# Agriculture and Food Production: Quo Vadis

# The International Assessment of Agricultural Science and Technology for Development (IAASTD)

Hans Rudolf Herren
*Millennium Institute*
Robert Watson
*World Bank*

# Overview

1. Key achievements in food, feed, fiber production (good news)

2. Key issues arising from increased food production (bad news)

3. Key Challenges ahead (good and bad news)

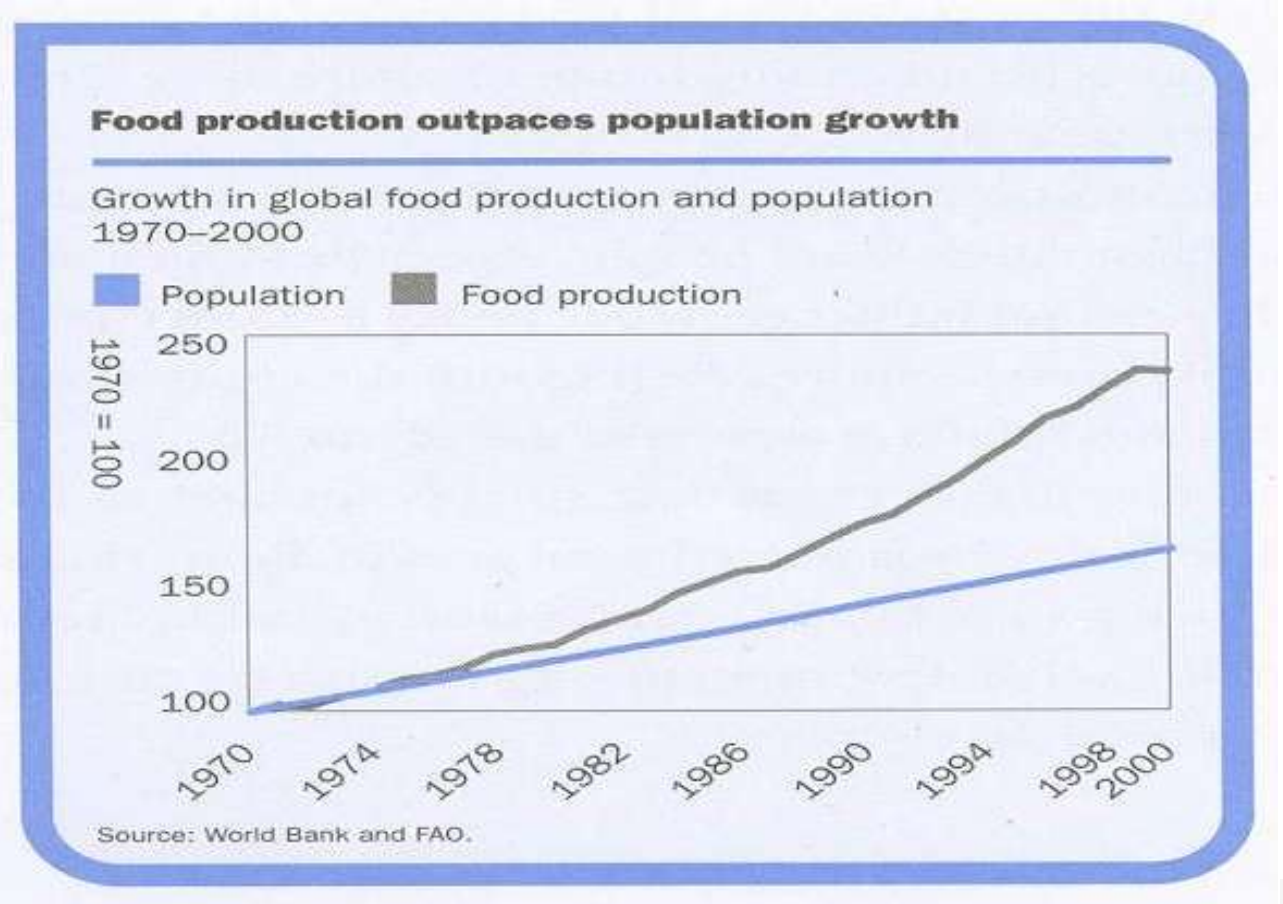
4. An introduction the IAASTD

5. IAASTD scenarios

# Key achievements of industrial or modern agriculture, through Agricultural Knowledge, Science and Technology

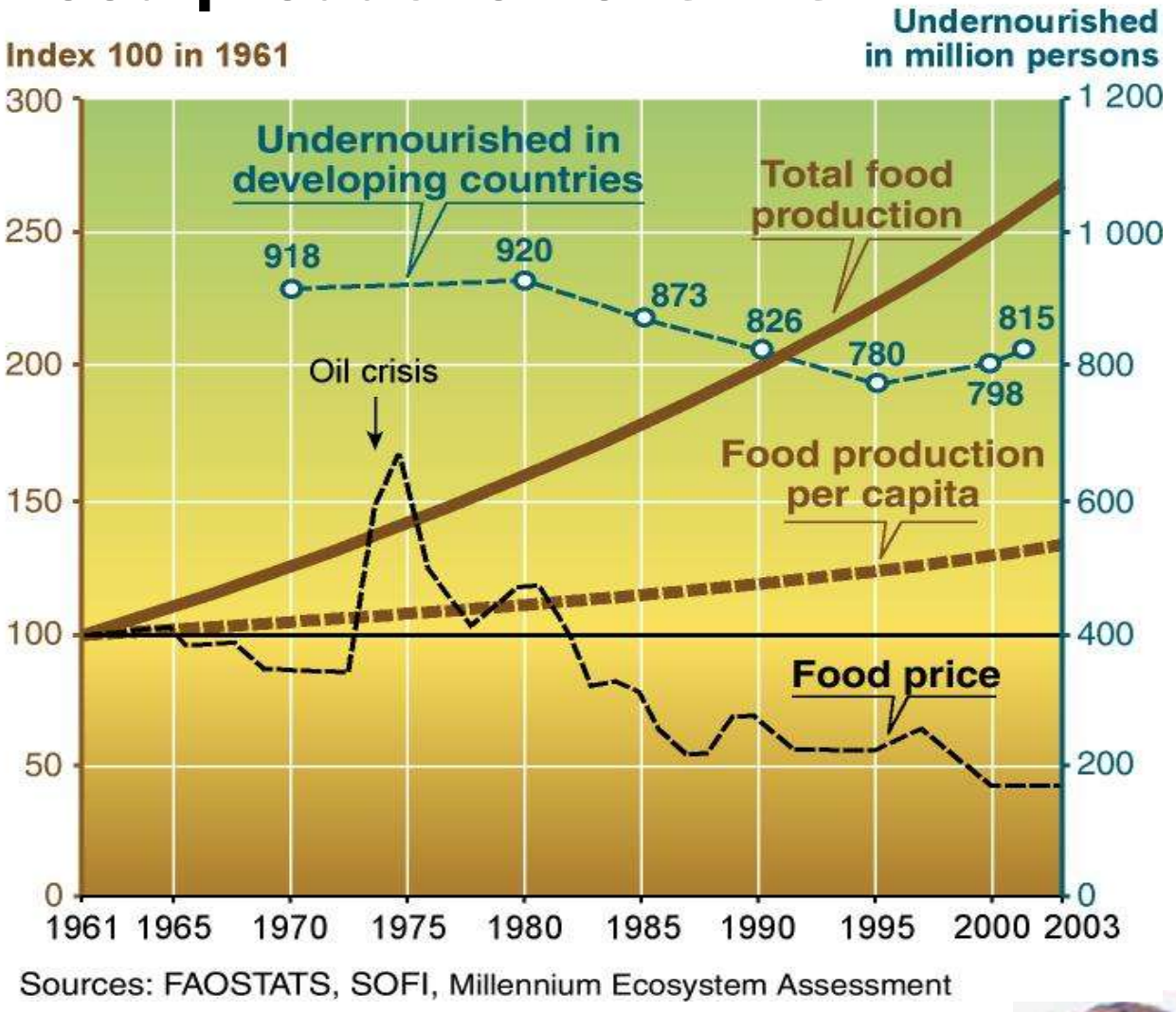
- Transformation of solar energy, in new and stored from into 10,000 new people per hour
- Enough food to feed today's population with room for tremendous wastage
- Caloric intake rising / % undernourished falling
- Lower food prices
- Transformation of agricultural societies into industrial ones (agriculture as catalyst for economic growth (parts of Latin America, China, Thailand)
- Rate of return of ag research high

# We have been successful in food production




# Global food production overview

- **Food production has more than doubled since 1960**
- **Food production per capita has grown**
- **Food price has fallen**




# Hunger and poverty

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

# Education

# Sustainable food production


October 2006

# Tsetse / Nagana

Gurage, Ethiopia

October 2006

# Tsetse / Nagana

Problem: Health of Domestic Animals

# Tsetse / Nagana

Gurage, Ethiopia

October 2006

# Tsetse / Nagana

Answer: Decline of Tsetse Flies

October 2006

# Tsetse / Nagana

**Ahmed Welela, 2005**

October 2006

# Mosquitoes and Malaria

Integrated Action: Drainage

**World Food Prize Symposium**
**Hans R. Herren and Robert Watson**

October 2006

# Mosquitoes and Malaria

Result: More land, more income, less malaria

# Income / Empowering Women: West Pokot



October 2006

# Income / Empowering Women: Addis Ababa

October 2006

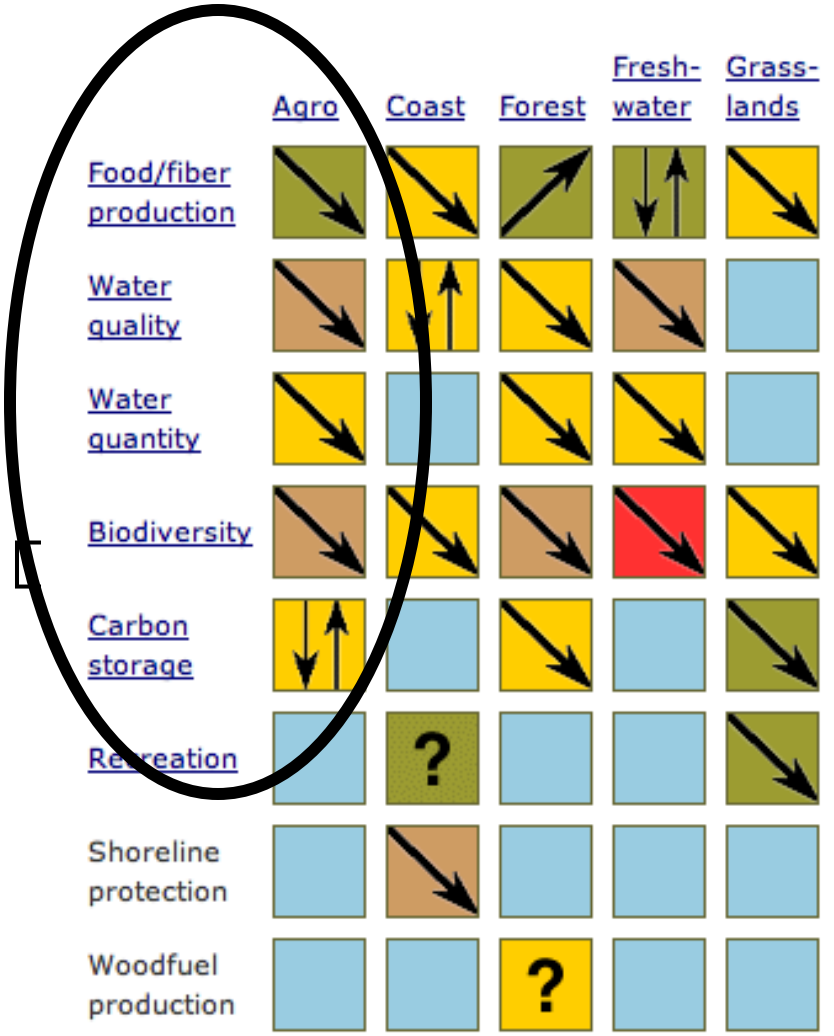
# Income / Empowering Women: Addis Ababa

