Comparison of Developed Country Sustainable Agriculture with Subsistence Systems of Cambodia: Which Technologies To Transfer?

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Calvin College
Personal Context

• Agricultural food production
  ▫ Education – Agronomy (Crop Production and Physiology) and the ‘other’ ASA
  ▫ Syngenta Seeds, Inc. Responsibilities
    • NAFTA Director, Product Development
    • Global Head, Seed Production Research
    • Research with “industrial” farmers applying SA

• Hunger and development
  ▫ Global Hunger
  ▫ Global Health, Environment & Sustainability
  ▫ Transforming Cambodia: development, food production
Agenda

• Why care?
  ▫ Sustainability & stewardship
  ▫ Population & hunger
• Food production systems
  ▫ Subsistence
  ▫ Industrial
  ▫ Green revolution
• Sustainable agriculture is ...
• Technologies to (and not to) transfer
Sustainability and the Faith Community

• Sustainability
  ▫ A largely secular term (?)
    “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs”

• Stewardship
  ▫ Genesis 1 “and God saw that it was good.”
  ▫ Genesis 2:15 “took the man and put him in the Garden of Eden to work it and take care of it.”
  ▫ Matt. 22:39: “And the second is like it: ‘Love your neighbor as yourself.’ ”

• Sustainability (=, >, <) Stewardship?
Sustainability (=, >, <) Stewardship

Stewardship

Ecological or Environmental

Economic

Health

Social or Community
Sustainable Agriculture … (Wikipedia)

• ... refers to the ability of a farm to produce food indefinitely, without causing irreversible damage to ecosystem health.

• ... integrates three main goals: environmental stewardship, farm profitability, and prosperous farming communities.

• Three co-existent dimensions of sustainability:
  ▫ Environment
  ▫ Economy
  ▫ Community
Life Expectancy

<table>
<thead>
<tr>
<th></th>
<th>1995</th>
<th>2000</th>
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<tbody>
<tr>
<td>Richest</td>
<td>78</td>
<td>79</td>
</tr>
<tr>
<td>Poorest</td>
<td>43</td>
<td>42</td>
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</table>
WHO, 2005

THE GLOBAL OBESITY PROBLEM

Obese adults in population %
- 30 – 40%
- 20 – 30%
- 10 – 20%
- 5 – 10%
- 0 – 5%
- No data

An obese adult is classified as having a Body Mass Index equal to or greater than 30

SOURCE: World Health Organization, 2005
Global Population and Hunger

- 9.5 B ⇒ Anticipated peak global population, 2050
- 6.2 B ⇒ Current global population
- 1.3 B ⇒ Number of people suffering from over nutrition
- 852 M ⇒ Number of people suffering from under nutrition
- 500 M ⇒ Number of undernourished who are ‘landless’
- 170 M ⇒ Number of undernourished children < 5 years old
Can both goals be accomplished simultaneously?
Three Food Production Systems

- 1.3 B rely on “Industrial Agriculture”
- 2.7 B rely on the “Green Revolution”
- 2.2 B rely on “Subsistence Farming”
Subsistence (2.2 B people)

- Polycultures with local genetics
- Labor intensive
- Low (no) technology
- Minimum pesticides or fertilizers
Trade-off’s for Resource-poor System

**Benefits**
- Potential for polycultures
- Genetic diversity
- Minimal capital investment
- Low input costs
- Fosters community

**Problems**
- Low yields
- Nutrient deficiency
- Soil erosion
- Pesticide toxicity
  - Human
  - Environmental
- (Water quantity and quality)
Industrial Agriculture System

- Competitive
- High volume, low return
- Efficient
- Reliance on fossil energy
- Technology
  - Precision agriculture
  - Genetics
  - Biotechnology
- Monocultures, 1 crop/year
- Fertilizers
- Pesticides

USDA, Economic Research Service
# Trade-off’s of Industrialized Systems

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Problems</th>
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</thead>
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<tr>
<td>• Large quantities of food</td>
<td>• Energy requirement</td>
</tr>
<tr>
<td>• Inexpensive food</td>
<td>• Capital investment</td>
</tr>
<tr>
<td>• Low labor costs</td>
<td>• Input costs</td>
</tr>
<tr>
<td>• <strong>Efficiency</strong> (?)</td>
<td>• Soil erosion</td>
</tr>
<tr>
<td></td>
<td>• Fresh water quality</td>
</tr>
<tr>
<td></td>
<td>• Low [organic matter]</td>
</tr>
<tr>
<td></td>
<td>• Lost community</td>
</tr>
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</table>
What kind of food production system should we export?
Rekindle the Green Revolution?

