Agricultural Knowledge, Science and Technology for Development

Technologies to address challenges such as agriculture and water

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Co-Chair IAASTD
www.agassessment.org
President Millennium Institute
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Overview

1. What is the problem with the present agriculture and food system?: Key findings of the IAASTD

2. Sustainable options for food security
Background “Agriculture at a Crossroads”

IAASTD: The Reports: www.agassessment.org

UNCTAD
UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT

ICY BRIEFS

Agriculture at the Crossroads: Guaranteeing Food Security in a Changing Global Climate

For a large number of developing countries, agriculture remains the single most important sector. Climate change has the potential to damage irreversibly the natural resource base on which agriculture depends, with grave consequences for food security in developing countries. However, agriculture is the sector that has the potential to transcend the problem of becoming an essential part of the solution to climate change. The provision of agriculture’s contribution is required to be rapid and significant. A more holistic vision of food security, climate-change adaptation and mitigation as well as agriculture’s pro-poor development contribution is required. A rapid and significant transition towards more sustainable, monoculture-based and high-input dependent production systems for small-scale farmers. The required transformation is however much more fundamental than simply tweaking the existing industrial agricultural systems.

In most developing countries, agriculture accounts for between 20-60% of GDP and employs up to 90% of the labor force, providing a livelihood for approximately 2.6 billion people globally. Despite increased world food production in the last half of the 20th century, the number of people suffering from chronic hunger has increased from under 100 million in 1990 to over 1 billion currently.

Key driving forces of GHG emissions from agriculture:
- Nitrous oxide from soil management
- Methane from livestock management
- Rice cultivation

For the majority of a country’s share of national GHG emissions.

IAASTD: The Reports: www.agassessment.org
Agricultural Knowledge Science and Technology:

What changes are needed to deal with the IAASTD Development and Sustainability Goals (MDG)

- Eradicating of Hunger and Poverty
- Improving Rural Livelihoods
- Improving Nutrition and Human Health
- Facilitating Environmentally, Socially, Equitably and Economically Sustainable Development

...the Challenges:

- Population and Demand Growth
- Shrinking Natural Resources / Energy
- Climate Change.....

....to which agriculture itself is contributing negatively
Global trends in agriculture

**Production**
- Crops: Increasing
- Livestock: Decreasing

**Productivity**
- TRENDS IN AUSTRALIAN AGRICULTURE 1950s – 1970s, Source: Bawden 2010

**Terms of Trade**
- Decreasing

**Net Farm Income**
- Decreasing

**Rural Employment**
- Labor: Increasing
- Farmers: Decreasing

**Environmental Degradation**
- Increasing

**Indebtedness**
- Increasing

**Role in the Economy**
- Decreasing
Understanding the problem: the green revolution

Synthetic fertilizers, irrigation and pesticide use are UNSUSTAINABLE

David Tilman et al. Science 2001
Understanding the problem: GHG
## Understanding the problem: Climate Change

<table>
<thead>
<tr>
<th>Global temperature change (relative to pre-industrial)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°C</td>
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<tr>
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</tr>
<tr>
<td><strong>Food</strong></td>
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<td><strong>Water</strong></td>
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<tr>
<td><strong>Ecosystems</strong></td>
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<td><strong>Extreme Weather Events</strong></td>
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<tr>
<td><strong>Risk of Abrupt and Major Irreversible Changes</strong></td>
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*Source: Stern Report*
Understanding the consequences: CC and water / temperature stresses

Projected losses in food production due to climate change by 2080.

Projected changes in agricultural productivity 2080 due to climate change, incorporating the effects of carbon fertilisation.

Understanding the consequences: Soil degradation

All agricultural soils show signs of degradation

World map of severity of land degradation – GLASOD (FAO 2000)
Understanding the consequences: over production and wastage

A gross estimate of the global picture of losses, conversion and wastage at different stages of the food supply chain. (Source: Lundqvist et al., 2008).
Understanding the consequences: over production and wastage

Food losses for different commodities.
(Source: Kantor et al., 1999).
"a fundamental shift in AKST and the linked agri-food system policies, institutions, capacity development and investments”

Paradigm change: Transition to sustainable / organic / agro-ecological / resilient agriculture

i.e., addresses multifunctionality:
• needs of the small-scale and family farms (social & economics);
• systemic and holistic approach;
• is part of the solution to hunger, poverty, health;
• is part of the solution to CC
Options for action: multifunctionality

...the inescapable interconnectedness of agriculture & culture
A major challenge and opportunity: The small scale farmer

- Pro-poor progress requires:
  - creating opportunities for innovations and entrepreneurship which targets this group
  - Increased public research and extension investment

- Small scale farm sustainability – poses difficult policy choices
  - Payment for ecological services
  - Decentralized governance systems, technology choices and education
Options for action

Empower, involve and support small scale/family farmers (women): WHY?

