Sustainable Agriculture, Developing Countries, and Micah 6:8. Does Cambodia Need Our Food System or do we need theirs?
Central Premise & Corollary

The *principles* of sustainable agriculture apply to developed and developing country food production systems, but many of the specific *practices* do not. *Encourage Biblically supported principles, not practices.*

If individuals engaged in development from developed countries rely too heavily on their food production experience to increase food production capacity, then we may actually promote unsustainable systems and could incur harm.
Micah 6:8 (NIV)

“He has showed you, O man, what is good.

And what does the Lord require of you?

To act justly and to love mercy and walk humbly with your God.”
Objectives

1. Remind you of ‘our’ industrial agricultural system, its purpose, and its unsustainability.
2. Define sustainable agriculture (SA) from the perspective of multiple stake-holders and describe steps taken to improve sustainability.
3. Use examples to distinguish practices of SA from principles
4. Compare SA practices of developed and developing countries to illustrate potential problems and possibilities (in both directions).
Global Context - Statistics

- 6.4 B
- 9.5 B
- 852 M
- 1.3 B
- 500 M
- 170 M
- 12 M
Global Context - Statistics

- 6.4 B – current human population
- 9.5 B – expected peak human population
- 852 M – under nourished population
- 1.3 B – over nourished population & impoverished
- 500 M – landless population
- 170 M – under nourished ≥ 5 years of age
- 12 M – annual death rate of under nourished ≥ 5 years of age
Geography of Under Nutrition (WHO)
Geography of...

Under Nutrition

Poverty ($1/d) (WHO)
Geography of Water Poverty
Sustainability

- What is sustainability?
  - Ecological
  - Economic
  - Community

- 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”

- Raven: “We must find new ways to provide for a human society that presently has outstripped the limits of global sustainability.”
Industrialized Food Production System Themes

- Cultural type?
- Scale?
- Complexity?
- Trade-off’s?
  - Positive ...
  - Negative ...
Industrialized Food Production System: Planting
Tillage and Fertilization
Value/Cost of Pesticides
Harvest
Industrialized Food Production
System Themes

- System type? Specialized monoculture
- Scale? Large “get big or get out”
- Complexity? Highly integrated, scientific, economic
- Trade-off’s?
  - Positive ...
  - Negative ...
State of the World

“Science, Sustainability and the Human Prospect” (Raven, Science - 2001)

- Soil erosion
  - 20% topsoil lost
  - 20% agricultural land developed (1.2%/yr)
- Water >50% diverted to humans
- Fix more nitrogen with fossil fuel than naturally
- Pesticides – 3M MT/year
- Extinction rate is 100 - 1000X geological baseline
- 66% of fisheries harvested faster than renewed
How Healthy the Agroecosystem?
(Worldwatch Institute, 2001)

- Production capacity is GOOD
- Ecological services are FAIR-POOR
- In the future, all goods and services will decline
**Sustainable Agriculture (SA)**

- **Sustainable agriculture** integrates three main goals: environmental stewardship, farm profitability, and prosperous farming communities. These goals have been defined by a variety of disciplines and may be looked at from the vantage point of the farmer or the consumer. ([http://en.wikipedia.org/wiki/Sustainable_agriculture](http://en.wikipedia.org/wiki/Sustainable_agriculture))

- “Sustainable Agriculture” means different things to different people ... a continuum

  ![Small variations on industrial model](https://via.placeholder.com/150)

  ![Agroecological principles](https://via.placeholder.com/150)
PRACTICES of SA Being Implemented

- Reduce soil erosion
- Increase water use efficiency
- Increase nitrogen use efficiency
- Integrated pest management systems
Reduce Soil Erosion

- From fall moldboard plowing
- To ...
  - Minimum tillage
  - No-till
  - Grassy waterways
  - Buffer zones
  - Terraces
  - Contour farming
Increase Water Use Efficiency

- From gravity systems
- To ...
  - high pressure pivots
  - To low pressure pivots
Increase Nitrogen Use Efficiency

- From full fall fertilization w/o stabilizer
- To ...
  - Spring application
  - Spring w/ N-serve
  - Split application as a side-dress
Integrated Pest Management

