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

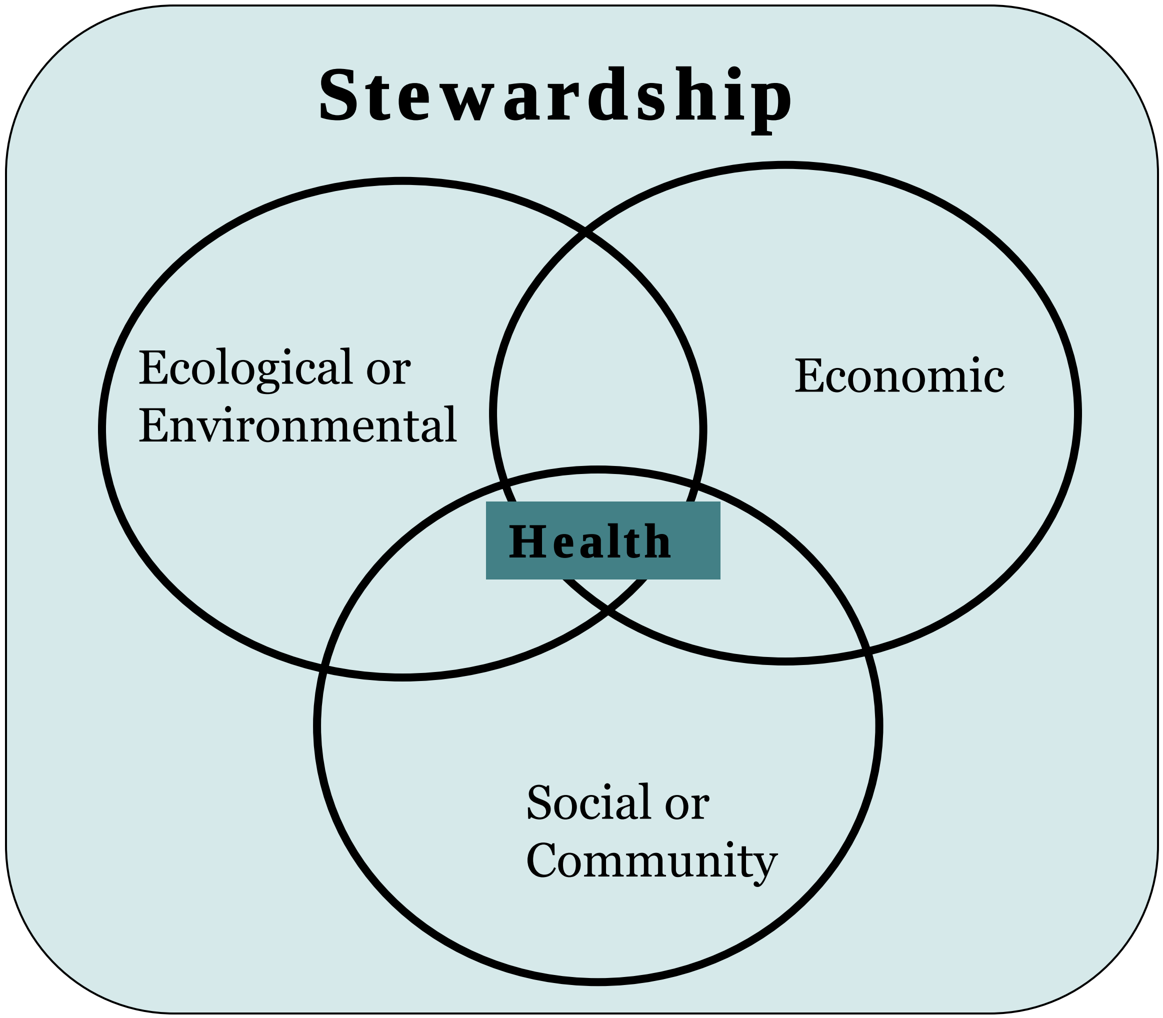
- Sustainability
  - A largely secular term (?)
  - The Brundtland Commission (“Our Common Future, Oxford, 1987, p 43)

    “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?