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

# ...key achievements at a price for the production base

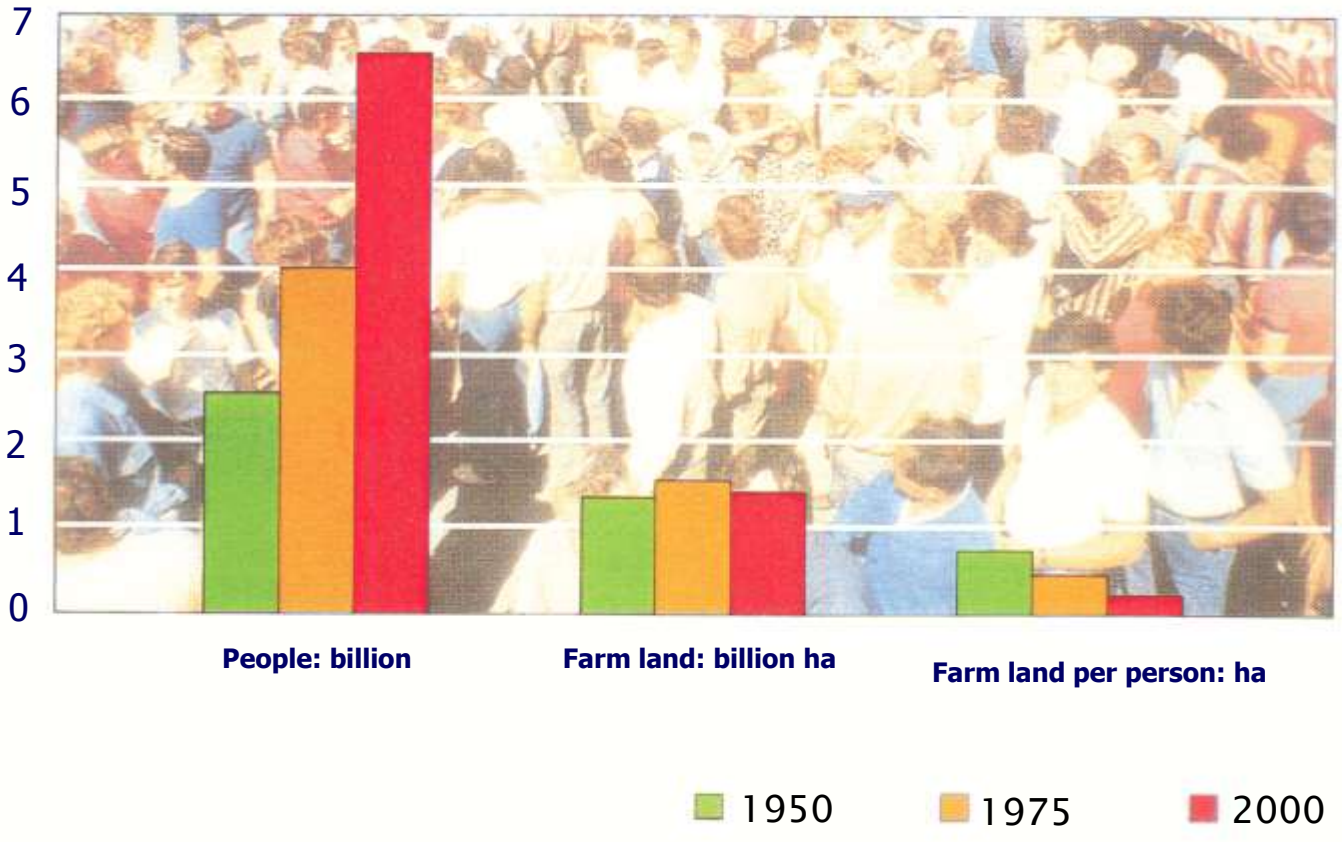
## Scorecard of ecosystem conditions and changing capacities

Scores estimate the predominant global condition or capacity by balancing the relative strength and reliability of the various indicators described.




# …why is the production base a concern?

## More people means less cultivated land per person for food, feed, fuel and fibre production driving the need for AKST




# The Status of the Agricultural Production Base; Characterized by Disconnects, both the in developed and developing world:

# Disconnects between agriculture and the environment

**Contemporary agriculture conflicts** with **healthy functioning of ecosystems….**

….Yet **agriculture depends** on **healthy ecosystems functions**:

-water supply,

-cycling of nutrients in soils,

# Disconnects between agriculture and the environment

**Contemporary agriculture conflicts** with **healthy functioning of ecosystems**….

Industrial farming required massive fertilizer, pesticides

500 arthropods spp resistant

400 herbicide resistant weed biotypes

150 resistant fungi & bacteria

# Disconnects between agriculture and the environment

**Agricultural and in general human activities have significantly disturbed water, carbon and nitrogen cycles**

# Disconnects between agriculture and the environment

**Contemporary agriculture conflicts** with **healthy functioning of ecosystems….**

….Yet **agriculture depends** on **healthy ecosystems functions**:

-water supply,

-cycling of nutrients in soils,

-Pollinators

-Natural pest control

# Disconnects between producers and consumers or land and cities

**Perpetual low prices** that consumers are generally willing to pay for food (making farming a precarious business),

is now **compounded** by

a **crisis of trust** amongst consumers, fueled by food scares (Mad Cow, Asian Bird Flu) and a sense that many supermarket foods are low on nutritional value, high on price.

# Disconnects between policies and expectations

Almost every country in the world cherishes its agricultural roots,

..in song, picture and mythology.

But this valuation is rarely translated into policy to support the family farms that are central to an agricultural community.

# Ecosystem Services

## The benefits people obtain from ecosystems

## or…agriculture's multifunctionality

### Provisioning

Goods produced or provided by ecosystems

- food
- fresh water
- fuel wood
- fiber
- biochemicals
- genetic resources

### Regulating

Benefits obtained from regulation of ecosystem processes

- climate control
- disease control
- flood control
- detoxification

### Cultural

Non-material benefits obtained from ecosystems

- spiritual
- recreational
- aesthetic
- inspirational
- educational
- communal
- symbolic

### Supporting

Services that maintain the conditions for life on earth.

- Soil formation
- Nutrient cycling
- Pollination

# Hidden Costs / Externalities

**Industrialized agriculture is giving rise to increasing incidences of food-borne illness:**

**We eat too much, we eat the wrong mix of food, and we get sick from our food. And we try to fix this in the wrong way:**

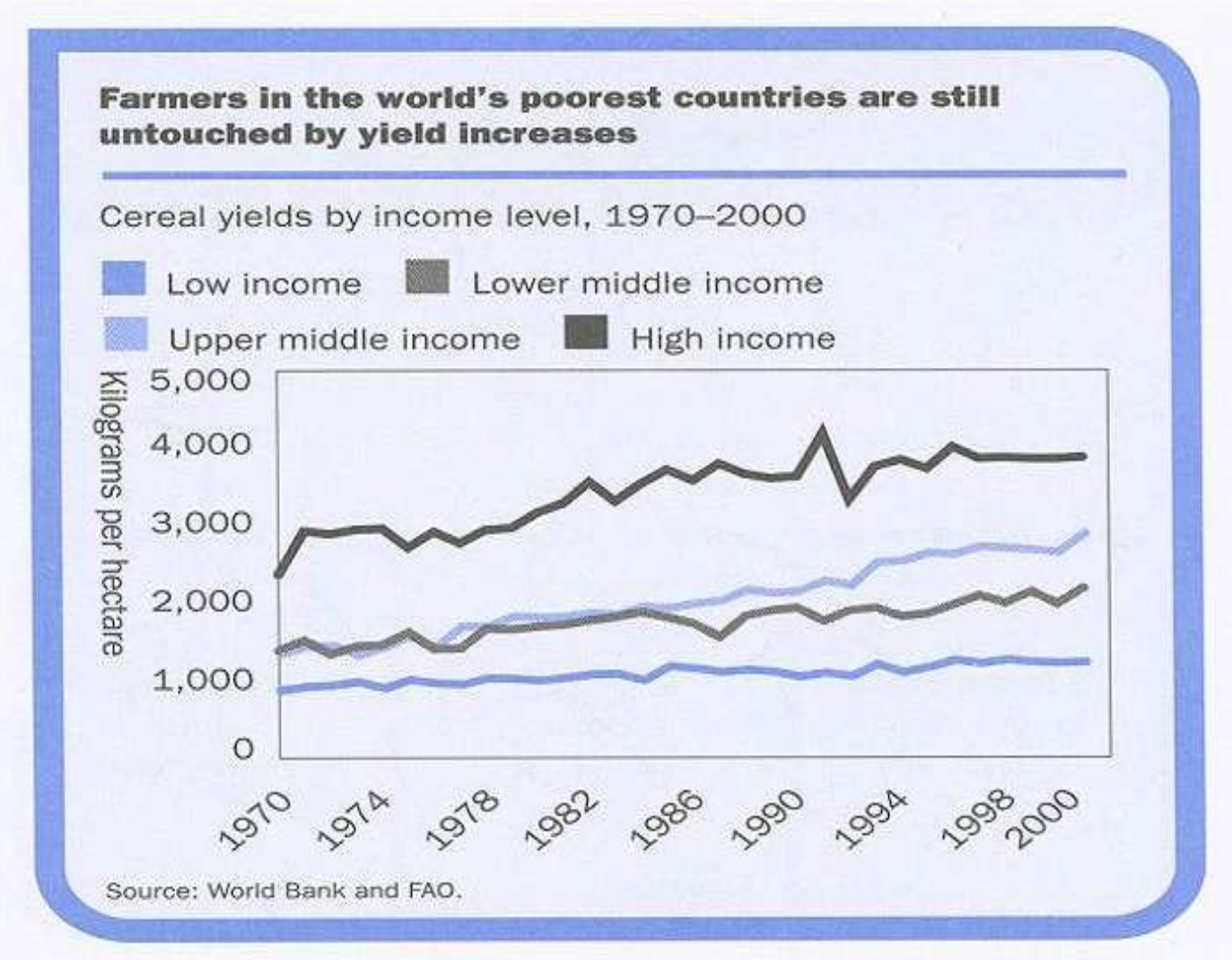
**The concentration of livestock into factory feedlots, broiler sheds and massive piggeries promotes infection and spread. More than 90% of pig herds and 50% of cattle in Denmark and the Netherlands are contaminated with *Campylobacter*, a food-borne bacteria causing diarrhea.**

