Food Resources

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Outline

- **Dimensions of the Food Crisis**
  - **Hunger, poverty, production, distribution**
- **Threats to Food Security: Present and Future**
- **Solutions to the Food Crisis**
  - **Theoretical (Present) Solution**
    - **Food Distribution**
  - **Real Solutions**
    - **Industrial Agriculture?**
    - **Alternative Agriculture**
    - **Vegetarianism**
    - **What Can You Do?**

Ayalech can no longer afford maize after a 600% rise in food prices in Ethiopia. She cooks wild cabbage for her hungry and malnourished children. http://www.theguardian.com/society/gallery/2009/mar/31/g20-food-prices-africa

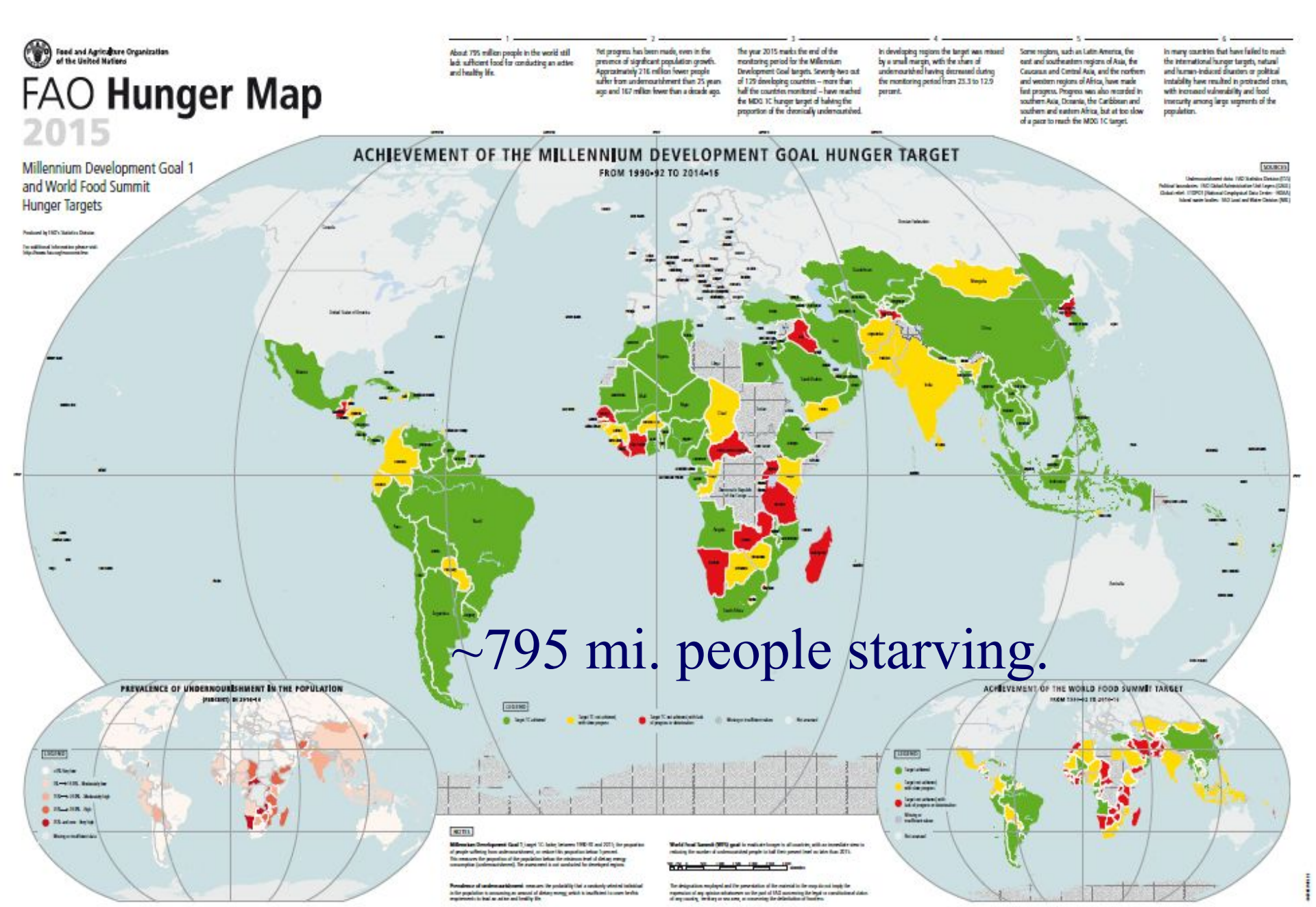
Forced to eat dirt!

Brittle, gritty and revolting, ***"mud cakes"*** *have been consumed by impoverished* ***pregnant women*** *seeking calcium, for years. But now the cakes have become a staple for* ***entire families*** *in Haiti.*

--The Hindu, Wed, Jul 30, 2008

Food and Health in India

- India ranked 15th in the 2011 Global Hunger Index (GHI) Report.[ref]
  - GHI went up from 22.9 to 23.7 between 1996 -2011.
- 60% of India's children below the age of three were malnourished (2005 report [ref])
  - 1 in 3 malnourished children in the world lives in India.
- 1.72 mi. children (<1 yr.) die each year before turning one.[18]
- Rampant diseases such as dengue, hepatitis, tuberculosis, malaria and pneumonia.[ref]



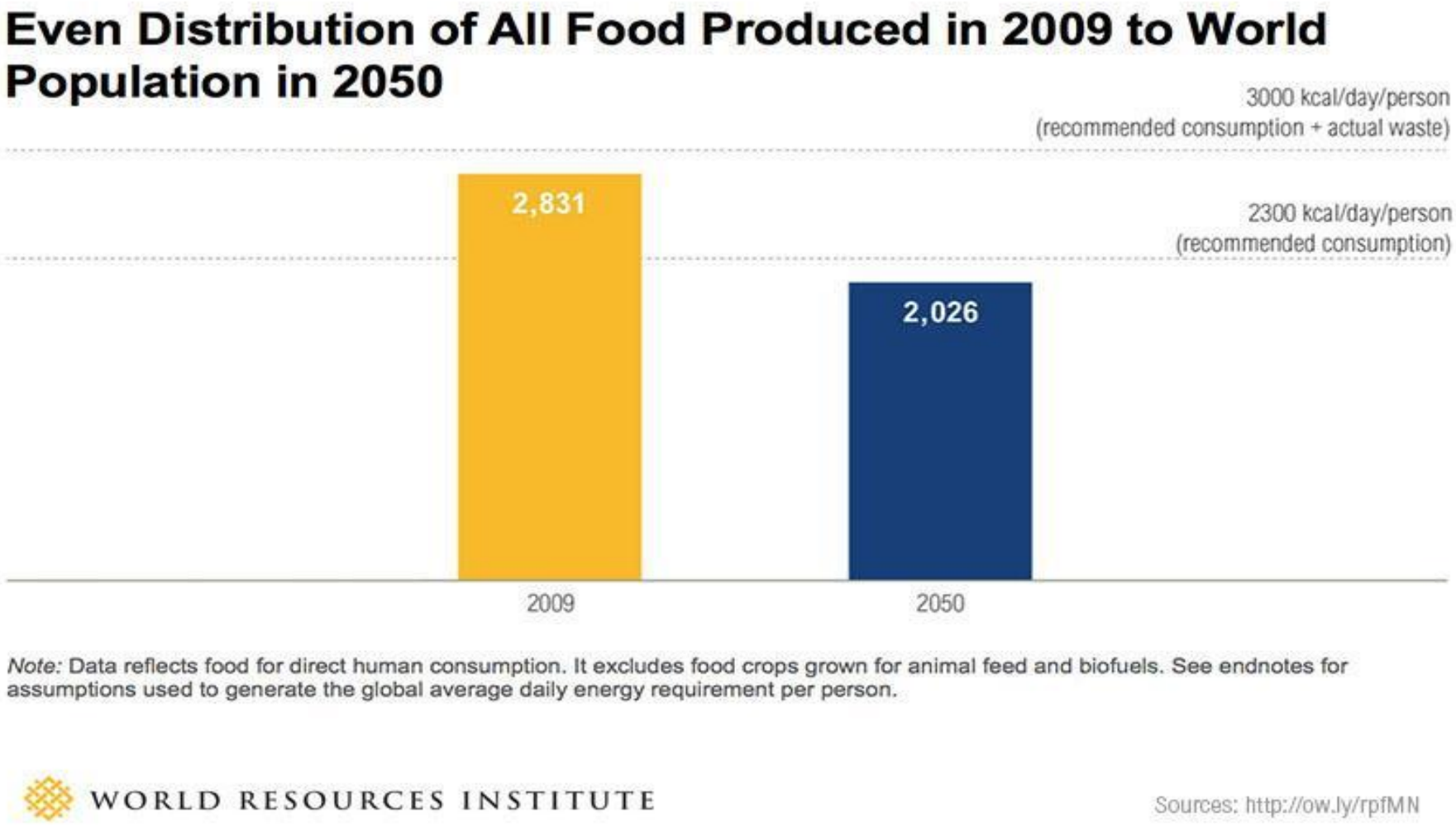
http://www.fao.org/3/a-i4674e.pdf

World Food Production

- Actually the world is producing enough food to feed everyone for now.
- Per capita food availability has risen:
  - From ~2220 kcal/person/day in the early 1960s
  - To 2790 kcal/person/day in 2006-08.
- Yet many people in the world still do not have sufficient income to purchase (or land to grow) enough food.
- Besides, population is projected to grow from 7bi. to 9.6 bi. (2012-2050).
- >50% will occur in sub-Saharan Africa, where 25% population is currently undernourished.

http://www.worldhunger.org/articles/Learn/world%20hunger%20facts%202002.htm

Per Capita Food Availability



http://www.wri.org/blog/2013/12/global-food-challenge-explained-18-graphics

Inequality in Society

- Nearly 1/2 of the world's population (> 3 bi.) live on <$2.50/day.
- More than 1.3 bi. <$1.25 a day.
- 80% of the world population lives on less than $10 a day.
- 1 bi. children worldwide are living in poverty.
- 22,000 children die each day due to poverty (UNICEF)
- 805 mi. worldwide do not have enough food to eat.
- The world's 358 billionaires have assets exceeding the combined annual incomes of countries having 45 percent of the world's people.

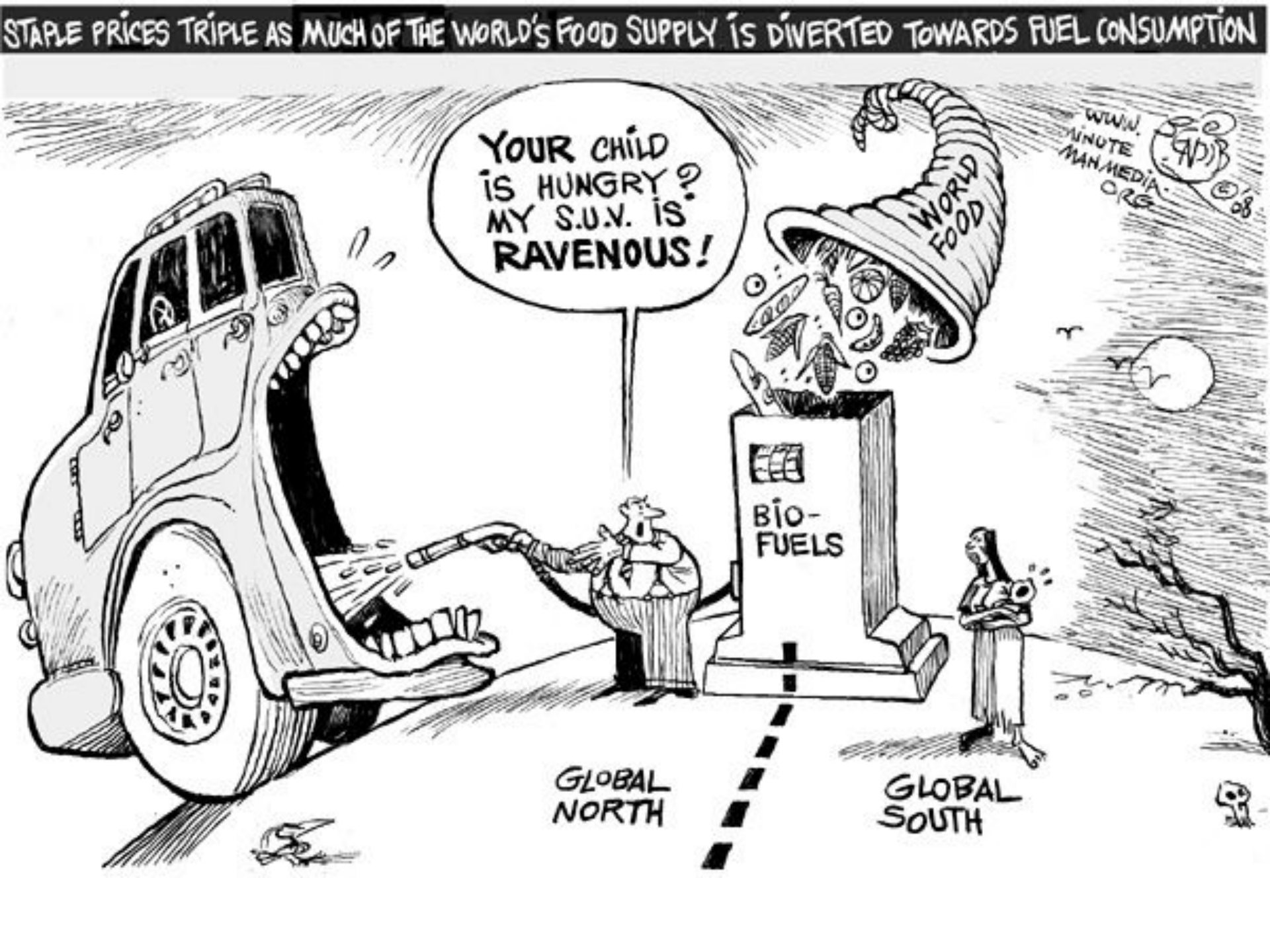
http://worldcentric.org/conscious-living/social-and-economic-injustice