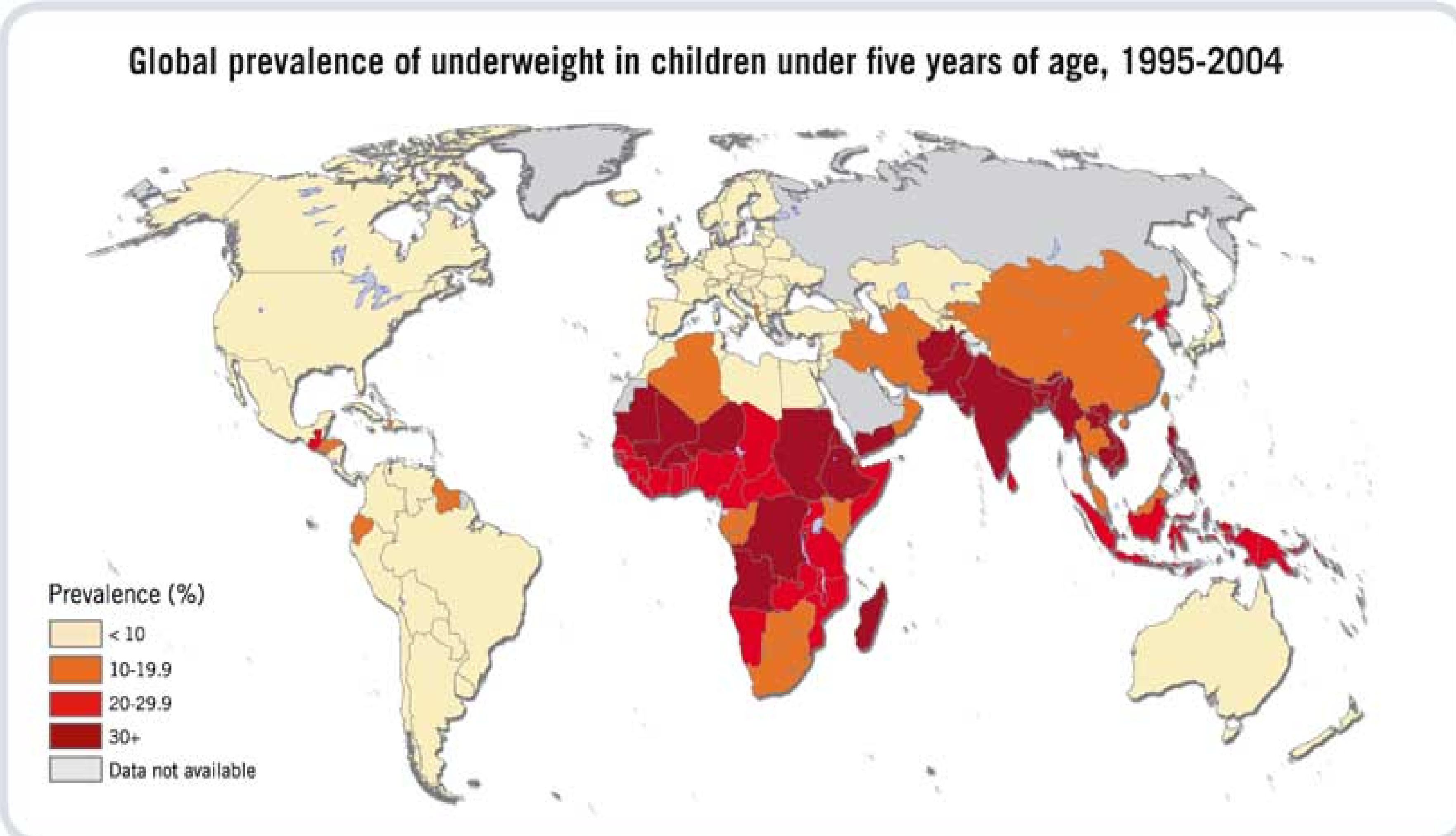
Sustainability **(=,>,<)** Stewardship