**About half of all the antibiotics used in the US are fed to livestock, and four-fifths of these are to promote growth and suppress disease, rather than treat it.**

# What's the problem?

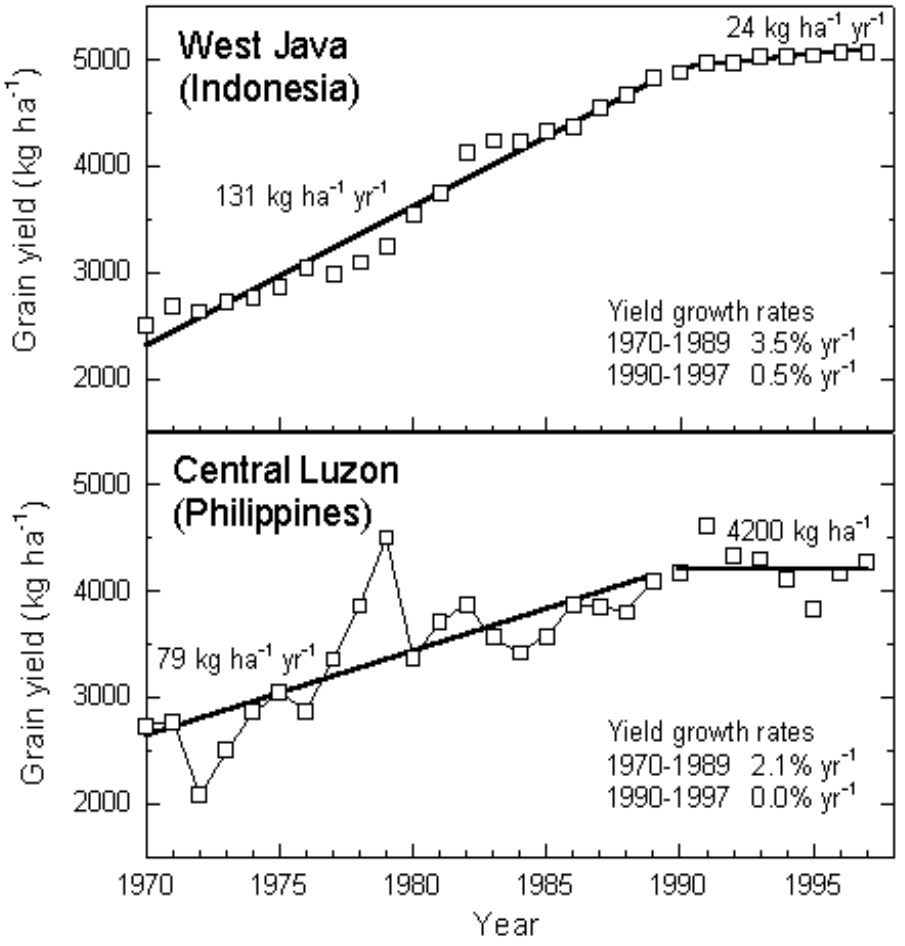
## Why should we worry?

