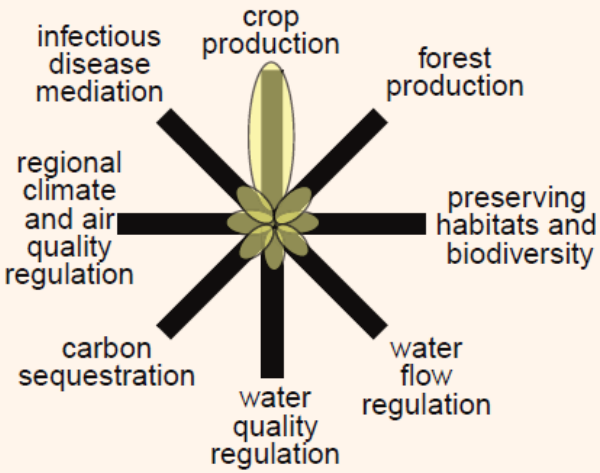
Food security



intensive cropland

Agriculture x Agro-ecosystem - overview

Agriculture (economy view)
- the primary sector of the economy
- providing food and materials for production

Agriculture x Agro-ecosystem

Agriculture (economy view)
- the primary sector of the economy
- providing food and materials for production

Agroecosystem (ecological view)
- specific type of planetary ecosystems
- functional unity of economically important organisms and environment
- narrower view - field; wider view - river basin, landscape, region
- originally, the most productive ecosystems

Importance of Agriculture

Productive function

- foodstuffs, industrial raw materials (textile and the leather industry, fats ...), and energy

Importance of Agriculture

Productive function

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Non-productive functions

- creation and maintenance of the typical cultural landscape - *Genius loci*
- maintaining functioning agroecosystems with specific biodiversity
- self-supply of the region with food, employment
- the environment of people and other organisms conservation of rural settlements, recreation

Coubine Othon
1883 - 1969
Krajina s obilným polem

Václav Špála
U Berounky


Van Gogh
Landscape under a stormy sky

Lack of food

- corresponds with population growth, but necessarily?

1798 **T. R. Malthus** - *An Essay on the Principle of Population*

- warning against food shortages in the future "*human population grows exponentially, food production only linearly*"
  - in the history, frequent famines that limited the growth of population

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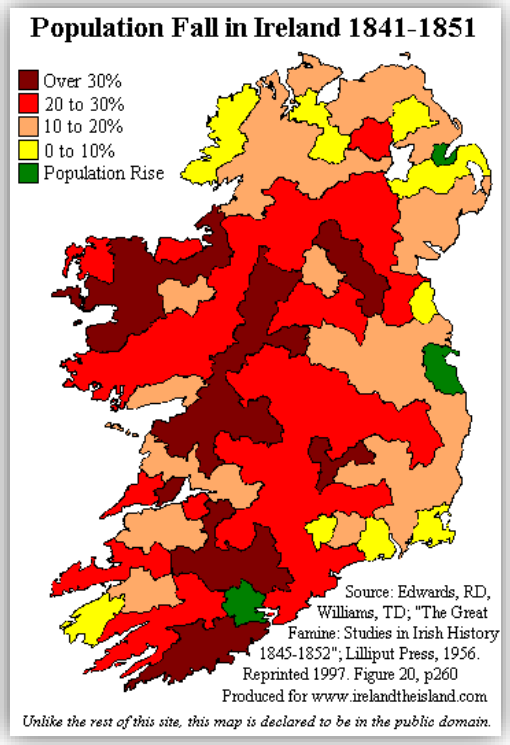
1845-1850 - Irish famine

- 1,000,000 victims, many others emigrated
- the primary source of food for the poor - potatoes
  - the potato mold destroyed the crop
- lack of food + loss of land (they did not pay the rent)
- the spread of cholera and typhoid exacerbated the destruction of the population



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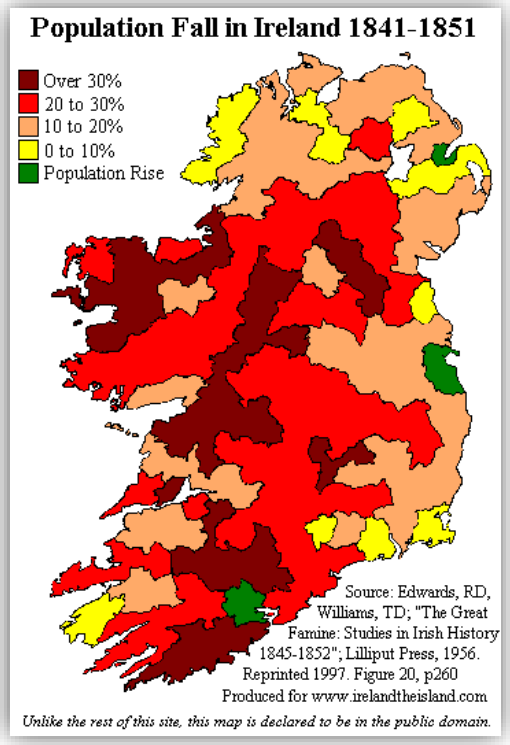
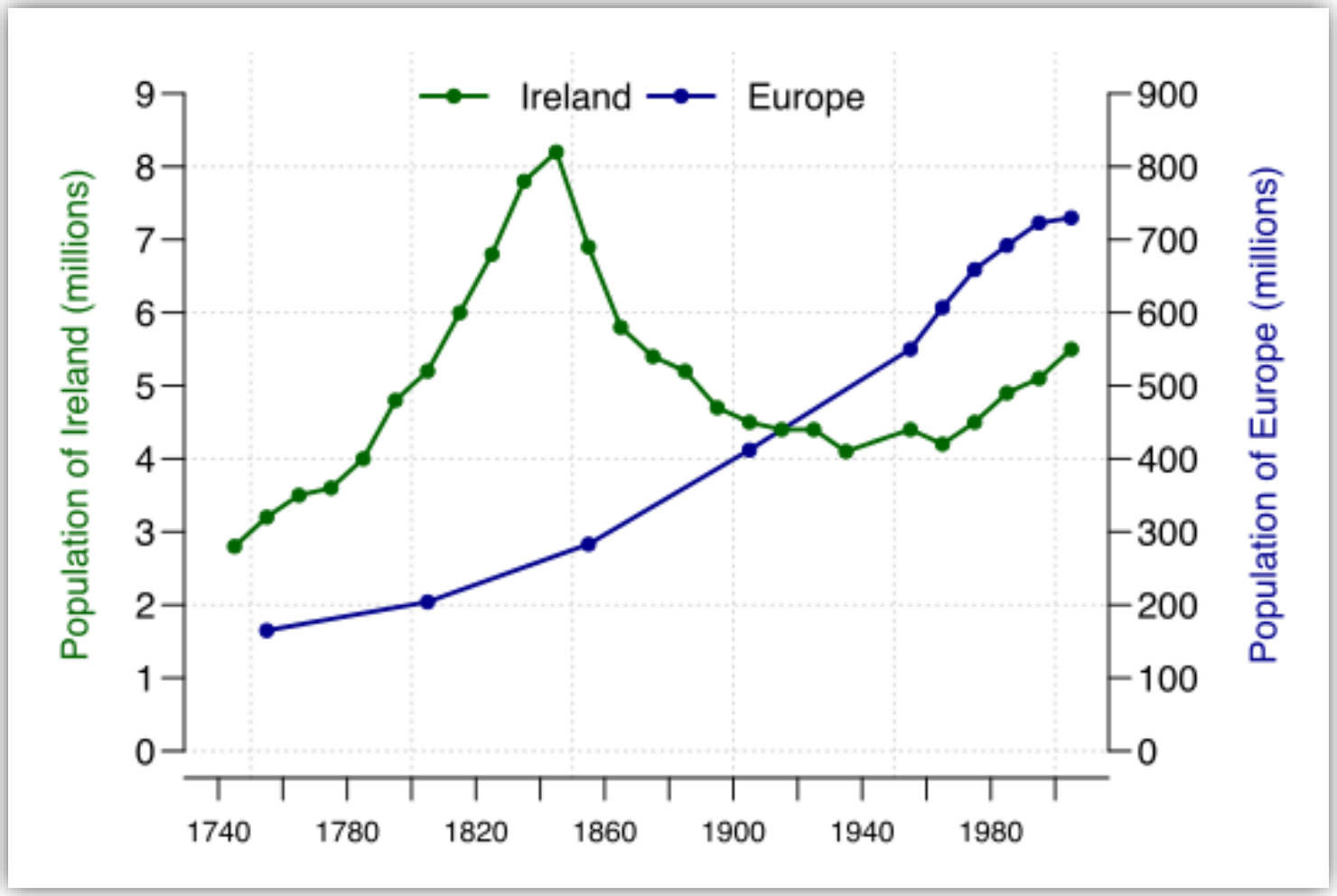


BUT - there was **enough food in Ireland** - corn, wheat, oats!
- the were sold to the UK at a much higher price than poor farmers could afford, according to rational calculations

The Almighty, indeed, sent the potato blight, but the English created the Famine. John Mitchel

