

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

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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 (?)
- The Brundtland Commission (“Our Common Future, Oxford, 1987, p 43)

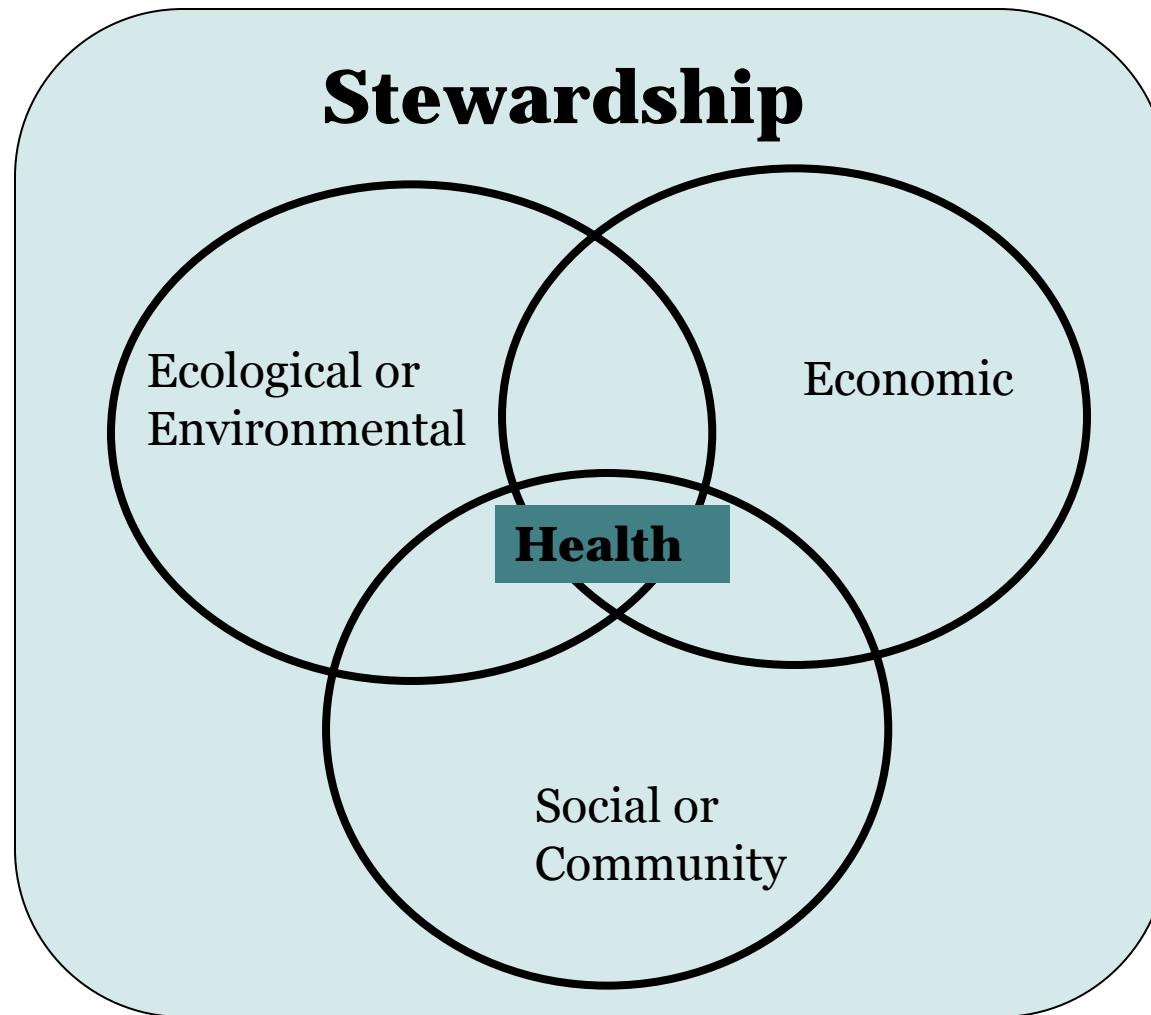
“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs”

- 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.’**”

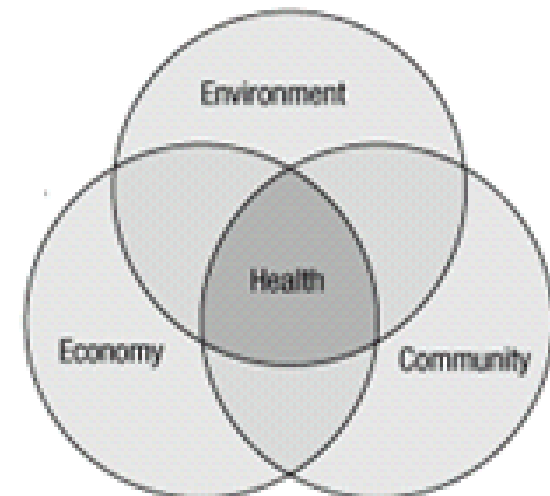
- Sustainability (=, >, <) Stewardship?

