Agricultural Sustainability: The complexity of the Issues

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Three main messages:

1. Burgeoning human population that must be fed

2. Meet this challenge without decreasing the integrity of managed and natural systems

3. Be prepared for known and unknown impacts of climate change on agriculture
1. The ‘Population Monster’: World population will increase from 6.8 billion today to 9.1 billion by 2050.
Food distribution, pricing
Increase in food prices

Source: FAO
FAO's latest projections indicate that global agricultural production must grow by 70 percent by 2050 in order to feed an additional 2.3 billion people.

Globally, 90 percent of required production increases are projected to come from augmenting yields and cropping intensity, and only 10 percent by expanding arable land. For developing countries, FAO estimates that ratio at 80/20. But in land-scarce countries, almost all growth would need to be achieved by improving yields.
Developed high yield, disease resistant, short-stature to double in many cases previous production of wheat

Yield increased because modified genes that regulate use of nitrogen

Norman Borlaug (1914-2009)
Costs: Nitrogen pollution
Costs: depletion of above and belowground water sources
Costs: climate change

Nitrous oxide (N$_2$O)

1.25% Life of 120 years and 200X infrared absorption as CO$_2$

Nitrogen fertilizer
How to increase yield?

Wheat

Rice

Corn

Irrigation

Genetic modification:
  - pest and disease resistance
  - drought resistance

Decrease post-harvest losses
2. Maintain the integrity of managed and natural ecosystems: Conserve Biodiversity

Ecosystem Services

Native Biodiversity → Agricultural Systems
Conserve Biodiversity

Example 1: Pollinators

Estimated 1/3 of the food consumed by humans comes from plants pollinated by animals. Domestic honeybees pollinate approximately $10 billion worth of crops in the U.S. each year.

Bee poisonings from pesticides result in annual losses of $14.3 million
Plan of Action of the African Pollinator Initiative
Conserve Biodiversity: Example 2

Natural Enemies

Crop plant
Conserve Biodiversity: Example 3

Genetic resources for both agricultural plants and animals
Conserve Biodiversity: Example 4

Soil Biodiversity

soil structure/nutrient availability/nutrient uptake/disease control
If temperatures rise by more than 2°C, global food production potential is expected to contract severely and yields of major crops like maize may fall. The declines will be particularly pronounced in lower-latitude regions - in Africa, Asia and Latin America, yields could drop by between 20-40 percent if effective adaptation measures are not taken.
Huge challenge before agriculture is to feed and clothe the increasing human population in a way that maintains the long-term productivity of agriculture with minimal damage to the Earth’s ecosystem.