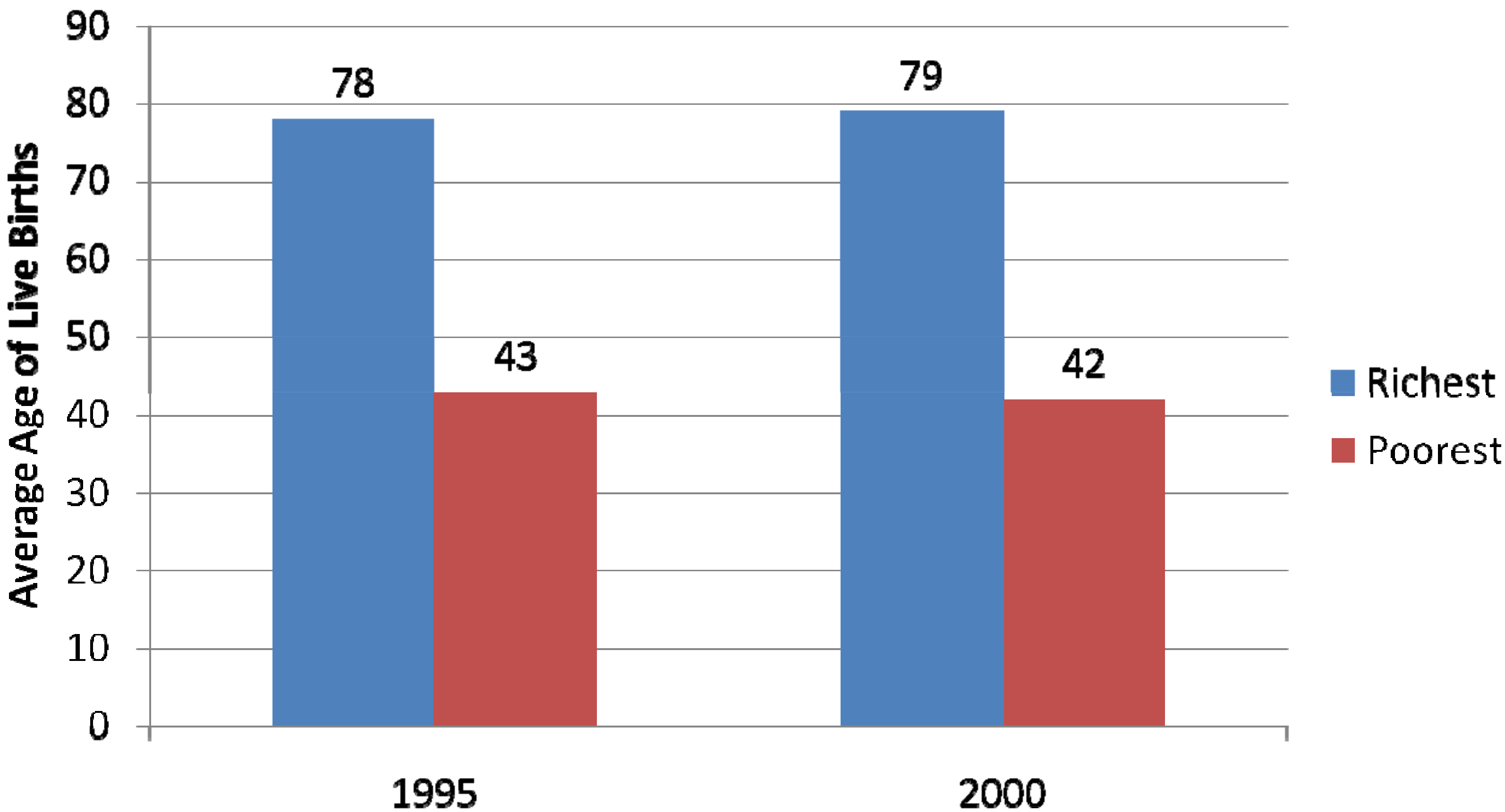
Sustainable Agriculture … (Wikipedia)

