有機農業は環境に優しいのか

キヤノングローバル戦略研究所　研究主幹　杉山大志

有機農業とは

我が国では、平成18年度に策定された「有機農業推進法※注1」において、有機農業を「化学的に合成された肥料及び農薬を使用しないこと並びに遺伝子組換え技術を利用しないことを基本として、農業生産に由来する環境への負荷をできる限り低減した農業生産の方法を用いて行われる農業をいう。」と定義されています。
注1 有機農業の推進に関する法律（平成18年法律第112号）

「有機農業の推進に関する法律」による有機農業の定義は以下のとおりです。

1. **化学的に合成された肥料及び農薬を使用しない**
2. **遺伝子組換え技術を利用しない**
3. **農業生産に由来する環境への負荷をできる限り低減する**

農業生産の方法を用いて行われる農業です。

【有機農業関連情報】トップ ～有機農業とは～：農林水産省 (maff.go.jp)

持続可能エネルギー

無料会員限定

MIT Technology Review
Published by KADOKAWA / ASCII

Sorry—organic farming is actually worse for climate change

有機農業への移行は「環境にやさしい」のか?

有機農業には「環境にやさしい」というイメージがある。だが、実際には収穫量が減少するため、温室効果ガスを貯蔵している土地の農地転換が必要となり、温室効果ガスの排出量増加につながるとの研究が発表された。

by James Temple　　2019.11.20

https://www.technologyreview.jp/s/169013/sorry-organic-farming-is-actually-worse-for-climate-change/

有機農業でCO2等は減らない？

nature COMMUNICATIONS

ARTICLE

https://doi.org/10.1038/s41467-019-12622-7 OPEN

The greenhouse gas impacts of converting food production in England and Wales to organic methods

Laurence G. Smith[1,2], Guy J.D. Kirk[1*], Philip J. Jones[3] & Adrian G. Williams[1]

Agriculture is a major contributor to global greenhouse gas (GHG) emissions and must feature in efforts to reduce emissions. Organic farming might contribute to this through decreased use of farm inputs and increased soil carbon sequestration, but it might also exacerbate emissions through greater food production elsewhere to make up for lower organic yields. To date there has been no rigorous assessment of this potential at national scales. Here we assess the consequences for net GHG emissions of a 100% shift to organic food production in England and Wales using life-cycle assessment. We predict major shortfalls in production of most agricultural products against a conventional baseline. Direct GHG emissions are reduced with organic farming, but when increased overseas land use to compensate for shortfalls in domestic supply are factored in, net emissions are greater. Enhanced soil carbon sequestration could offset only a small part of the higher overseas emissions.

Table 1 Total GHG emissions from crop and livestock production under conventional and organic production allowing for High, Medium and Low levels of overseas LUC and soil C sequestration as in Fig. 3

	Conventional	Organic		
		High	Medium	Low
Emissions (Mt CO_2e yr^{-1})	49.3 ± 2.1	77.1 ± 4.2	59.8 ± 2.7	46.6 ± 4.1
Fraction as CO_2 (%)	34	59	48	33
Fraction as CH_4 (%)	36	25	32	41
Fraction as N_2O (%)	29	16	21	26
Difference from conventional baseline		$p < 0.05$	NS	NS

*Data are means ± 1 std. dev

https://www.nature.com/articles/s41467-019-12622-7

面積vs収量で結論が変わる

ANNUAL REVIEWS

Annual Review of Resource Economics

Organic Agriculture, Food Security, and the Environment

Eva-Marie Meemken[1] and Matin Qaim[1,2]

[1]Department of Agricultural Economics and Rural Development, University of Goettingen, 37073 Goettingen, Germany; email: mqaim@uni-goettingen.de

[2]Center of Biodiversity and Sustainable Land Use (CBL), University of Goettingen, 37073 Goettingen, Germany