Sustainability (=, >, <) Stewardship



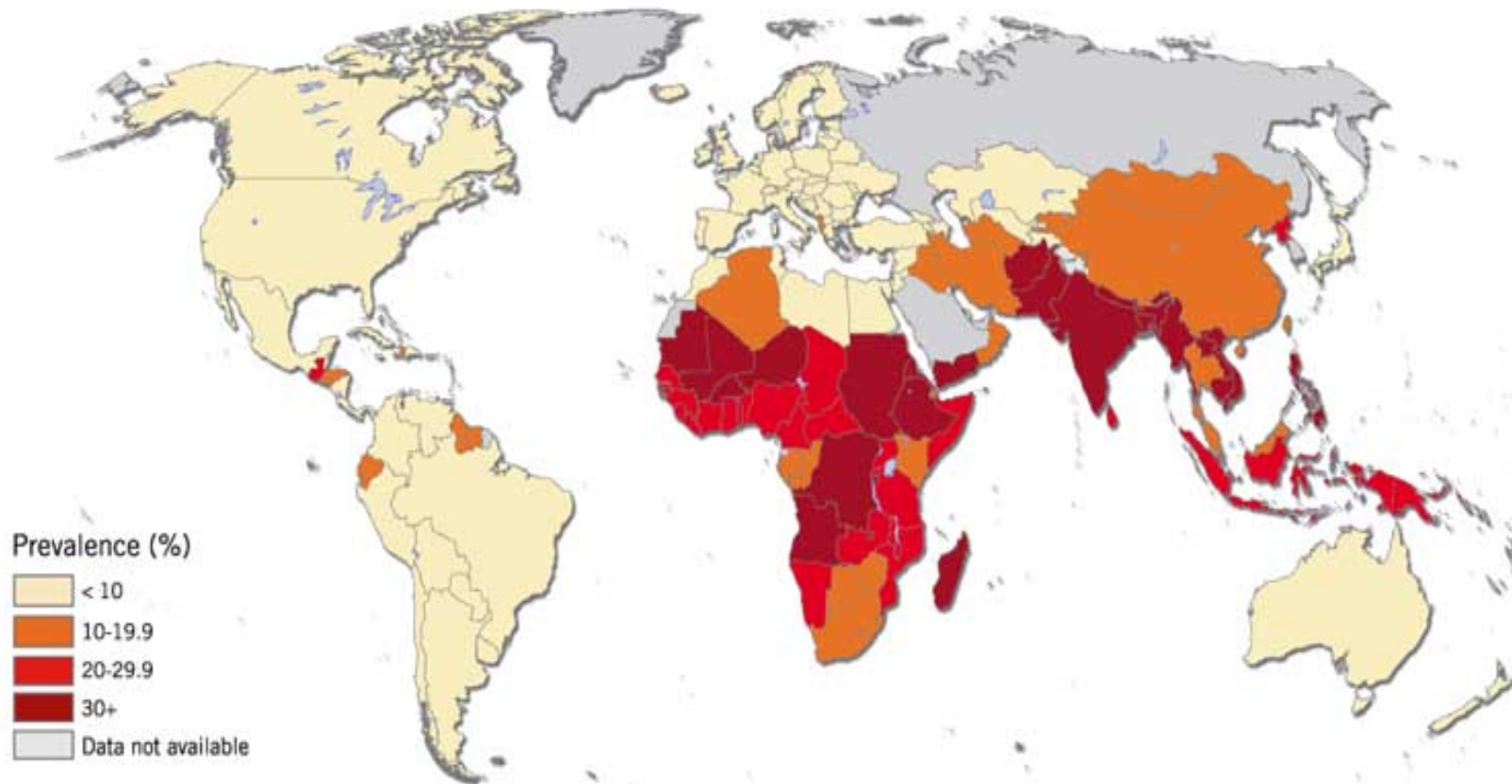
Sustainable Agriculture ... (Wikipedia)