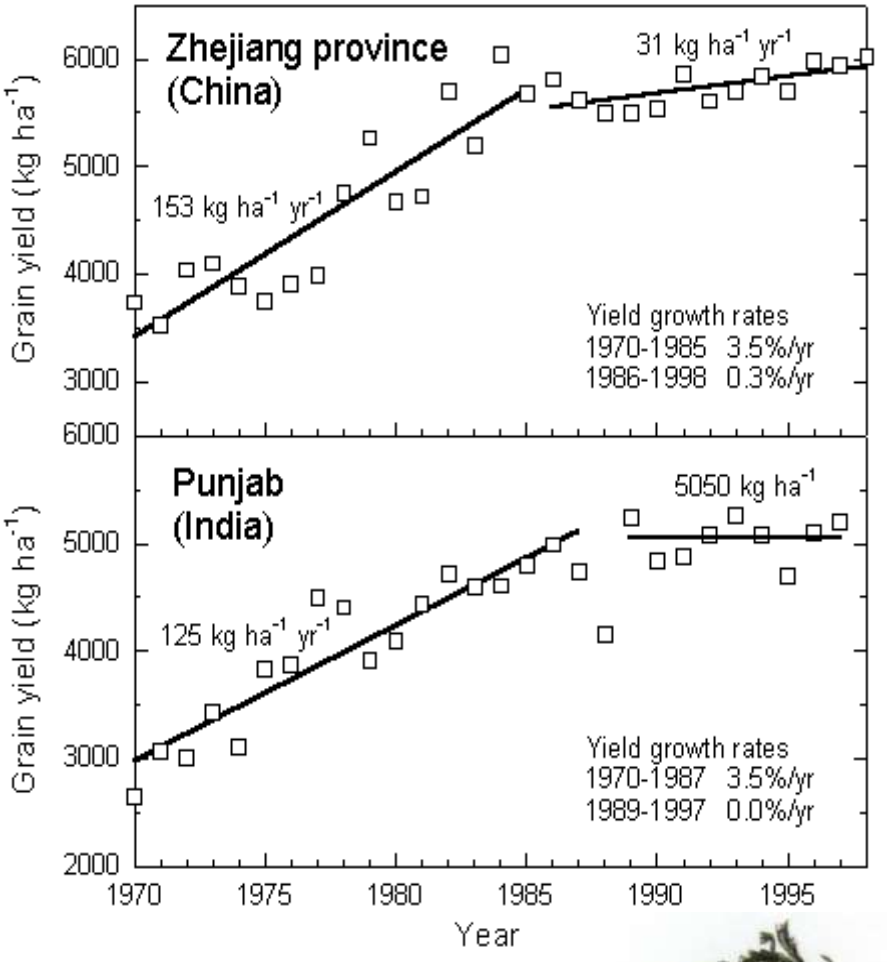
# …. there is the crop yield gap



# Yield Trends -NOT increasing

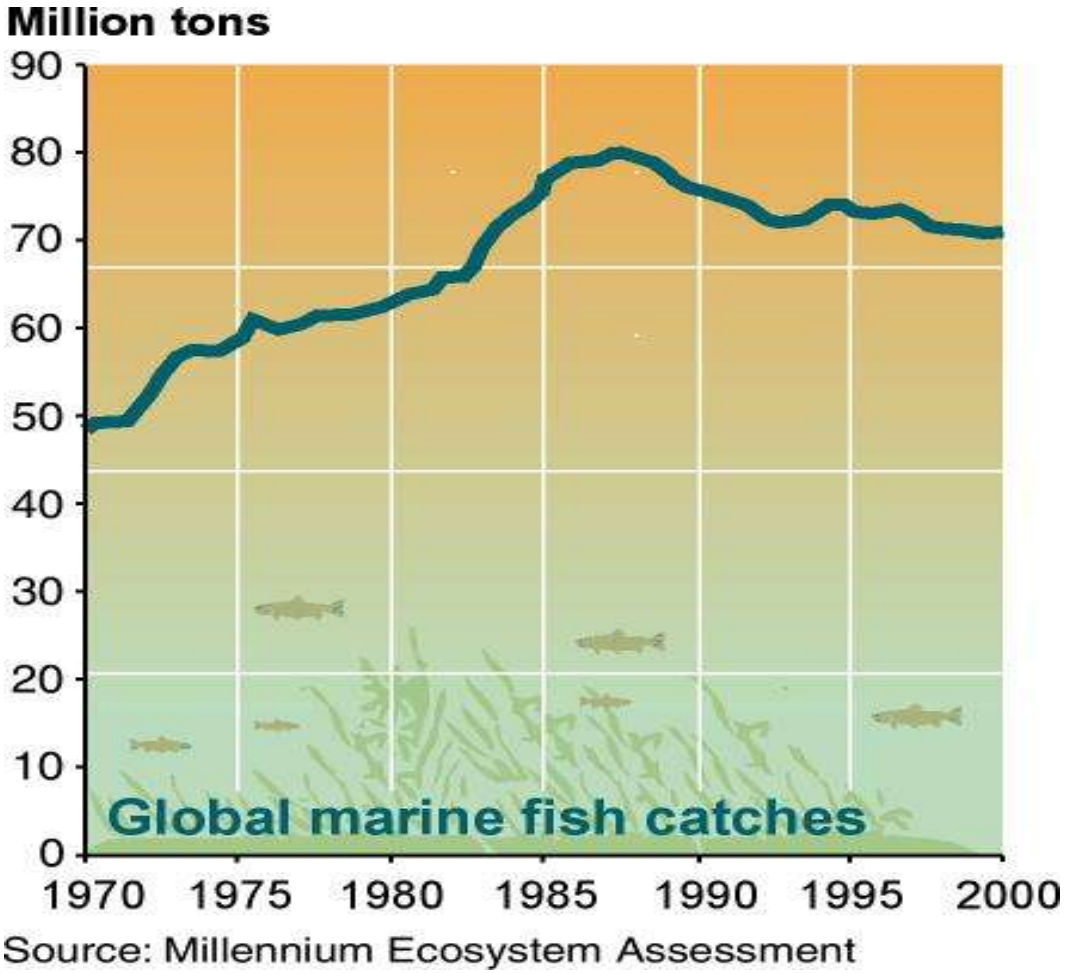
*(from Cassman, 1999)*




# Capture Fisheries

**25% of commercially exploited marine fish stocks are overharveste d (*high certainty)***



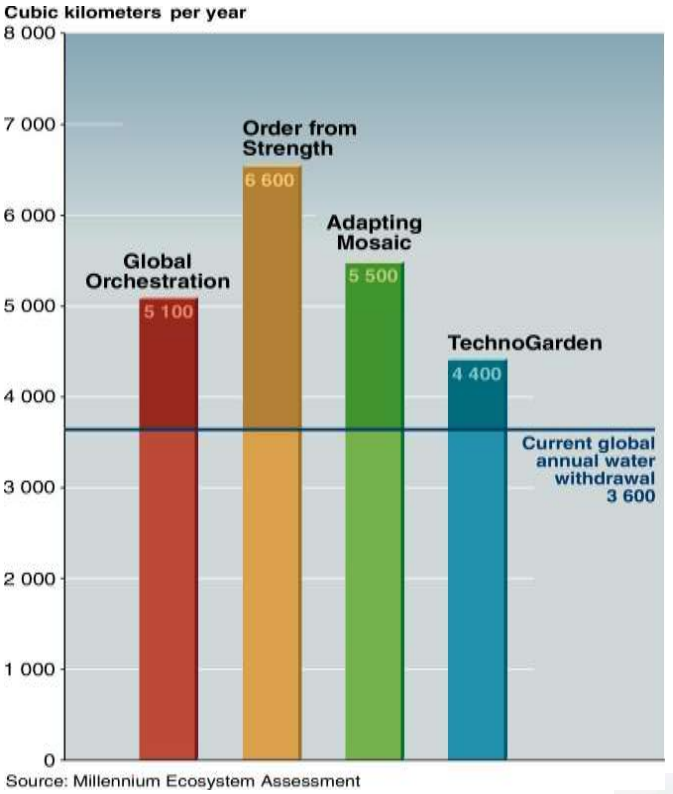

**Marine fish harvest declining since the late 1980s**

# Water under MA Scenarios

## Water Availability

- Global water availability increases under all MA scenarios. By 2050, global water availability increases by 5–7% (depending on the scenario)
- Demand for water is projected to grow by between 30% and 85%

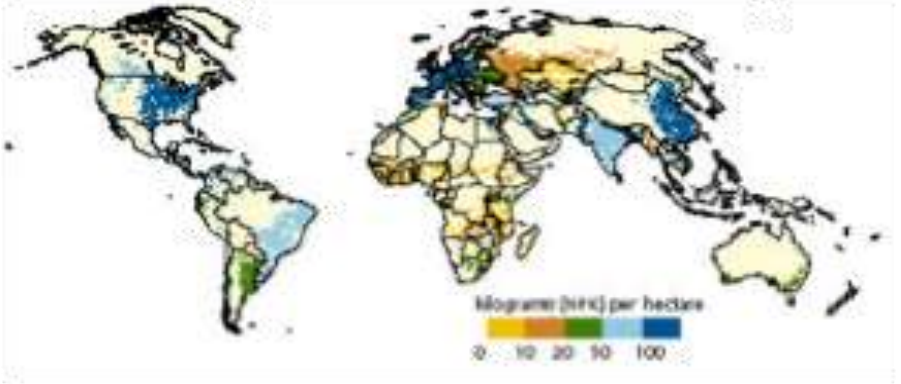
## Water Withdrawals in 2050 under MA Scenarios



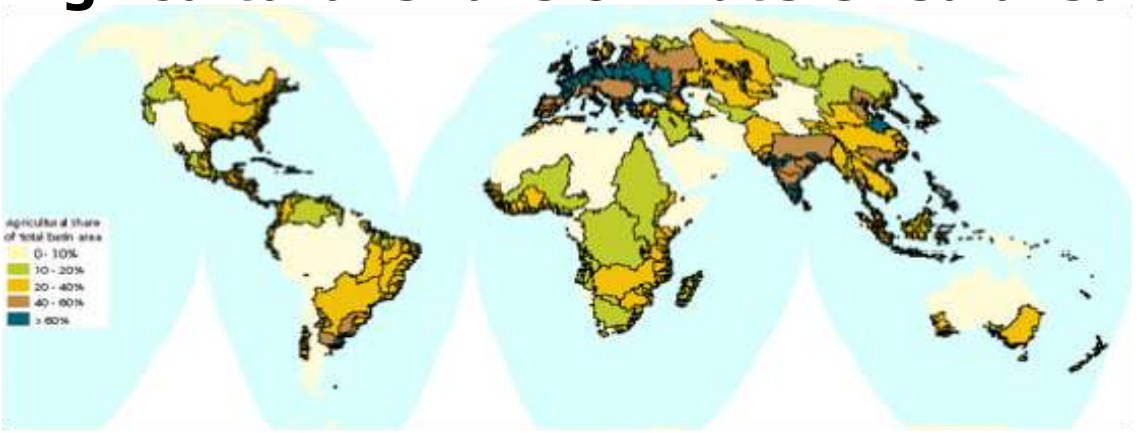

# The Production Base

Water

## Application of inorganic fertilizers



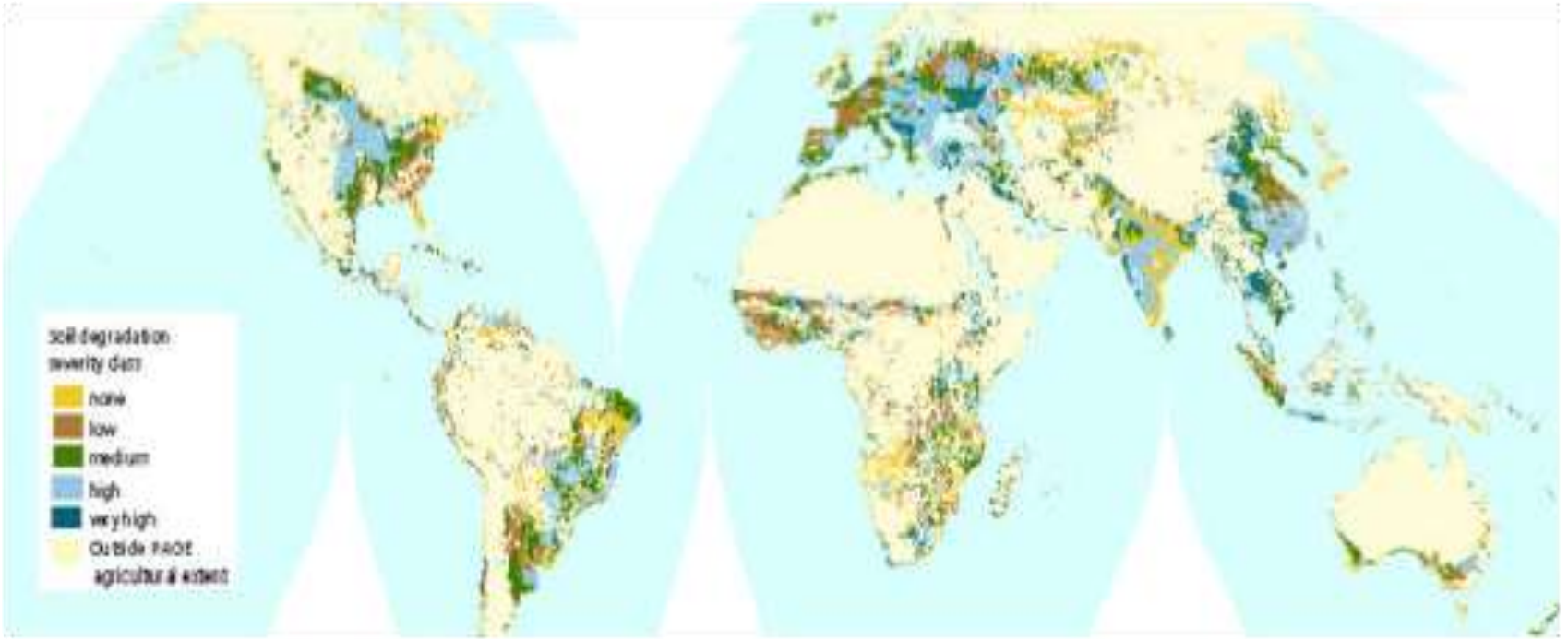

## Agricultural share of watershed area



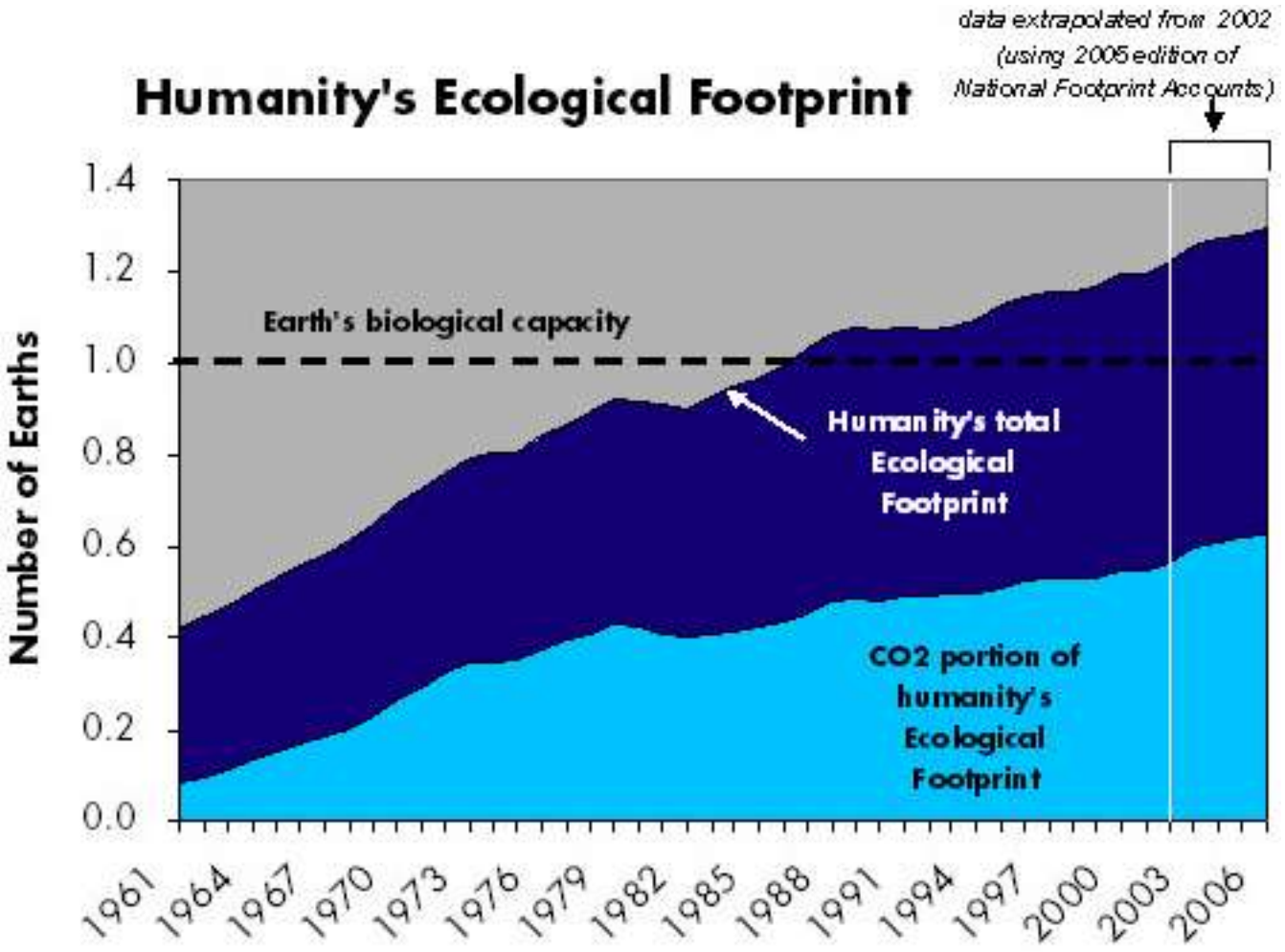

**Areas of high use of inorganic fertilizers often correspond to areas where the agriculture share of watershed areas is high, leading to nutrient overloads in waterways.**