Annu. Rev. Resour. Econ. 2018. 10:39–63

First published as a Review in Advance on March 29, 2018

The *Annual Review of Resource Economics* is online at resource.annualreviews.org

https://doi.org/10.1146/annurev-resource-100517-023252

JEL codes: O13, Q01, Q16, Q56, Q57

Keywords

organic food, nutrition and health effects, environmental effects, climate change, technology adoption, smallholder farmers

Abstract

Organic agriculture is often perceived as more sustainable than conventional farming. We review the literature on this topic from a global perspective. In terms of environmental and climate change effects, organic farming is less polluting than conventional farming when measured per unit of land but not when measured per unit of output. Organic farming, which currently accounts for only 1% of global agricultural land, is lower yielding on average. Due to higher knowledge requirements, observed yield gaps might further increase if a larger number of farmers would switch to organic practices. Widespread upscaling of organic agriculture would cause additional loss of natural habitats and also entail output price increases, making food less affordable for poor consumers in developing countries. Organic farming is not the paradigm for sustainable agriculture and food security, but smart combinations of organic and conventional methods could contribute toward sustainable productivity increases in global agriculture.

Table 2 Mean organic crop yields in comparison to conventional yields (results from global meta-analyses)

Crop	Meta-analyses		
	Seufert et al. (2012)	de Ponti et al. (2012)	Ponisio et al. (2015)
Cereals	−26%	−21%	−22%
Roots and tubers	Not included	−26%	−29%
Oilseeds	−11%	−26%	−12%
Legumes/pulses	−10%	−12%	−15%
Fruits	−3%	−28%	−8%
Vegetables	−33%	−20%	−13%
All crops	−25%	−20%	−19%

Table 3 Environmental effects of organic versus conventional agriculture

Effect category	Per unit of land	Per unit of output
Land use	Not applicable	Land use 20–110% higher[a,b,c] Land use for organic diets 40% higher[d]
Energy use	Energy use 10–70% lower[e]	Energy use 15–21% lower[a,b]
Greenhouse gas (GHG) emissions	Nitrous oxide emissions 14–31% lower[a,c] GHG emissions 39% lower[c]	Nitrous oxide emissions 8% higher[a] GHG emissions 0–10% lower[a,b,c] GHG emissions of organic diet equal to conventional diet[d]
Nutrient leaching/ eutrophication potential	Nitrate leaching 30–31% lower[a,c] Ammonia emissions 18% lower[a] Phosphorus losses 1% lower[a]	Nitrate leaching 5% lower globally[c] and 49% higher in the EU[a] Ammonia emissions 11% higher[a] Eutrophication potential (phosphate equivalents) 36% higher[b] Acidification potential (sulfur dioxide equivalents) 13% higher[b]
Soil quality	Soil organic matter 6–7% higher[a,c,g] Larger and more active soil microbial communities[f]	Not applicable
Biodiversity	Species richness 30–34% higher[h,i] Organism abundance 50% higher[h] Species evenness higher[k]	Biodiversity loss through indirect land-use change not evaluated in available studies

https://www.annualreviews.org/doi/pdf/10.1146/annurev-resource-100517-023252

食肉生産効率：飼料、品種、健康管理の改善

Achieving Peak Pasture

Shrinking Pasture's Footprint by Spreading the Livestock Revolution

JUN 14, 2019 PRINT SHARE

Pastureland is by far the single largest human land use on the planet. Globally, we use twice as much land for producing meat and milk from cattle and other ruminants as we do for growing crops.

For centuries, global pasture area expanded, with severe environmental consequences. Since the 1700s, an area nearly the size of North America has been converted to pasture. Further, pasture expansion has been a major driver of deforestation in the Amazon and degradation of many of the world's natural grasslands, threatening biodiversity and worsening climate change.

Read the report here.

In the past 20 years, however, something remarkable has occurred, something that few predicted: global pasture has begun to decline. According to data from the Food and Agriculture Organization of the United Nations, there are 140 million fewer hectares of pasture today than there were in 2000, an area roughly the size of Peru.