- ... 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

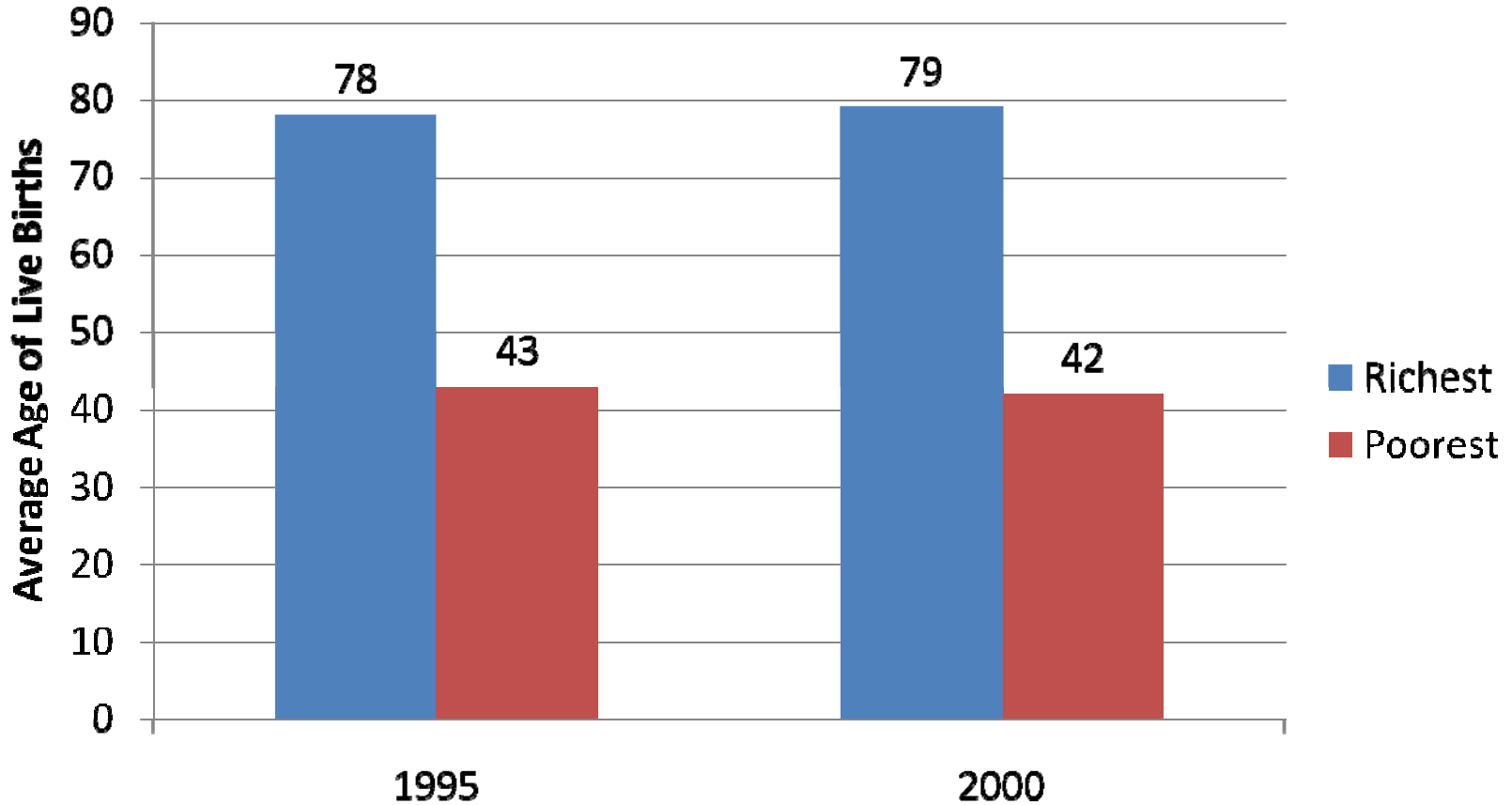


WHO, 2005

Global prevalence of underweight in children under five years of age, 1995-2004

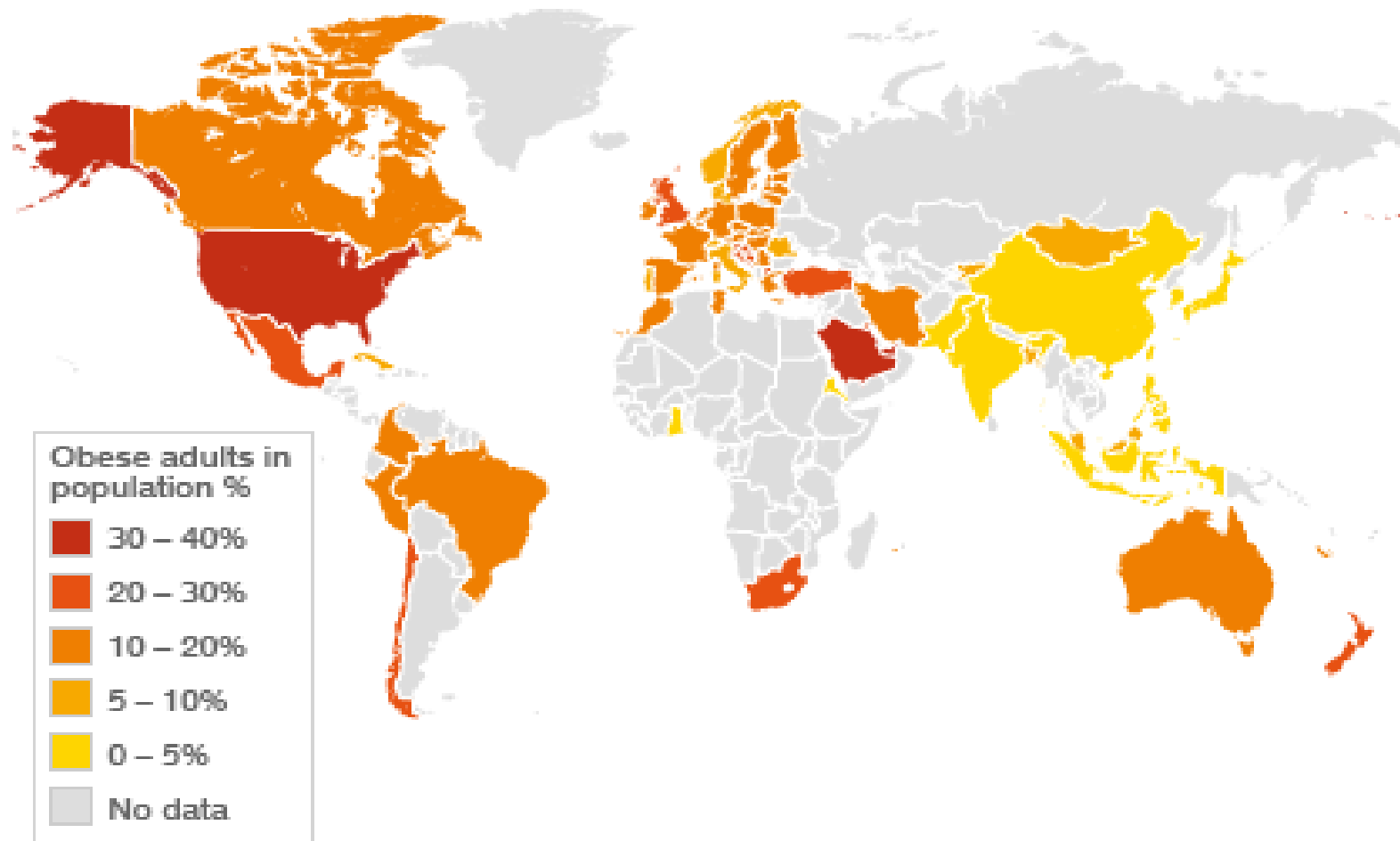


Life Expectancy



WHO, 2005

THE GLOBAL OBESITY PROBLEM