- … 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

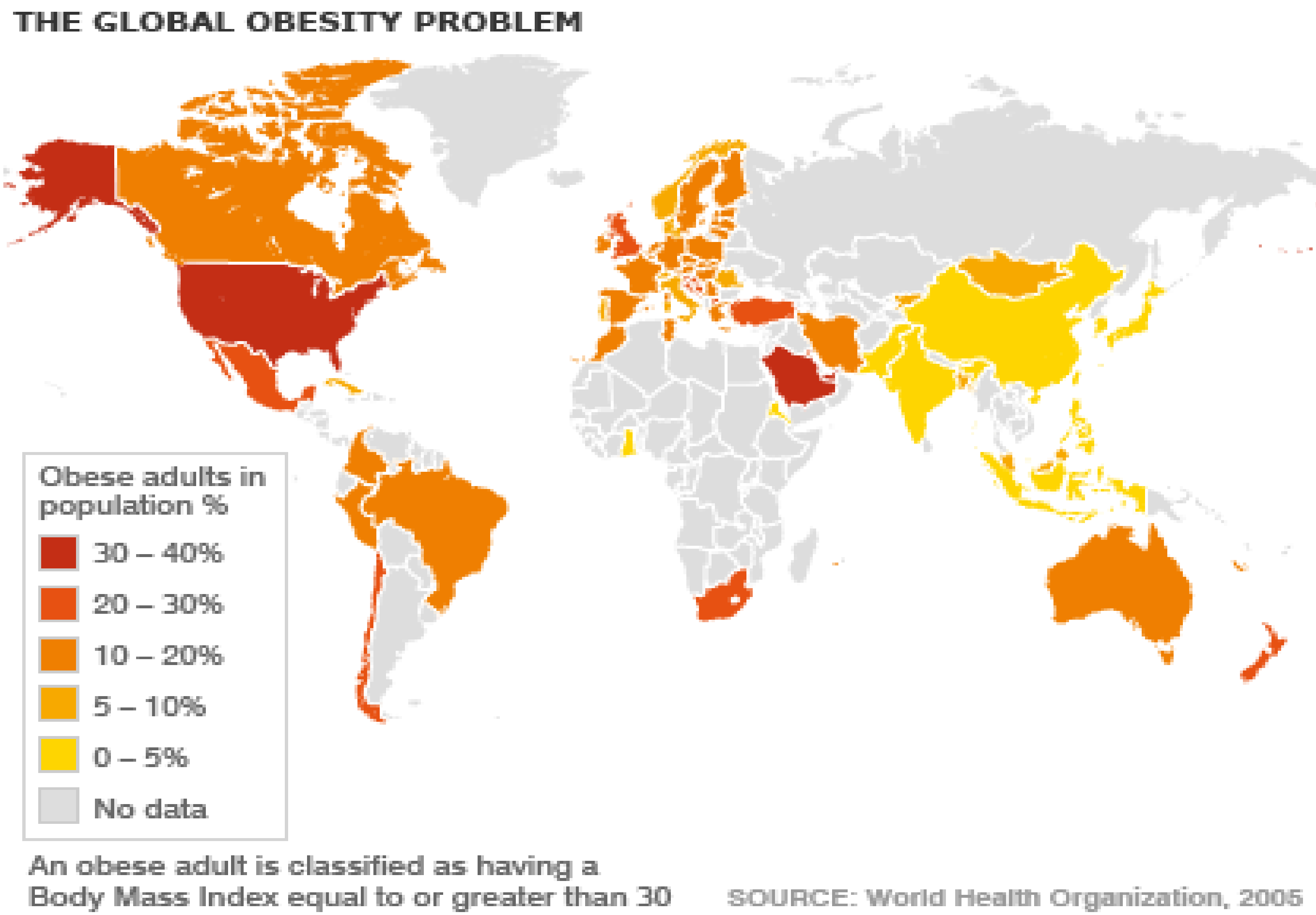
WHO, 2005


Global prevalence of underweight in children under five years of age, 1995-2004
Prevalence (%)
< 10
10-19.9
20-29.9
30+
Data not available

Life Expectancy



WHO, 2005

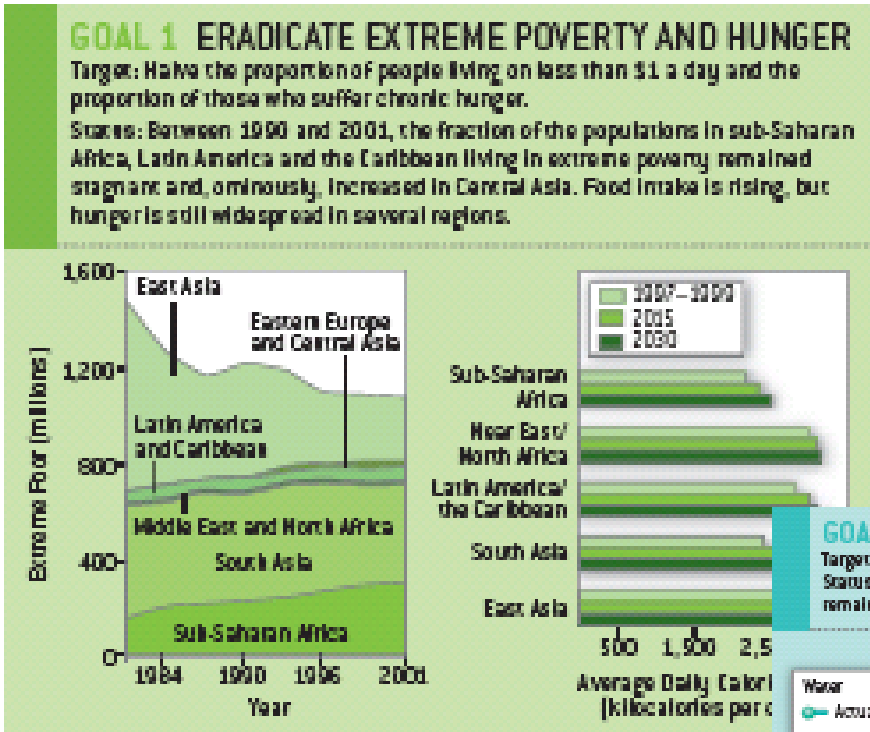

THE GLOBAL OBESITY PROBLEM
Obese adults in population %
30 – 40%
20 – 30%
10 – 20%
5 – 10%
0 – 5%
No data
An obese adult is classified as having a Body Mass Index equal to or greater than 30
SOURCE: World Health Organization, 2005