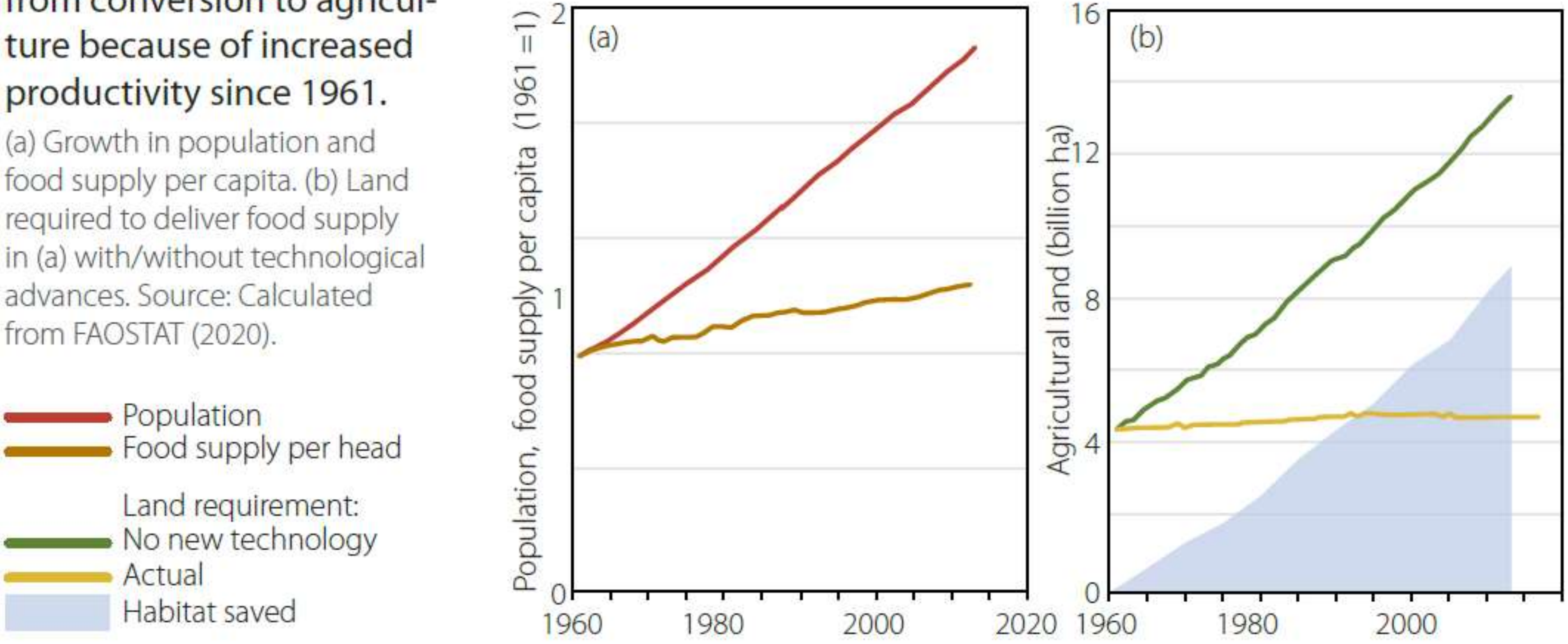
https://thebreakthrough.org/articles/achieving-peak-pasture

There are three primary levers for raising productivity: better feed, optimized breeds, and improved animal health. Ensuring that animals receive an energy-rich and nutritionally balanced diet is essential for improving animal yields, and higher productivity of forage grasses as well as supplemental crop-based feeds means that more feed can be grown on less land. Cattle can also be bred to be higher-yielding and better adapted to regional conditions. Finally, protecting animals' health and welfare makes them more productive.

生産性向上は自然保護の鍵

Figure 23: Habitat saved from conversion to agriculture because of increased productivity since 1961.