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Lack of food – causes

Bengal Famine 1943 **1-4,000,000 Victims - Why?**

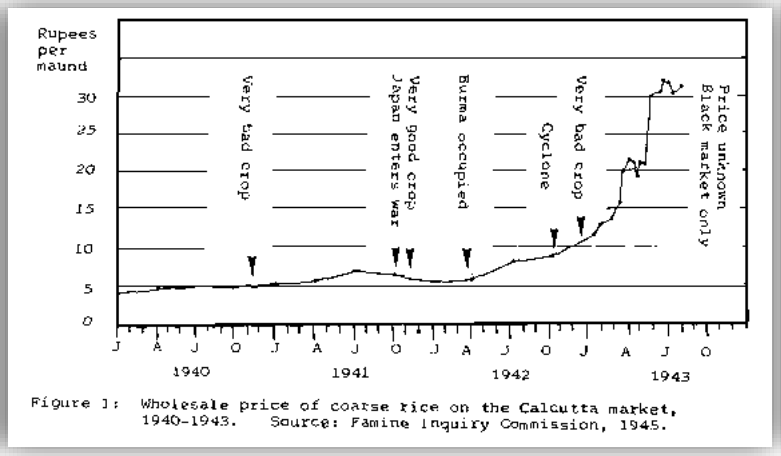
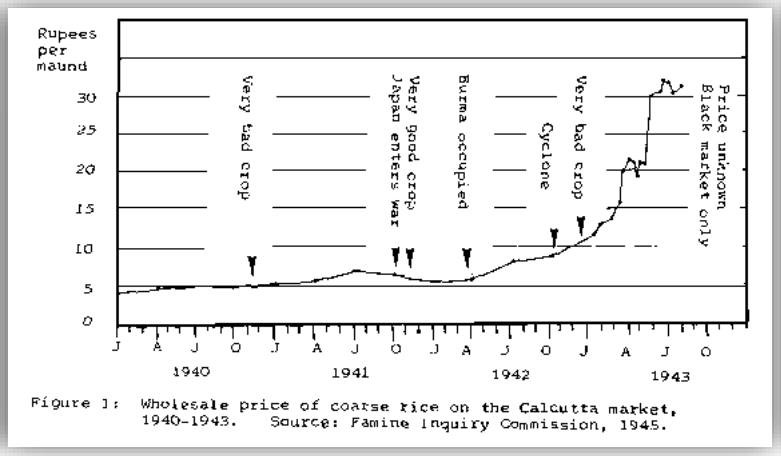


Figure 1: Wholesale price of coarse rice on the Calcutta market, 1940-1943. Source: Famine Inquiry Commission, 1945.

Lack of food – causes

Bengal Famine 1943 1-4,000,000 Victims - Why?

- there was a crop failure in Bengal, but this is a periodic phenomenon
- however, the war was raging (GB x J) and it was necessary to supply cities (soldiers) first
- grain prices have risen significantly - poor people could not afford it



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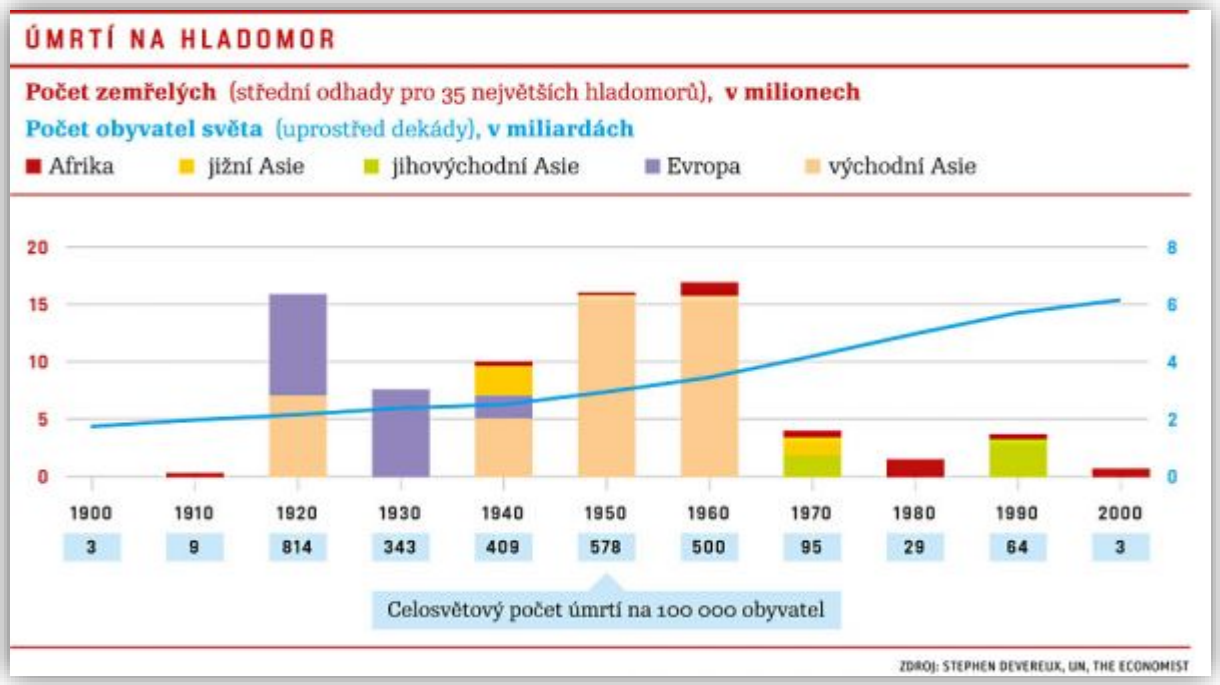
Lack of food – causes

Ukrainian famine (1932-1933) 2.7-7 000 000 victims - Why?

Chinese famine (1959-1961) 20-40,000,000 Victims - Why?

Ethiopian famine (1984) - 1,000,000 Victims - Why?



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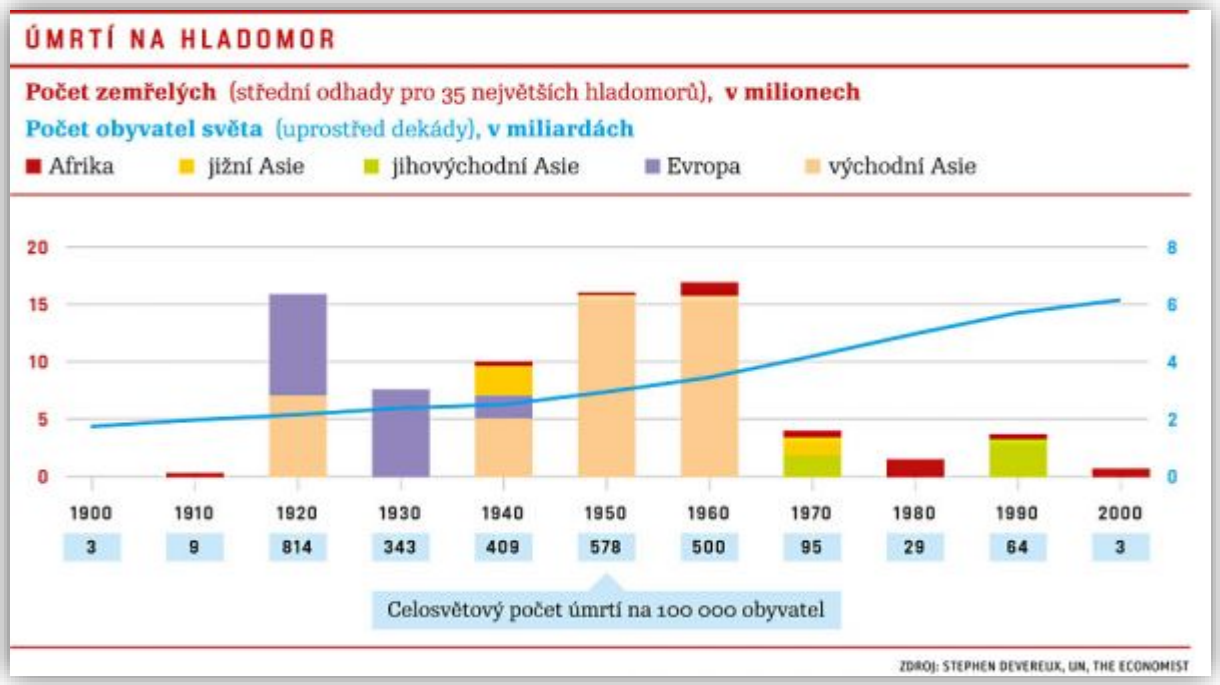

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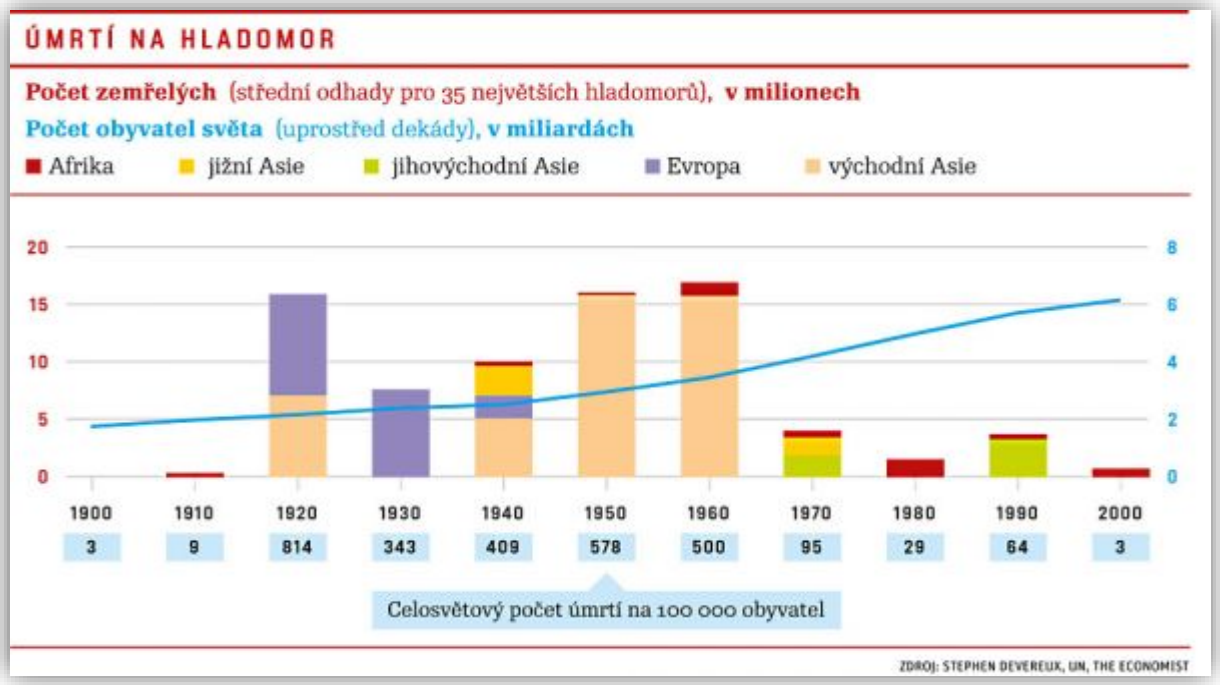

Most of the great famines in the 20th century were the result of political decisions in undemocratic dictatorships!