Spare Arms and Feed the Hungry

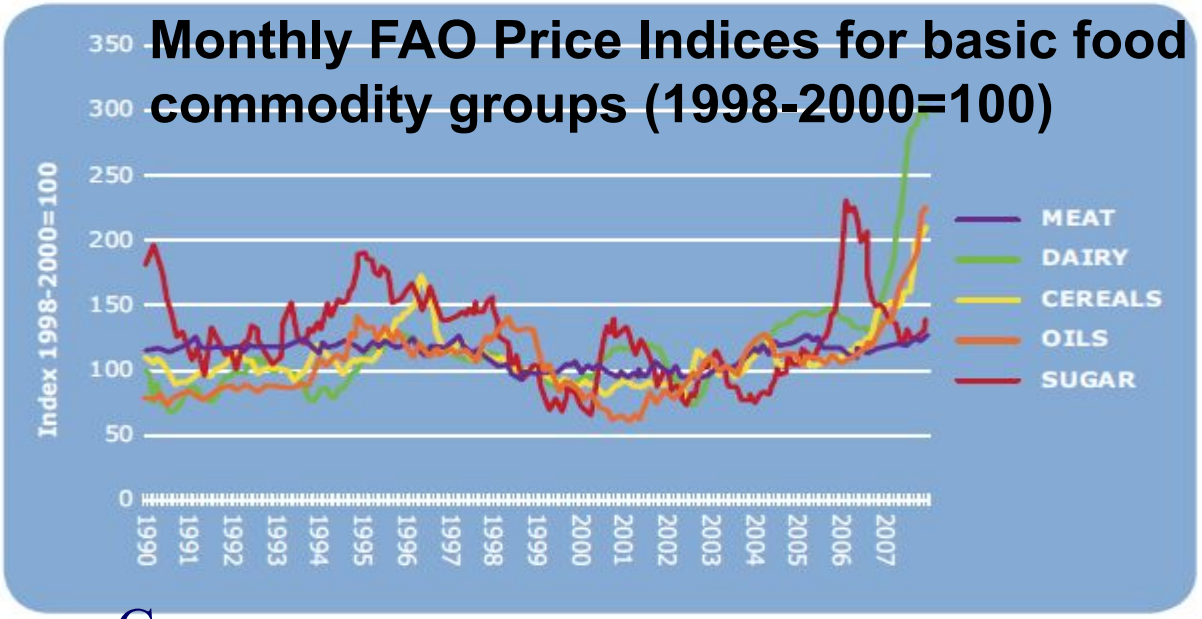
Is solving the hunger problem impossible?

….Perhaps not!

- For the price of one missile, a school full of hungry children could eat lunch every day for 5 years
- 100 mi. child hunger deaths (over 1 decade: 1990-2000) could be prevented for:
  - the price of 10 stealth bombers, or
  - World military expenditure in 2 days!


STAPLE PRICES TRIPLE AS MUCH OF THE WORLD'S FOOD SUPPLY IS DIVERTED TOWARDS FUEL CONSUMPTION
YOUR CHILD IS HUNGRY? MY S.U.V. IS RAVENOUS!
WORLD FOOD
BIO-FUELS
GLOBAL NORTH
GLOBAL SOUTH
WWW.MINUTEMANMEDIA.ORG
©'08

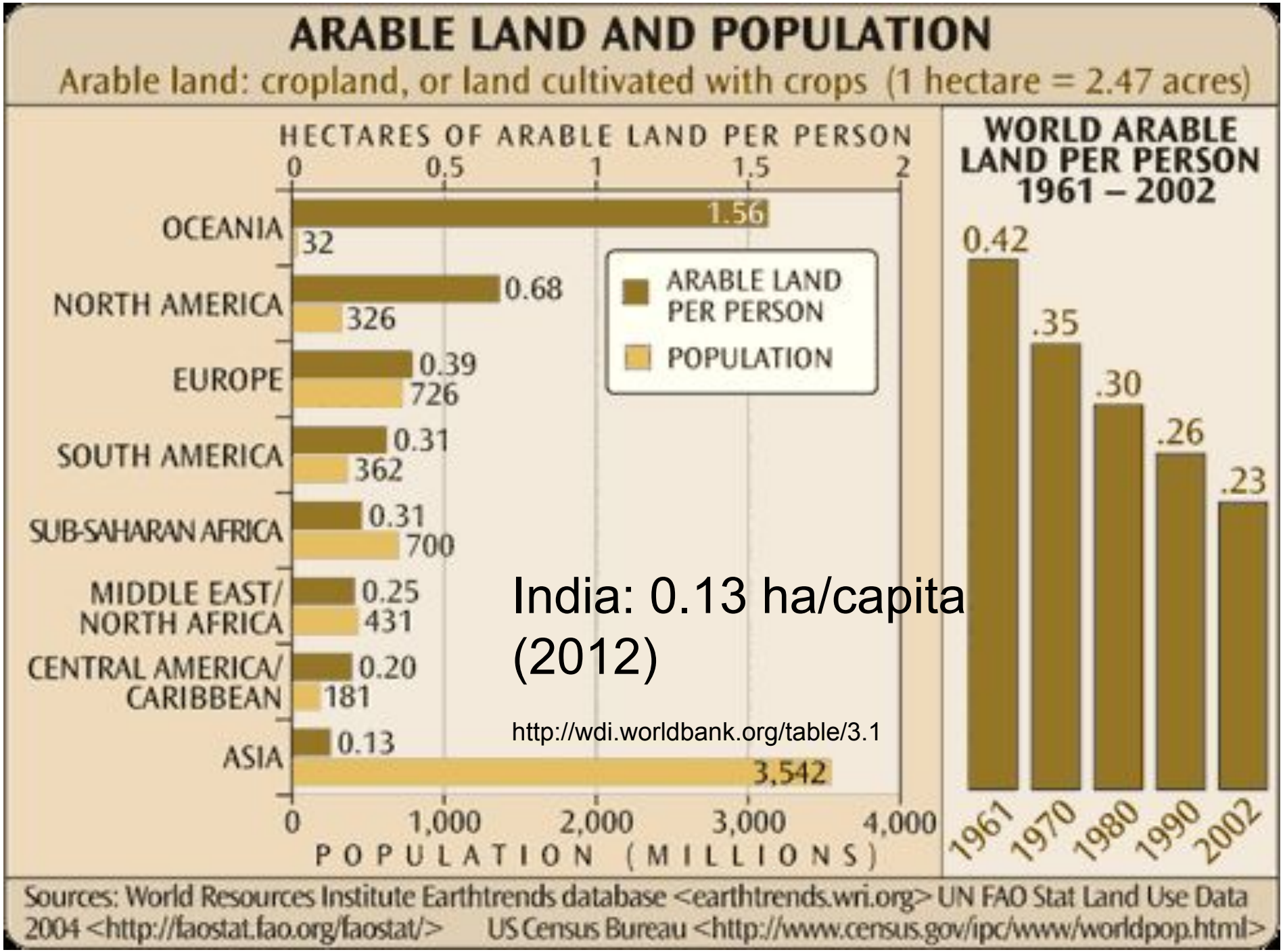
Rising and Fluctuating Food Prices



The poor consumers and the poor farmers are the worst affected.

- Causes:
  - Losses in yields due to adverse weather conditions
  - Fluctuations in energy costs
  - Increased demand due to rising population.
  - Increased preference for meat and dairy products.
  - Diversion of food crops and land for biofuel production
  - Financial speculation and price fixing.[ref]
  - Policy factors.

http://www.fao.org/docrep/012/i1059e/i1059e00.pdf, http://www.helsinki.fi/taloustiede/Abs/DP35.pdf


ARABLE LAND AND POPULATION
Arable land: cropland, or land cultivated with crops (1 hectare = 2.47 acres)
HECTARES OF ARABLE LAND PER PERSON
0
0.5
1
1.5
2
OCEANIA
1.56
32
NORTH AMERICA
0.68
326
EUROPE
0.39
726
SOUTH AMERICA
0.31
362
SUB-SAHARAN AFRICA
0.31
700
MIDDLE EAST/ NORTH AFRICA
0.25
431
CENTRAL AMERICA/ CARIBBEAN
0.20
181
ASIA
0.13
3,542
ARABLE LAND PER PERSON
POPULATION
0
1,000
2,000
3,000
4,000
POPULATION (MILLIONS)
WORLD ARABLE LAND PER PERSON 1961 – 2002
0.42
.35
.30
.26
.23
1961
1970
1980
1990
2002
India: 0.13 ha/capita (2012)
http://wdi.worldbank.org/table/3.1
Sources: World Resources Institute Earthtrends database <earthtrends.wri.org> UN FAO Stat Land Use Data 2004 <http://faostat.fao.org/faostat/> US Census Bureau <http://www.census.gov/ipc/www/worldpop.html>

Agricultural Yields in India

- Roughly 60% of India's land is under agriculture.
- Indian agricultural yields are generally low due to:
  - Soil and land degradation.
  - Low percentage of irrigated land (only 35% of arable land).
  - Low agricultural technology and know-how.

http://wdi.worldbank.org/table/3.2
http://en.wikipedia.org/wiki/Agriculture_in_India

Food Wastage and Spoilage

- 1/3rd of world's food is wasted [ref]; while 0.8 bi. people go hungry.
- Millions of tons of foodgrains rot in warehouses
- Cold-storage facilities are available for only 10% of India's perishable food [ref]. 370 mi. tons of perishables at risk.
- Large quantities of prepared food is wasted world over.

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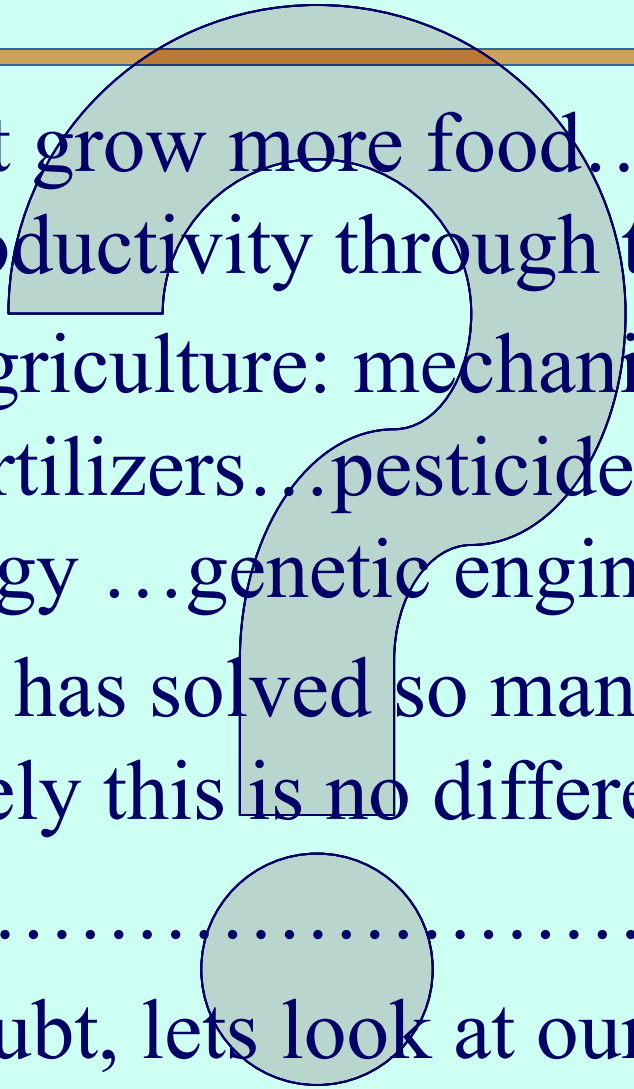
    - Alternative Agriculture
    - Vegetarianism
    - What Can You Do?

Threats to Future Food Security

- Rising population
- Unequal distribution
- Diversion of foodgrains as livestock feed and biofuels.
- Reduced productivity of important agricultural regions world-wide due to desertification, droughts, land degradation, pollution…effects of industrial agriculture, deforestation, industrialization and urbanization.
- Global climate change: droughts, famines, floods and severe weather episodes, shifting temperature, rainfall and humidity patterns
- Food Wastage and Spoilage
- Genetic pollution due to GMOs
- Loss of crop and wild biodiversity

Solutions???



- So, we must grow more food…drastically improve productivity through technology—
- Industrial agriculture: mechanization, chemical fertilizers…pesticides… biotechnology …genetic engineering…
- Technology has solved so many problems for us…surely this is no different!…
- Right????? ……OR NOT??
- When in doubt, lets look at our leaders

What are our leaders doing?

- G8 Summit on Global Food Crisis and Poverty Alleviation in 2008.
- Leading industrialized nations on the island of
- Hokkaido, Japan

Summit that's hard to swallow

World leaders enjoy an 18-course banquet as they discuss how to solve

Global Food Crisis

http://www.dailymail.co.uk/news/article-1032909/Summit-thats-hard-swallow--world-leaders-enjoy-18-course-banquet-discuss-solve-global-food-crisis.html

Just what the starving millions need!

Lunch & Dinner Menu

Working Lunch

White asparagus and truffle soup
Chaud-froid of Kegani crab
Almond oil foam and tapenade
Supreme of chicken, with stuffed thigh, nuts and orange savoury and beetroot foam
Cheese selection
Peach compote, ice-cream and raspberry coulis
Coffee and petits fours

Wines

Chateau Grillet 2005
Chambolle-Musigny 2005

Dinner

Corn and caviar
Smoked salmon and sea urchin
Hot onion tart
Winter lily bulb and summer savoury
Kelp-flavoured beef and asparagus
Diced tuna, avocado and soy sauce jelly, and herbs
Boiled clam, tomato, shiso in jellied clam soup
Water shield and pink conger with soy sauce vinegar
Boiled prawn with tosazu vinegar jelly
Grilled eel and burdock
Fried goby fish with soy sauce and sugar
Hairy crab bisque soup
Grilled bighand thornyhead fish with pepper sauce
Milk-fed lamb flavoured with herbs and mustard, and roast lamb with cepes and black truffle
Cheese, lavender honey and caramelised nuts
G8 'Fantasy' dessert
Coffee and candied fruits and vegetables

Wines

Le Reve Grand Cru Brut/La Seule Gloire Champagne
Sake/Isojiman Shuzo Shizuoka
Corton Charlemagne 2005/Louis Latour Bourgogne
Ridge California Monte Bello 1997,
Tokaji Esszencia 1999

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Theoretical Solution

- Since presently the world already produces enough food, the hunger problem can be solved theoretically, to a large extent by better and more equitable distribution.
- …easier said than done!