(a) Growth in population and food supply per capita. (b) Land required to deliver food supply in (a) with/without technological advances. Source: Calculated from FAOSTAT (2020).



https://www.thegwpf.org/content/uploads/2021/02/Goklany-EmpiricalTrends.pdf

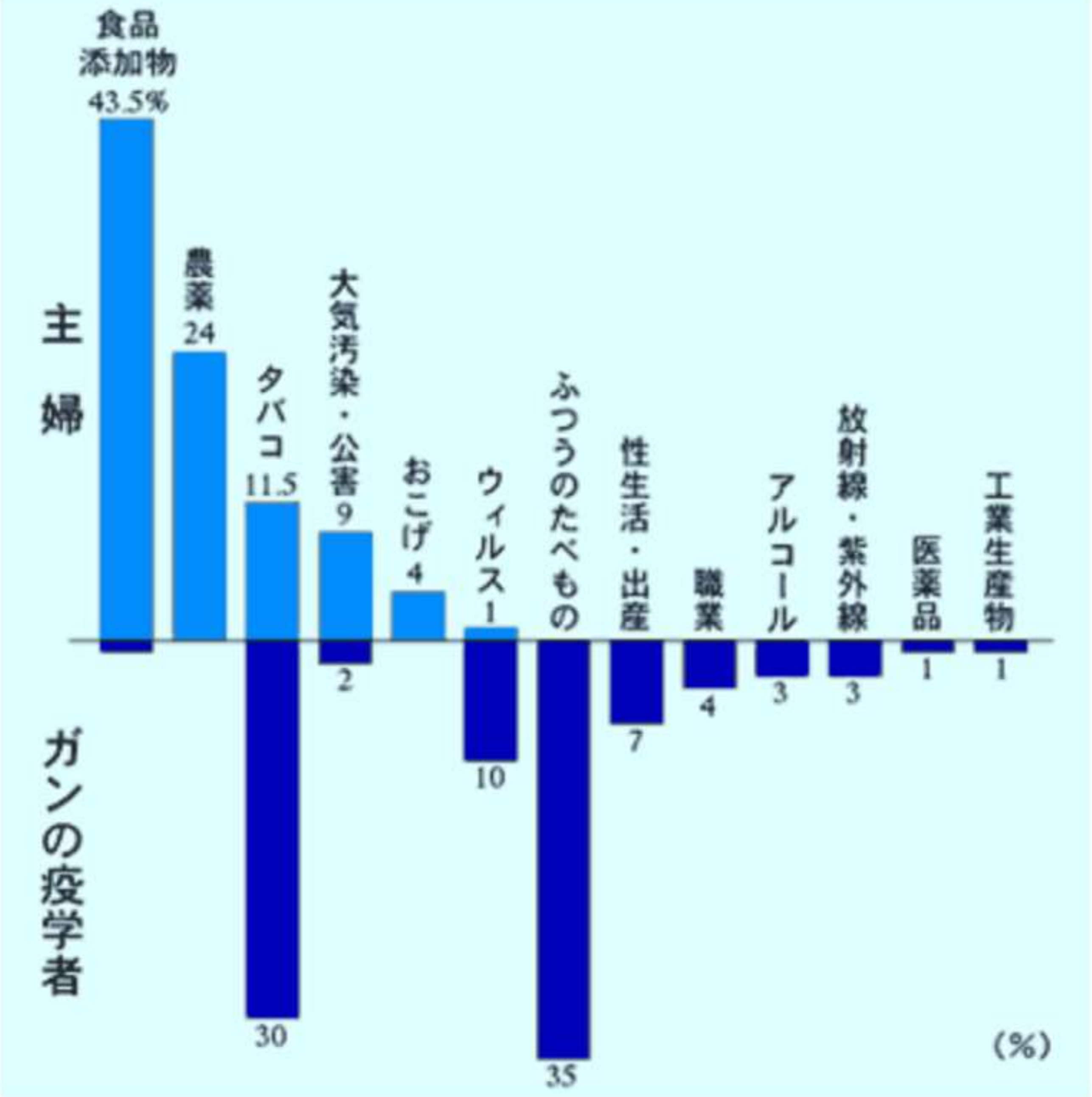
世界の食料生産の半分は窒素肥料に依存

Nitrogen fertilisers: It has been estimated that the Haber- Bosch process is responsible for 48% of global food production; that is, they have increased food production by 92%.