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



UN Millennium Development Goals

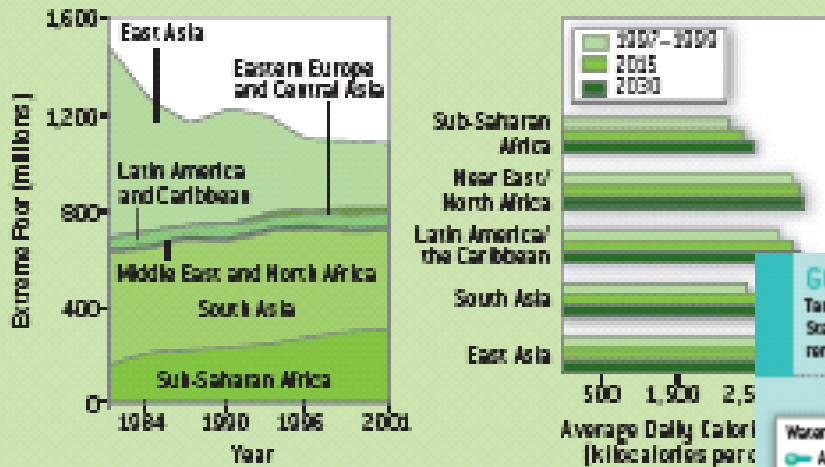
Keep the promise
Millennium Development Goals



GOAL 1 ERADICATE EXTREME POVERTY AND HUNGER

Target: Halve the proportion of people living on less than \$1 a day and the proportion of those who suffer chronic hunger.