Global Population and Hunger

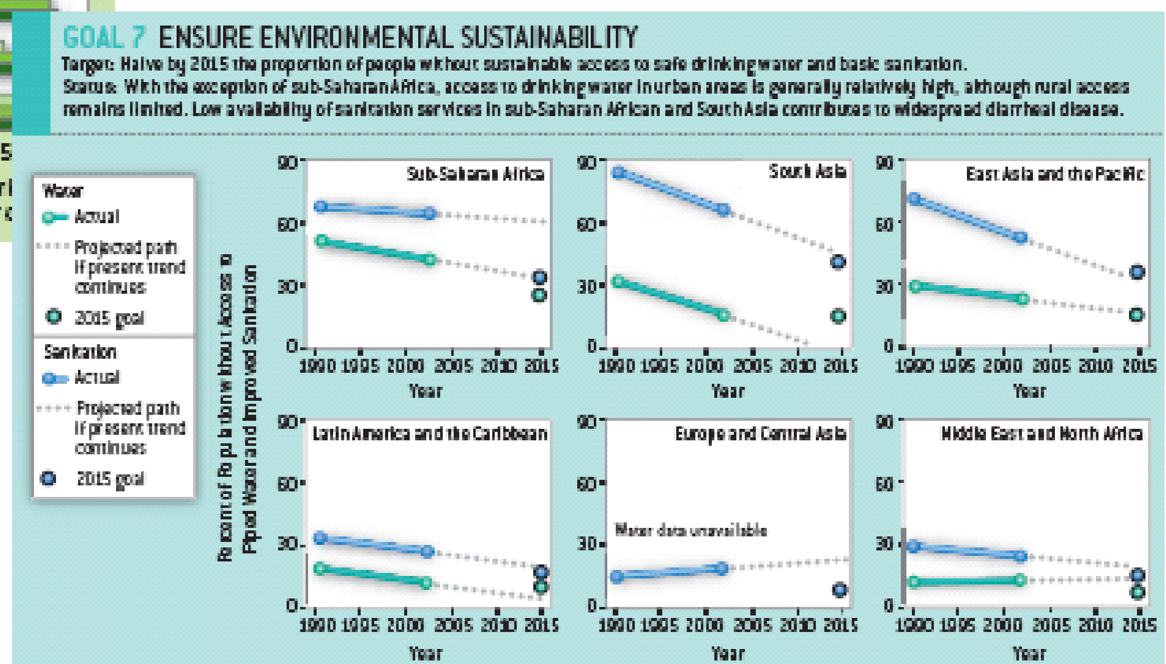
- 9.5 B ⇒Anticipated peak global population, 2050
- 6.2 B ⇒Current global population
- 1.3 B ⇒Number of people suffering from over nutrition
- 852 M ⇒Number of people suffering from under nutrition
- 500 M ⇒Number of undernourished who are ‘landless’
- 170 M ⇒Number of undernourished children < 5 years old