# The Production Base

**Soil degradation from agricultural practices is now severe enough to reduce yields on about 16 percent of agricultural land.**



# …then there is the ecological footprint trend



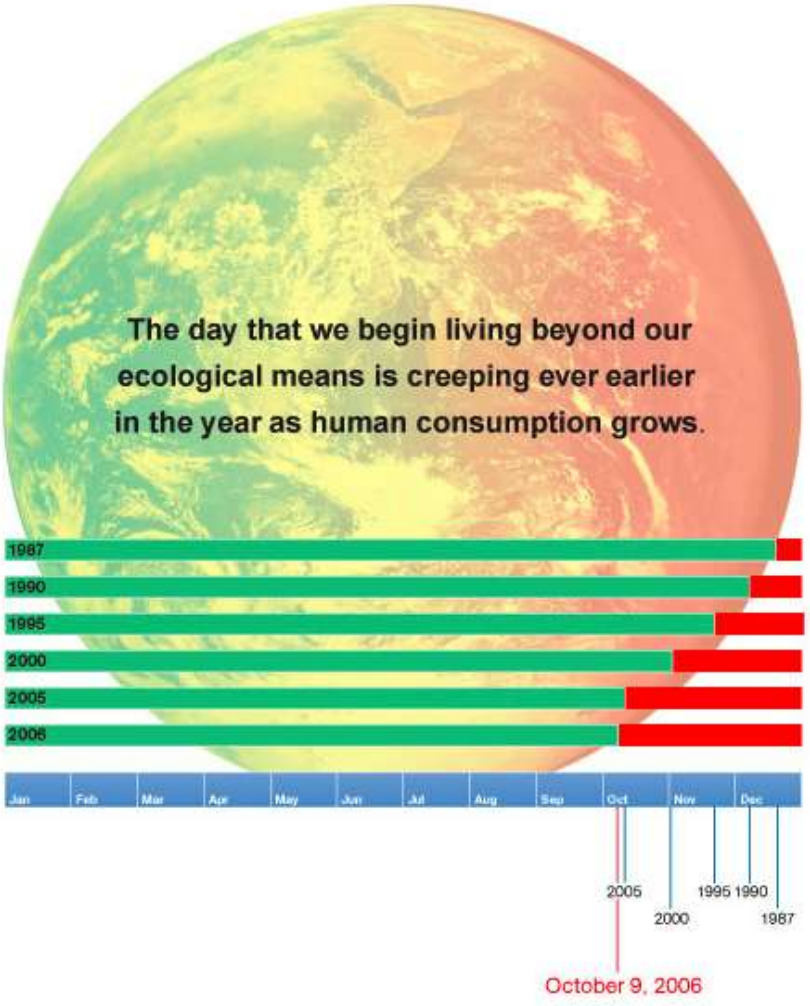

# …and the fact that we now are eating our capital

From October 9th and continuing through the end of the year, the world is living beyond its ecological means.

- 30% more in one year than nature can regenerate in that same year

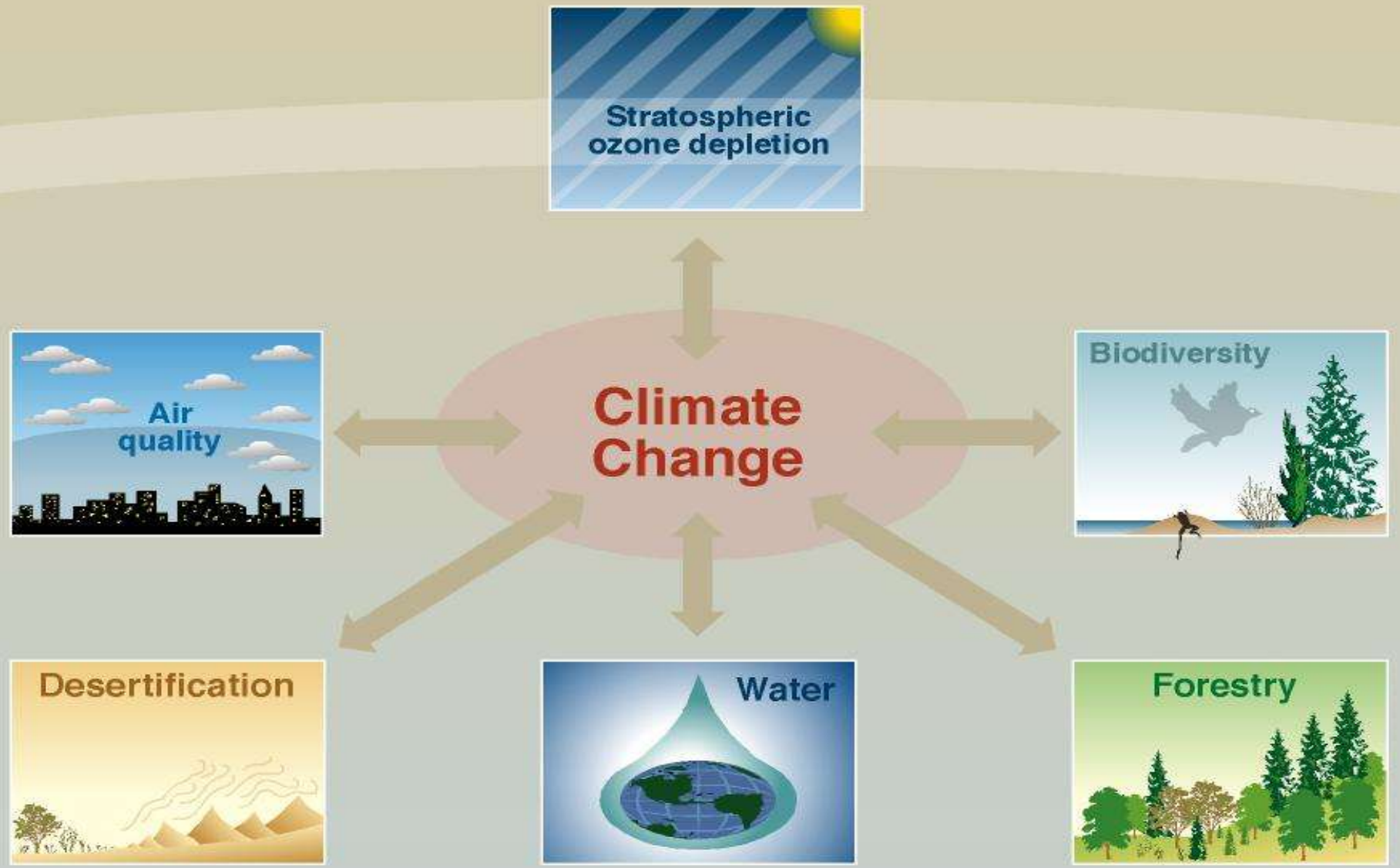
- the ecological deficit is maintained by liquidating the planet's natural resources