Status: Between 1990 and 2001, the fraction of the populations in sub-Saharan Africa, Latin America and the Caribbean living in extreme poverty remained stagnant and, ominously, increased in Central Asia. Food intake is rising, but hunger is still widespread in several regions.

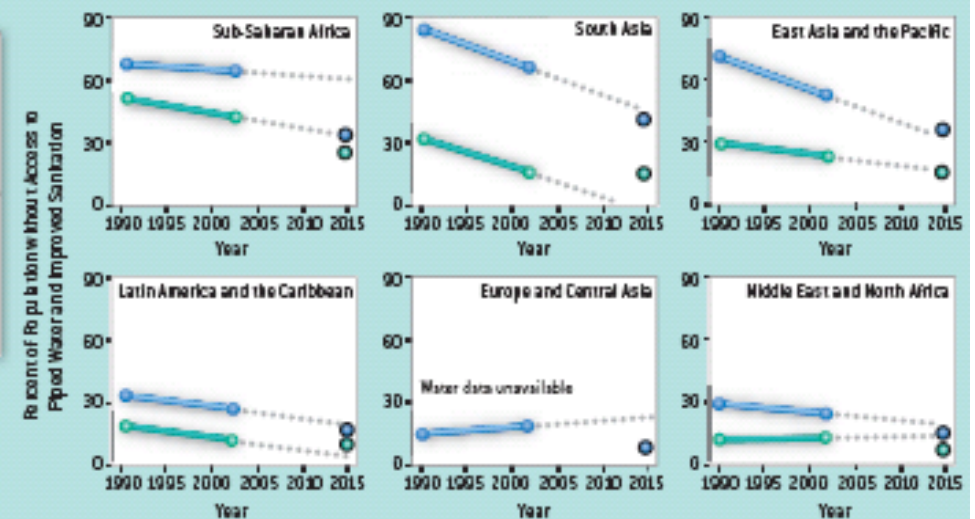
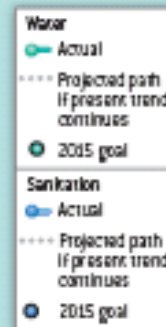


Can both goals be accomplished simultaneously?

GOAL 7 ENSURE ENVIRONMENTAL SUSTAINABILITY

Target: Halve by 2015 the proportion of people without sustainable access to safe drinking water and basic sanitation.

Status: With the exception of sub-Saharan Africa, access to drinking water in urban areas is generally relatively high, although rural access remains limited. Low availability of sanitation services in sub-Saharan Africa and South Asia contributes to widespread diarrheal disease.





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

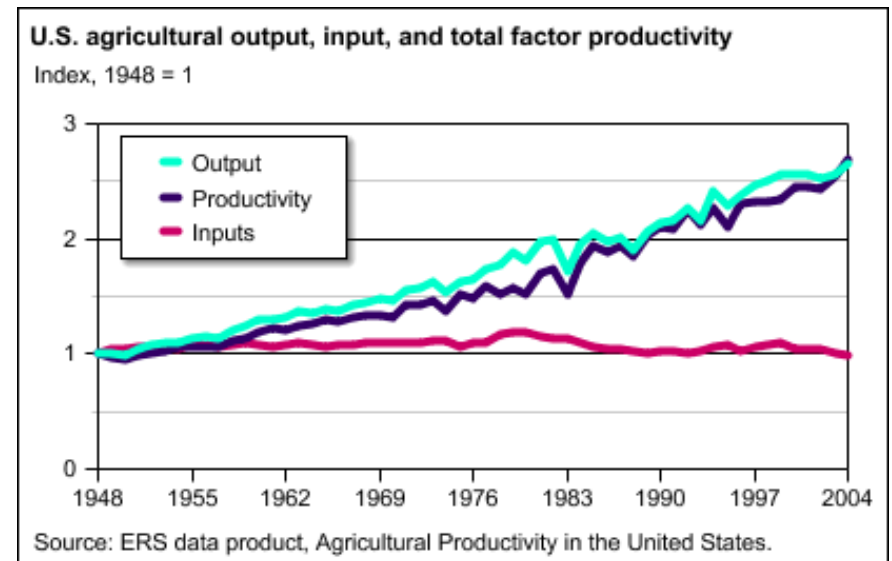
- Potential for polycultures
- Genetic diversity
- Minimal capital investment
- Low input costs
- Fosters community

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

Benefits

- Large quantities of food
- Inexpensive food
- Low labor costs
- **Efficiency (?)**

Problems

- Energy requirement
- Capital investment
- Input costs
- Soil erosion
- Fresh water quality
- Low [organic matter]
- Lost community

What kind of food production system should we export?