UN Millennium Development Goals

keep the promise
Millennium Development Goals
2015



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

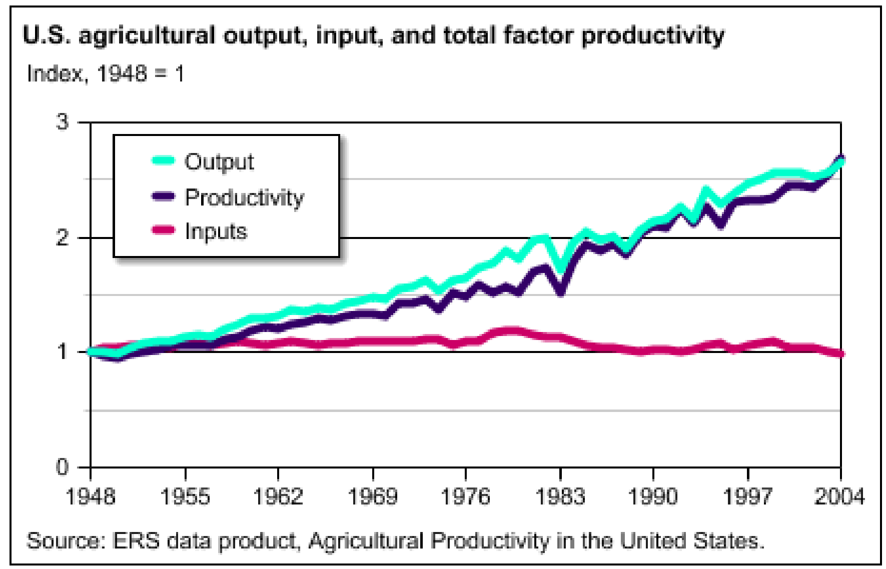
- Potential for polycultures
- Genetic diversity
- Minimal capital investment
- Low input costs
- Fosters community

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

<u>Benefits</u>

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

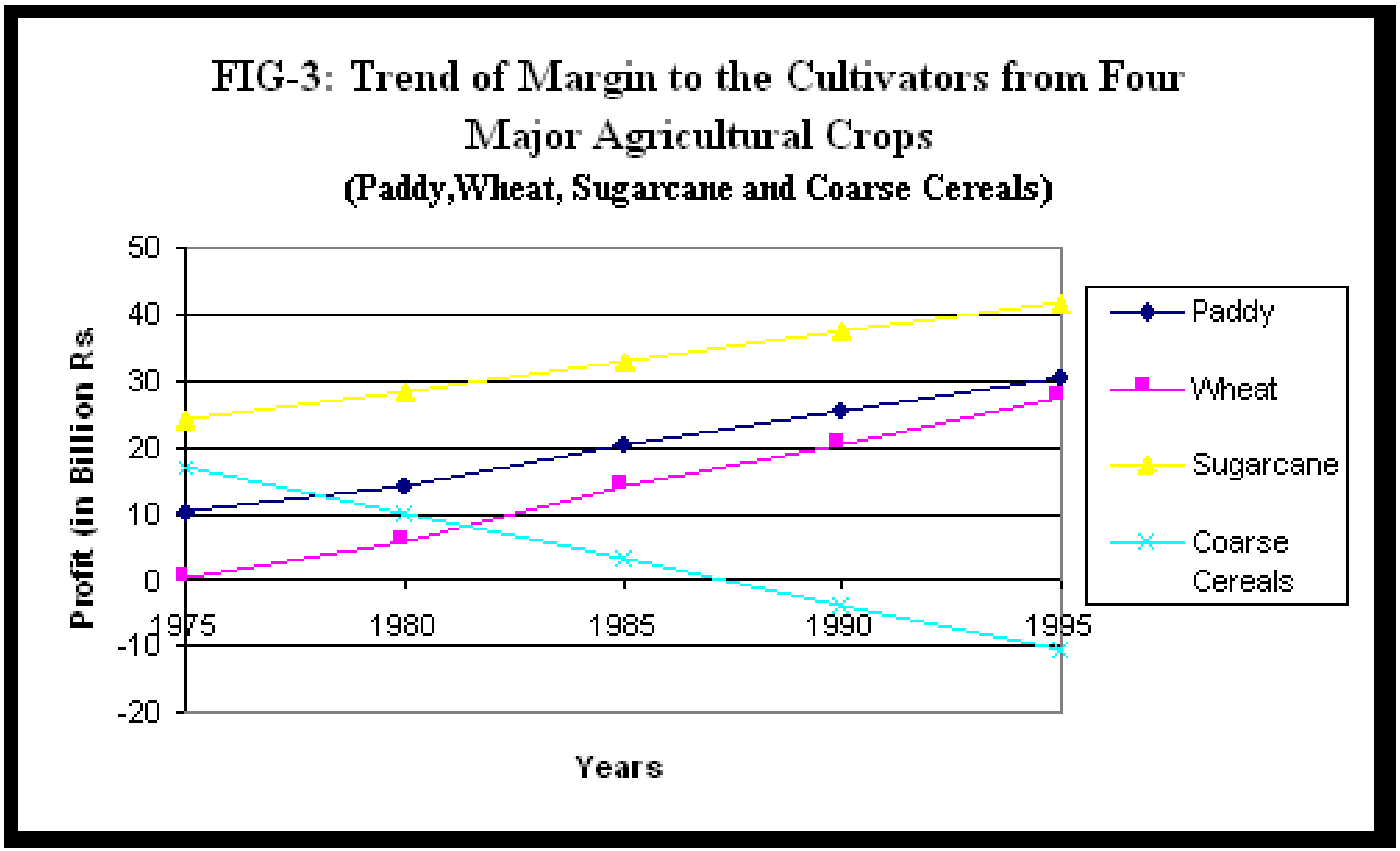
<u>Problems</u>

- 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?