Food Distribution: Haves and Have-nots

- Excess food production in developed countries (low population densities); insufficient food production in developing countries (high population densities).
- High food prices: unaffordable to the poor countries and the poor people in a country.
- Developed countries must enable purchase of food by poor countries at subsidized prices, while offering the producers a fair price for their crop.
- The govts. and state depts of poor countries should effectively distribute food to the poor masses at subsidized rates.

Food Distribution and World Debt

- The poorest 52 countries (37 in Africa) $376 bi. debt.
- This forces the countries to use their land for growing cash crops for export.
- This, prevents solving the hunger problem.
- Cancelling world debt would will allow them to recover their economy, agriculture, and technology to solve their food crisis.
- Will the present world economic order allow this to happen?

Food Distribution: Wars

- War, (esp. civil war) is one of the major causes for persistent hunger in a country…often triggered by resource control issues between govts. and dissenting groups.
- Destroys or disrupts agriculture, economy, food distribution systems, transportation etc. for extended periods.
- Often prevents aid (food and medical aid) entering or reaching those areas of need.

Food Distribution: Wars

- Wars divert a nation's resources to funding the war process.
- There is little money to fund equipment, technology to increase food supplies, or to afford imports of food from abroad.
- Peace negotiations in hunger stricken areas help to allow aid in and the country to focus its time and resources onto solving their hunger problems.

- More tangible improvements in food distribution…..

Food Distribution: Market Facilities and Management

- Public market facilities are inadequate or in a derelict condition affecting the local economy, small traders, and consumers.
- Many food traders occupy roads around markets.
- Traders are taxed by the govt. without providing market facilities.
- Rat and pest-infested warehouses…unhygenic and
- Insufficient, ill-designed, ill-maintained and high-priced cold storage.
- This leads to high spoilage of food and hygiene and safety problems.

Food Distribution: Market Facilities and Management

- Poor transportation facilities and road infrastructure, delays at octroi and other check posts, limited refrigerated transportation facilities
- Regulation and Taxation: Fruit and vegetables sometimes have to transported through a series of wholesale markets, compulsory middlemen, and a series of market and municipal taxes, leading to high prices.
- Corruption in the subsidized distribution system leads to diversion of the subsidized food to the open market at a high prices.

Food Distribution: Food Miles

- “Food miles” - the total distance in miles the food item is transported from field to plate
- A convenient indicator of sustainability
- Has led to a general movement towards local production and local consumption in order to minimize food miles.
- It raises fundamental questions about the sustainability of the globalised food trade and the increasing concentration of the food supply chain and distribution in the hands of fewer and fewer transnational corporations.

Food Distribution: Food Miles

- Sourcing food locally and preferring seasonal foods. (Avoid foods with high food miles and out-of-season foods)
- Local, regional and national food self-sufficiency should be encouraged.
- Internalising the social costs of transport to reflect the costs to society of pollution, congestion, accidents, noise and so on, in the prices paid by transport users.
- Preventing irrational food trade: identical produce is simultaneously imported and exported between developed countries in Europe and America.
- In the name of ‘free trade’, poor and populous countries cultivate cash crops for export to advanced countries, and import their own food supplies.

Food Distribution: Food Miles

- This benefits supermarkets, corporations, traders, middlemen, etc.
- But an even impoverish the farmer by forcing him into the debt trap of industrial agriculture and undermining their own food security.
- It leads to the lengthening of the supply chain, high spoilage rates, high prices for the consumers, high GHG emissions during transportation, refrigeration etc.
- Need to improve the wider sustainability of the food supply chain e.g. ethical trading, improved energy efficiency in the local food sector.
- Reducing transport impacts e.g. cleaner vehicles, improved logistics, rail freight, etc.

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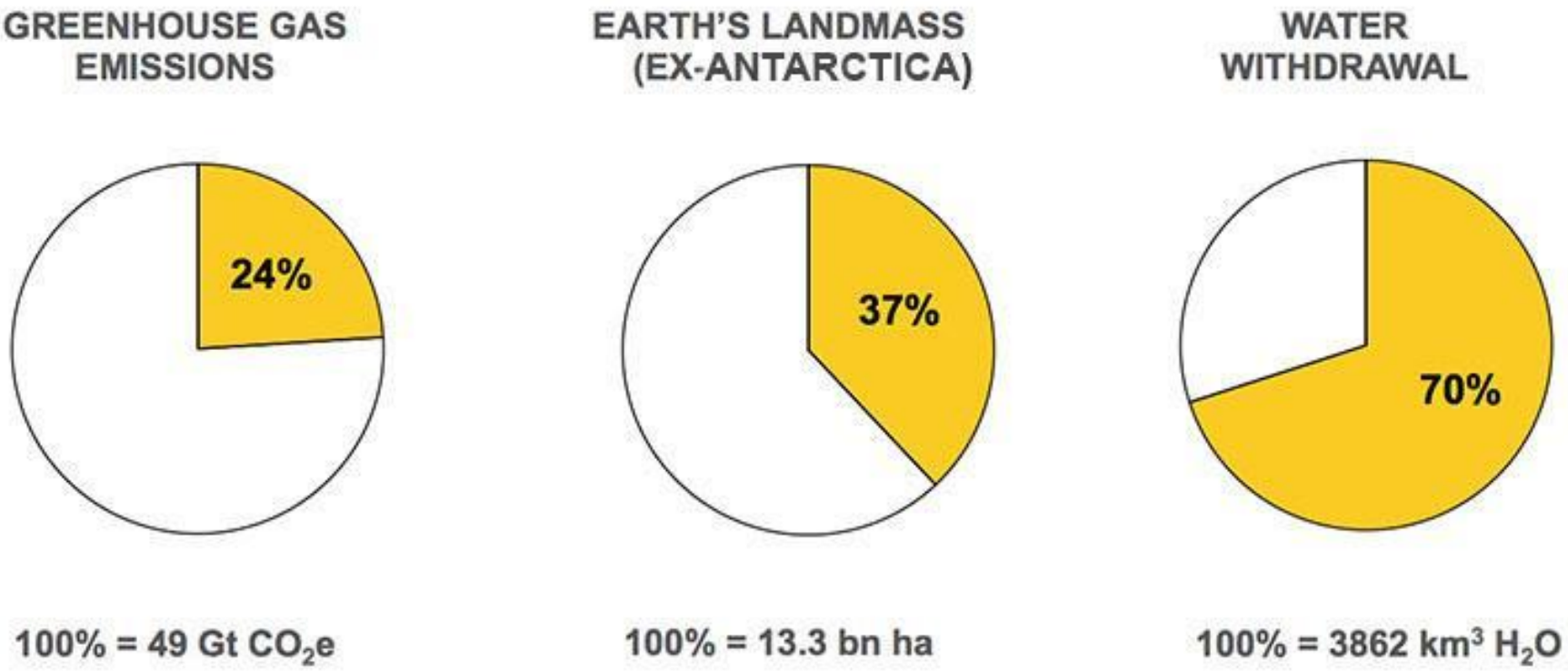
Real Solutions to the Food Crisis

- A more fundamental, practical and sustainable solution to the food crisis is complex.
- There are no simple solutions
- It requires a deep understanding of conventional (industrial) agriculture, its economics, socio-economic issues and sustainability
- It also requires a deeper understanding of natural processes, ecology, biodiversity, evolution etc.

- Can industrial agriculture solve the food crisis?

Agriculture's Share of Global Environmental Impact (2010)



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Sources: http://ow.ly/rpfMN

http://www.wri.org/blog/2013/12/global-food-challenge-explained-18-graphics

Conventional Farming

Activity	Environmental Impact
Land clearing	Loss of biodiversity and habitats, topsoil loss, reduced water recharge, CO_2 emissions.
Heavy Equipment	Soil compaction, waterlogging, high cost, oil dependence
Ploughing	Loss of soil structure, porosity, moisture, moisture carrying capacity, biomass/humus, biota; CO_2 emissions
Fertilizers	Fast plant growth & micronutrient deficiency, loss of soil fertility, and biota, eutrophication, nitrates pollution.
Pesticides, Herbicides	Toxicity to man & environment, POC, increased resistance in pests and weeds, ozone depletion (MeBr)
Irrigation	Waterlogging, salination, evaporative losses, CH_4 emissions

Corporate Monopolization of Agriculture

- By end of 2001 worldwide:
  - Top 10 agrochemical corporations…84% of the $30 bi. market
  - Top 10 veterinary pharmaceutical companies…60% of the $13.6 bi. world market.
  - 10 pharmaceutical companies…48% of the $317 bi. world market.
- Only 6 corporations controlled 98% of the world's market in GM crops.
- The same 6 firms also controlled 70% of the world's pesticide market.
- 94% of all GM crops grown worldwide were from 1 company's germplasm: Monsanto's.

http://www.greens.org/s-r/33/33-03.html

"…The agricultural sciences have over time become increasingly subordinated to capital and…this ongoing process has shaped both the content of research and, necessarily, the character of the products."

–Jack Kloppenberg rural sociologist in *First the Seed.*

"What is profitable affects, or even determines, what is 'scientifically true.'

–Hugo de Vries (biologist)

Impacts of Pesticide Use

- High preconsumer human health costs to conventional agriculture, particularly in the use of pesticides.
- It is estimated that 25 mi. agricultural workers in developing countries are poisoned each year by pesticides.
- Watch video:

  100% Cotton (35min)

Conway, G. and Pretty, J. N., *Unwelcome Harvest: Agriculture and Pollution, Earthscan Publications, London, 1991, p. 645.*
Jeyaratnam, J., Acute pesticide poisoning: A major problem. *World Health Stat. Q., 1990,* ***43, 139–144.***

Are We Violating the Constitution?

- Pesticide use violates the right to life enshrined in Article 21 in our Constitution
- Article 47 of the Constitution:

The State shall regard the raising of the level of nutrition and the standard of living of its people and the improvement of public health as among its primary duties and in particular, the state shall endeavor to bring about prohibition of the consumption except for medicinal purposes of intoxicating drinks and of drugs, which are injurious to health.

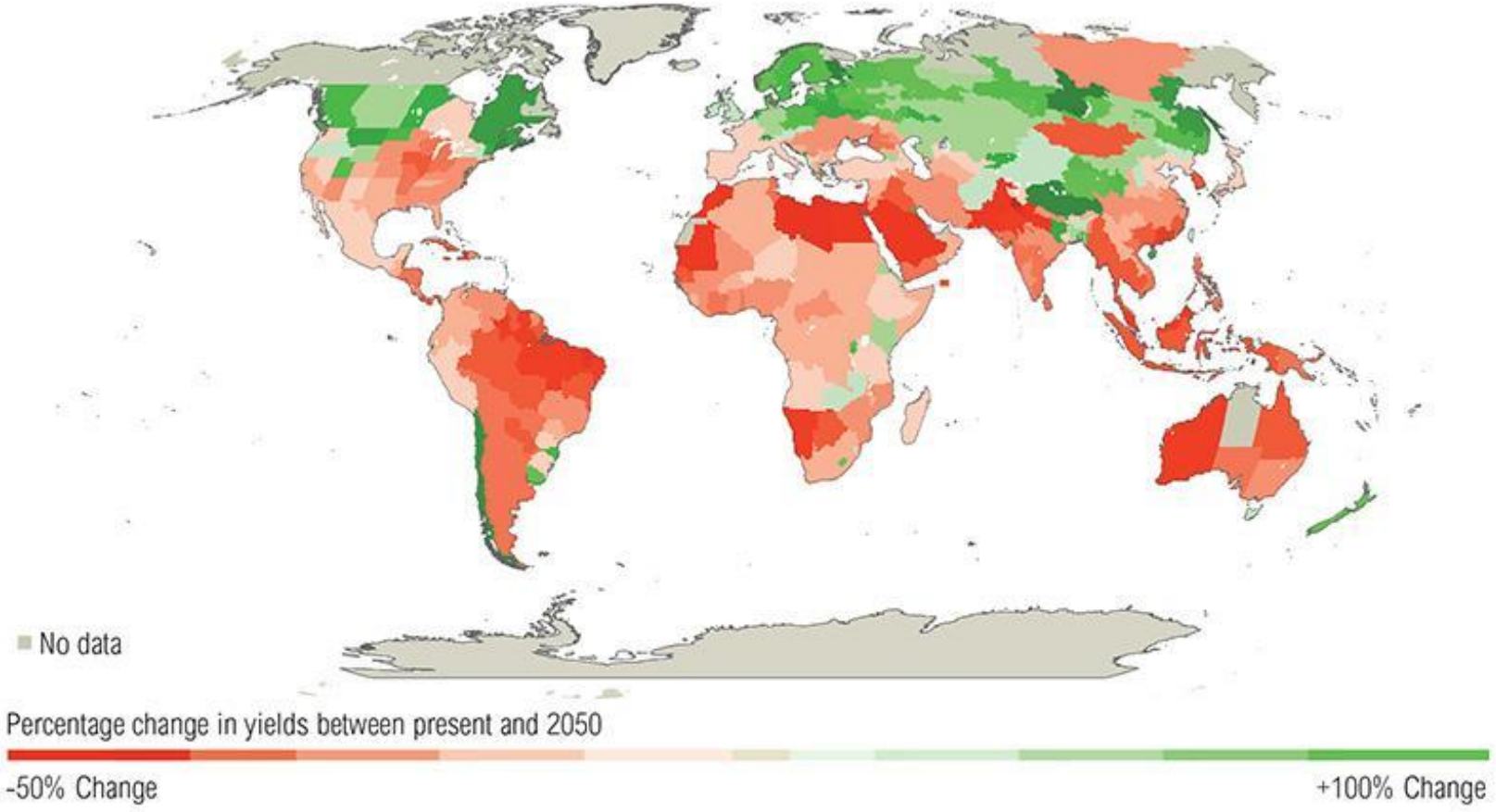
—Ravi Agarwal, Director, Srishti

More Impacts

- Devastation of natural ecosystems
- Desertification and loss of topsoil soil
- Unfair practices of fertilizer and pesticide companies causing social injustice and suicides
- Benefits large corporations and middle men
- Impoverishes the poor farmer and makes the consumer unhealthy