- end result = bankruptcy

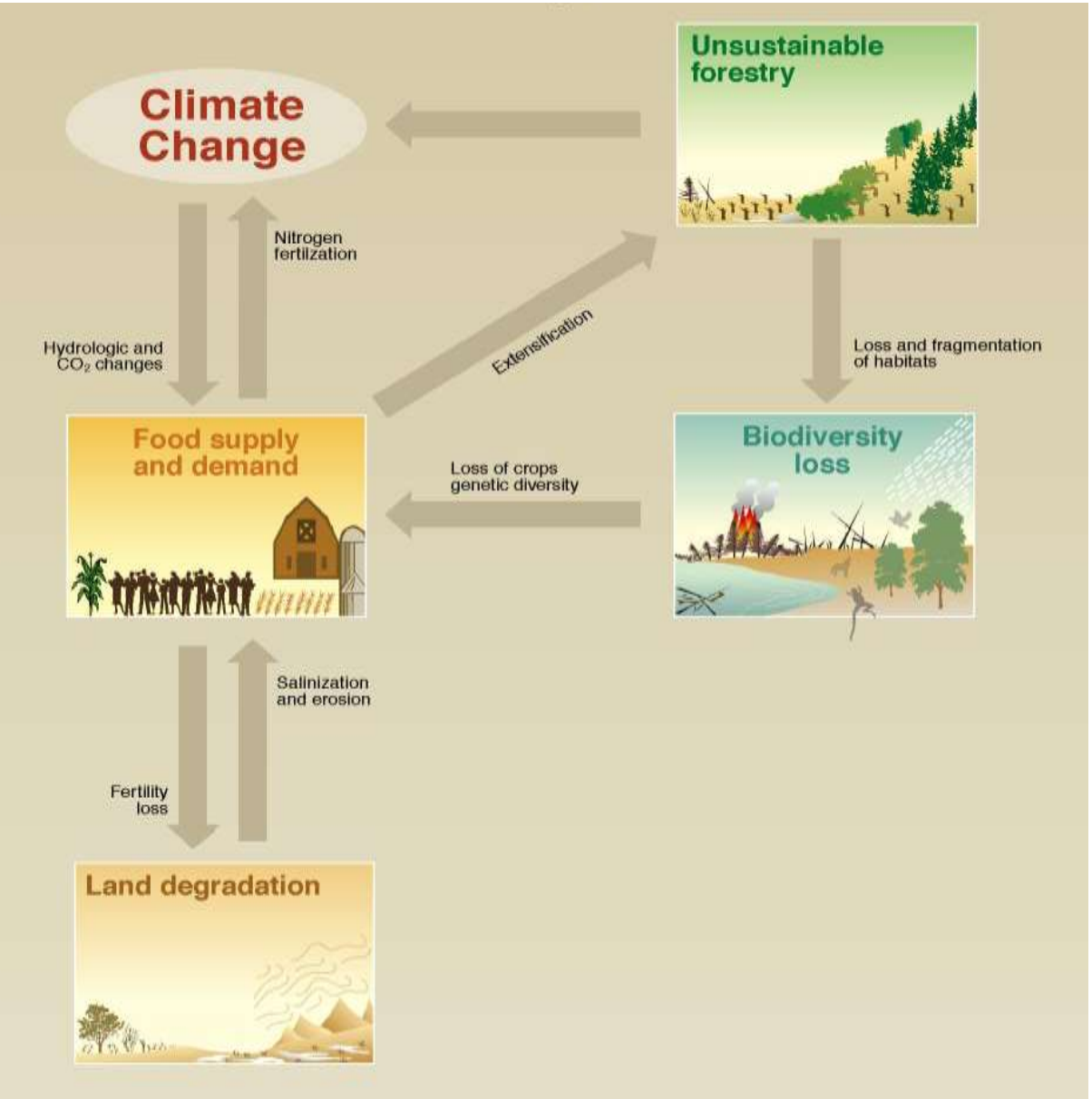



October 2006

# Linkages between climate change and other environmental issues



# Agricultural Practices Affect the Environment and Environmental Degradation Affects Agricultural Productivity

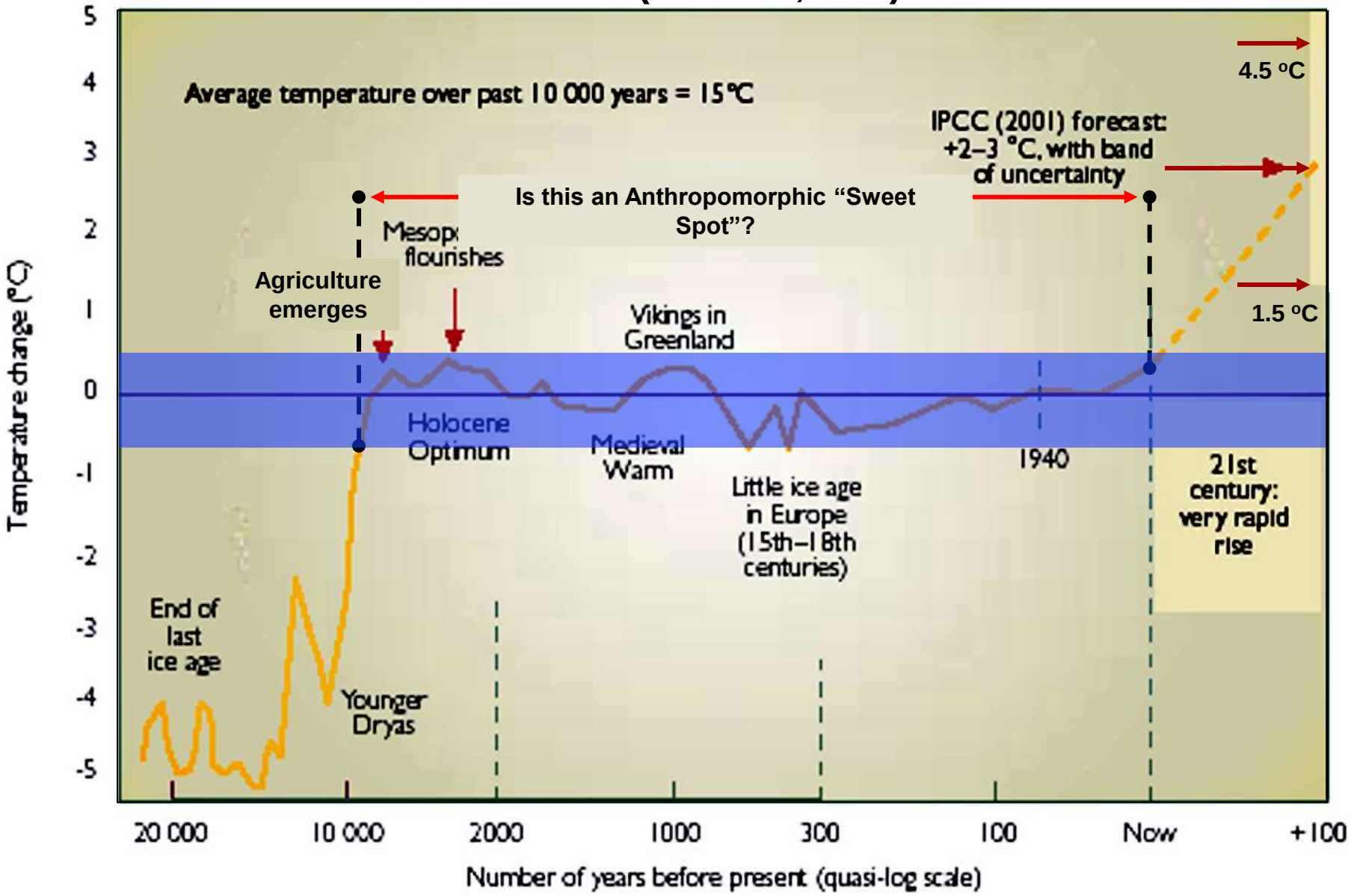


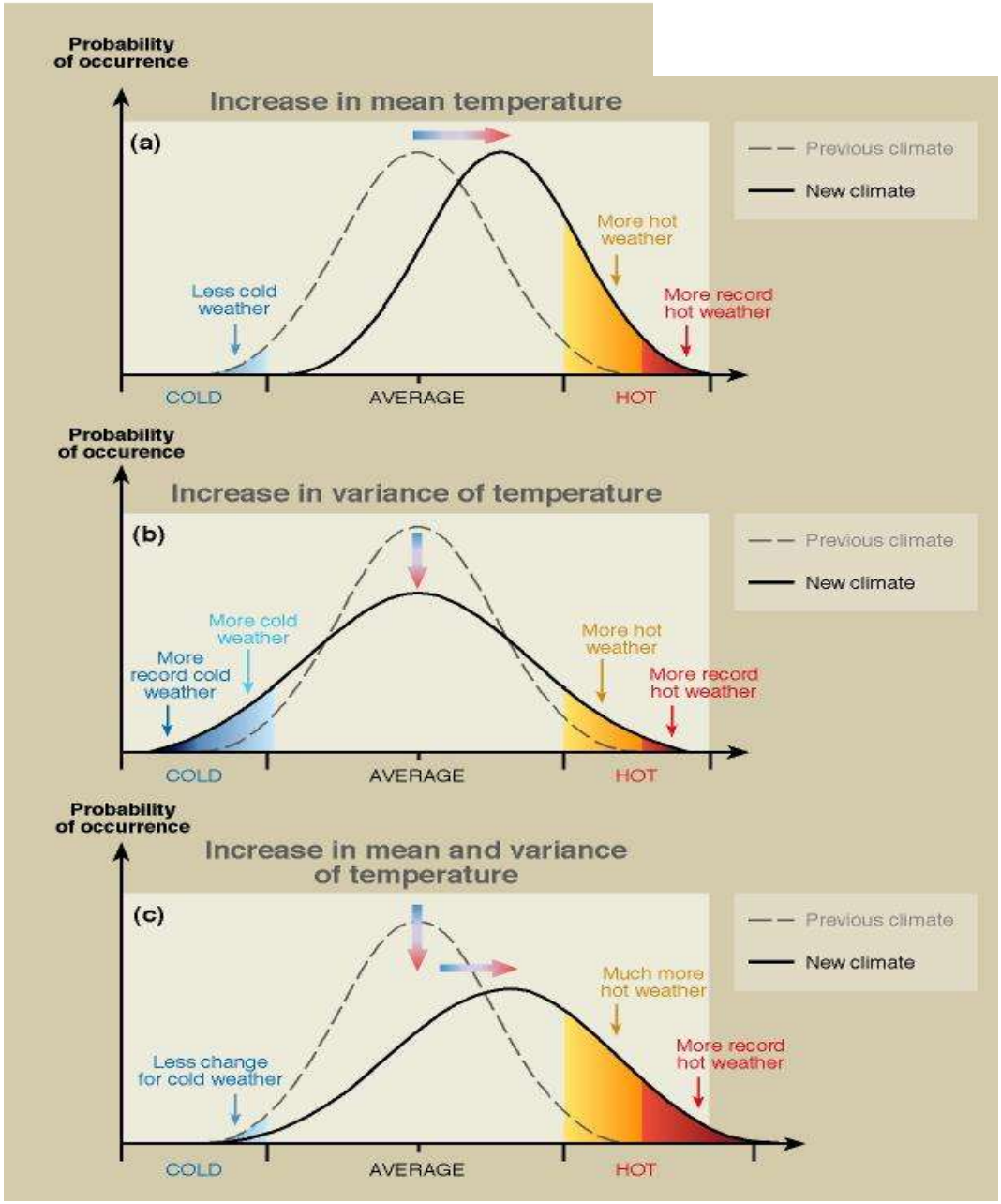

**Can crop, animal and fish traits be improved to address the projected changes in climate – what are the roles of traditional breeding and modern forms of biotechnology?**

**How will the loss of genetic diversity affect future agriculture?**

**Can soil degradation be reversed and productivity enhanced**

# The Last 20,000 Years seems to have been Ideal for the Development of Human Societies. Is this a Historic "Sweet Spot" that Enabled Humans to Flourish? (R Corell,2006)