https://www.thegwpf.org/content/uploads/2021/02/Goklany-EmpiricalTrends.pdf

https://www.researchgate.net/publication/248828433_How_a_century_of_ammonia_synthesis_changed_the_world/link/0a85e53077b6926661000000/download

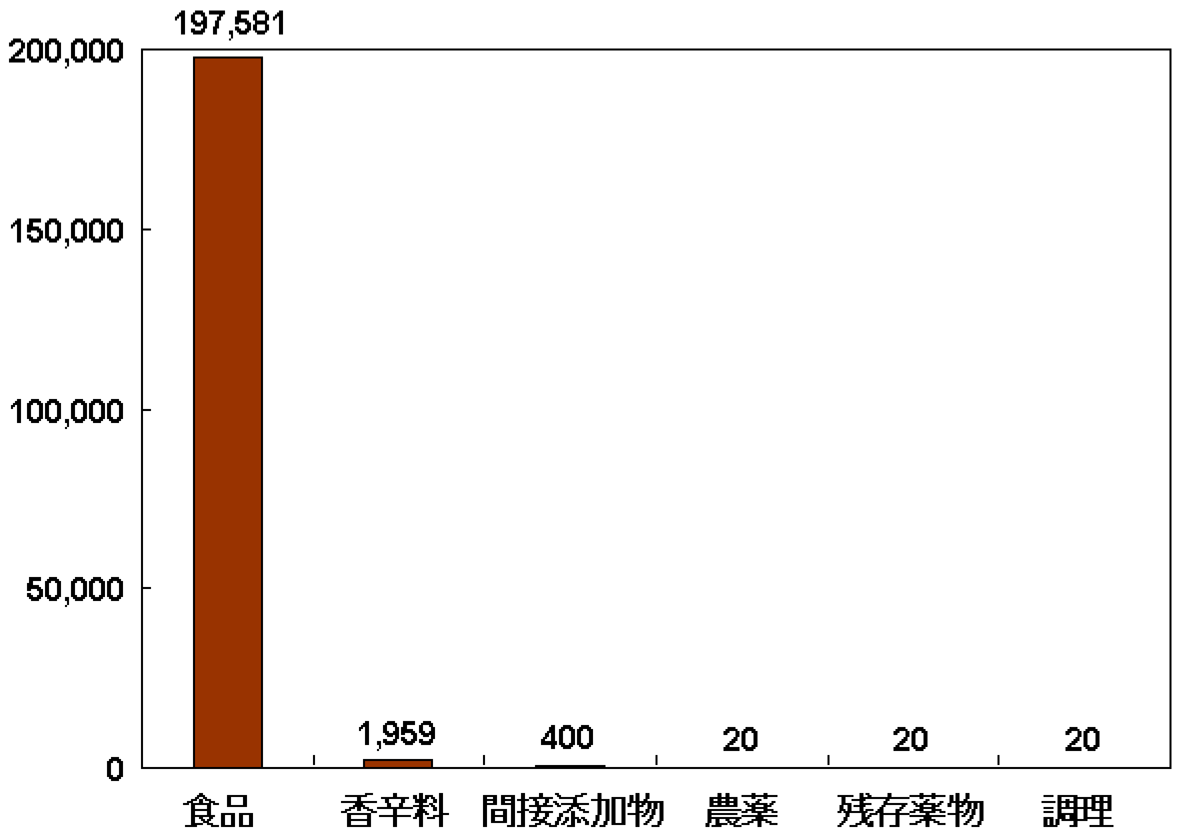
西尾道徳の環境保全型農業レポート (ruralnet.or.jp)