Green Revolution

- after WW2 population in SE Asia – ↓ mortality = ↑ population
- after **Bengal famine** - introduction of **new varieties + industrialization**

Objective: **to significantly increase agricultural production**

- 60s - the beginning of the Green Revolution in India
- introduction of HYV crops - eg drought resistant rice IR8 with yield 5 t / ha (x 1.5 t / ha earlier), moreover grown for a shorter time

→ possible two harvests per season

- modern agricultural machinery (plows, tractors, harvesters ...)


↑ harvest = ↑ demand for soil fertility and water resources

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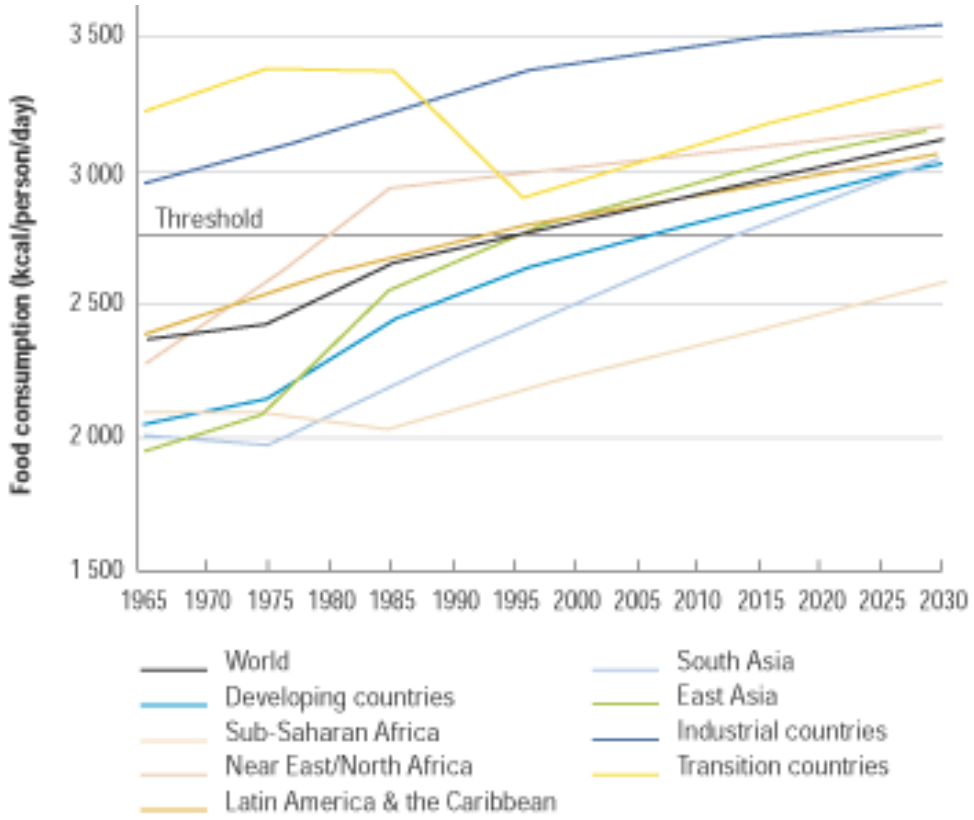
Industrial (intensive) agriculture

Pros

- high production = food security!



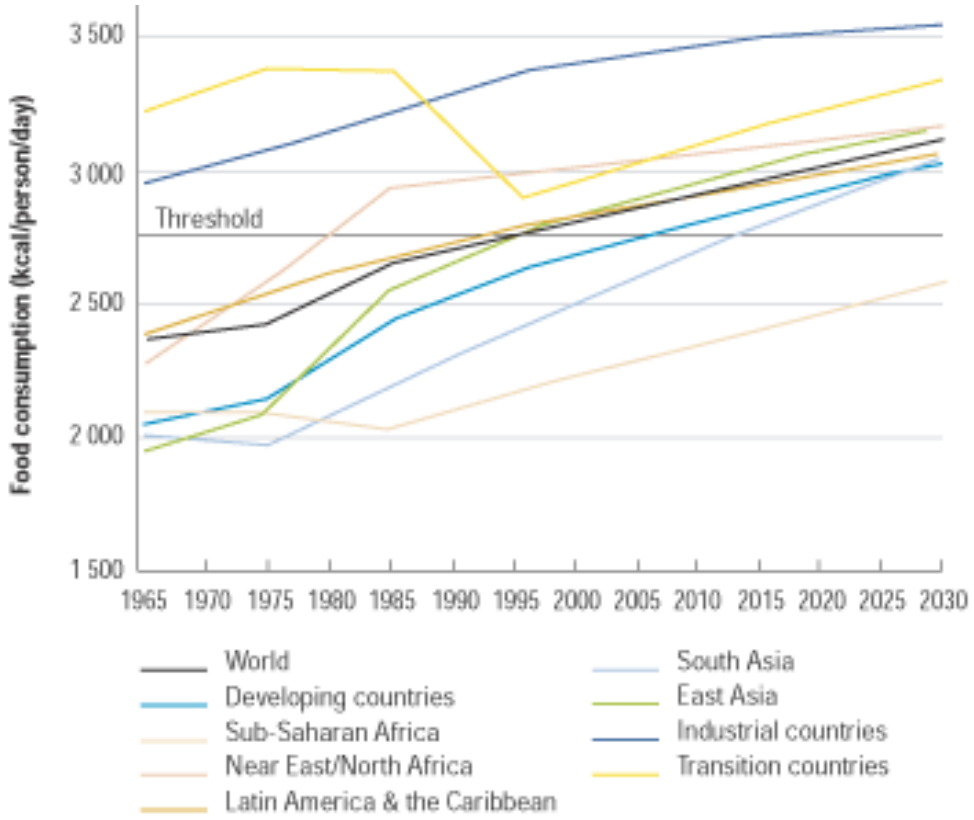
This figure shows a global food security situation that is consistently improving, at both global and developing country levels. The threshold of 2,700 kcal is taken as an indicator of the level of satisfaction of food security requirements.

Source: FAO, 2002.

Industrial (intensive) agriculture

Pros

- high production = food security!
- less land use!