Climate Change To Reduce Yields

Most studies now project adverse impacts on crop yields due to climate change (3°C warmer world)



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Sources: http://ow.ly/rpfMN

Impacts on Land

In the past 20 yrs.:

- Tropical forests lost to agriculture: 15 mi. ha/yr
  - tremendous loss of genetic diversity.
- Soil erosion and other forms of land degradation: 5-7 mi. ha of farming land/yr.
- Waterlogging and salination: 1.5 mi. ha/yr.
- Other damaged land: 30 mi. ha

http://www.i-sis.org.uk/FAOPromotesOrganicAgriculture.php

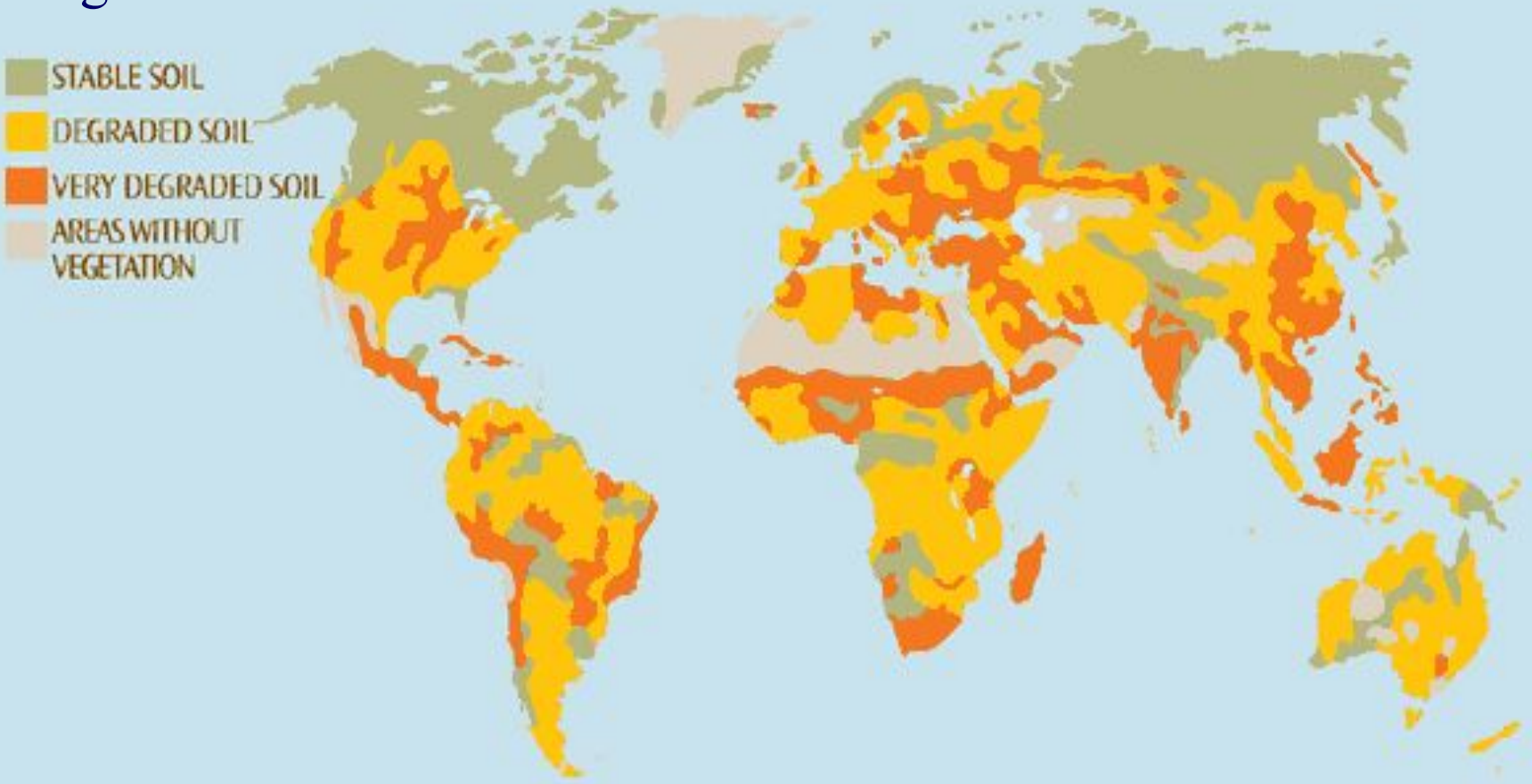
Impacts on Land: Irreversible Land Degradation

- South Asia: ~ 50% land degraded and useless for food production.
- China: 27% irreversible loss of land for agriculture, loss rate (2,500 sq. km /year).
- Madagascar: 30% of the arable land irreversibly barren.

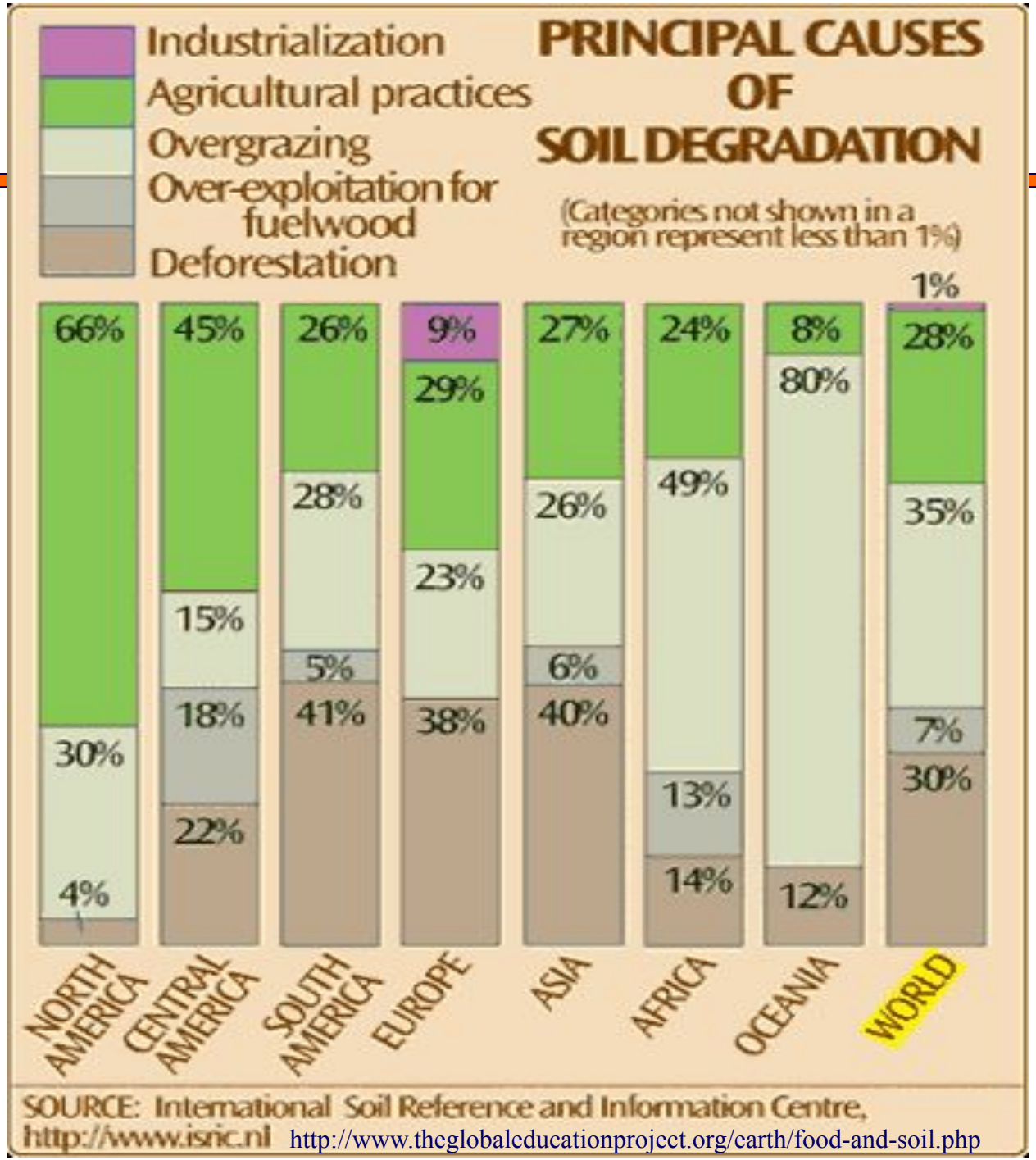
- ^ [a] [b] [c] Ron Nielsen, *The Little Green Handbook*, Picador, New York (2006) ISBN 0-312-42581-3
- ^ UNEP, *Global Environmental Outlook 2000*, Earthscan Publications, London, UK (1999) which may also be viewed at http://www.unep.org/geo2000/ov-e/index.htm, including an optional PDF download

World Soil Degradation

About 2 bi. ha of soil, (~15% of Earth's land area), an area larger than the United States and Mexico combined, have been degraded through human activities.



http://www.theglobaleducationproject.org/earth/food-and-soil.php



http://www.theglobaleducationproject.org/earth/food-and-soil.php

Watch Video: Soil: Who Needs It? (14)

Soil Carbon Sink

- Soils contain ~1,395 gigatons of C; Vegetation ~650 gigatons, atmosphere ~750 gigatons…(*United Nations Food & Agriculture Organisation*)
- "Soil organic carbon is the largest [terrestrial C] reservoir in interaction with the atmosphere."
- It includes plant litter, burnt char, other biomass and humus (organic carbon polymers, lignin, aliphatic compounds, waxes and terpenoids)
- More organic matter tends to accumulate in the litter and soils of colder regions boreal forests and Taiga.

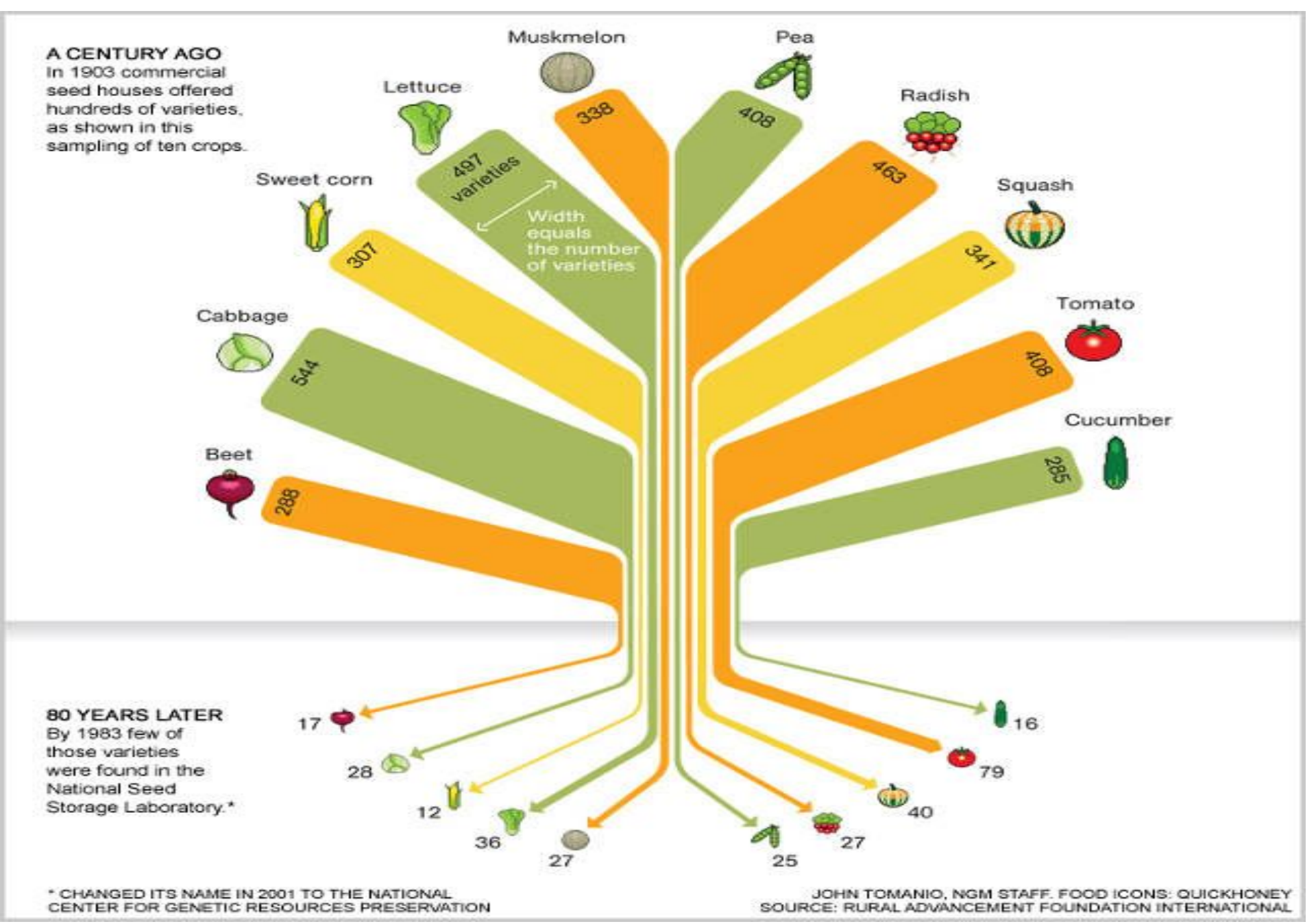
- http://www.nature.com/nature/journal/v298/n5870/abs/298156a0.html
- ^ Swift, Roger S. (November 2001). "Sequestration of Carbon by soil". *Soil Science* **166** (11): 858–71. doi:10.1097/00010694-200111000-00010. http://www.soilsci.com/pt/re/soilsci/abstract.00010694-200111000-00010.htm.
- ^ Batjes, Niels H. (1996). "Total carbon and nitrogen in the soils of the world". *European Journal of Soil Science* **47**: 151–63. doi:10.1111/j.1365-2389.1996.tb01386.x.
- ^ Klaus Lorenza, Rattan Lala, Caroline M. Prestonb, Klaas G.J. Nieropc (15 November 2007). "Strengthening the soil organic carbon pool by increasing contributions from recalcitrant aliphatic bio(macro)molecules". *Geoderma* **142** (1-2): 1–10. doi:10.1016/j.geoderma.2007.07.013.