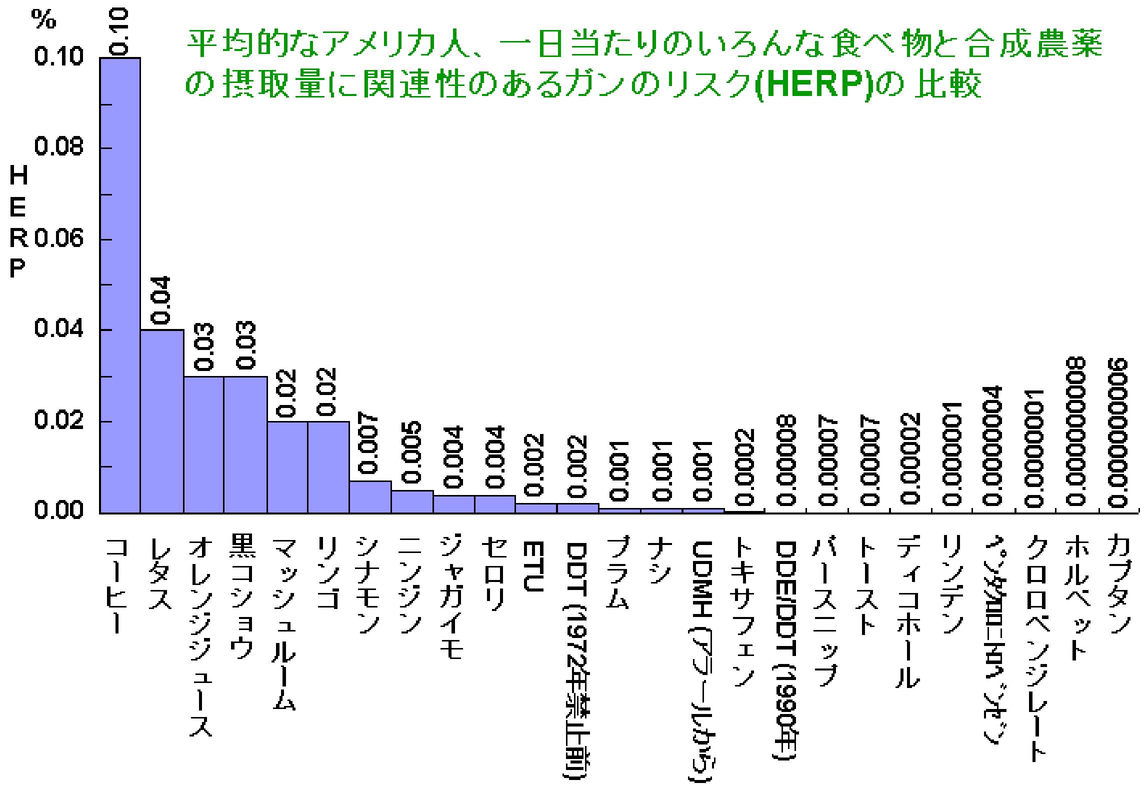
出典：「暮らしの手帖」第25号（3世紀）1990年4・5号
ガンの原因について主婦とガンの疫学者の考え方の違い

- https://www.midori-kyokai.com/yorozu/qa.html#q05

アメリカでの食品からのガン死の件数



ビョルン・ロンボルグ著、山形浩生訳「環境危機をあおってはいけない」（文芸春秋、2003年）



ビョルン・ロンボルグ著、山形浩生訳「環境危機をあおってはいけない」（文芸春秋、2003年）

http://junko-nakanishi.la.coocan.jp/zak266_270.html

慣行農業と慣行エネルギーへのアンチテーゼとしての有機農業と再エネの類似性

	慣行農業	慣行エネルギー
技術要素	肥料、農薬、（遺伝子組み換え）	化石燃料（石油、石炭、天然ガス）、（原子力）
提示されている代替技術	有機農業、（スマート農業）	再生可能エネルギー（太陽光、風力など）
懸念されているリスク	環境汚染（水質など）、健康被害	気候変動、大気汚染
経済便益	食料供給（穀物、野菜、肉・魚）	燃料供給（熱、動力）、原料供給（肥料、農薬、鉄、セメント、プラスチック）
代替技術の懸念リスク	コスト、土地圧力、食料不足	コスト、土地圧力、鉱物投入増、エネルギー不足