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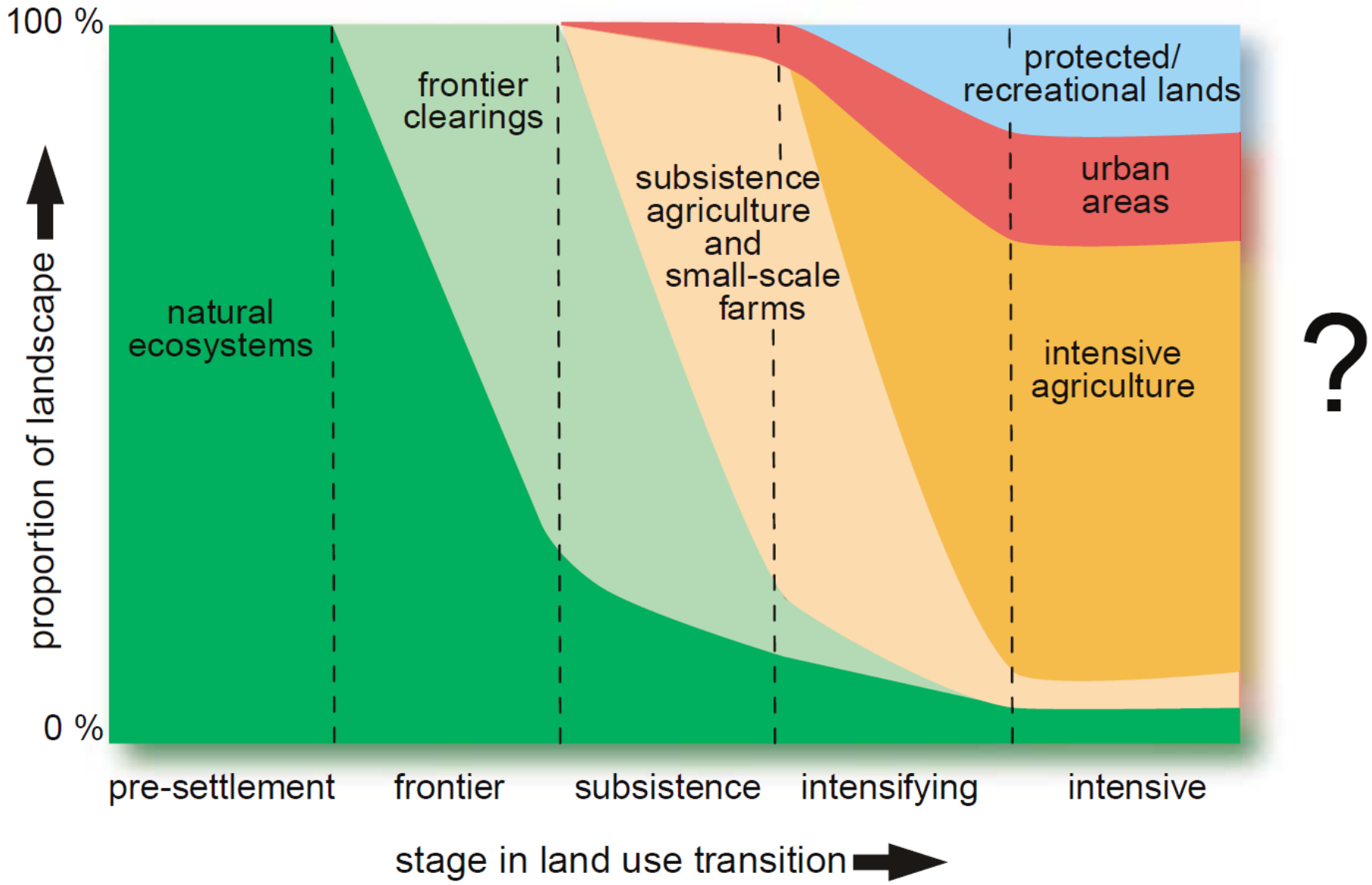
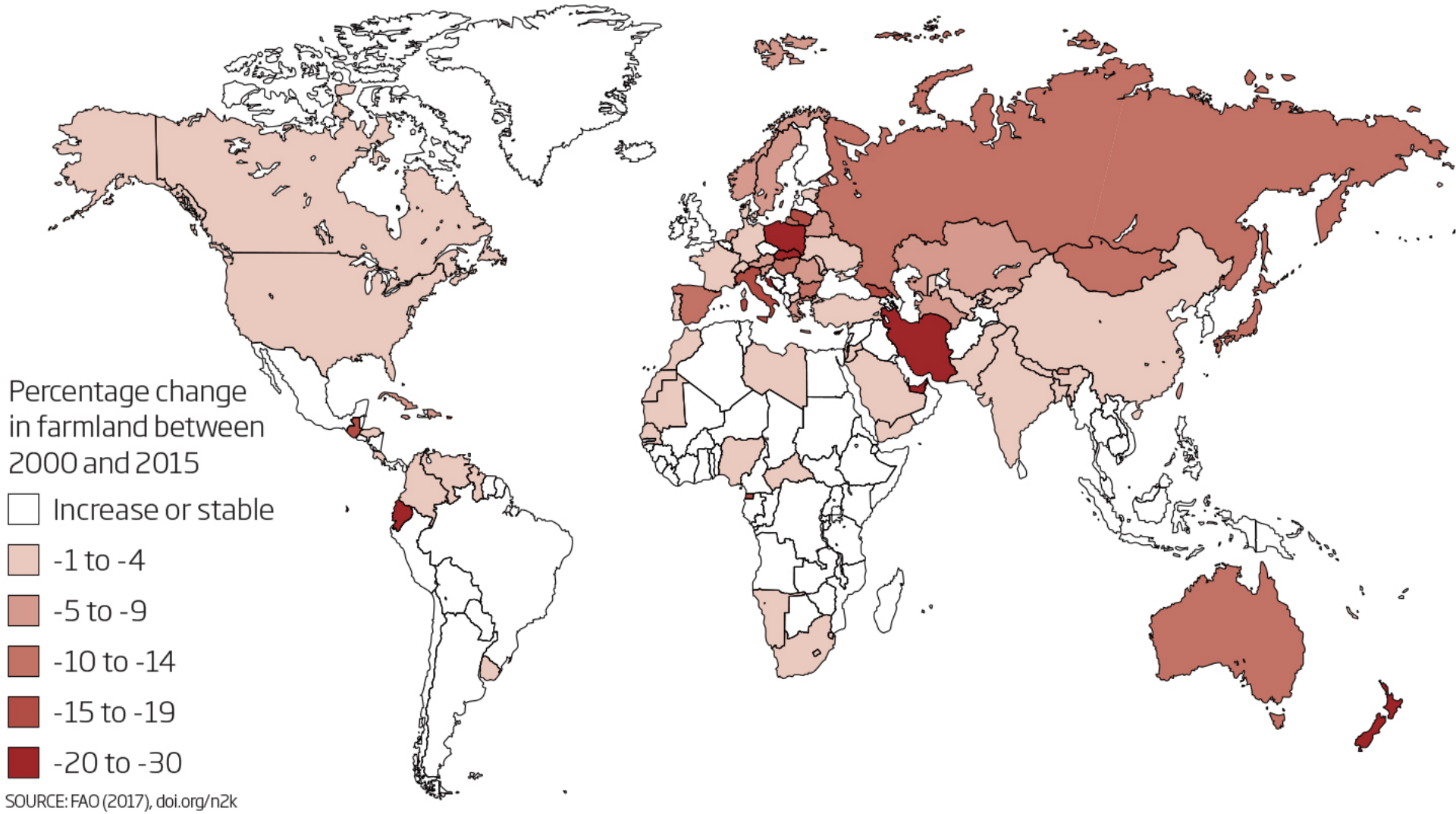
Global consequences of land use



Stephen Wilkes/Getty

Shrinking farmland

For the first time, more land is being left to return to nature than is being cleared for agriculture



SOURCE: FAO (2017), doi.org/n2k

Characteristics of intensive agriculture

Agrochemicals

- use of mineral fertilizers (N, P, K)
- excessive use of synthetic pesticides
- production, distribution and application of agrochemicals, storage and liquidation of stocks

Meet production

- livestock breeding (Baraka movie)
- breeding, transport, slaughter (unnatural conditions, stress, abuse)

