The Sustainable Intensification of Agriculture

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#100HeartsandHabits
Changes in per capita GDP and life satisfaction, USA (1946-2011)

Changes in per capita GDP and life satisfaction, Japan (1952-2011)

Changes in per capita GDP and life satisfaction, UK (1946-2011)
Relationship between GDP and life satisfaction at country level (n=145)

Overall life satisfaction (2006-10)

GDP per capita (PPP$, 2009)

Relationship between GDP and HDI at country level (n=173)

Human Development Index (HDI)

GDP per capita (PPP$, 2009)
Relationship between world agricultural land area and world plant food production (1961-2010)

\[ R^2 = 0.9321 \]

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

Agricultural land area (billion ha)

Relationship between all fertilizers applied and world plant food production (1961-2010)

\[ R^2 = 0.9107 \]

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

Fertilizer consumption (Mt per year)

Relationship between world agricultural machinery and world plant food production (1961-2010)

\[ R^2 = 0.9643 \]

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

Total tractors, harvesters and threshers
Gross cereals produced and amount available to humans for food (1961-2007)

Changing meat consumption with gross national income in China, India, Brazil, UK and USA (1961-2007)
Sustainable Intensification
Agro-ecological knowledge

- Application of ecological knowledge to agricultural systems
  - Scientists, extensionists, farmers

- Use of ecosystem services provided by plants, animals and micro-organisms and by physical resources
  - Study of soils, pests and predators, water, trees, organic matter
  - Predation, parasitism, nitrogen-fixation
  - Scale and hierarchy

- Tendency is towards diverse agro-ecosystems with multi-functional components
  - Integrated technologies and practices complement best seeds and breeds
Social capital

- Relations of trust that lubricate co-operation
- Common rules, norms and sanctions for behaviour
- Connectedness and social institutions

- 3 types
  - Bonding, bridging and linking social capital

- Fundamental basis for sustainability
  - lowers the costs of working together
  - facilitates co-operation between people
  - increases flows of knowledge and understanding
  - maintains cultures

- 500,000 new social groups established worldwide in late 1990s-2000s
Sustainable Intensification: some evidence

- University of Essex studies
  - 286 cases in 57 countries (2006)
  - 30 cases in Africa (2011) 
    (commissioned by Foresight)

- Approx 20 million farmers adopted sustainable intensification in 2000s

- Yields: mean increase of 1.67x (286 cases) and 2.13x (Africa)
Food improvements: sustainable intensification

**Additive**
- New components  
  e.g. fish
- Small patches  
  - Raised beds for vegetables
- Land rehabilitation  
  - Formerly degraded becoming productive
- More livestock per household  
  - More fodder trees
- New crops or trees  
  - e.g. domesticated indigenous trees
- Short-maturing varieties permitting 2 crops/yr  
  - e.g. orange fleshe sweet potato, Uganda

**Multiplicative**
- Increased yields per hectare  
  - New varieties and new agronomy and agro-ecological management
Conservation agriculture
Magic beans
Integrated Pest Management
Push-pull IPM, Kenya

![Diagram of push-pull IPM system]

![Bar chart showing number of farmers]

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Number of farmers:
- 1997: 0
- 1998: 5000
- 1999: 10000
- 2000: 15000
- 2001: 20000
- 2002: 25000

Years:
- 1997
- 1998
- 1999
- 2000
- 2001
- 2002
- 2003
- 2004
- 2005
- 2006
- 2007
- 2008
- 2009

Main Crop

Trap Crop

Attract natural enemies

Attract moths

Moths are pushed away
Soil Conservation and Agroforestry
Green Wall of Sahel
### Terroirs côté Niger

<table>
<thead>
<tr>
<th>Distance</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>19 km</td>
<td>au nord de la frontière Niger-Nigeria</td>
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<tr>
<td>12 km</td>
<td>au nord de la frontière Niger-Nigeria</td>
</tr>
<tr>
<td>8.5 km</td>
<td>au nord de la frontière Niger-Nigeria</td>
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</tbody>
</table>

### Terroirs côté Nigeria

<table>
<thead>
<tr>
<th>Distance</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5 km</td>
<td>au sud de la frontière Niger-Nigeria</td>
</tr>
<tr>
<td>14.5 km</td>
<td>au sud de la frontière Niger-Nigeria</td>
</tr>
<tr>
<td>38 km</td>
<td>au sud de la frontière Niger-Nigeria</td>
</tr>
</tbody>
</table>

**Figure 2 :** Vue comparative de trois terroirs de part et d’autre de la frontière Niger-Nigeria
Fertilizer fallows
Catchment approach to soil and water conservation, Kenya
Relative yield change after/with project

Yields before/without project (kg/ha)

- maize
- sorghum/millet
- beans/soya/peas/groundnut
- rice
- wheat
- potato/sweet pot/cassava
- cotton
- vegetables

- no change
Crop improvements

- Local research highly effective
- Participatory
  - research, varietal testing and breeding
- Locally-developed plant and animal materials
- Focus on orphan crops
  - Cassava, plantain, orange fleshed sweet potatoes, tef, pigeonpea, soybean
Common lessons
Social infrastructure

• Social capital a prerequisite to impact and scaling up
  • Farmer Field Schools, cooperatives, Rural Resource Centres, business groups, Common Interest Groups, micro-credit groups, catchment groups

• Local research capacity highly effective
  • Participatory
  • Locally-developed plant materials and animals

• Increased knowledge leads to increased productivity
  • Farmers don’t know everything – especially on pests & diseases
Common lessons
Social infrastructure

• Innovative co-learning and extension platforms
  • Videos
  • Mobile phones
  • Participatory plant breeding
  • Farmer field schools
  • Rural resource centres
  • Civil society campaigns

• Focus on women and children
  – Women’ groups; food for children
    • Orange-fleshed sweet potato;
    • Milk
  – Business opportunities for women’s groups
    • Cassava processing – Cameroon, Uganda
    • Vegetables
Common lessons
Emergent private sectors

• Emergence of new private sectors
  • Aquaculture entrepreneurs
    – Business development driving economic growth
  • Private seed and input suppliers
    – Crops, trees & shrubs
  • Women’s groups

• Novel partnerships (a form of social capital)
  • Private sector, NGOs, public sector, CSOs, farmers, banks
  • Create trust
  • Narrow-sense better than wide-sense (to avoid transaction costs)
  • New associations emerging

• New private sector partners
  • Ghana grains partnership
  • Unilever (Liptons) and smallholder tea growers
Common lessons
Enabling policy environments

• Incentives: Often needed to help establish social and technical infrastructure
  • WFP for Conservation Agriculture
  • Subsidies for fertilizers (eg Malawi)
  • Support for stone bunds, nursery trees, FFS

• Research, extension and incentives
  – Kenya NALEP
    • 20+ years of support to extension
    • 500,000 farmers reached per year
    • 7500 CIGs; many new enterprises

  – Malawi
    • Fertilizer subsidies
    • Surplus food production for country
    • Also 345 fertilizer fallows groups
The Edge of Extinction

TRAVELS WITH ENDURING PEOPLE IN VANISHING LANDS

"Jules Pretty is both a serious thinker and a fine writer. There's nothing like this book, and it will be widely read and well regarded." —BILL MCKIBBEN

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How we could live better

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#EdgeExtinction

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