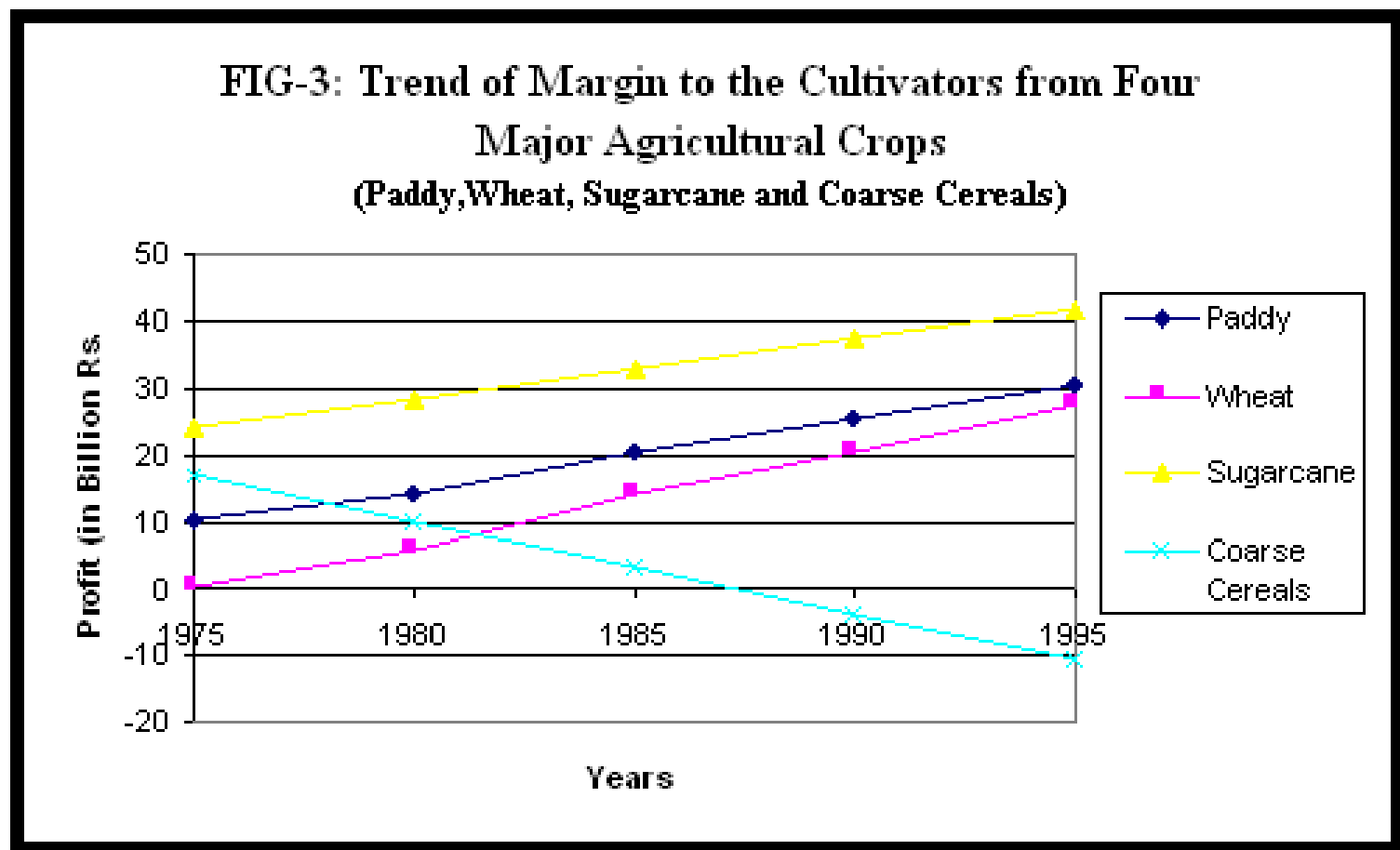
Rekindle the Green Revolution?