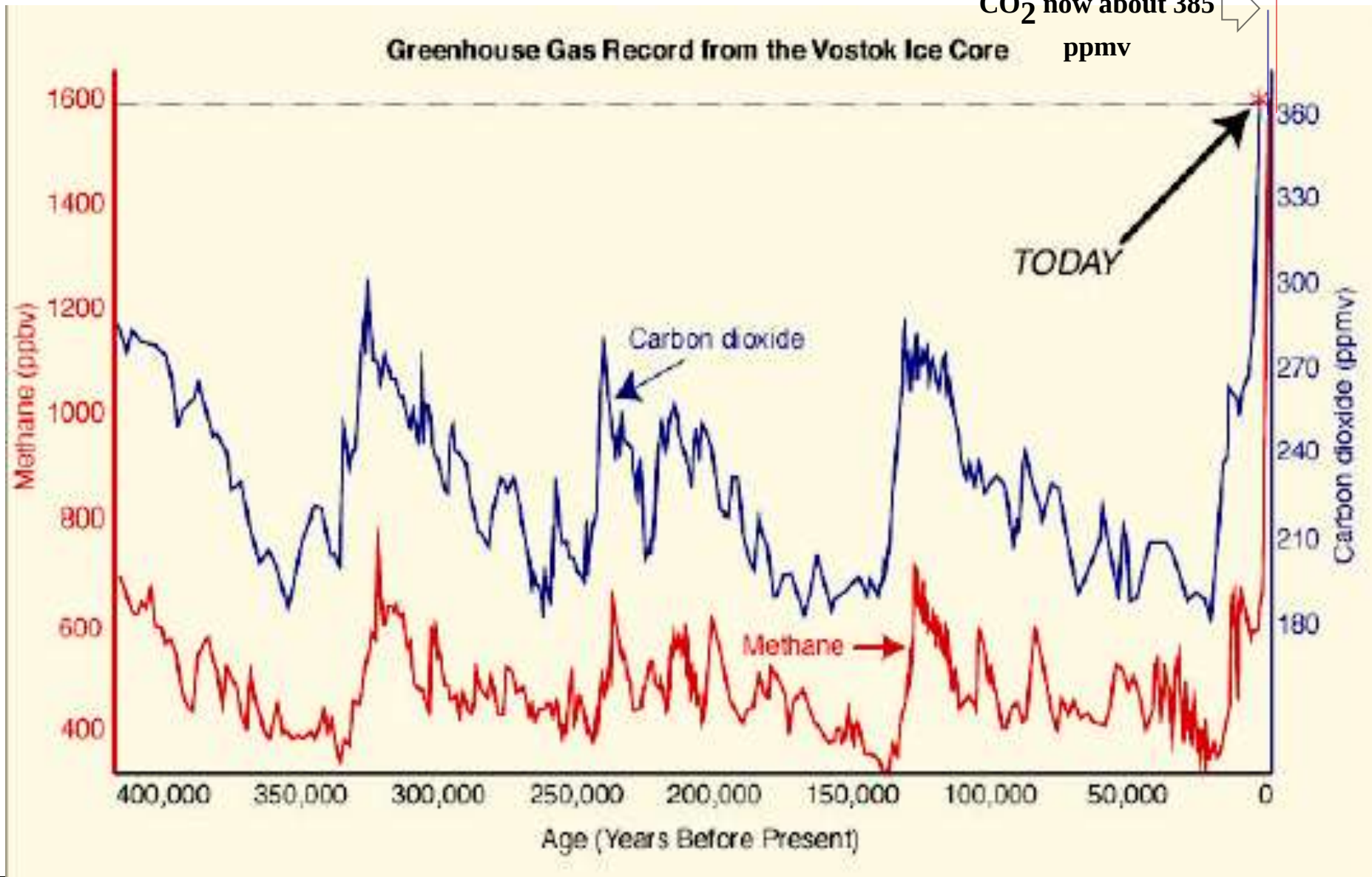



# More hot days and heat waves

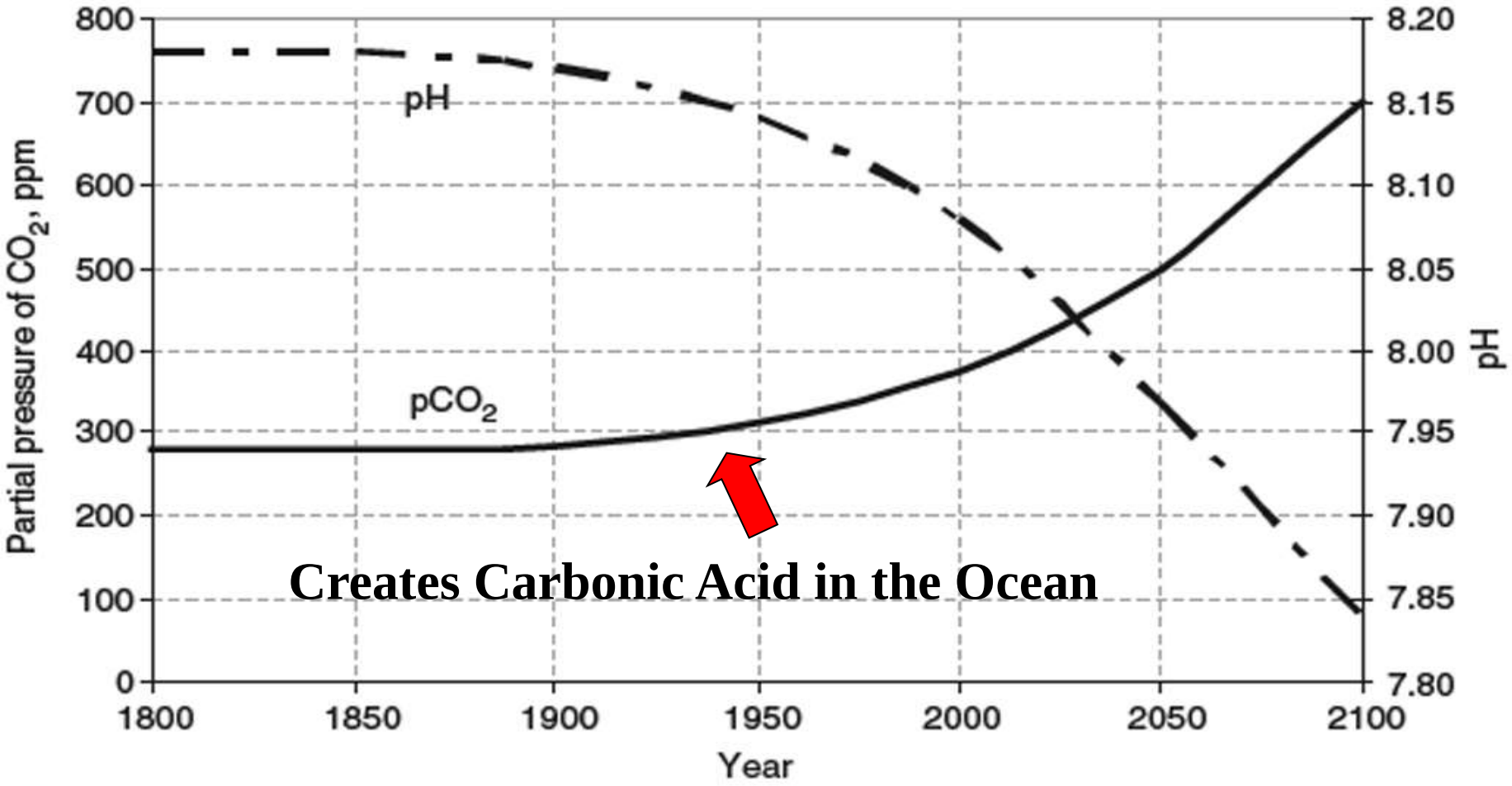
**Methane increased from ~ 700 ppbv to <1700 ppbv = doubling of the concentration of methane during the past 150 years**

**$CH_4$ now about 1750 ppbv**

**$CO_2$ now about 385 ppmv**



# Impact of Increased Atmospheric Carbon Dioxide on Oceanic pH




**Past and projected changes in atmosperic carbon dioxide and sea-water pH and projected assuming current rates of emissions.**

**Source: *Avoiding Dangerous Climate Change* (2006) and redrawn from Zeebe and Wolf-Gladrow data of 2001**

# Review of the Main Challenges Ahead

- Increasing population (from 6 to 8/9 billions)
- Decreasing productive land
- Water (quality, quantity, distribution and access)
- Climate change (specially hard on developing countries)
- Biodiversity crisis
- Pollination
- Pest management
- Energy crisis
- Ecosystem service restoration and maintenance
- Cheap food policies

...the "food system disconnects"

# How to deal with the Main Challenges Ahead

We can and need to be "cautiously" optimistic about the future, and without more delays:

- Develop informed policies in support of sustainable development for the long term (participatory process at national and global levels), avoid quick fixes/techno fixes
- Increase public research equally from molecular to ecosystem Assure the best education for all at all levels and everywhere (use ICT)
- Give agriculture and food systems the priority it deserves in national budgets, trade agreements
- Do not short change our food production base for fuel

# For a future, we will need all the A (and other) KST to deal with these challenges

**…the kind of society and food system should however remain the peoples choice**

**…on to the IAASTD**

# What is an Assessment?

- An assessment is a **critical evaluation** of information for guiding decisions on complex, public issues.
- The topic is **defined by the stakeholders**, who are typically decision makers. Assessments are policy relevant, but not prescriptive.
- Assessments are **conducted by a credible group of experts** with a broad range of disciplinary and geographical experience, in a balanced and transparent way.
- Assessments ***reduce* complexity and *add value*** by summarizing, synthesizing and sorting what is known and widely accepted from what is not known (or not agreed)
- Assessments relate to the situation at a **particular time and in a given geographical domain**. Often repeated after some period.

# What are the outputs of the IAASTD ?

- Primary outputs will include an ensemble of peer-reviewed sub-global and global assessment reports each with a summary for decision makers on the role of agricultural knowledge science and technology (AKST) in development.

# The Value of International Assessments

International assessments can raise awareness and prompt informed action by all stakeholders – especially useful for contentious and complex regional and global issues

Examples:

- Long-range acid deposition – regional agreements in N. America and Europe
- Stratospheric ozone depletion – Vienna Convention and the Montreal Protocol
- Human-induced climate change – UN Framework Convention on Climate Change and the Kyoto Protocol
- Loss of biological diversity - Convention on Biological Diversity
- Large Dams

# What is the IAASTD ?

**……..a unique international effort that will**

- **evaluate** the relevance, quality and effectiveness of agricultural knowledge, science, and technology (AKST); and effectiveness of public and private sector policies as well as institutional arrangements in relation to AKST,
- **Share views and create** a common vision of the future of agriculture among a diverse set of stakeholders,
- is **multi-thematic**, addresses nutritional security, livelihoods, human health, and environmental sustainability; **multi-spatial**, combining global and sub-global assessments; **multi-temporal,** taking a short- and long-term perspective (now to 2050); **integrates** local knowledge with institutional knowledge and looks at policy and institutional issues in light of history and plausible future scenarios.