Loss of Soil Carbon

- Agricultural practices such as tilling, exposing soil to the sun and burning lead to high soil temperatures, disruption of plant root systems, destruction of soil microflora and fauna…leading to oxidation of humus—C-emissions.
- Deforestation and burning leads to huge emissions of carbon.
- Water logging/submergence of forests and soils (esp. peat bogs) releases huge amounts of carbon in the form of CO_2 and CH_4.
- C-sink capacity of the world's agricultural and degraded soils is 50 to 66% of the total historic carbon loss of 42 to 78 gigatons C

Loss of Crop and Wild Biodiversity

- Monopolization of agriculture by seed and agrochemical MNCs
- Extensive crop monocultures
- Loss of highly adapted and diverse indigenous crops and landraces
- Reduced resilience to changing climate
- More susceptible to MNCs power politics
- Reduced independence for farmer.
- Debt trap



http://g.fastcompany.net/multisite_files/codesign/imagecache/inline-large/post-inline/food-variety-tree-754.jpg

Risks of Genetically Modified Organisms (GMOs)

- "Genetic engineering is not merely causing genetic pollution of biodiversity and creating bio-imperialism, monopolies over life itself. It is also causing knowledge pollution—by undermining independent science, and promoting pseudo science. It is leading to monopolies over knowledge and information."

–Dr Vandana Shiva | Author, Activist, Pioneer, Scientific Advisor, Mother

Navdanya www.navdanya.org/

Watch Video: **Seed Freedom (2.29)**

Risks of GMOs

Part 1

Part 2

Part 3

Part 4

Documentary: Poison on a Platter by Mahesh Bhat (30 min)

External Costs of Industrial Agriculture

- Industrial agriculture and the green revolution has masked significant externalities, affecting natural resources and human health as well as agriculture itself.
- Environmental and health problems associated with agriculture have been increasingly well documented
- External costs of agriculture in the UK alone have been estimated as 1.1–3.9 bi. pounds/yr.
- As the external costs of farming are not internalized in the price of food, tax payers (or more likely the future generations) will have to pay the bill that is getting bigger every day.

Subba Rao, I. V., Soil and environmental pollution – A threat to sustainable agriculture. *J. Indian Soc. Soil Sci., 1999,* ***47, 611–633.***
Pretty, J., The real costs of modern farming. *Agric. Syst., 2000,* ***65,*** 113–136

Summing Up Corporate Agriculture

- Agriculture related firms form a nexus: Seed firms; agrochemical concerns; agroforestry; veterinary services and medicine; food industry; biotechnology; pharmaceuticals; nanotech, bioinformatics.
- Capitalized market valued between $2.5–4 trillion.
- Approximately 12 firms control 75% of this market.
- These corporations are not committed to humanitarian ends—i.e., feeding and curing people, or tackling hunger or disease.
- Instead, they are committed to feeding themselves and their shareholders increasing profits, making well people better, and fomenting simultaneously social sickness and corporate wealth.
- The name of the game is, privatize benefits and socialize costs.

http://www.greens.org/s-r/33/33-03.html

Death Trap of Industrial Agriculture

- 70% of all Indians are small marginal farmers with land holdings of a few acres or less.
- Giant seed and agrochemical MNCs market expensive seeds to them promising extraordinary yields, quality and profits.
- However, the crops are addicted to high water use and agrochemical inputs such as fertilizers and pesticides …often marketed by the same MNCs.
- Majority of introduced commercial crops (esp. hybrids and GMOs) are not adapted to local conditions.

Watch Video: Nero's Guests (56min)

Death Trap of Industrial Agriculture

- These crops are more vulnerable to climatic changes, disease and pest attack.
- Farmers are urged to turn traditional diverse farms into cash crop monocultures.
- MNCs also aggressively market farm machinery in the name of higher productivity and profits.
- Forces farmers to borrow; oft. at unreasonably high interest rates (30-60% p.a.) from private moneylenders.
- Produce is sold by farmers in a market controlled by traders and MNCs, and which is subject to price-fixing and the vagaries of government policies.

Death Trap of Industrial Agriculture

- Farmers cannot indulge in "unauthorized seed-saving". Patent violation…lawsuits.
- F1 hybrids, Terminator Technology (sterile seeds).
- Must purchase seed for the next season from the seed corporation…at ever-increasing prices.
- Newer seeds need higher and higher inputs of newer and deadlier pesticides and fertilizers…purchased from the same MNCs.
- Repeated borrowing becomes necessary
- Crop failures or inability to sell crops at a suitable price causes the debt to spiral out of control…farmer suicides.

Death Trap of Industrial Agriculture

- The excessive fertilizers lay waste the land…depleted soil carbon, deficiency of micronutrients, loss of soil biota, eutrophication and pollution of waterways.
- Excessive irrigation: water logging, salinization of soils, groundwater depletion.
- Excessive pesticides, herbicides: pollution of air, land and water,
- Heavy farm machinery: soil compaction (plough pan) water logging.

Indian Farming: Cost Breakup

S. No.	Item	%Cost
1.	Seed	20
2.	Chemicals	32
3.	Diesel (groundwater pumping)	10
4.	Labor	38
	TOTAL INPUT COST	**100**

- Avg. potato and onion farming in Northern India
- http://www.globalresearch.ca/index.php?context=va&aid=3204

Indian Farming: Cost Breakup

- Assuming 4.4 metric tonnes/acre each of potato and onion
- 5 yr-avg. ex-farm prices is about Rs. 200/quintal for potato and Rs. 250/quintal for onion.
- Does not include post-harvest wastage: 10 to 40% on account of drying, rotting, and losses in transit (various government estimates).
- Once in ~3 yrs. prices crash by as much as 30-50%, largely engineered by traders, leaving farmers deeply in debt.

Indian Farming: Cost Breakup

Input Rs./acre	Output Rs./acre	Interest owed	Profit Rs./acre	Remarks
38,000	44,500	0	6,500	Self-financed, Hired Labor
23,560	44,500	0	20,900	Self-financed, Family Labor
38,000	44,500	6,840	-340	50% inputs financed @36% p.a., Hired Labor
23,560	44,500	6,840	14,100	50% inputs financed @36% p.a., Family Labor
38,000	31,150	6,840	-13,690	50% inputs financed @36% p.a. 30% crash in market price
23,560	31,150	6,840	750	50% inputs financed @36% p.a. 30% crash in market price, Family Labor

http://www.globalresearch.ca/index.php?context=va&aid=3204

Indian Farming: Cost Breakup

- Small and marginal farmers cannot store the produce or afford warehouse charges.
- Distress sale further erodes a farmer's financial viability.
- Those who store their surplus end up losing 10-20% stock due to spoilage and drying shrinkage.
- This neutralizes any gains through seasonal price fluctuation.

Ineffective Government Policies

"The talk of helping farmers with greater access to market, a promise that has been repeated by every politician and every Agriculture Minister since 1947, is unlikely to resolve the problem of assured minimum income. Small and marginal farmers can't benefit from market access; rather the market left to its own devices works against their interest."

—Arun Shrivastava, Global Research, 2006

http://www.globalresearch.ca/index.php?context=va&aid=3204

Indian Farming: Winners and Losers

Income from…	USD / acre/yr
Seeds	168.89
Diesel	84.45
Fertilizers and pesticides	270.23
Total to corporations	**523.57**

Corporations

Net income	USD /acre/ yr
With hired labor	144.00
With family labor [excluding cost of capital]	464.00

Farmers

70% of Indians

Industrial Agriculture Leads to Food Insecurity

- Unsustainable yields.
  - Yields decline due to soil degradation, pest attack (pesticide resistance)
  - Increased agrochemical use becomes necessary…expensive
- Needs excessive irrigation…resource depletion and land degradation.
- Leads to crop monocultures: inherently unstable
- Degradation of prime agricultural lands, loss of topsoil—a permanent loss.
- Poor resilience to changing abiotic and biotic factors…global climate change.

Industrial Agriculture Leads to Food Insecurity

- Serious and widespread preconsumer and consumer health effects of pesticides, nitrate contaminants.
- Eutrophication and toxification of precious and scarce water resources.
- Inequitable food distribution inspite of surplus production due to MNC domination, politics and govt. policies.

Outline

- Dimensions of the Food Crisis
  - Hunger, poverty, production, distribution
- Threats to Food Security: Present and Future
- Solutions to the Food Crisis
  - Theoretical (Present) Solution
    - Food Distribution
  - Real Solutions
    - Industrial Agriculture?
    - **Alternative Agriculture**
    - Vegetarianism
    - What Can You Do?

Human System vs Ecosystem

Anthroposystem

- Very simple ecosystem; max. 3 trophic levels
- Open system; minimal recycling
- High efficiency of transfer of biomass to higher trophic level
- Monoculture; high density
- Few favored species encouraged; weeds destroyed
- Static, highly unstable
- Few people feed the rest-agriculture

Ecosystem

- Often highly complex food webs
- Often closed systems with significant recycling
- Low efficiency of transfer of biomass to higher trophic level
- High biodiversity
- Natural balance in species populations achieved adapted to conditions
- Robust, stable, dynamic, adaptable, evolving

Problems with Human Systems

- Dependent on very few species
  - 80% of world food from 15 species.
  - Human consume only 150 out of the estimated 50,000 edibles.
  - Out of 10,000 cereals, not one new has been cultivated in the past 2000 yrs.
- Inherently unstable
  - Irish Great potato famine (1845-47) wind-borne potato blight fungus; near total crop failure
  - 1 million dead due to starvation, typhoid and cholera
- Require constant inputs; pesticides, fertilizers, etc.
- Prone to pest attacks and failures
- Pollute soil, air, water
- Soil degradation and topsoil loss

Alternative to Industrial Agriculture

- Adopt low input sustainable/organic farming methods
- Use indigenous or traditional crops
- Improve farm diversity
- Use organic, biological pest management methods.

Alternative Farming—Different Preoccupations

- Sustainability—Sustainable farming
- Ecological—Ecological agriculture
- Mimicking nature—Natural
- Chemical free—Organic
- Avoiding tillage—No till, Zero tillage, minimal tillage
- Biodynamic, Rishi Krishi

Alternative Farming

Characteristics	Environmental Benefit
No-till, minimal tillage	Retains soil structure, porosity, organic matter, biota, high percolation, C-sequestration.
Minimal earthmoving	Minimize habitat and topsoil loss, C-sequestration.
Minimal Equipment	Reduced capital costs, compaction, and oil dependence
Ground Mulch, Manures, residue	Reduced cost, evaporation. Improved pest resistance, better product and keeping quality, balanced fertilization, C-sequestration.
Interplant	More crop diversity, resilience to pest attack, maintenance of soil fertility

Alternative Farming

Characteristics	Environmental Benefit
Natural Pesticides/ predators	Low or no toxicity to humans, preserves and improves biodiversity
Beneficial Organisms, earthworms, Bees	Better fertilization, pollination, yields, supplementary income
Local crops	Excellent adaptation to local conditions, natural pest resistance, Not addicted to fertilizers and pesticides, increased crop diversity…resilience
Minimal irrigation	Low salinization, low depletion of water resources, low CH4 emissions due to waterlogging

Farm Diversity

- High farm diversity (in crops and enterprises) reduces economic risk.
  - Plant a variety of crops
  - Intercrop with nitrogen fixing crops
  - Follow crop rotation with nitrogen fixing crops or pasture grasses.
  - Keep livestock
  - Start value-added enterprises
- Farms become more self-sufficient in terms of nutrients, livestock feed, soil organic matter and energy.

http://www.cog.ca/documents/Economics%20of%20organic%20farming.pdf

Indigenous Crops with Diversity

- Traditional and indigenous crops are highly adapted and resilient to local conditions (including microclimate, soil, pests etc.) over hundreds or even thousands of yrs.
- Require minimal inputs. Can be very successfully grown using organic methods and without mechanization.
- Reduce the farmer's need to borrow: own seed, own manure, no pesticide etc…beats the debt-trap.
- Premium market price…due to better quality and organic certification.
- Increasing crop diversity on farm, improves resilience to weather fluctuations in rainfall, weather conditions, pest attack etc; prevents a total crop failure—inherent insurance policy

Indigenous Crops with Diversity

- Improve farmers' diets.
- Occupy an ecological niche and minimizes environmental impacts incl. soil degradation, water wastage, habitat destruction, pollution, etc.
- Encourage seed saving: dynamic seed banks—diverse gene pool of successful adaptations to local conditions.
- Encourage local agribusiness such as processing and preservation of traditional foods.
- This provides local food security (during off season), community income and reduces dependence on large commercial agricultural companies that can be exploitative to small farmers.

Questions About Alternative/ Organic Farming

- Can alternative farming produce enough food for everybody?
- Is it economically feasible?
- Is it possible to meet the nutrient requirements of crops entirely from organic sources?
- Are there any significant environmental benefits of alternative farming?
- Is the food produced by organic/alternative farming superior in quality?
- Is it possible to manage, weeds, pests and diseases in alternative farming?

Viable Option for Future Food Security

- Neither conventional, nor organic/alternative agriculture might be sufficient to provide for future food needs due to enormous projected growth in population.
- Yet, modeling studies indicate that large-scale conversion to organic agriculture would neither result in drastic reduction in world food supplies nor necessitate conversion of undisturbed lands to agriculture.
- In fact, widespread conversion to organic agriculture would result in crop yield increases as a result of increased investment in research and extension.

Avery, D. T., Saving the planet with pesticides and plastic: The environmental triumph of high-yield farming. Hudson Institute, Indianapolis, 1995, p. 432.
Trewavas, A. J., The population/biodiversity paradox. Agricultural efficiency to save wilderness. *Plant Physiol., 2001,* ***125, 174–179.***
Lampkin, N. H., Estimating the impact of widespread conversion to organic farming on land use and physical output in the United Kindom. In *Economics of Organic Farming (eds Lampkin, N. H.* and Padel, S.), CAB, Wallingford, UK, 1994, pp. 353–359.