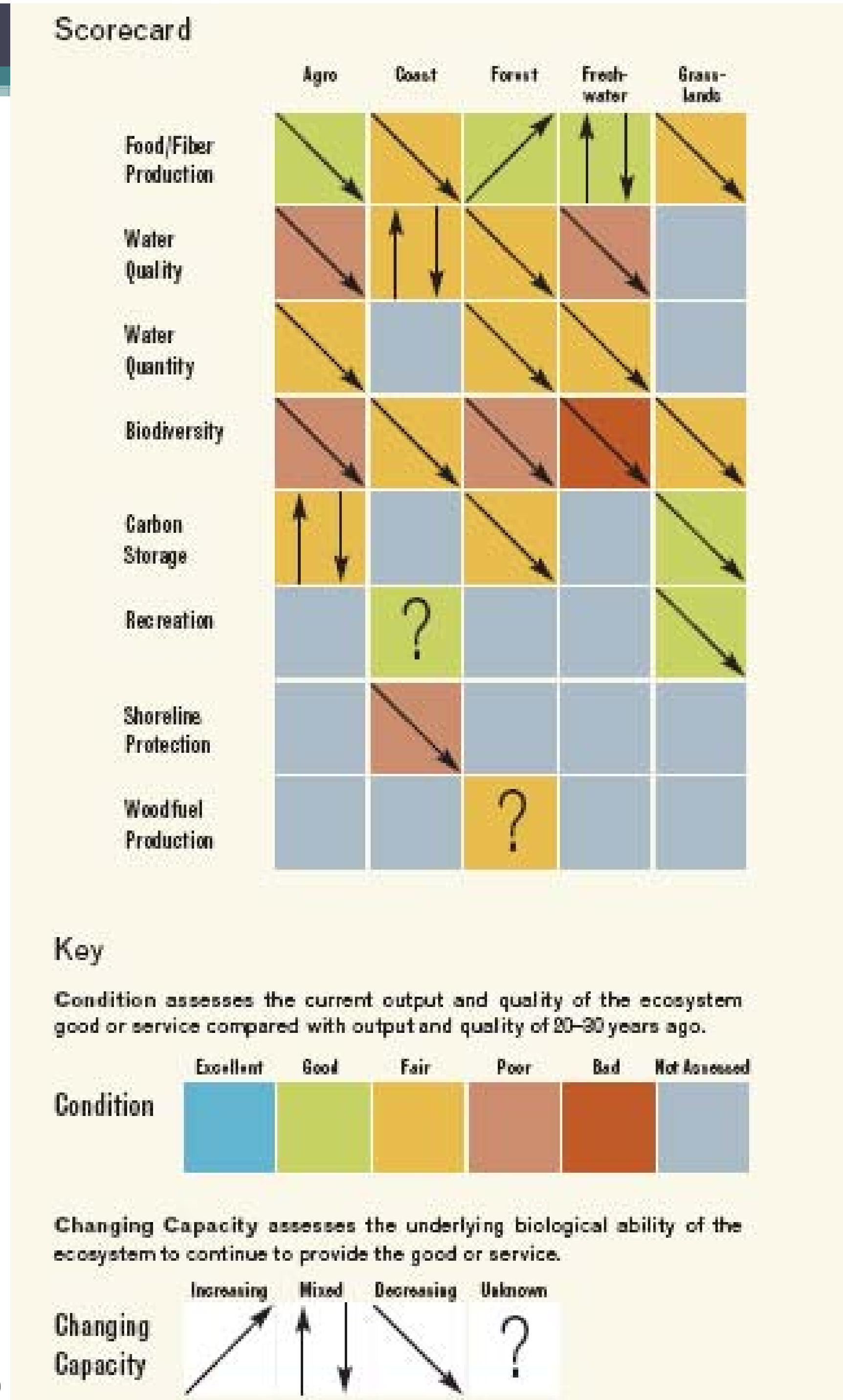
Rekindle the Green Revolution?

“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/

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[1] 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!