- use of industrial feedstuff
- controlled reproduction, one-sided breeding

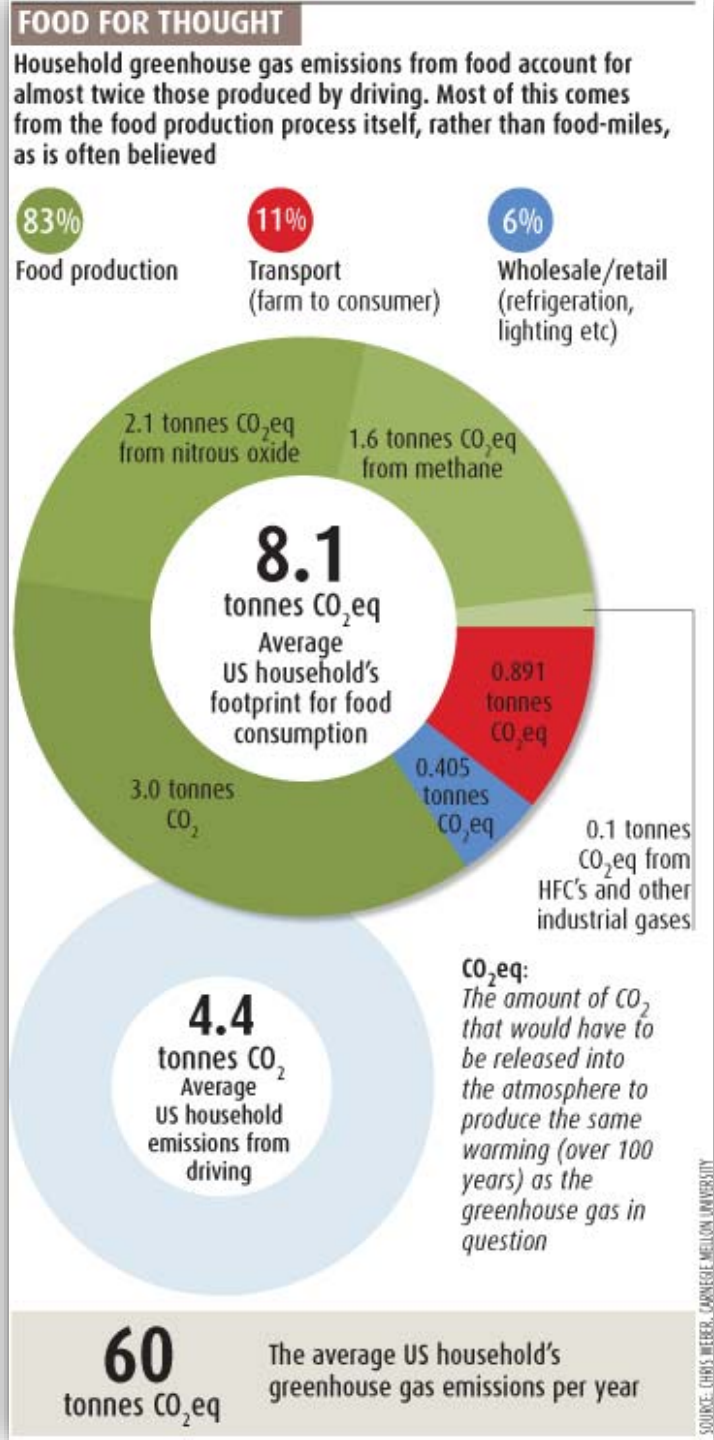
Characteristics of intens. agriculture

Food storage

- reduction of direct collection → transport distances are increasing

→ the need for long durability

→ chemical treatment, cooling



Characteristics of intens. agriculture

Food storage

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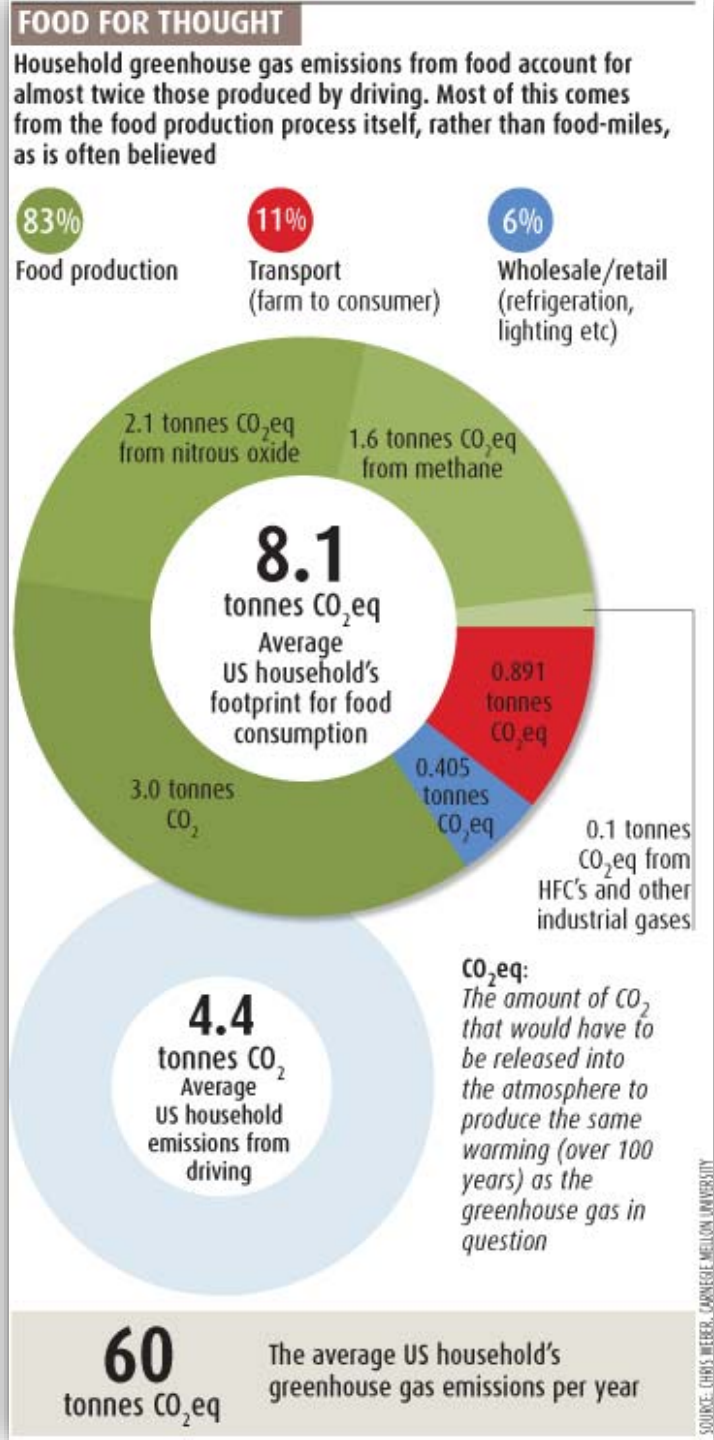
→ chemical treatment, cooling

- from the place of production to an American consumer plate ~ 2400 km; CZ?

  - transport as a whole ~ 11% of CO2 emissions from total food production (USA)



Characteristics of intens. agriculture

EROEI – *energy return on energy invested*

- industrialization of agriculture decreases EROEI
  - because of increasing amount of auxiliary energy

Auxiliary energy (AE)

- all E invested in the agri. production **except of natural E** (sun)

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AE in crop production

- agrochem. 46%, fossil E 22%, machines 13%, seeds 10%, work 9%

↑ share of AE in agrochemicals. given by high E intensity of N fertilizers

- 80 GJ / t (P fertilizers 6 times less, K fertilizers 9 times less)
- N fertilizers highest consumption

- the most demanding for AE is sugar beet: 40 GJ/ha, alfalfa: 13 GJ/ha
- the largest E output - sugar beet: 214 GJ/ha, alfalfa 107 GJ/ha

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E balance

- specific consumption per GJ produced:
  lucerne 0.12, sugar beet 0.19, potatoes 0.43, meat 0.9
  = per 1 GJ DE there are 1,1 GJ livestock products = **EROEI**

Negative aspects of intensive agriculture

Social

- marginalization of agriculture as a part of economy (belongs to the groups with the lowest life-standard)
- now - circa 4% of the population; circa 3% of GDP
- before 1940 - 35% of the population (product. age), the strongest political party in Czechoslovakia

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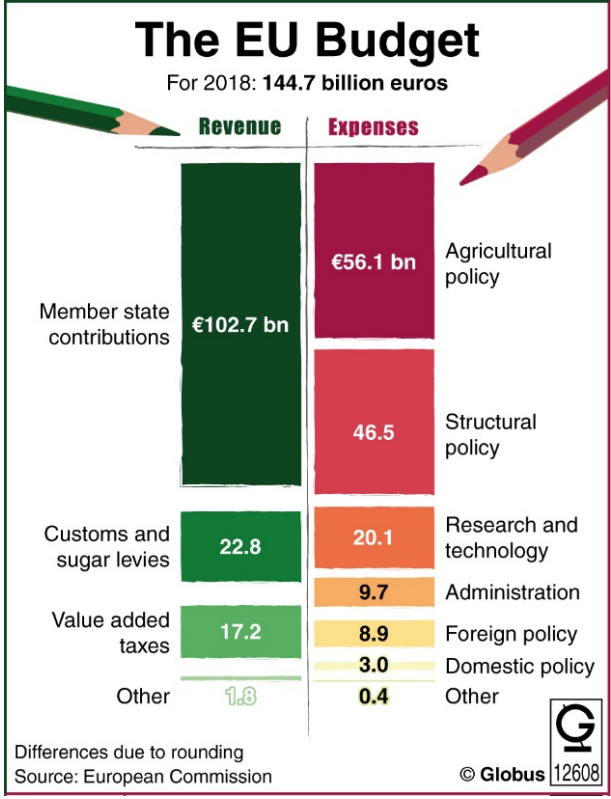
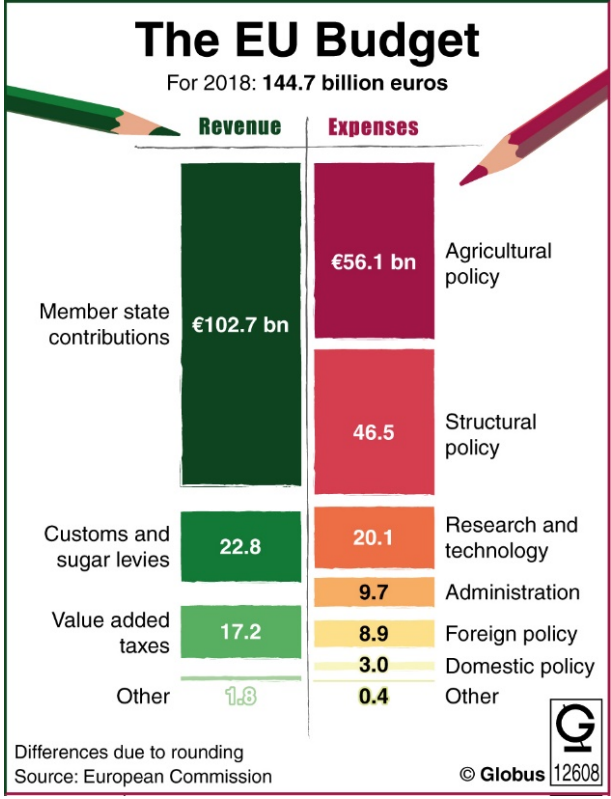


Economical

- high state subsidy (EU)
- concentration of sales into large chains → dependence of private households on agro-concerns, pressure to increase revenues
- exports to world markets are growing - subsidies
- self-insufficiency

Negative aspects of intensive agriculture



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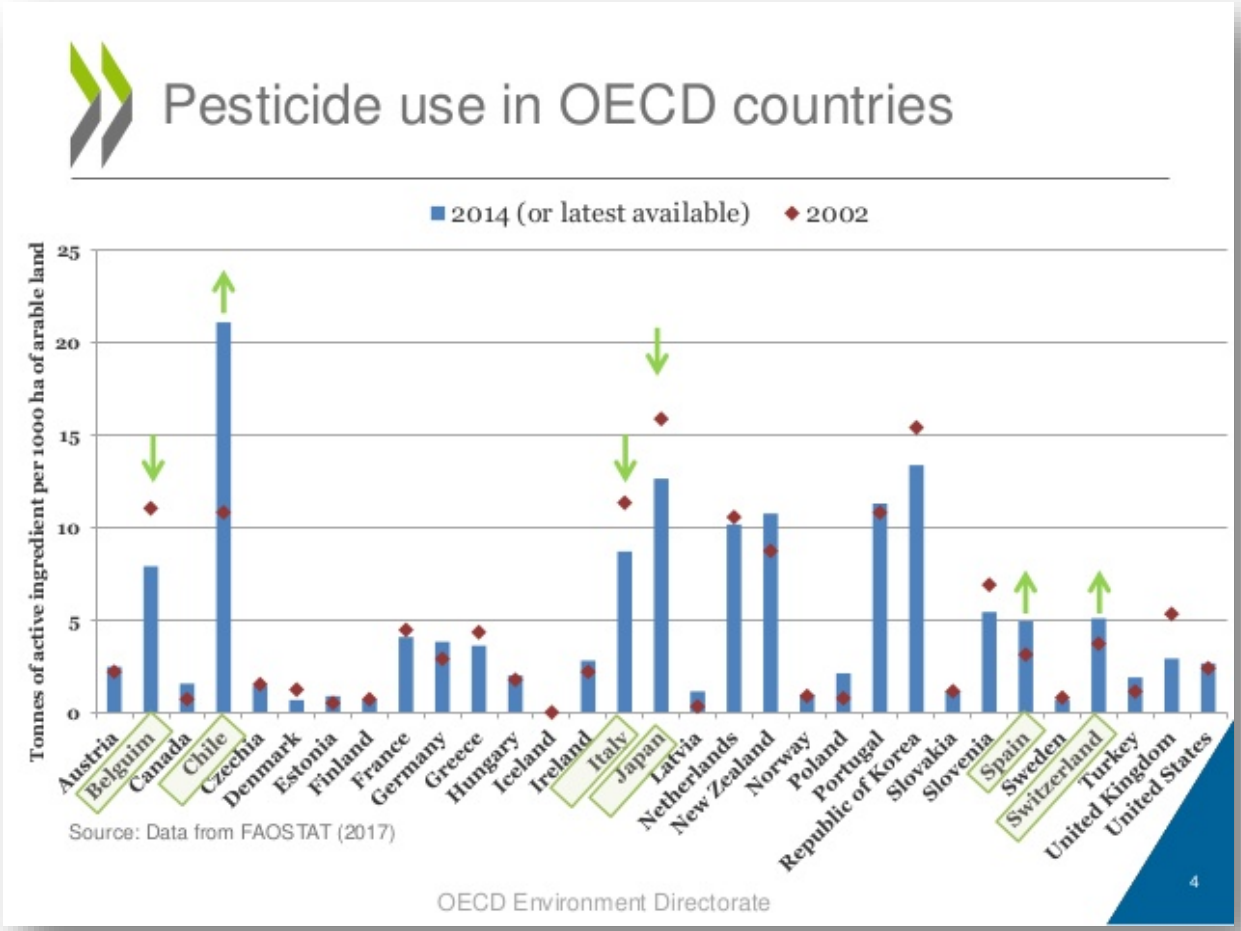
Ethical

- poor handling with animals
- intensive use of resources (v, p) at the expense of other ecosystems.