- From “see’em, spray’em”
- To ...
  - Economic calculators
  - Biotechnology traits
How applicable *do you* think these SA Practices are to the agrarian system? (Imagine, Cambodia)

- Large equipment
- Monocultures
- Chemical fertilizers and pesticides
- Labor

... Needed: a different sort of efficiency
PRINCIPLES of Sustainable Agriculture Broadly Apply

- Protect diversity (Deut. 10:14, I Chron. 29:11, Job 41:11, Ps. 24:1)
  - Monocultures ... low biodiversity, loss of resilience

- Establish a rest period (Ex. 23:10-11a, Lev. 25:3-4)
  - Crop rotation ... erosion, nitrogen fixing crops, irrigation

- Don’t pollute the land (Num. 35:33, Gen. 2:15)
  - Pest control ... reliance on pesticides, chemical fertilizers

- God sustains (Ps. 65:9, II Chron. 7:13, Col. 1:17)
  - Holistic system ... working with ecological forces
Importing Industrialized Ag: Potatoes in Carchi, Ecuador

- **History**
  - Productive area for potatoes
  - Pests: insects, Phytophthora disease
  - Industrialized – monocultures and pesticides increased yield 80%
  - Inflation increased costs, not potato prices

- **Pesticides and health**
  - 24 carbamates & 28 organophosphate’s)... 90% “highly toxic”
  - 60% population
  - 21 fatalities + 171 poison/100,000/year
  - Families affected, more so “bread winners”
Sustainability Rubric

- Community / social behaviors
  - Family exposure
  - Little to no PPE (personal protective equipment)
  - Labels in English, sold as “plant medicine”

- Environment
  - Continuous potato cropping (no lifecycle break)
  - Few natural predators
  - Insects and diseases adapted to chemicals

- Economic
  - 33% of input cost was chemicals
  - Yield declined from initial gains
  - Excess supply decreased commodity value
  - In last decade (1990’s), lost money 4 years of 10
What Happened?

- “EcoSalud” ... *motivated* by widows
  - Community development (train trainers)
    - Pesticide handling
    - Clothes washing
  - Integrated Pest Management
- “Safe Use” & financial planning education

**Outcomes**

- Scout for pests, no anecdotal spraying
- Reduced spray # from 12 to 7, a.i. load 50%
- Reduced human health issues
- Similar yields, lower costs, greater profitability
Cambodian Context

- Rice diet – protein, vitamin deficiencies
- 85% rural agrarian farmers
- 3-month wet season, 9-month dry
- Average income ~$1/day
- Insufficient water during the dry season
- Depleted soil fertility
- Some pesticide use
- Little access to inorganic fertilizers
Angkor Hospital for Children
Reduce Soil Erosion, Promote Insect Predators
Integrated Pest Management: Chickens, Ducks
Increase Water Use Efficiency
Drip Irrigation: “Gold Standard” Water Use Efficiency

NAWSA MAD:
$3 kit
$40 storage tank
Burlap bag
Improved nutrition
+$90 income/year
Increase Nitrogen Use Efficiency
Compost Collection and Distribution in Fields
Increase Nitrogen Use Efficiency

Nitrogen Fixing Azolla-Anabaena
Integrated Systems: Increase Water & Nitrogen Use Efficiency

- Well
- Catfish ponds
- 50-gallon drum
- Trickle irrigation
- Vegetable garden
Who's Technology?

- Vitamin A deficiency
  - Biotechnology and “Golden Rice”
  - Or ... vegetable garden

- Higher rice yields
  - Fertilizers, pesticides
  - System of Rice Intensification (SRI)
What Sort of Efficiency?
What does “agroecology” look like and how might we become truly sustainable?
Conclusions

- **SA principles** are broadly applicable to food production systems
- **SA practices** are conflated with the industrialized food production system in developed country context
- The sort of **efficiency** required by people in developing country contexts is not the sort of efficiency provided by industrialized systems
- **Humble dialogue** among developed and developing practitioners coupled with judicious testing of technical applications could improve the sustainability of both food production systems