Sustainable Agriculture and the State of the World Food System

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Since the late 1960s

Biodiversity loss
Cultural loss
Climate change
Why?
Consumption patterns
Converging aspirations and ways of living
**Income**

20% people in North
- 15% have 81% of the income

80% people in South
- 880 million < $1 per day
- 2.1 billion < $2 per day
Land resources
4 people per ha cropland
• 5% irrigated
• 30% degraded
57 ha pasture; 69 ha forest

Progress with food?
• Yields up 3x in 50 years in North
• 354 kg food per person in world

Water
North America
430 litres per person per day

Europe
150-200 l/day

South
1.3 billion absolute scarcity

But
• 800 m people hungry (rising to 900m?)
• 650 m people obese
Motor vehicles

North America
• 75 per 100 people [50 million new vehicles per year]

Japan
• 57 per 100

Europe
• 27 per 100

China, India and Africa
• 0.7 to 2 per 100

Carbon emissions

North
13 t per person

USA 20 t

Europeans 8-12 t

South
0.3 tonnes
A myth

- World can be saved by bringing everyone up to same consumption levels as those in N America and Europe
  - But at this level and type of consumption – we would need 6 to 8 worlds
A myth

• World can be saved by bringing everyone up to same consumption levels as those in N America and Europe
  – But at this level and type of consumption – we would need 6 to 8 worlds

• Our great deceit –
  – that modern civilisation is built on idea of inevitable technological progress,

• Now need different consumption patterns and divergent livelihoods

• Need new ways of thinking
Great Progress on food

- Past 50 years
  - more cereals and animals per ha
  - more meat and milk per animal
  - more food produced per person employed

But very fossil fuel dependent
Cereal production, area and yields, world (1961-2004)

- Cereal production (1961=0.88 bn t)
- Cereal area (1961=648 M ha)
- Cereal yield (1961=1.35 t/ha)

Head of livestock, world (1961-2004)

- Cattle and buffaloes (1961=1.03 bn)
- Chickens (1961=3.89 bn)
- Pigs (1961=0.46 bn)
- Sheep and goats (1961=1.34 bn)

Irrigated area and agricultural machinery, world (1961-2002)

- Irrigation area (1961=139 M ha)
- Tractors, harvesters and threshers (1961=13.6 M)

World fertilizer consumption (1961-2002)

- All fertilizers (1961=31.2 Mt)
- Nitrogenous fertilizers (1961 = 11.6 Mt)

Pretty, 2008, Phil Trans Roy Soc Lond
Relationship between all fertilizers applied and world plant food production (1961-2002)

Food production (cereals, coarse grains, pulses, roots and tubers, oil crops)

Fertilizer consumption (Mt per year)

\[ R^2 = 0.9009 \]

Relationship between world agricultural machinery and world plant food production (1961-2002)

Food production (cereals, coarse grains, pulses, roots and tubers, oil crops)

Total tractors, harvesters and threshers

\[ R^2 = 0.98 \]

Relationship between world irrigation area and world plant food production (1961-2002)

Food production (cereals, coarse grains, pulses, roots and tubers, oil crops)

Irrigated area (M ha per year)

\[ R^2 = 0.98 \]

Relationship between world agricultural land area and world plant food production (1961-2002)

Food production (cereals, coarse grains, pulses, roots and tubers, oil crops)

Agricultural land area (billion ha)

\[ R^2 = 0.98 \]

Pretty, 2008, *Phil Trans Roy Soc Lond*
New Threats and Options

- World food system in new danger
  - Consumers think they can buy food anywhere, anytime
    - But also now disconnected from food production
  - Biofuels
    - Cereals into ethanol
  - Climate change
    - Yields down in Australia & Vietnam
    - IPCC predicts 50% yields cut in much of Africa (by 2020-30)
  - Economic growth and changing consumption patterns
    - Food price uncertainty (doubled 2005-2008; fell back)
    - Riots in Egypt, Cameroon, Cote d’Ivoire, Senegal, Burkina Faso and Madagascar
  - Reductions in overseas assistance to agriculture
    - From $8bn in 1980s to $3.4 bn today
    - % of ODA to agriculture down from 18% to 3.5%
New Threats and Options