Negative aspects of intensive agriculture

Environmental and Health

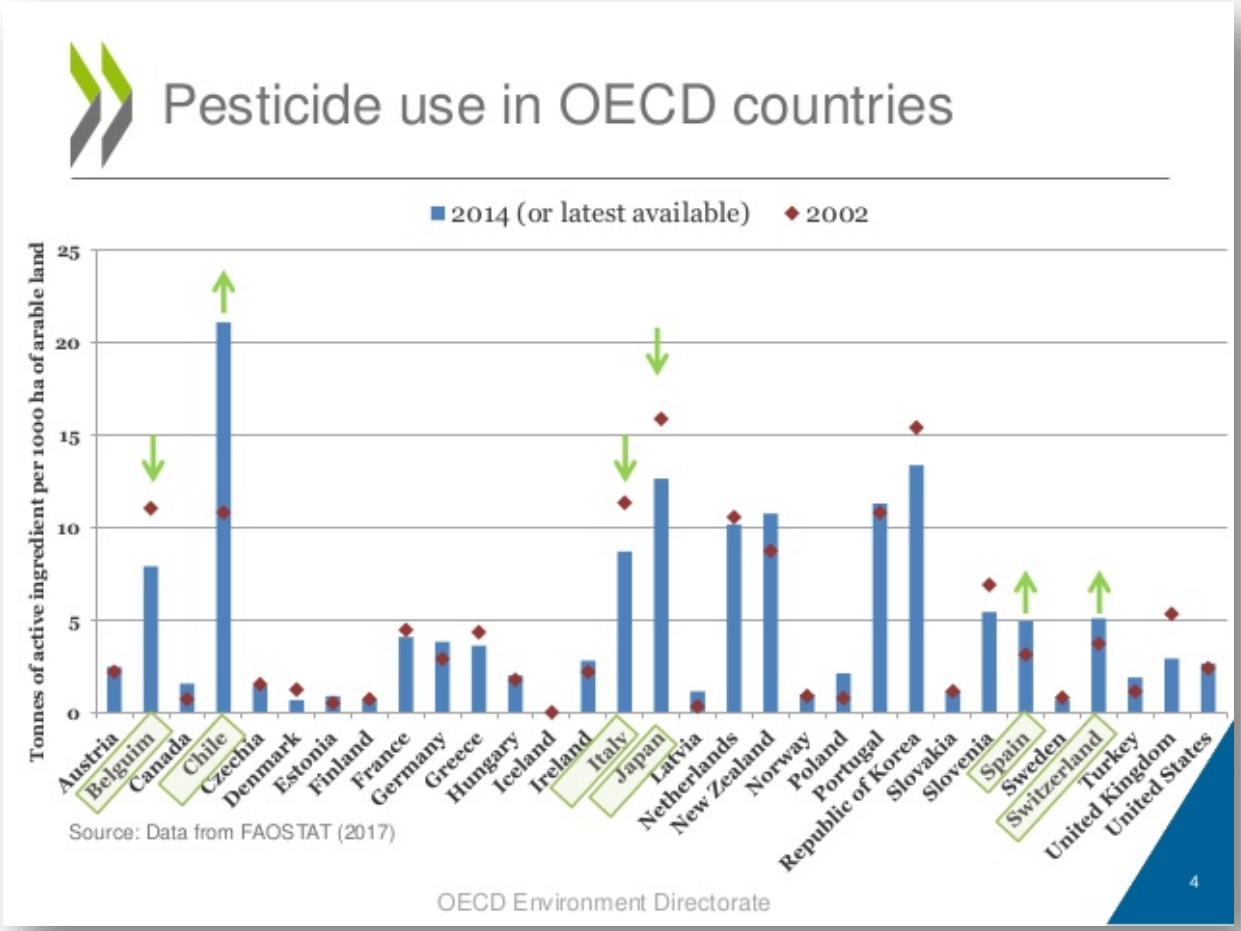
- globally, the intensity of non-renewables use increases
- soil, water and crop contamination, reduced soil fertility, erosion
- reducing biodiversity, increasing pest and disease resistance



Negative aspects of intensive agriculture

Environmental and Health

- globally, the intensity of non-renewables use increases
- soil, water and crop contamination, reduced soil fertility, erosion
- reducing biodiversity, increasing pest and disease resistance
- landscape damage



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Sustainable agriculture

„*A type of agricultural production that meets the needs of the present and does not limit the needs of future generations*“ (OECD def.)

- Protects the land used for agricultural production, water, genetic resources
- It does not degrade the environment
- A manageable, economically self-sufficient and socially acceptable system in practice

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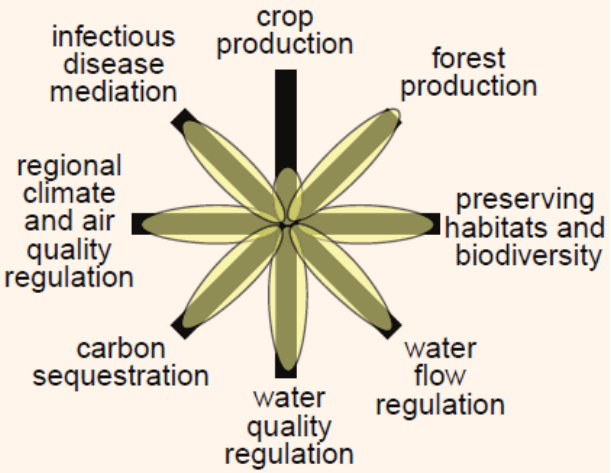
Necessary aims to reach a sustainable agriculture

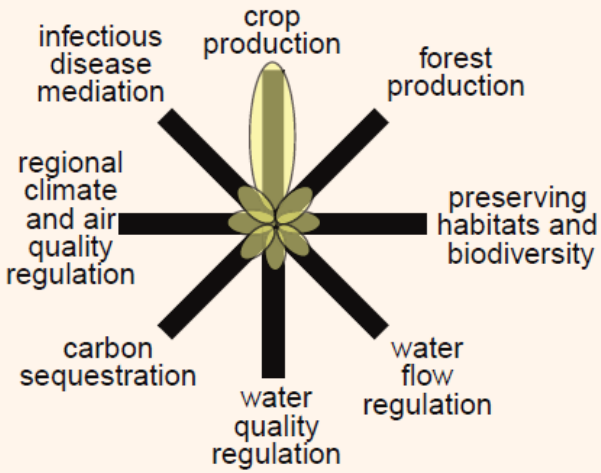
1) Higher diversity of flora and fauna on arable land and permanent grassland
2) Increased crop diversity.
3) Creating conditions leading to the protection of non-productive ecosystems and wild organisms