Viable Option for Future Food Security

- Limiting population drastically is a matter of necessity
- Equitable food distribution is also required.
- Prevention of diversion of foodgrains towards livestock feed must be prevented…a case for vegetarianism.
- Prevention of conversion of agricultural lands (or produce) into fuel farms must be prevented.
- If the above critical issues are successfully addressed, organic agriculture is an economically viable, environmentally friendly and socially nurturing option.

Organic Farming Yields

- Avg. yield increases due to organic farming—A survey of 208 projects in developing tropical countries:
  - 5–10% in irrigated crops and
  - 50–100% in rainfed crops
- Significantly higher yields than conventional when under stress caused by drought, heat, excessive rain or unseasonably cold weather, disease or pest attack.
- 30% reduced yields in transitional phase (1-4 yrs.) depending upon intensity of mechanization and chemical use prior to switchover. Yields recover after transitional period.
- Premium prices after transitional phase.
- Steady annual growth in demand (20-25%) for organic food in developed and developing countries.

Pretty, J. and Hine, R., Reducing food poverty with sustainable agriculture: A summary of new evidence. SAFE Research Project, University of Essex, Wivenhoe Park, UK, 2001, p. 136. http://www.ias.ac.in/currsci/feb252005/561.pdf
http://www.cog.ca/documents/Economics%20of%20organic%20farming.pdf

Do Polycultures Overyield Monocultures?

- Overyield in polycultures is common.
- The traditional corn/beans/squash polyculture of Mexico produces overyields as high as 50 %
- Some studies found overyields as high as 150 %
- Another study: consistent 5-15% increase in yields due to intercropping
- Perennial polyculture: The Land Institute
  - 19% overyield with a mixture of eastern gamagrass and Illinois bundleflower,
  - 26% overyield with 3-species mixture (eastern gamagrass, Illinois bundleflower, and the cool season (C3) mammoth wild rye.

S. R. Gliessman, "Sustainable Agriculture: An Agroecological Perspective," in John Andrews and Inez Tommerup, eds., *Advances in Plant Pathology, Vol. 11, Academic Press, London, 1995, pp. 45–57 (referenced in Geno* and Geno, 2001).
M. Liebman, "Polyculture Cropping Systems," in *Agroecology: The Science of Sustainable Agriculture, M. A.* Altieri, ed., Intermediate Technology Publications, London, 1995, pp. 205–218 (referenced in Geno and Geno, 2001).
R. W. Snaydon and P. M. Harris, "Interactions Below Ground—The Use of Nutrients and Water," in *Proceedings of the International Workshop on Intercropping, R. Willey, ed., International Crops Research Institute for* the Semi-Arid Tropics, Patancheru, Andhra Pradesh, India, 1981, pp. 188–201 (referenced in Geno and Geno, 2001).

Low Inputs and Sustainable Productivity

- Organic farm production costs < conventional farms, with low purchased inputs.
- Inputs eliminated or drastically reduced are: fertilizers, pesticides, purchased feed, veterinary bills, and replacement livestock
- Organic farmers have lower fixed (overhead) costs for depreciation and interest charges attached to capital inputs, such as machinery and equipment.
- Enrichment of soil ensures future (sustainable) productivity.
- No increase in tillage needs for weed control upon following good management practices and improving soil structure.

Economic Feasibility of Organic Agriculture

Organic Farming is certainly economically feasible due to the following reasons:

- High or ‘at par’ yields
- Low inputs
- Better storage quality of products
- Premium prices and growing demand
- Farm self-sufficiency
- Increased resilience and high productivity under adverse conditions
- Sustainable use of local resources
- Empowerment of farmers and local communities.

Economic Feasibility of Organic Agriculture

High Profits!!

Good returns due to premium prices and comparable yields

Low inputs. Local inputs of manure etc.

Profit = (total returns) - (total costs or inputs)

Economic Feasibility: Testimony from Cotton Farming

The economic study of organic cotton cultivation compared to conventional cotton cultivation in India, over a period of 6 yrs.:

- Reduction in cost of cultivation
- Increased gross and net returns

Rajendran, T. P., Venugopalan, M. V. and Tarhalkar, P. P., Organic cotton farming in India. Central Institute of Cotton Research, Technical Bulletin No. 1/2000, Nagpur, 2000, p. 39.

Organic Foods Retain Quality Better

- Organic products retain post-storage quality better than conventional products.
- Can fetch a better market price after storage
- Reduced spoilage during storage.

Reganold, J. P., Glover, J. D., Andrews, P. K. and Hinman, H. R., Sustainability of three apple production systems. *Nature, 2001,* **410, 926–930.**
Benge, J. R., Banks, N. H., Tillman, R. and De Silva, H. N., Pairwise comparison of the storage potential of kiwi fruit from organic and conventional production systems. *N. Z. J. Crop Hortic. Sci.,* 2000, **28, 147–152.**

Organic food: Safe and Healthful

- Studies reject the claim that organic foods increase exposure to microbiological contaminants
- Organic foods are proved superior in terms of health and safety

Pell, A. N., Manure and microbes: Public and animal health problem? *J. Dairy Sci., 1997,* ***80, 2673–2681.***
Burros, M., Anti-organic and flawed. *New York Times, 17 February* 1999.
Jones, D. L., Potential health risks associated with the persistence of *Escherichia coli O157 in agricultural environments. Soil Use Manage., 1999,* ***15, 76–83.***
Rutenberg, J., Report on organic foods challenged. *New York Times, 31 July 2000, p. C 11.*

Organic food: Safe and Healthful

- Higher levels of vitamin C and essential minerals such as calcium, magnesium, iron, and chromium—The UK Soil Association..
- An independent study found higher levels of all 21 nutrients in organic crops, particularly potatoes, cabbage, spinach and lettuce.
- Higher micronutrient content that contributes to better health
- Consumers have lower incidence of non-communicable diseases and boosts plant and animal immunity against disease
- Up to 50% fewer mycotoxins (toxins produced by fungi)

http://www.i-sis.org.uk/FAOPromotesOrganicAgriculture.php

Organic food: Safe and Healthful

- Organic products have significantly lower pesticide residues than conventional products.
- Significantly lower nitrates in organic foods (nitrates are associated with intensive use of nitrogen fertilizers) are significant food contaminants

FAO, Food safety and quality as affected by organic farming. Agenda item 10.1. In Twenty-Second FAO Regional Conference for Europe, Porto, Portugal, Food and Agriculture Organization of the United Nations, 24–28 July 2000.
Woese, K., Lange, D., Boess, C. and Bogl, K. W., A comparison of organically and conventionally grown foods – Results of a review of the relevant literature. *J. Sci. Food Agric., 1997,* ***74, 281–293.***
Benbrook, C. and Baker, B., Placing pesticide residues and risk in perspective: Data-driven approaches for comparative analyses of organic, conventional and IPM-grown food. In *Ecological Farming Conference, Monterey, CA, 24–27 January 2001, www.eco-farm.org.*

Successful Pest Management

- Preventative pest and disease management strategies are successful
- Involves selection of hardy crops and varieties.
- Improving soil and plant nutrients to grow healthy plants that are resistant to disease and pests.
- Use of ‘organic’ pesticides e.g. neem products.
- Biological pest control: encourage natural predators like spiders, wasps, frogs, lizards, birds by providing suitable habitats.
- Timing planting, harvest and watering, etc.
- Pest and disease incidence is less severe in organic farms.

Organic: Environment Friendly

- Organic farming systems (compared to conventional farming) performed significantly better on 18 environmental impact indicators and worse in none.
  - A review of over 300 published reports
  - Environmental impact indicators (floral diversity, faunal diversity, habitat diversity, landscape, soil organic matter, soil biological activity, soil structure, soil erosion, nitrate leaching, pesticide residues, CO_2, N_2O, CH_4, NH_3, nutrient use, water use and energy use), organic farming systems performed significantly better in 12 and performed worse in none.

Stolze, M., Piorr, A., Haring, A. and Dabbert, S., The environmental impact of organic farming in Europe. In *Organic Farming in Europe: Economics and Policy, University of Hohenheim, Hohenheim,* Germany, 2000.

Organic Input Availability

- Application of organic manure is the only option to improve the soil organic carbon for sustenance of soil quality and future agricultural productivity.
- Theoretically 700 mt of agricultural waste in India/yr. for conversion to manure.

	Theoretical Availability	Estimated Actual Availability
Manure basis tonnes /ha arable land/yr	5	1.5
NPK basis Kg/ha arable land/yr	100	33

Katyal, J. C., Organic matter maintenance: Mainstay of soil quality. *J. Indian Soc. Soil Sci., 2000,* ***48, 704–716.***
72. Tandon, H. L. S., In *Plant Nutrient Needs, Efficiency and Policy Issues: 2000–2025, National Academy of Agricultural Sciences,* New Delhi, 1997, pp. 15–28.

Sequestering Carbon Benefits Agriculture

- Adding 1 ton C/ha to degraded soil can increase crop yield by 20-40 kg/ha for wheat, 10-20 kg/ha for maize, and 0.5-1 kg/ha for cowpeas.
- Can offset fossil fuel emissions by 0.4-1.2 gigatons C/yr…5-15% of the global fossil-fuel emissions.
- Soil C can be improved by afforestation, agroforestry, no-till farming, cover crops, manuring and sludge application, improved grazing, water conservation and harvesting, efficient irrigation, avoiding water logging.
- Soils under conservation tillage contain 30–50% more C than soils under traditional tillage (Nelson, 1999).

http://www.sciencemag.org/cgi/content/abstract/304/5677/1623

Sequestering Carbon Benefits Agriculture

- Regenerative agriculture (no-till, mulching, cover cropping, manuring, biochar) if practiced on the planet's 3.5 bi. tillable acres, could sequester up to 40% of current CO_2 emissions—agricultural carbon sequestration.
- At a C-sequestration rate of 2,000 lb/ac/year (over 1,760,000 km^2) of USA's cropland could sequester 25 % (1.6 bi. tons) of USA's total fossil C-emissions (6.5 bi. tons)
- The same practices can dramatically enhance yields (by 50-100%) on rain-fed or drought prone lands.
- Organically managed soils can thus convert CO_2 from a greenhouse gas into a food-producing asset.

http://en.wikipedia.org/wiki/Carbon_sink

^ A report recently released by Rodale Institute and based on nearly 30 years of research in its side-by-side studies of organic and conventional agriculture. ^ Lappé, Anna (9 May 2008). "Timothy LaSalle of Rodale on the surprising climate benefits of organic farming". *Grist*. http://www.grist.org/feature/2008/05/09/index.html?source=rss.

Organic Agriculture: Human Friendly

- Organic agriculture, can integrate tradition, new knowledge and innovation
- It can lead to an increased engagement in farming
- It can trigger greater opportunities for rural employment and socio-economic upliftment.
- Positive health impacts
- Local food security and nutrition
- Empowerment of farmers and local communities.

Watch Video: Farming - The Gandhian Way - A Tribute to Shri. BHASKAR SAVE (12 min)

Agriculture: The Natural Paradigm

- Natural ecosystems are self-supporting.
- They do not require external inputs other than rainwater, sunlight etc.
- They lead to an improvement in fertility and productivity over time.
- Can we design agricultural systems on the lines of natural ecosystems?
- **Nearly, self-supporting...requiring minimal inputs...and yet highly productive**

Food Forests and Agroecosystems

- Geoff Lawton's: 7 Food Forests in 7 minutes (7 min)
- 300 Year Old Food Forest in Vietnam (6 min)
- Padma Shri Subhash Palekar's Zero Budget Natural Farming in India - How it can transform Agriculture in - Current Affairs 2018 (16 min) - Hindi
- Kailash Murthy and Natural Farming (13 min)

Superiority of the Natural Paradigm

Very High Efficiency!!

- High yields.
- Overyielding polycultures

$$\text{Efficiency} = \frac{\text{Output}}{\text{Inputs}}$$

Low inputs of:

- manure
- labor
- machinery
- irrigation, etc.

Meet The Grandfather of Natural Farming...

Masanobu Fukuoka

- Agricultural scientist, farmer, philosopher, admirer of Gandhi.
- Awards: Ramon Magsaysay Award, Desikottam Award, Earth Council Award
- Author of: " The One-Straw Revolution" By Masanobu Fukuoka (and 3 other titles)
  - No-till, no fertilizer, no pesticide, ground mulch and green cover, direct seeding (seed balls)

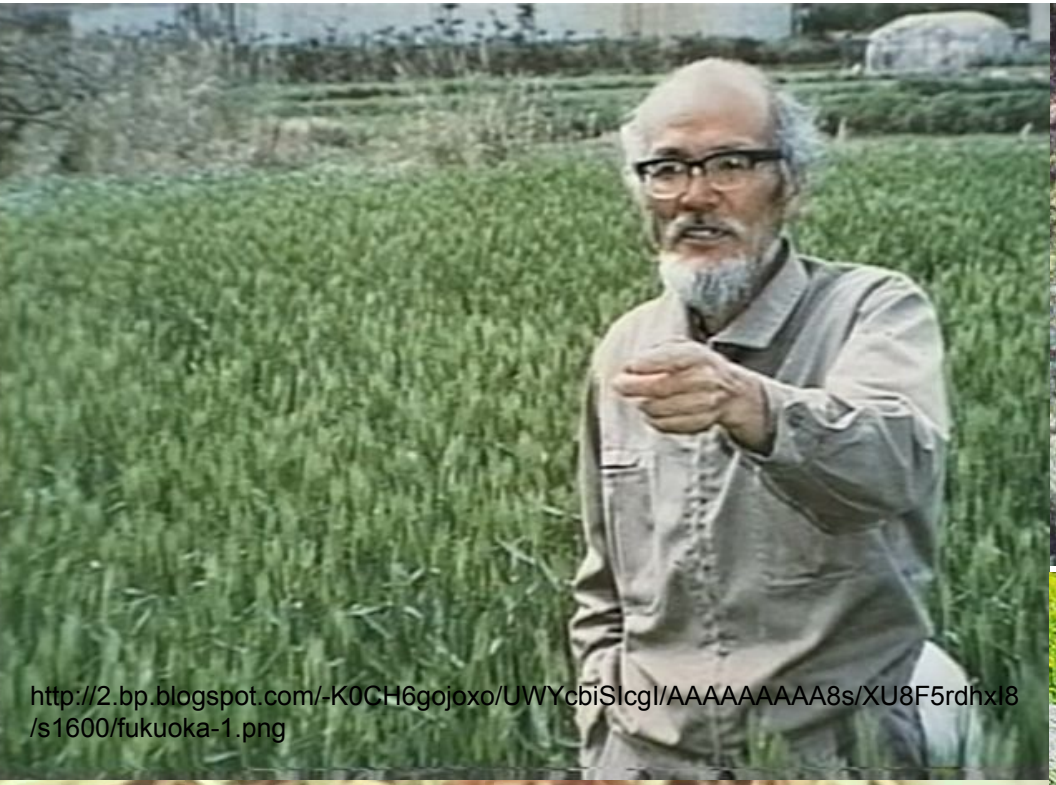
Watch Videos:

- **One Straw Revolution - by Masanobu Fukuoka (24.38)**
- **How to do Masanobu Fukuoka's natural farming. (13.28)**
- **Masanobu Fukuoka rice and orchard techniques (5.35)**

Masanobu Fukuoka

(1913-2008)

https://en.wikipedia.org/wiki/Masanobu_Fukuoka



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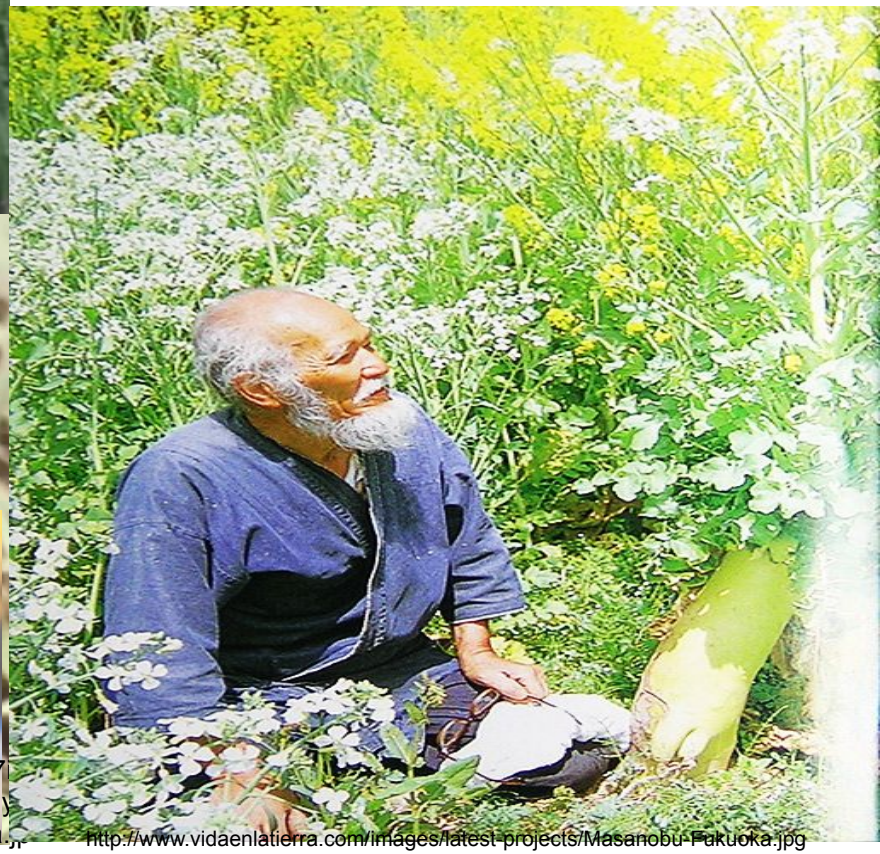

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http://i.ytimg.com/vi/XSKSxLHMv9k/maxresdefault.jpg

http://2.bp.blogspot.com/--cXAANZ7Y/T7Z2rDYPYyI/AAAAAAAAB2c/8nygLeBVAc/s1600/masanobu-fukuoka.jpg

Outline

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    - Alternative Agriculture
    - **Vegetarianism**
    - What Can You Do?

Vegetarianism and Sustainability

Dr R. K. Pachauri, Chairman of IPCC: “We didn’t say it before, but we are saying it now. One of the best ways to fight global warming is to adopt a vegetarian diet”. Speech in Geneva, January 15, 2008

A Crowded Earth

- World meat production has surged nearly 5-fold between 1950—1997 (44 → 211 million tons)
- The world fish harvest surged 6-fold between 1950-2000 (21 → 120 mi. tons)…per capita consumption tripled.
- Per capita meat production stands at 36 kg (> 2x of 1950 level)
- ~6 bi. humans share the Earth's natural resources with nearly 1 bi. pigs, 1.3 bi. cows, 1.8 bi. sheep and goats, and 13.5 bi. chickens. (~ 3 heads of livestock/ person)

World's Livestock Population Growth

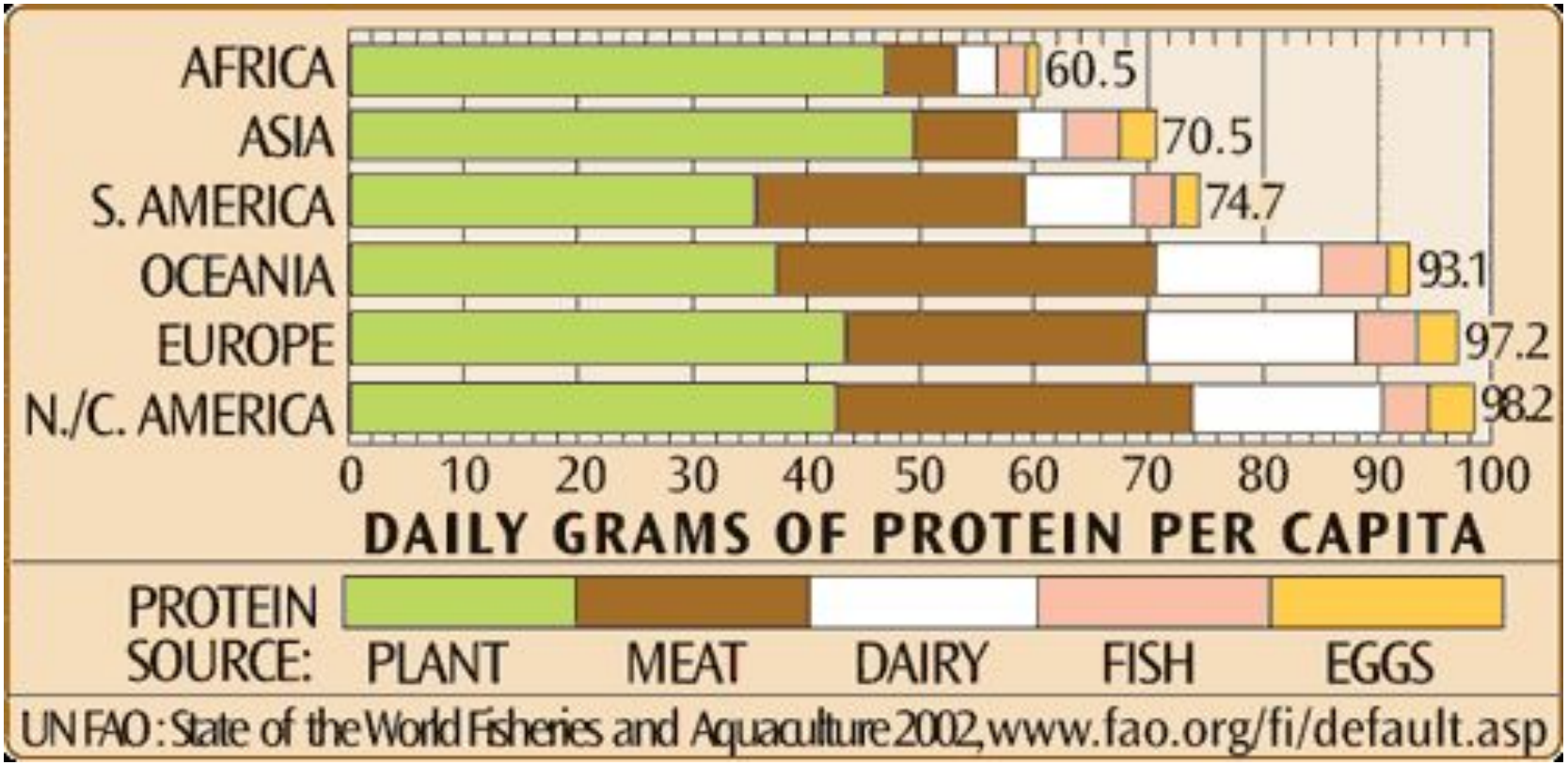
Livestock	1960	1997	Increase
	(billion)	(billion)	(percent)
Cattle	0.94	1.33	42
Sheep and Goats	1.34	1.77	32
Pigs	0.41	0.94	131
Chickens	3.90	13.41	244
Humans	3.08	5.85	90

Source: UN Food and Agriculture Organization, FAOStats, 21 June 1998.

Country-wise Meat Consumption

Country (kg meat/person/yr)	Beef	Pork	Poultry	Mutton	Total
United States	44	31	48	1	123
Germany	16	54	15	1	86
Italy	26	35	19	2	82
United Kingdom	16	25	27	6	74
Brazil	36	9	24	-	70
New Zealand	37	-	-	29	66
China	5	35	11	2	53
Russia	19	13	13	1	46
Japan	12	17	12	1	40
Egypt	8	-	6	1	16
India	1	-	1	1	3
Indonesia	-	-	2	-	2
All Industrial Nations	21	25	24	2	72
All Developing Nations	5	11	7	1	24

Per Capita Protein Intake: Sources



- "10 kcalories (kilogram-calories or 'large calories') of exosomatic energy are spent in the U.S. food system per calorie of food eaten by the consumer. Put another way, the (US) food system consumes ten times more energy than it provides to society in food energy."

Meat Eating and Health Problems

- The avg. American consumes nearly twice his or her weight in meat each year.
- High growth in consumption of meat (esp. high-fat meat), dairy products and eggs—more cholesterol, saturated fat, and protein.
- Global epidemic of lifestyle diseases: heart attacks, strokes and cancers.
- Chinese government to limit the country's meat consumption: to avoid massive health care costs (100s of bi. of USD)

https://www.worldwatch.org/node/1626

In China a recent shift to meat-heavy diets has been linked to increases in obesity, cardiovascular disease, breast cancer and colorectal cancer.

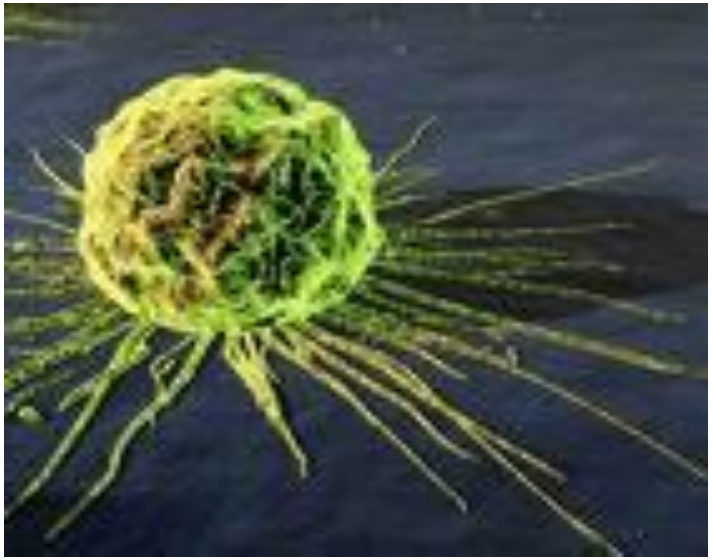
Superiority of Plant Protein

- Professor Colin Campbell: “There is a mountain of compelling evidence that so called “low quality” plant protein which allows for slow but steady synthesis of new proteins is the *healthiest* type of protein”

“Heart Attack Proof” Diet

- Diets of Dr. Dean Ornish and Dr. Caldwell Esselstyn keep cholesterol levels below 150, the level below which no one has ever suffered a heart attack.

At the turn of the century, heart disease and cancer used to cause 8% and 4% of deaths.



Now they cause 36% and 22% of deaths.

"The vast majority, perhaps 80 percent to 90 percent, of all cancers, cardiovascular diseases, and other forms of degenerative illness can be prevented, at least until very old age, simply by adopting a plant-based diet."

Dr. T. Colin Campbell
Cornell University

Healthy Human Diet

- For infants: mother's milk.
- For adults: fruits, vegetables and whole grains, pulses, nuts .

Barry A. Popkin, Scientific American, June, 2008

Meat Eating—A Net Drain on Economy?

- Conservative estimate: excessive meat consumption linked to health care costs of $60—120 bi./yr in USA.
- Domestic cash receipts for the meat industry totaled roughly $100 billion in 1997.
- It is possible that this industry is a net drain on the American economy.

…Dr. Colin Campbell of Cornell University

Starvation Deaths

- 1 person dies every second directly or indirectly due to hunger…4000/hr…100,000/day…36 mi. /yr
- 58 % of all deaths are due to hunger (2001-2004 estimates)
- 1 child dies every 5 seconds directly or indirectly due to hunger…700/hr…16,000/day…6 mi./yr.
- 60% of all child deaths are due to hunger (2002-2008 estimates)

http://en.wikipedia.org/wiki/Starvation

Saving Grain for the Hungry

- The world already produces enough food for the present 7 billion people; could even support double — 12 billion people.
- But 36 % of world's grain (21% in developing countries and 70% in industrial nations) feeds livestock, poultry, and fish farms…inefficient converters of grain
- 1 kg meat ➔ ~7 kg of grain (corn or wheat)…human food!
- 670 mi. tons of the world's grain used for feed could feed 800 mi. people.
- In 2007, 923 mi. undernourished.

Saving Grain for the Hungry

- 10% of this feed (67 mi. tons of grain) could sustain 225 mi. people or keep up with world population growth for the next three years.
- If each American reduced his meat consumption by only 5 %, (1 dish less/week); the 7.5 mi. tons of grain saved, could feed all the 25 mi. people going hungry in the US each day.