- **Options** – for transformed landscapes and foodscapes

- Emphasise in-country production (rather than just trade on world market)

- Focus on small farmers as well as large

- **Agricultural sustainability**
  - Focus on increasing yields plus supply of environmental goods and services
Idea of Agricultural Sustainability

• Does not mean ruling out any technologies or practices on ideological grounds
  – All technologies have something to offer
    • GM, modern, organic, traditional
    • G x E crucial relationship
  – If a technology improves productivity for farmers, and does not cause undue harm to the environment, then it is likely to have some sustainability benefits

• Agricultural systems emphasising these principles tend to be multi-functional within landscapes and economies
  – jointly produce food and other goods and services

Sustainability implies a balance between a range of agricultural and environmental goods and services

Pretty et al, 2008, Phil Trans Roy Soc Lond
Environmental costs and food miles

- Agricultural externalities well-recognised problem

- Food miles – new
- UK/Europe
  - One in 4 trucks carry agri-food products in Europe
  - UK (since 1983)
    - t-km up 65%
    - Mt lifted up 23%
    - vkm up 46%

- Domestic internal food miles much more important than international

- Cost of transport greater than environ costs from farms

Proposition

- Need for a new synthesis of all types of agricultural systems and ideologies

- Promise and evidence coming from many systems and places
  - Not either-or
  - But both-and

Mechanisms to enhance food-crop production

- Genetic factors
- Agro-ecological factors
- Social and institutional factors
Agricultural sustainability: some evidence

- University of Essex study of 286 sustainable agriculture projects and initiatives in 57 countries
- 12 million farmers have adopted sustainable agriculture practices and technologies since mid 1990s
- 36 million hectares
  - equivalent to ~ 3% of the 960 million hectares of arable and permanent crops in Africa, Asia & Latin America
Agroecological technologies & practices

- **Agroforestry**
  - incorporates multifunctional trees into agricultural systems, and collective management of nearby forest resources

- **Integrated pest management**
  - uses ecosystem resilience and diversity for pest, disease and weed control, and seeks only to use pesticides when other options are ineffective

- **Integrated nutrient management**
  - seeks both to balance the need to fix nitrogen within farm systems with the need to import inorganic and organic sources of nutrients, and to reduce nutrient losses through erosion control

- **Conservation tillage**
  - reduces the amount of tillage, sometime to zero, so that soil can be conserved and available moisture used more efficiently

- **Aquaculture**
  - incorporates fish, shrimps and other aquatic resources into farm systems, such as into irrigated rice fields and fish ponds, and so leads to increases in protein production

- **Water harvesting**
  - in dryland areas, which can mean formerly abandoned and degraded lands can be cultivated, and additional crops grown on small patches of irrigated land owing to better rain water retention

- **Livestock integration**
  - into farming systems, such as dairy cattle, pigs and poultry, including using zero-grazing cut and carry systems
Zero-Till & Conservation Agriculture in Brazil & Argentina

• Zero-tillage
  • No ploughing of soil
  • GM technologies and herbicides
  • Brazil - 25 million hectares
  • Argentina - 19 million hectares

• Benefits
  • better input use, water retention, diverse rotations, increased organic matter in soils (thus more carbon sequestration)
  • reduced erosion and water pollution
  • Yields up and more stable year on year: maize up from 3 to 5 t/ha (Brazil); wheat up from 2 to 3.5 t/ha (Argentina)
Integrated Pest Management in rice

Learning to make best use of beneficial insects & arthropods

Farmer field schools
IPM in rice

- Farmers attend farmer field schools (‘schools without walls’) during whole rice season ~ meet each week to learn new agro-ecological principles for rice and pest management.
- 4 million farmers trained in 175,000 FFS
  - Indonesia 1.1 m
  - Vietnam 930,000
  - Bangladesh 650,000
  - Philippines 500,000
  - India 255,000
  - Egypt 210,000