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)

Scorecard

	Agro	Coast	Forest	Fresh-water	Grass-lands
Food/Fiber Production	Green, ↘	Yellow, ↘	Green, ↗	Yellow, ↑↓	Yellow, ↘
Water Quality	Red, ↘	Yellow, ↑↓	Yellow, ↘	Red, ↘	Blue, □
Water Quantity	Yellow, ↘	Blue, □	Yellow, ↘	Yellow, ↘	Blue, □
Biodiversity	Red, ↘	Yellow, ↘	Red, ↘	Red, ↘	Yellow, ↘
Carbon Storage	Yellow, ↑↓	Blue, □	Yellow, ↘	Blue, □	Green, ↘
Recreation	Blue, □	Green, ?	Blue, □	Blue, □	Green, ↘
Shoreline Protection	Blue, □	Red, ↘	Blue, □	Blue, □	Blue, □
Woodfuel Production	Blue, □	Blue, □	Yellow, ?	Blue, □	Blue, □

Key

Condition assesses the current output and quality of the ecosystem good or service compared with output and quality of 20-30 years ago.

Condition	Excellent	Good	Fair	Poor	Bad	Not Assessed
	Blue	Green	Yellow	Red	Dark Red	Light Blue

Changing Capacity assesses the underlying biological ability of the ecosystem to continue to provide the good or service.

Changing Capacity	Increasing	Mixed	Decreasing	Unknown
	↗	↑↓	↘	?

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/>



integrated pest management

[Educational Materials](#)
[FAQs](#)
[Videos](#)
[Decision Aids](#)

Field Crops

Fruits

Vegetables

Landscape & Turf

Greenhouse

Home, Yard & Garden

Livestock



Field Crops



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.

[Alfalfa](#) - [Corn](#) - [Sorghum](#) - [Soybeans](#) - [Wheat](#)

Related Links:

- [Illinois Insect Monitoring Network 2004](#)
- [Pest Management and Crop Development Bulletin](#)
- [2000-2001 Interactive Agronomy Handbook](#)
- [1999-2000 Agronomy Handbook](#)
- [Illinois Agricultural Pest Management Handbook \(IAPMH\)](#)
- [Illinois Insect Management & Insecticide Evaluations \(1996\)](#)

FIELD CROPS

Hot Topics
Soybean Aphid Workshop
Download and view
powerpoint presentations
from the workshop....

more

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	<input type="text"/>
Enter expected survival rate ¹ Enter percentage as a decimal (for example, 20% = 0.2)	<input type="text"/>
Enter the number of plants examined	<input type="text"/>
Choose an expected yield loss per borer:	5% (Early Whorl) ▼
Enter the expected yield (in bushels per acre)	<input type="text"/>
Enter the value of grain per bushel	\$ <input type="text"/>
Choose a percentage for control:	80% (granules) ▼
Enter the cost of control per acre	\$ <input type="text"/>
<input type="button" value="Calculate!"/>	

Calculator Inputs	Scenario
	1
# larvae	20
Survival rate	20%
# plants	10
Expected % Loss per Insect	5%
Expected Corn Yield	200
Value Of Corn	\$3/BU
% of Insects Controlled	80
Cost to Treat	\$15/A
Bottomline	-5.39
Would You Spray?	No

Calculator Inputs	Scenario	
	1	2
# larvae	20	30
Survival rate	20%	20%
# plants	10	10
Expected % Loss per Insect	5%	5%
Expected Corn Yield	200	200
Value Of Corn	\$3/BU	\$3/BU
% of Insects Controlled	80	80
Cost to Treat	\$15/A	\$15/A
Bottomline	-5.39	-0.59
Would You Spray?	No	No

Calculator Inputs	Scenario		
	1	2	3
# larvae	20	30	20
Survival rate	20%	20%	50%
# plants	10	10	10
Expected % Loss per Insect	5%	5%	5%
Expected Corn Yield	200	200	200
Value Of Corn	\$3/BU	\$3/BU	\$3/BU
% of Insects Controlled	80	80	80
Cost to Treat	\$15/A	\$15/A	\$15/A
Bottomline	-5.39	-0.59	9.00
Would You Spray?	No	No	Yes

Calculator Inputs	Scenario			
	1	2	3	4
# larvae	20	30	20	20
Survival rate	20%	20%	50%	50%
# plants	10	10	10	10
Expected % Loss per Insect	5%	5%	5%	6%
Expected Corn Yield	200	200	200	200
Value Of Corn	\$3/BU	\$3/BU	\$3/BU	\$3/BU
% of Insects Controlled	80	80	80	80
Cost to Treat	\$15/A	\$15/A	\$15/A	\$15/A
Bottomline	-5.39	-0.59	9.00	13.80
Would You Spray?	No	No	Yes	Yes