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

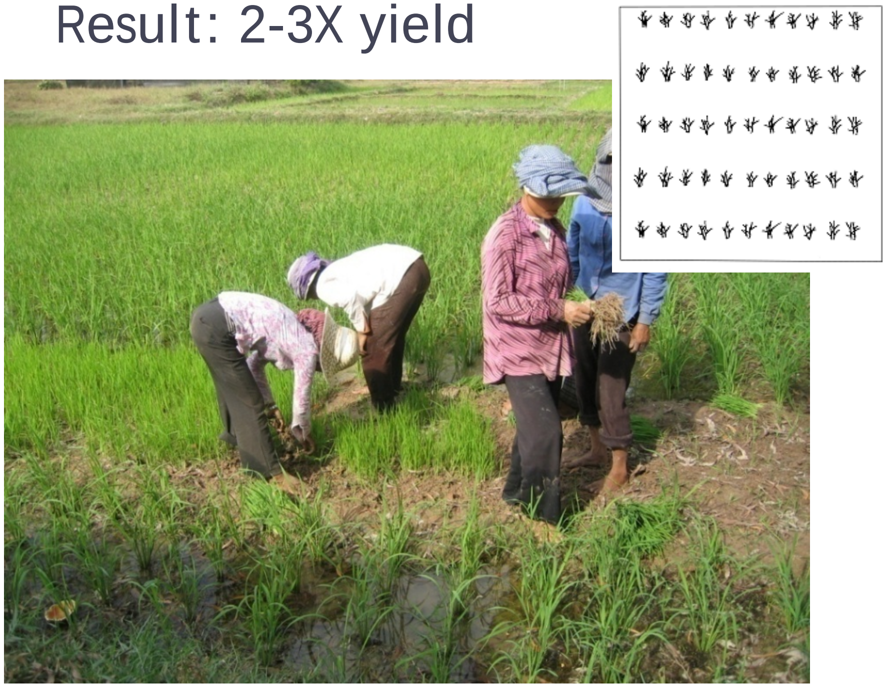
Potential Technologies to Transfer

- 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"

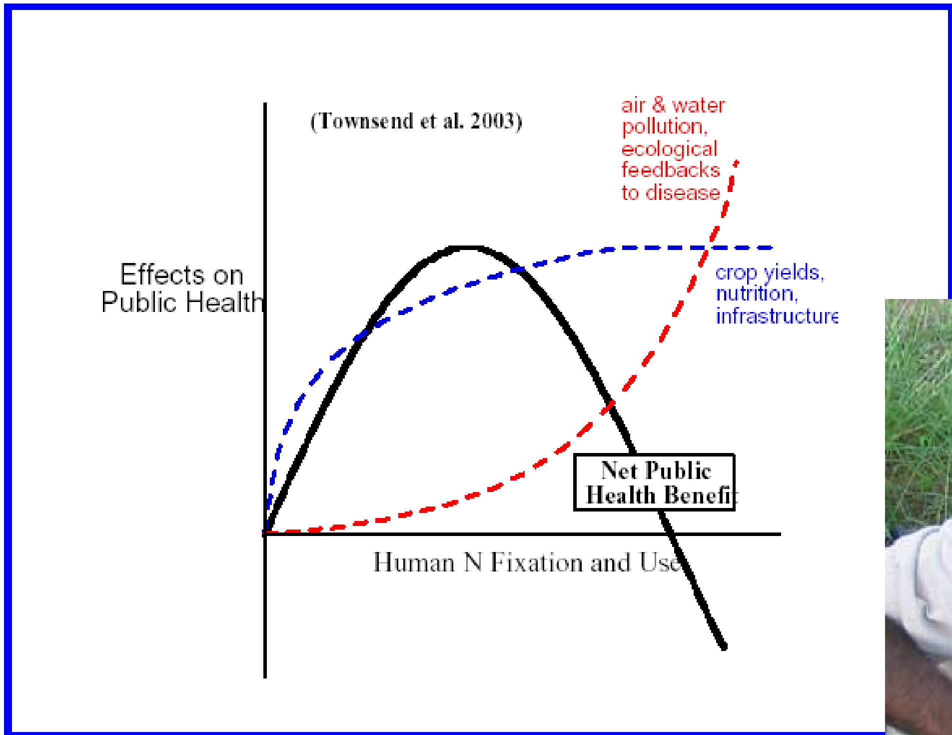
1. No additional inputs needed!
2. *Transplant single plants, earlier (8-12 day old seedli*
3. Transplant quickly and don't press root into soil
4. Transplant in square grid
5. *Let soils dry occasionally and hand weed*

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.