1.5 billion peasants on 380 million farms
800 million people growing urban gardens
410 million gathering the hidden harvest of forests and savannas
190 million pastoralists
100 million peasant fishers

In addition 370 million of these are also indigenous people
Options for action

PEASANTS FEED AT LEAST 70 % OF THE WORLD’S POPULATION

- Share of world’s food that comes from hunting / gathering: 12.5%
- Share of urban food produced by city-dwelling peasants: 7.5%
- Share of world’s food that comes from the industrial food chain: 30%
- Share of world’s cultivated food that produced by peasants: 50%
Options for action

Empower, involve and support small scale/family farmers (women) with:

• sustainable agricultural practices (S&T information, knowledge sharing)
• restoration and management of ecosystem services
• crop/animal and labor productivity increases, appropriate mechanization
• promote diversity of crops, animals and systems
• safety nets (insurances, etc)
Options for action: the system’s approach

Using natural systems to regulate pest outbreaks

(example of push-pull greater farm productivity vs higher yields 2 to 10X)

WIRED Magazine, November 2008
ECONOMICS OF INTEGRATING EDIBLE BEANS IN THE ‘PUSH-PULL’ SYSTEM

![Bar chart showing total labour costs, total variable costs, total gross revenue, and net benefits for different cropping systems.](chart.png)
Options for action: animals on farm

Managing natural resources to benefit people

It is imperative to put the animals back on farm:

- Sanitation,
- Health,
- Carbon cycle,
- Sustainability
Options for action: trees on farm

„Agroforestry“ with Faidherbia albida
Options for action: water

Water will be an issue (too much or too little), but much less in well managed and restored soils:

- conservation ag
- agroecology
- organic ag
Options for action: Mechanization

Minimum Till without Herbicides
Options for action: Organic agriculture

Organic Corn - 1995 Drought

Better infiltration, retention, and delivery to plants helps avoid drought damage

Organic  Conventional
Options for action

- Improve markets (fair), infrastructure, and institutions (reverse rural-urban flow; more and green jobs)
- Expand and disseminate
  - agroecological oriented research (participatory research)
  - knowledge and technology innovations
  - AKST for transition to sustainable agriculture (animals on farm, animal, plant and system diversity, biological control & IPM, conservation ag., PES) (more R&D jobs)
Options for action

Biotechnology and genetic engineering
- Issues of definition, cost:benefit, suitability, alternatives and safety

Business as usual is not an option
Options for action

Biotechnology

• So far little impact on IAASTD Development and Sustainability Goals

• Methodological limitations in efficacy and safety testing

• Problem oriented R&D to continue, but not at the expense of other agricultural research, education and training

• Patent (IP) issue (increased costs for farmers, restricted experimentation, research and seed exchange; undermining local practices that would assure food security and economic sustainability)

• Exposure of farmers to liabilities, long term dependency, etc.
Options for action: GMO’s
Options for action: closing the yield gap

Farmers in the world’s poorest countries are still untouched by yield increases

Cereal yields by income level, 1970–2000

- Low income
- Lower middle income
- Upper middle income
- High income

Source: World Bank and FAO.
Options for action: do more of what works

SRI: System of rice intensification
Options for action: do more of what works

Biological control and IPM: Proven practices
Encouraging a wider genetic base in agriculture...trees, fruits, grains, vegetables, lost crops, animals for nutrition, cultural diversity, incomes, pest control, resilience to climate change

Option for action: increase diversity...
Options for action: a challenge

Transition to sustainable / organic / ecological / resilient agriculture
What does it take?
Investing between 0.1% and 0.16% of total GDP ($83-$141 Billion) / year 2011-2050

<table>
<thead>
<tr>
<th>Year</th>
<th>2011</th>
<th>2030</th>
<th>2050</th>
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<tbody>
<tr>
<td>Scenario</td>
<td>Unit</td>
<td>BAU</td>
<td>B2</td>
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<tr>
<td></td>
<td>Bn $/Yr</td>
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<tr>
<td>Crop production</td>
<td>Bn $/Yr</td>
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<td>Livestock production</td>
<td>Bn $/Yr</td>
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<td>Employment</td>
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<tr>
<td>Soil quality</td>
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<td>Agriculture water use</td>
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<tr>
<td>Harvested land</td>
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<td>15</td>
<td>22</td>
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<td>Deforestation</td>
<td>M Ha/Yr</td>
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<td>2973</td>
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<tr>
<td>Calories per capita per day (available for supply)</td>
<td>Kcal/P/D</td>
<td>2081</td>
<td>2315</td>
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<tr>
<td>Calories per capita per day (available for household consumption)</td>
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Option for action: benefits......
be part of the CC solution

Potential for sequestering carbon

<table>
<thead>
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<th>Land Use</th>
<th>Area (ha)</th>
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<tbody>
<tr>
<td>Grassland</td>
<td>3'488'000'000</td>
</tr>
<tr>
<td>Arable Crops</td>
<td>1'405'000'000</td>
</tr>
<tr>
<td>Permanent Crops</td>
<td>130'000'000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5'023'000'000</strong></td>
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Organic @ 2 tonnes per hectare

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<tbody>
<tr>
<td><strong>Total</strong></td>
<td>10</td>
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<tr>
<td><strong>Gt C</strong></td>
<td></td>
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<tr>
<td><strong>Annual GHG emissions</strong></td>
<td>49 Gt CO$_2$ equ.</td>
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Options for action

New Equitable & Sustainable Way Forward

- Bring all sectors responsible for sustainable development into a comprehensive systemic analysis, to recognize that policy decisions in one sector (i.e., transportation) strongly affect other sectors (input & market access).
- Promote responsible governance and behavior at global, regional and local levels.
- Invest in long-term gains versus short term quick fixes (i.e., deal with the cause not the symptoms by understanding the system); in enabling conditions for a new age agrarian society.
Options for action: everything is connected…
No silver bullets….
You cannot solve the problem with the same kind of thinking that created the problem

Albert Einstein

Thank you