Inefficiency of Protein Production

USA:

- 7 bi. livestock heads consume 5x grain consumed by the entire American population.
- 41 mi. tons/yr of plant protein is fed to U.S. livestock to produce 7 mi. tons of animal protein for human consumption.
- 26 mi. tons of the livestock feed comes from grains and 15 mi. tons from forage crops.
- 1 kg of high-quality animal protein produced, consumes 6 kg of plant protein.

Energy

- In the USA, 20 times as much energy is required to produce one calorie of animal food as is required to produce one calorie of vegetable food

Energy Consumption

	(Fuel input): (Protein produced)
Chicken	4:1
Beef	54:1
Lamb	50:1
Turkey	13:1
Pork	17:1
Eggs	26:1
Milk	14:1
Grains	3.3:1*

(Fossil Fuel input Kcal): Protein produced Kcal)

* Figure pertains to grain farming by conventional methods. This can be made drastically more efficient by using natural farming methods.

http://www.news.cornell.edu/releases/Aug97/livestock.hrs.html

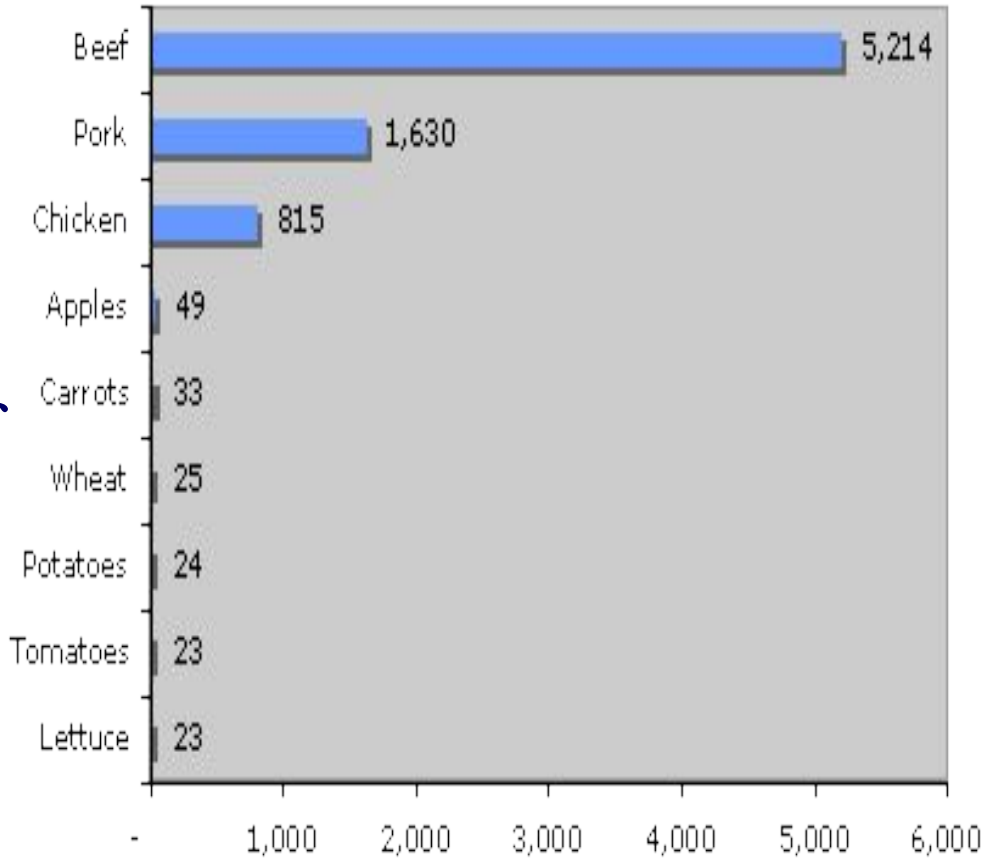
Contribution to Global Climate Change

- World's livestock production is the largest source of anthropogenic methane emissions…EPA
- Livestock herds account for ~ 25 % of anthropogenic emissions of methane…climate change.
- Stagnant waste lagoons of factory-farm operations emit an additional 5 % percent of human-induced methane.

Water Use

- U.S. agriculture accounts for 87 % of all the fresh water consumed each year.
- Livestock direct use 1.3 %
- Livestock total use ~ 50 % (incl. forage and grain production for livestock)
- 1 kg beef takes 100 tons of water
- 1kg wheat takes 0.9 tons of water
- 1 kg potatoes 0.5 tons of water

Gallons of water to produce 1 lb of various foods (236)



Water

- To produce 1 lb. of feedlot beef requires 7 lbs. of feed grain, which takes 7,000 lbs. of water to grow.

One half of all US water resources are used to grow meat.

Pass up one hamburger, and you'll save as much water as you save by taking 40 showers with a low-flow nozzle.

1  = 40 

Meat eaters require 14 times as much water for their diets as do vegetarians.

Water Pollution

- For example, shifting from pork to chicken requires half the grain, and hence half as much water.
- The massive quantities of waste produced by livestock and poultry threaten rivers, lakes and other waterways with pollution, toxic algal blooms and massive fishkills.
- US livestock waste is 130 times that produced by humans. ,
- Livestock farms are getting larger throughout the world.

Water Pollution

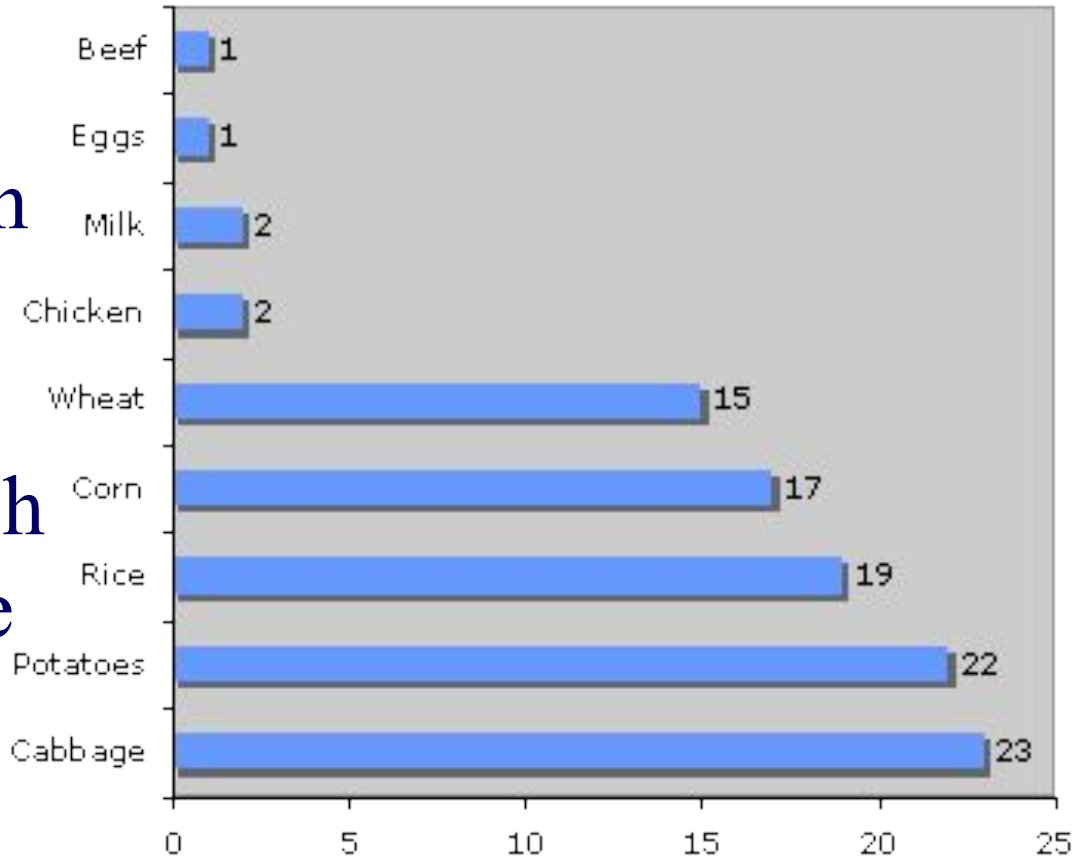
- According to the Environmental Protection Agency, factory farming pollutes U.S. waterways more than ***all*** industrial sources combined.

In the U.S., livestock now produce ***130 times*** as much waste as people do. Just one 50,000 acre hog farm in Utah, for example, produces more sewage than the city of Los Angeles!!

Land

- According to scientists at the Smithsonian Institute, the equivalent of seven football fields of land is bulldozed every minute, much of it to create more room for farmed animals.

Number of people whose caloric needs can be met on 2.5 acres of land for the following foods (294)



80% of all US agricultural is used in some way to raise animals—that's roughly half of the total land mass of the U.S.

Diet and Land Requirement

S. No.	Diet	Area (sq. yards)/capita	Population that can be supported by Earth. (multiples of 1985 population of ~5 bi.)
1.	Grains	200	60
2.	Potatoes	600	20
3.	Milk	1500	8
4.	Pork	4000	3
5.	Beef	10000	1

Masanabu Fukuoka (translated by Frederic P. Metreaud) "The Natural Way of Farming – The Theory and Practice of Green Philosophy" 1985 Japan Publications Inc. ISBN 0-87040-613-2.

Forest

- Of the Amazonian rain forest cleared in South America, more than 38 percent has been used for ranching.

More than 260 million acres of U.S. forest have been cleared to create cropland to grow grain to feed farmed animals.

Soil

- “85% of topsoil erosion (wind and water) in USA is due to raising animals for food” …Howard Lyman (American Mad Cow Activist)…
- This is 13 times above the sustainable rate.
- >302 mi. ha devoted to producing feed for the U.S. livestock population (272 mi. ha pasture and 30 mi. ha. cultivated feed grains)
- Iowa: Topsoil loss at 30x soil formation rate. Lost 50% of topsoil in just 150 years of farming—soil that took thousands of years to form.

Animal Slaughter and Torture Before Being Killed

- Every year, nearly ***9 billion animals*** are killed for food in the United States alone!!
- Video: Can you Face the Reality of Factory Farming? (6.08min)
- Video: Meet Your Meat (12.48)
- Whether animals are raised in factory farms, or in open farms, the slaughter, the pain, the suffering and death are common and inevitable.

Food, Spirituality and Humanity

- When plentiful vegetarian food is available.
- Yet, humans insist on consuming non-vegetarian food.
- It is simply for the sake of one's tongue.
- This is needless "himsa" (unjustified violence).
- The highest Dharma (righteousness) is refraining from unjustified violence (ahimsa).
- Do we not have any sympathy for the sorrow and suffering of other living beings?

Vegetarianism and Spirituality

- The dying animal says "As this person (*saḥ*) is killing and consuming me (*mām*) in this lifetime, so shall I kill and consume him in my next lifetime." This is real meaning of the word 'mā*m*sa*ḥ*' (meat) as explained by the wise ones. --Sh*ā*stras
- The butcher kills for the sake of those who buy and consume the meat.
- All are fellow-conspirators in the killing.
- As per the law of karma, every action has an equal and opposite reaction. It is inevitable.
- So all of them face the same end in their next birth.

Reducing Meat: Win-Win Situation

- Massive reductions in meat consumption in industrial nations will ease the healthcare burden while improving public health
- Declining livestock herds will take pressure off of rangelands and grainlands, allowing the agricultural resource base to rejuvenate.
- Lowering meat consumption worldwide will allow more efficient use of land and water resources. Relevant for increasing population.
- Make grain more affordable to the world's chronically hungry.
- **Humanity becomes more human!**

Food Crisis: What can you do?

- Avoid MNC-marketed hybridized/GM crops and products.
- Eat home-cooked, fresh food; avoid preserved, processed or junk food.
- Be vegetarian: Spare the grain for hungry humans. Have a heart! "Don't turn your stomach into a graveyard for unfortunate dead animals!"—Lokmanya Tilak
- Farmer microfinancing options
- Local community-operated warehousing, cold storage and food processing/preservation industry for farmers to survive unfair price-fixing, and market crashes.

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"When human beings come to understand that animals also experience pleasure and pain they will acquire a new dimension of wisdom. It is because of our human sense of duty and our higher understanding that we should be sympathetic to all living beings."

P.R. Sarkar

Outline

- Dimensions of the Food Crisis
  - Hunger, poverty, production, distribution
- Threats to Food Security: Present and Future
- Solutions to the Food Crisis
  - Theoretical (Present) Solution
    - Food Distribution
  - Real Solutions
    - Industrial Agriculture?
    - Alternative Agriculture
    - Vegetarianism
    - **What Can You Do?**

Food Crisis: What can you do?

- Support local produce: local farmers, retailers
- Grow your own food: urban gardens, community gardens/farms, terrace gardens.
- Adopt low input, small-scale, biodiverse, organic/natural farming methods integrated with sustainable land and watershed management.
- Both farmers and consumers should support crop diversity. Plant and purchase delicious and nutritious minor millets, pulses and vegetables.

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Food Crisis: What can you do?

- Ensure dignity of farmers and workers
- Ensure living wages
- Work for a profound rural change:
  - Land reforms, education, health, infrastructure
- Provide restitution for the injustices of the past and present
- Developed countries to avoid exploitative practices and policies by their govts and MNCs towards poor countries.
- Cancel debts of poorer countries.

Food Crisis: What can you do?

- Enable distribution of surplus food to poor countries
- Fuel plantations must be restricted to marginal lands. Other alternative energy/fuel sources should be researched and promoted.
- Stop war: Promote peace negotiations; resolve issues reg. sharing of scarce resources, religious intolerance and hatred.
- Limit global warming and pollution, land degradation, deforestation, etc.

Reading and Video Resources

- " The One-Straw Revolution" By Masanobu Fukuoka (and 3 other titles)
  - No-till, no fertilizer, no pesticide, ground mulch and green cover, direct seeding (seed balls)
- "Rishi Krishi" By Mohan Shankar Deshpande
  - Angara, earthworms, amritapani, natural pesticides
- "Permaculture" By Bill Mollison
  - Sustainable community, planned designs, natural patterns
  - Food Forests in 7 minutes (7 min) with Geoff Lawton.
  - 300 Year Old Food Forest in Vietnam (6 min) with Geoff Lawton
- Farming - The Gandhian Way - A Tribute to Shri. BHASKAR SAVE
- Nero's Guests by P. Sainath.

Learning is not compulsory…neither is survival.

--W. Edwards Deming