Calculator Inputs	Scenario				
	1	2	3	4	5
# larvae	20	30	20	20	20
Survival rate	20%	20%	50%	50%	50%
# plants	10	10	10	10	10
Expected % Loss per Insect	5%	5%	5%	6%	5%
Expected Corn Yield	200	200	200	200	150
Value Of Corn	\$3/BU	\$3/BU	\$3/BU	\$3/BU	\$3/BU
% of Insects Controlled	80	80	80	80	80
Cost to Treat	\$15/A	\$15/A	\$15/A	\$15/A	\$15/A
Bottomline	-5.39	-0.59	9.00	13.80	3.00
Would You Spray?	No	No	Yes	Yes	Yes

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





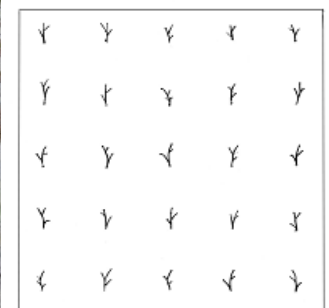
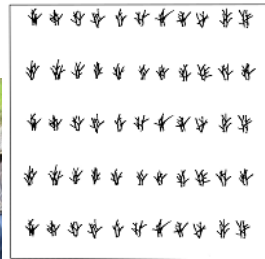
Potential Technologies to Transfer

- 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

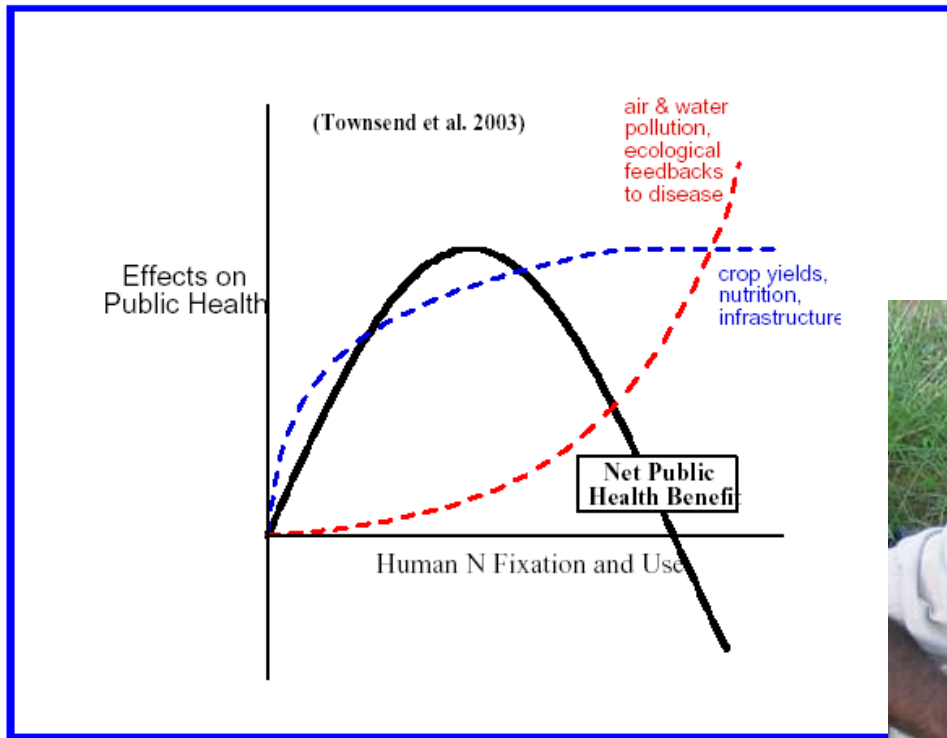


Fertility: From “no till” to “compost” and “no burn”



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)

IRRI
International Rice Research Institute

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Rice Science for a Better World

IRRI is a nonprofit research and training center established to reduce poverty and hunger, improve the health of rice farmers and consumers, and ensure environmental sustainability through collaborative research, partnerships, and strengthening of national agricultural research and extension systems.

What's new **RSS**

- IRRI in Time, Wall St. J., Newsweek, AFP, BBC, CNN, NPR, Reuters & VOA
- In the media: IRRI and rice price crisis
- IRRI DG calls for 2nd Green Revolution
- Full-text IRRI books on Google
- Video of Svalbard Seed Vault opening
- Hybrid Rice Consortium & Symposium
- Rice News Worldwide
- IFAD Upland Newsletter, Vol. 1 No. 1

MEMBER:
CGIAR

Bringing Hope, Improving Lives: IRRI's Strategic Plan 2007-2015
Rice Research and the UN Millennium Development Goals

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Waterproof rice

IRRI
irri.org

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.