Biodiversity



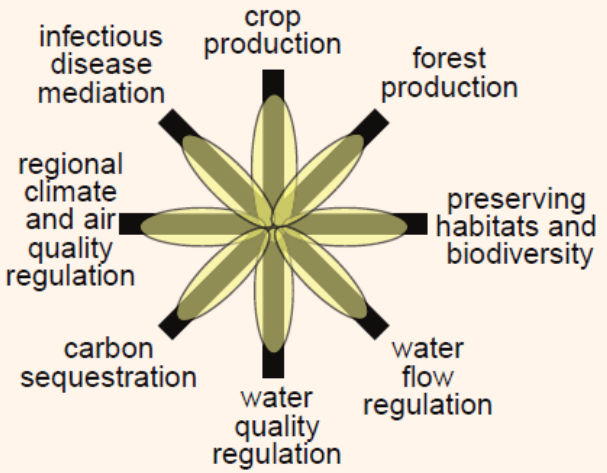
natural ecosystem

Food security



intensive cropland

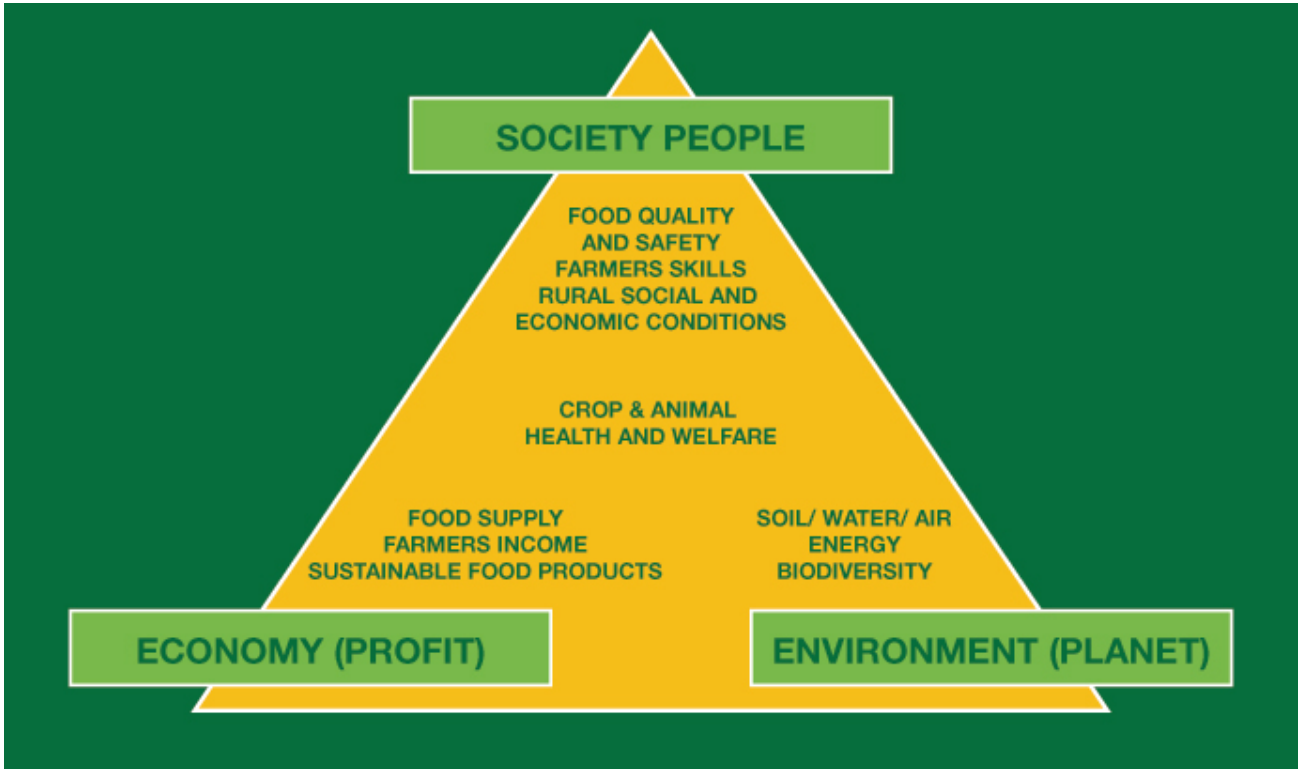
Biodiversity + Food security



cropland with restored ecosystem services

Sustainable agriculture

- Creating rural communities and traditions.
- Economic stability of rural areas.
- Protection of existing and planting of new habitats (shrubs, bands of shrubs or grasslands), forest edges, wet habitats, flowering bands.



Organic agriculture (farming)

- alternative to industrial (intensive, conventional) agriculture
- **law 242/2000 Col. on Organic agriculture**

*„**A** special type of farming that respects the environment and its constituents by restricting or prohibiting the use of substances and practices that burden and pollute the environment or increase the risk of contamination of the food chain, and that pay increased attention to the external manifestations and welfare of farmed animals.“* ***(Law 242/2000* Col.)**

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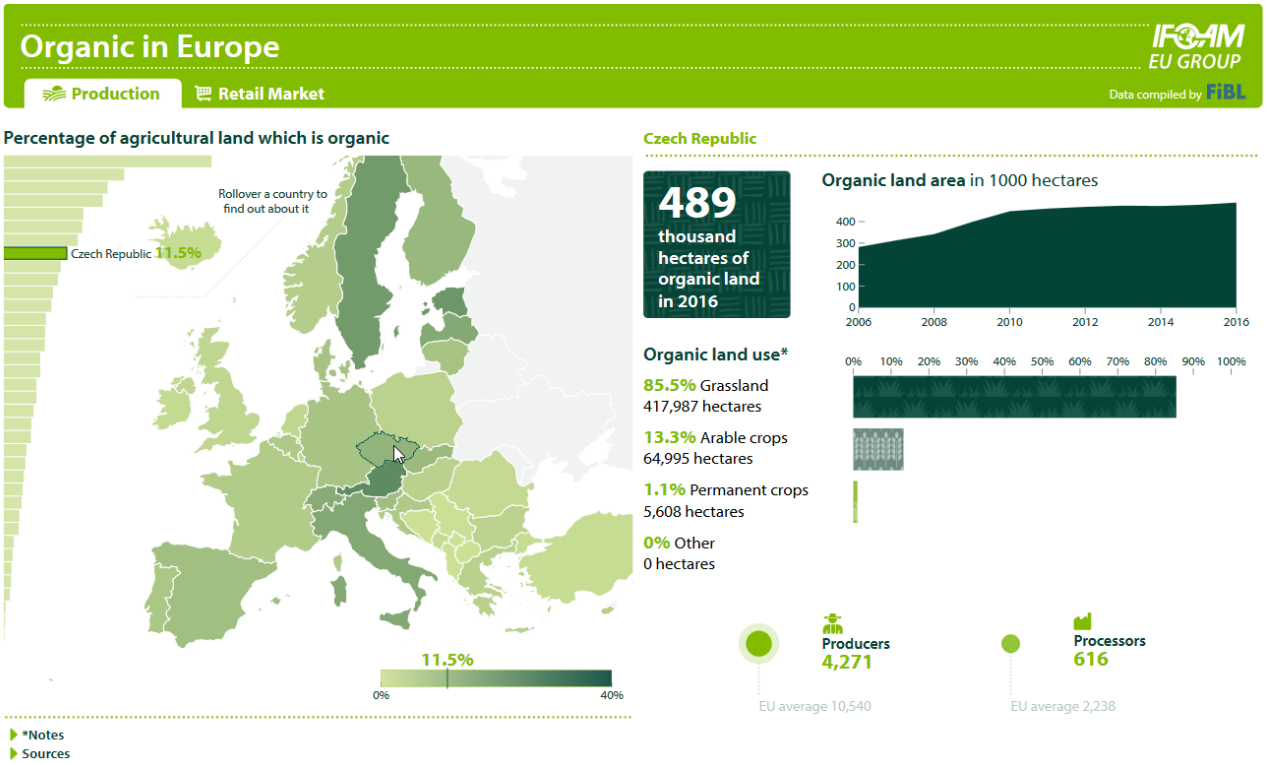
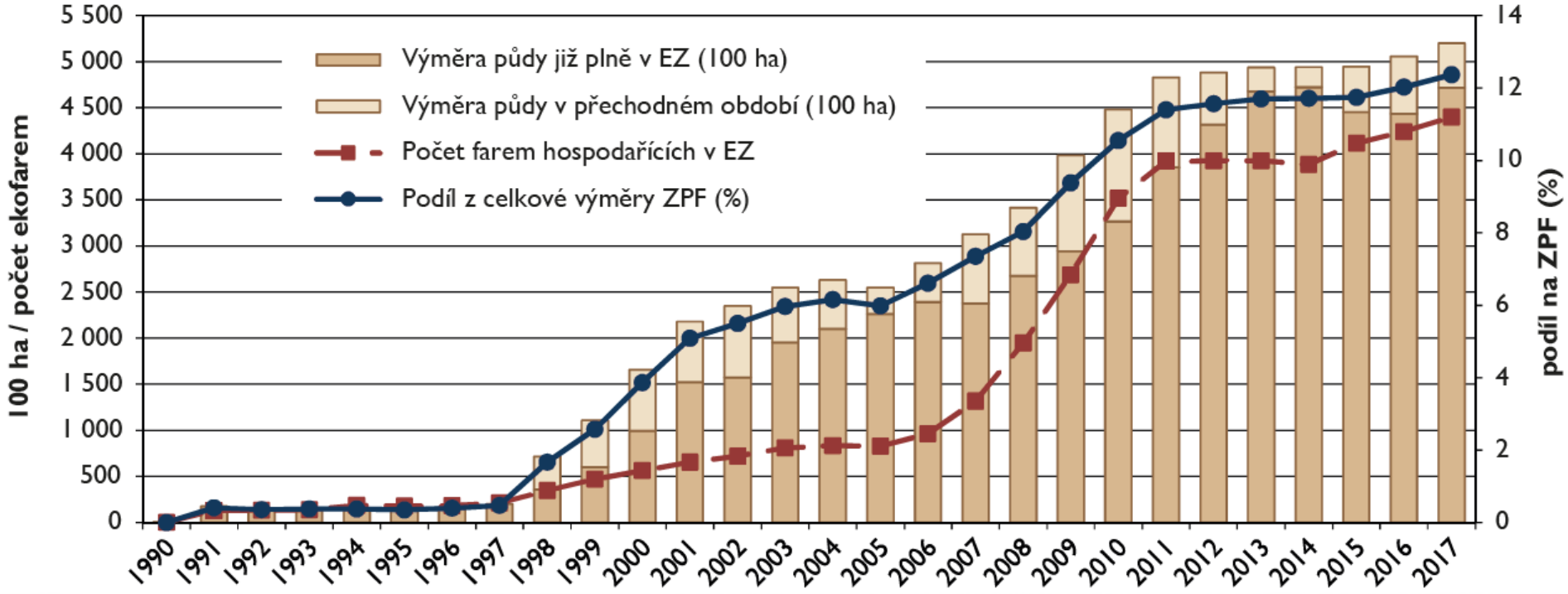
70’ – IFOAM International Federation of Organic Agriculture



Organic farming in Czechia

Graf I Vývoj celkové výměry půdy a počtu farem v EZ a podílu na celkovém ZPF (1990–2017)



Zdroj: MZe a REP (údaje vždy k 31. 12. daného roku); zpracoval ÚZEI.