Dr Norman E. Borlaug
Nobel Laureate
“India” Benefitted from the Green Revolution
Drivers of the Green Revolution

- Improved genetics
- Fertilizers
- Pesticides
- Is this an environmental ‘report card’ we can afford to export?
- Community?

(World Resources, 2000-2001)
Sustainable Agriculture

• Agronomic practices
  ▫ Soil management
    • Minimum to no-till residue mgt
    • Contour farming
    • Terraces
    • Cover crops
  ▫ Water use efficiency
  ▫ Fertilizer use efficiency
  ▫ Integrated pest mgt (IPM)
    • Herbicides
    • Insecticides

• Economics
• Community
Integrated Pest Management (IPM)
http://www.ipm.uiuc.edu/

U.S. farmers grow the crops that feed the entire world. There are more than 2 million farms in the United States. Efficiency in farming practices has raised individual crop output over the years. Better understanding of pest management is a valuable tool in increasing crop output.

The IPM Website covers insects, weeds, diseases, and has a list of related links for five of the major crops in the state of Illinois. You can use the links below to get to each crops main page, and use the navigation tool to the right to skip to different sections.

Related Links:
- Illinois Insect Monitoring Network 2004
- Pest Management and Crop Development Bulletin
- Illinois Agricultural Pest Management Handbook (IAPMH)
- Illinois Insect Management & Insecticide Evaluations (1996)
European Corn Borer

- Corn stalk boring larvae
- >$1B / year
- Control options
  - “God’s will”
  - “see’m, spray’m”
  - IPM calculator
  - Bt Corn
Management Calculator for First-Generation European Corn Borer

To decide whether it will be profitable to treat a field infested with first-generation corn borers, the following information is needed:

- Total number of larvae found.
- Total number of plants examined.
- Expected yield per acre.
- Value of grain per bushel.
- Cost per acre for insecticide treatment.

Enter these data into the following worksheet to calculate the gain or loss for applying an insecticide to control corn borers.

Enter total number of larvae found

Enter expected survival rate
Enter percentage as a decimal
(for example, 20% = 0.2)

Enter the number of plants examined

Choose an expected yield loss per borer: 5% (Early Whorl)

Enter the expected yield
(in bushels per acre)

Enter the value of grain per bushel

Choose a percentage for control: 80% (granules)

Enter the cost of control per acre

Calculate!
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<th>Scenario</th>
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<td># larvae</td>
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<tr>
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<td>20%</td>
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<td># plants</td>
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<td>Expected % Loss per Insect</td>
<td>5%</td>
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<td>Expected Corn Yield</td>
<td>200</td>
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<tr>
<td>Value Of Corn</td>
<td>$3/BU</td>
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<td>% of Insects Controlled</td>
<td>80</td>
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<td>Bottomline</td>
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S.A. & Developing Countries: Guiding Principles

• Build local agronomic knowledge

• Evaluate technological applications in local context

• Empower adoption of economically beneficial and sustainable practices

• Enable local leadership to teach themselves

• Avoid ‘western’ arrogance: Reverse engineer “source” applications
Potential Technologies to Transfer

- Crop growth and development
- Fertility management
- Genetics
- Pesticides
- Polyculture systems: inter-planting, sequential land use
SRI: From “narrow row soybean” to “system of rice intensification”

1. No additional inputs needed!
2. *Transplant single plants, earlier (8-12 day old seedlings)*
3. Transplant quickly and don’t press root into soil
4. Transplant in square grid
5. *Let soils dry occasionally and hand weed*

Result: 2-3X yield
Fertility: From “no till” to “compost” and “no burn”
Fertility: From “Hairy Vetch” to “Azolla - Anabaena”
Genetics:
From “hybrids” to “improved land races”
From “Bt corn” to “disease resistance”

• Yield potential

• Disease resistance

• Application of biotechnology (USAID)
Pesticides: From pesticides to livestock and residue management to enhance insect predators

- **Pesticides**
  - Chrysanthemums (pyrethroids)
  - Chickens and ducks

- **Natural approaches**
  - Rice residue
  - Natural insect predators

- **Technical information leading to economic advice**
Polyculture: From one crop per year to vegetables in the dry season
In Conclusion ...

- Hunger and sustainability issues should be addressed concomitantly, are NOT NECESSARILY contradictory, AND require the leading of the faith community.

- Sustainable agricultural CONCEPTS apply, but technologies SELDOM apply to food production issues in developing countries directly (efficiency).

- Development of appropriate technologies MUST be conducted in local context, considering agronomic (environment + economic) and community needs.