Outcomes

- Rice yields up 5-7%;
- Costs of production down (Bangladesh ~ 80% of farmers use no pesticides);
- Fish-rice-vegetable systems produce synergistic benefits.
The velvetbean in Central America

• Velvet bean (*Mucuna pruriens*)
  • Multiple cropped with maize
  • Fixes 150 kg N/ha per year
  • Produces 50-100 tonnes biomass per ha/year
  • Improves and regenerates soils

45,000 families in Guatemala, Honduras & Nicaragua growing *mucuna*

• Crop yields up from 400-600 kg/ha to 2000-2500 kg/ha
• Social capital critical –
  – farmers’ groups, experimentation, and extension
Catchment approach to soil and water conservation, Kenya
Patch intensification, Kenya

- Manor House & ABLH using double-dug beds with composting, green and animal manures ~ last 4-6 seasons
- Better water holding capacity and higher organic matter
  - beds more productive, more diverse and able to sustain vegetable growth into dry season
- Benefits for women and children
  - 75% of households free from hunger during year
  - Households buying vegetables during year down from 85% to 11%
  - Proportion selling vegetables up from 20% to 77%
Both yields and environmental services improved

- Carbon footprint
- Biodiversity
- Water use

In every case:

Social capital formation was a key pre-requisite

Pretty *et al*, 2006, *ES&T*
Transformations are possible

Guatemala  Kenya  India
Paraikulum women’s group
(1991 to early 2000s)
The village of Paraikulum – changes over decade +

Tamil Nadu, India
Food story telling

- Easier for fruit, vegetables, some meats, and value-added produce (wine, cheese, cider, cocoa)
  - Strength of farmers’ markets & community supported agriculture
  - Localised food systems – easier to tell the story
- But very hard foods sold as bulk commodities (e.g. cereals, oil seed)
  - Need to tell a better story about what farming is for
Connections to food consumers

• Each time consumers buy or eat food
  • Choices make a difference to farm families and natures elsewhere
  • Most important political act – and made on a daily basis
  • But structures of food systems limit choices

• Connections lost when we think of food as a commodity
  • Large supermarket – 25,000 food lines
  • Few apparent sign of food or farm crisis
  • Yet now
    – Diet-related illness now more costly than smoking
    – Understanding of food production collapsed
Telling the sustainability story

• Landscape full of stories and meanings
• But industrialised landscapes - lost many of their meanings
  • We have forgotten much about human linkages with the rest of nature
  • We have come too easily to believe another story ~ that we have the earth under our control

– Ben Okri “everything is a story… spiders, the wind, a leaf, a tree, the moon, silence, a glance, a mysterious old man, an owl at midnight, an egg by the river, are all impregnated with stories.”
A new era for land management?

- Food
- Wildlife
- Landscape aesthetics
- Carbon sequestration
- Health services
- Flood protection
- Clean water
- Social capital
- Income generation
- Genetic material
- Historic features
Thinking like a mountain

• Aldo Leopold – Sand County Almanac (1949)
  – Idea of the Land Ethic
    • “We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect…”

• This century – a new opportunity to transform consumption behaviour and landscapes?

• And maintain biodiversity and economy?

• And reduce hunger?
Thinking like a mountain

Transilvania, Romania
Priorities for 21st C

• More food from same land without harming supply of environmental services
  • And eventually without oil

• Improve investments in science and technology for both G and E outcomes
  • Biotechnology and agroecology
  • Search for a new synthesis

• Improve delivery and engagement mechanisms
  • Increase numbers of facilitators (extensionists) for social capital formation
  • Partnerships between agencies (GO, NGO, private)
  • Increased investment in agriculture

• Focus on novel pro-poor policies
  • Especially on what small farmers can do
  • Allow place-based solutions to emerge
“The Koyukon are not troubled with the idea that everyone must follow the same ways, or that one way is accepted only at the expense of another. Diversity is a vehicle; there are many truths”

Richard Nelson
Gary Snyder
“Nature is not a place to visit; it is home”

Gary Snyder