Rules of Organic Farming

- without the use of agrochemicals, with the exception of some selected, more gentle inorganic substances (eg blue vitriol), and only in special circumstances

- preservation of greenery (limits, chains, alleys)
- measures against erosion, eg postponing plowing after the winter

- exclude the cultivation of GM crops

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- space for lying, rest, stable with straw, range including grazing and natural food

- the prohibition of caging and housing cattle and pigs on steel grates

- ban on the addition of growth promoters, meat-and-bone meal, synthetic substances to feed,

- hormonal synchronization of heat or embryo transfer

Organic farming could feed the world

13:46 12 July 2007 by **Catherine Brahic**

A switch to organic farming would not reduce the world's food supply and could also increase food security in developing countries, say the authors of a new study.

They claim their findings lay to rest the debate over whether organic farming could sustainably feed the world. Organic farming avoids or heavily restricts the use of synthetic pesticides and fertilisers, as well as livestock feed additives.

Numerous studies have compared the yields of organic and conventional methods for individual crops and animal products (see 20-year study backs organic farming).

Now, a team of researchers has compiled research from 293 different comparisons into a single study to assess the overall efficiency of the two agricultural systems.

Available materials

Ivette Perfecto of the University of Michigan in the US and her colleagues found that, in developed countries, organic systems on average produce 92% of the yield produced by conventional agriculture. In developing countries, however, organic systems produce 80% more than conventional farms.

More Latest news

Hippo dung is health food for river animals

18:45 15 April 2015

20-year study backs organic farming

19:00 30 May 2002 by **Fred Pearce**
For similar stories, visit the **Food and Drink** and **Endangered Species** Topic Guides

The world's longest running experiment in comparing organic and conventional farming side-by-side has pronounced chemical-free farming a success.

"We have shown that organic farming is efficient, saves energy, maintains biodiversity and keeps soils healthy for future generations," says Paul Mader of the Research Institute of Organic Agriculture in Frick, Switzerland, which carried out the 21-year study.

Although crop yields on organic plots in the experiment were on average 20 per cent lower than those on conventional plots, the ecological and efficiency gains more than made up for it, Mader says.

Soils nourished with manure were more fertile and produced more crops for a given input of nitrogen or other fertiliser. "The input of nutrients like nitrogen were as much as 50 per cent lower, so overall the organic system was more efficient," he told **New Scientist**.

Not all crops did equally well. Potato yields on organic plots were only 60 per cent of those on conventional plots. But organic winter wheat achieved 90 per cent, and grasses fed on manure did just as well as those fed on fertiliser.

Mader argues that the biggest bonus is the improved quality of the soil under organic cultivation, which should ensure good crops for decades to come.

Earthworms and fungi

Organic soils had up to three times as many earthworms, twice as many insects and 40 per cent more mycorrhizal fungi colonising plant roots. Soils microbes went into overdrive, transforming organic material into new plant biomass faster than microbes in conventional plots.

More predictably perhaps, organic plots contained up to 10 times as many weed species as conventional plots sprayed with herbicides.

"Under European conditions, we can clearly grow our food with much less

More Latest news

Hippo dung is health food for river animals

18:45 15 April 2015
Rivers filled with hippo faeces may sound disgusting, but the excrement provides nutrition for fish and aquatic insects

War and religion: the metaphors hampering climate change debate

15:59 15 April 2015
Climate change is often painted as a battle to be fought or a creed with scant evidence. Such

Think organic food is better for you, animals, and the planet? Think again

BJØRN LOMBORG

12 JUNE 2016 • 5:33PM

The organics hype is just that - hype CREDIT: WAYNE FARRELL/ALAMY

What we eat is seen as more important than ever. And everywhere we are urged to go organic: we are told it is more nutritious, it improves animal welfare and helps the environment. In reality, that is mostly marketing hype.

In 2012 Stanford University's Centre for Health Policy did the biggest

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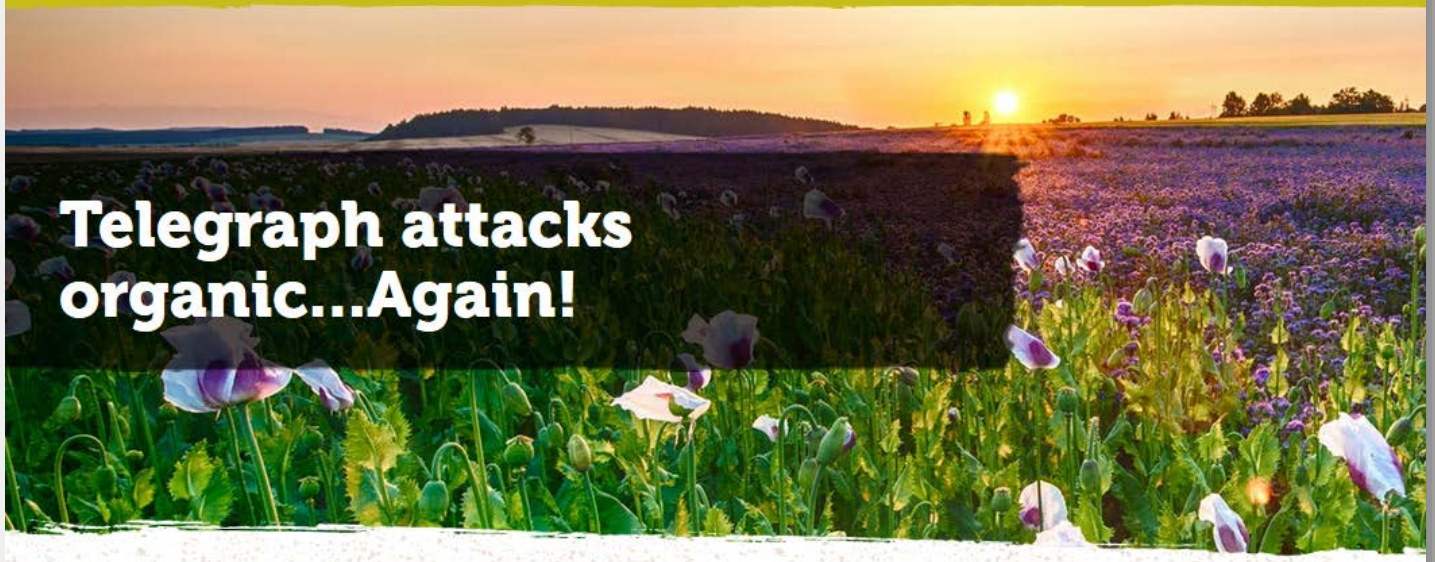


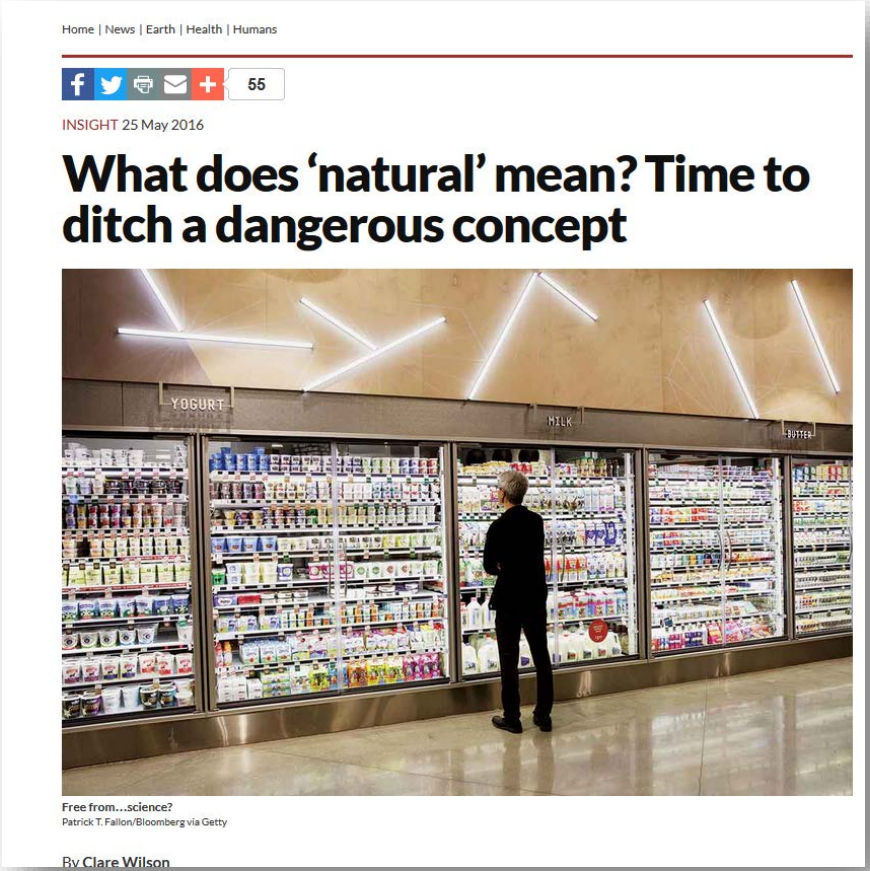
Telegraph attacks organic

13 June 2016

Bjørn Lomborg wrote in the Telegraph over the weekend that what we eat is more important than ever. Great, couldn't agree more – but unfortunately, the agreements stopped there. He then went on to suggest, among other things, that 'going organic would kill more than 13,000 people in the US each year'.

Think organic food is better for you, animals, and the planet? Think again. Is this pure fantasy?

Of course, his wildly inaccurate criticisms of organic food and farming ignore recent and comprehensive research, including three international meta-analyses published in the British Journal



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INSIGHT 25 May 2016

What does 'natural' mean? Time to ditch a dangerous concept

Free from…science?
Patrick T. Fallon/Bloomberg via Getty

By Clare Wilson

The Green movement has done much good in raising awareness of the dangers of global warming, but it often falls into the trap of thinking that Mother Nature is always best.

Its blanket opposition to GM food makes no sense. We have been genetically modifying our crops for millennia; current GM food presents no threat to health and could help solve nutritional deficiencies. It's vital to step back from using antibiotics in farming, but many people would not be alive today if not for modern agriculture.