# What is the IAASTD ?

- Intergovernmental process with a 60 member multi-stakeholder Bureau (governments, private sector, NGOs, producers, consumers, international organizations)
- Co-sponsored by World Bank, FAO, WHO, UNEP, UNDP, UNESCO and GEF
- Co-chaired by Hans Herren and Judi Wakhungu
- Director – Bob Watson
- To be completed by October/November 2007 after two rounds of peer-review and plenary approval

# What is IAASTD's purpose?

- is to **assess** agricultural knowledge, science and technology (AKST) in order to generate, disseminate, access and use AKST more effectively to reduce hunger and poverty, improve rural livelihoods, and facilitate equitable, environmentally, socially and economically sustainable development.
- to **guide** policy and management decisions,
- to **build and enhance** local and regional capacity to design, implement and utilize scientific assessments.

# IAASTD

- The proposed assessment will complement, not duplicate, other assessment activities, e.g.,
  - the IAC Study on Science and Technology Strategies for Improved Agricultural Productivity and Food Security in Africa
  - the MDG Task Force on Hunger
  - The IWMI Comprehensive Assessment of Water Management in Agriculture: Guiding Policy Investments in Water, Food, Livelihoods and Environment
  - The CGIAR Science Council Strategy and Priority Setting Exercise
  - The relevant chapters from the Millennium Ecosystem Assessment
  - The relevant chapters from the Intergovernmental Panel on Climate Change
  - The relevant chapters of the 2007 Global Environmental Outlook

# Scope and features of the Assessment

# Overall Goal

The overarching question for the IAASTD is:

"How can we reduce hunger and poverty, improve rural livelihoods and facilitate equitable, socially, environmentally and economically sustainable development through the generation, access to and use of agricultural knowledge, science and technology?"

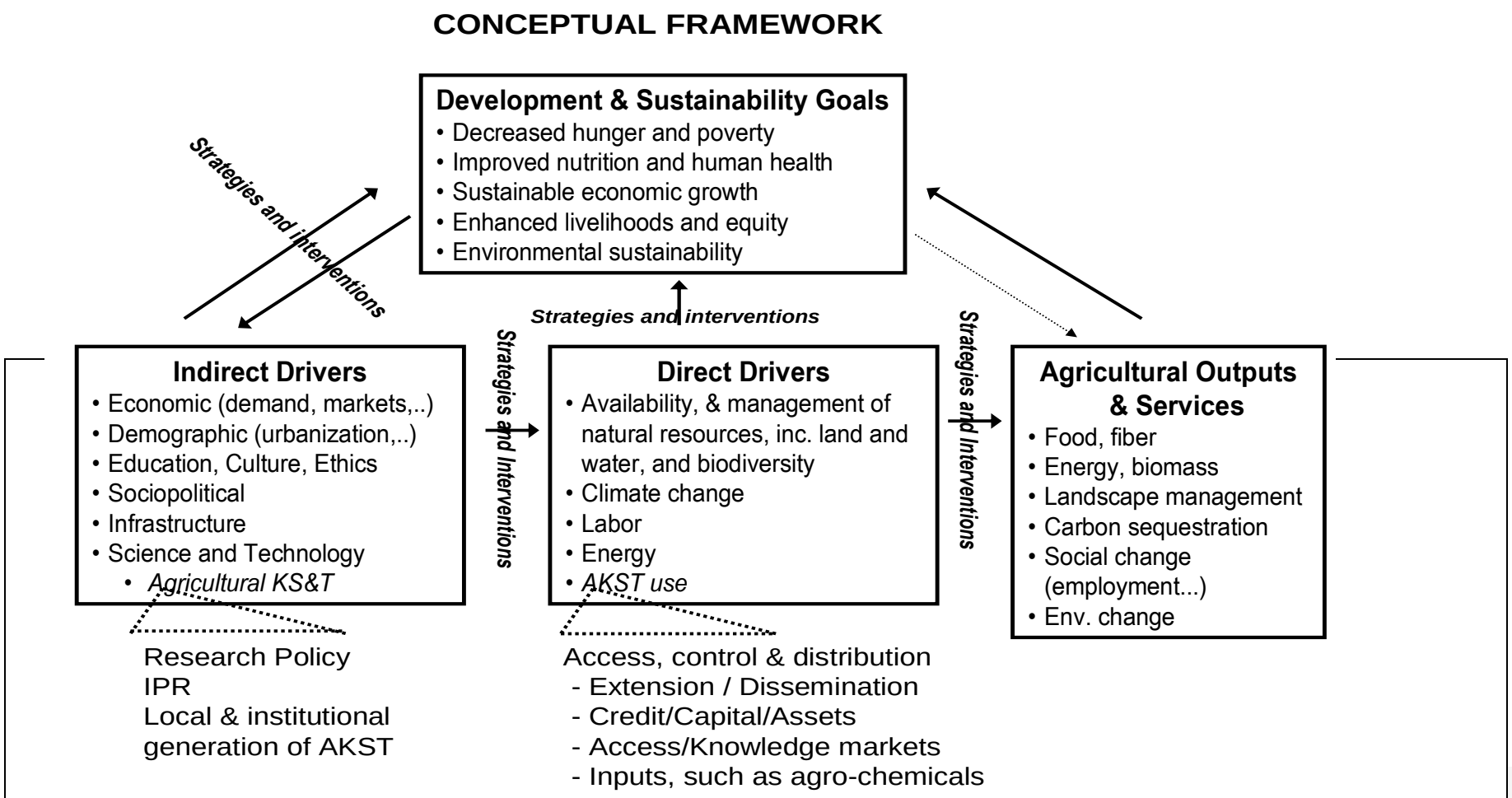
# The Four Broad Questions

- What are the challenges that can be addressed through agricultural KST?
- What are the likely positive and negative consequences of agricultural KST?
- What are the enabling conditions required to optimize the uptake and diffusion of agricultural KST?
- What investments are needed to help realize the potential of agricultural KST?

# The Basic Structure

- A global and five sub-global assessments
  - Sub-Saharan Africa (SSA)
  - East and South Asia and Pacific (ESAP)
  - Latin America and the Caribbean (LAC)
  - Central/West Asia and North Africa (CWANA)
  - North America and Europe (NAE)

# Conceptual Framework



# Overall Structure for the Global Assessment

**A: Historical (past 50 years) and current perspectives**

Context, define AKST, conceptual framework and indicators. Assess the efficacy of different AKST systems, and the contribution of AKST systems in achieving the development and sustainability goals of improved nutrition, human health, and livelihoods; reduced hunger and poverty; and social and environmental sustainability.

**B: Plausible futures (present to 2050)** (broad global scenarios, with regional specificity) – will analyze the positives and negatives for hunger, poverty alleviation, human health, social (gender and equity) and environmental considerations both qualitatively and quantitatively.

**C&D: Options for Action** Assess options to enhance the role of the generation, access, dissemination, and use of AKST in achieving the development and sustainability goals in a more effective, efficient, equitable, sustainable and transparent way. Options for technology, capacity strengthening, policies and funding strategies.

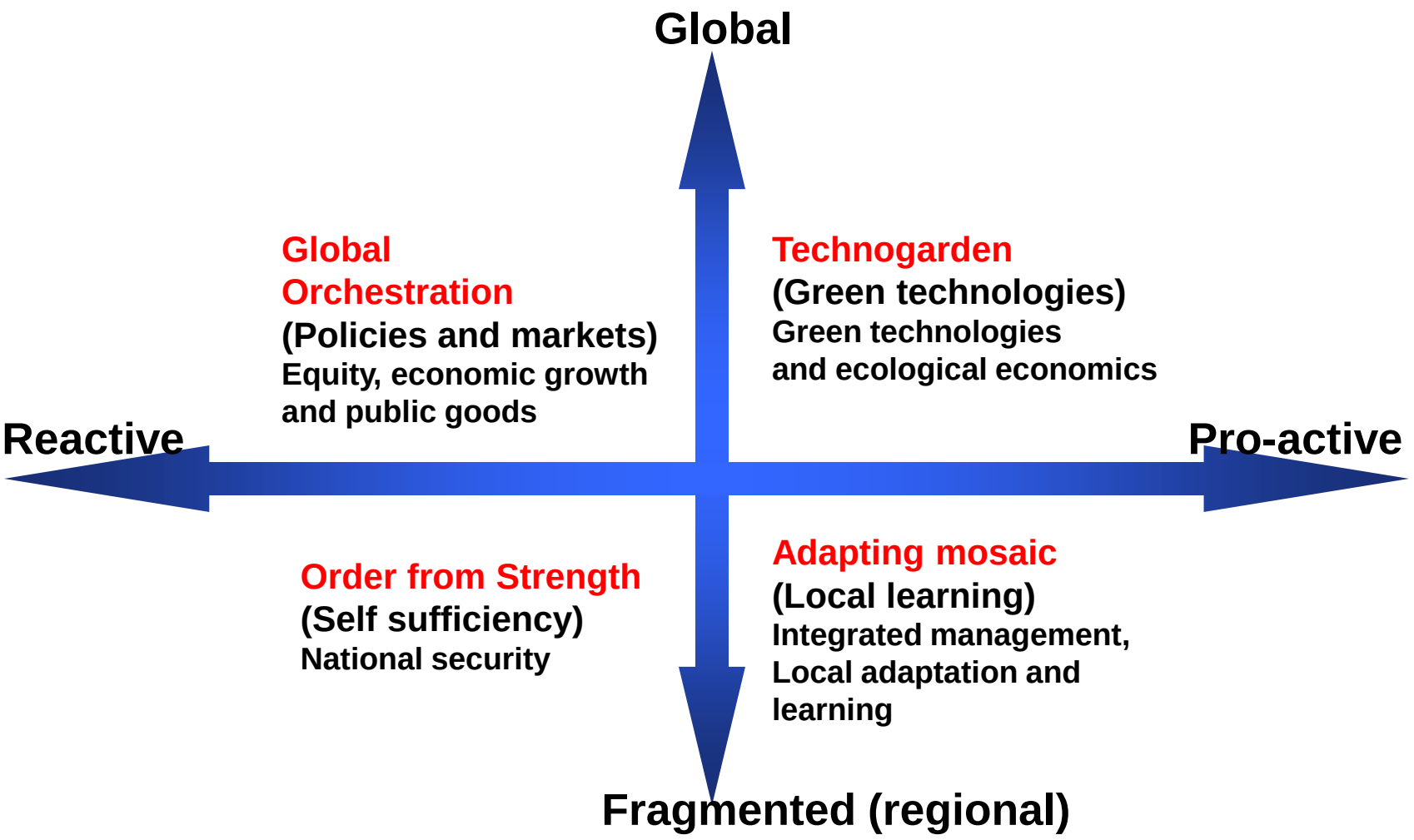
# IAASTD

# The progress so far: Scenarios

**World Food Prize Symposium**

**Hans R. Herren and Robert Watson**

October 2006




***What are the consequences of plausible changes in development paths for ecosystems and their services over the next 50 years and what will be the consequences of those changes for human well-being?***

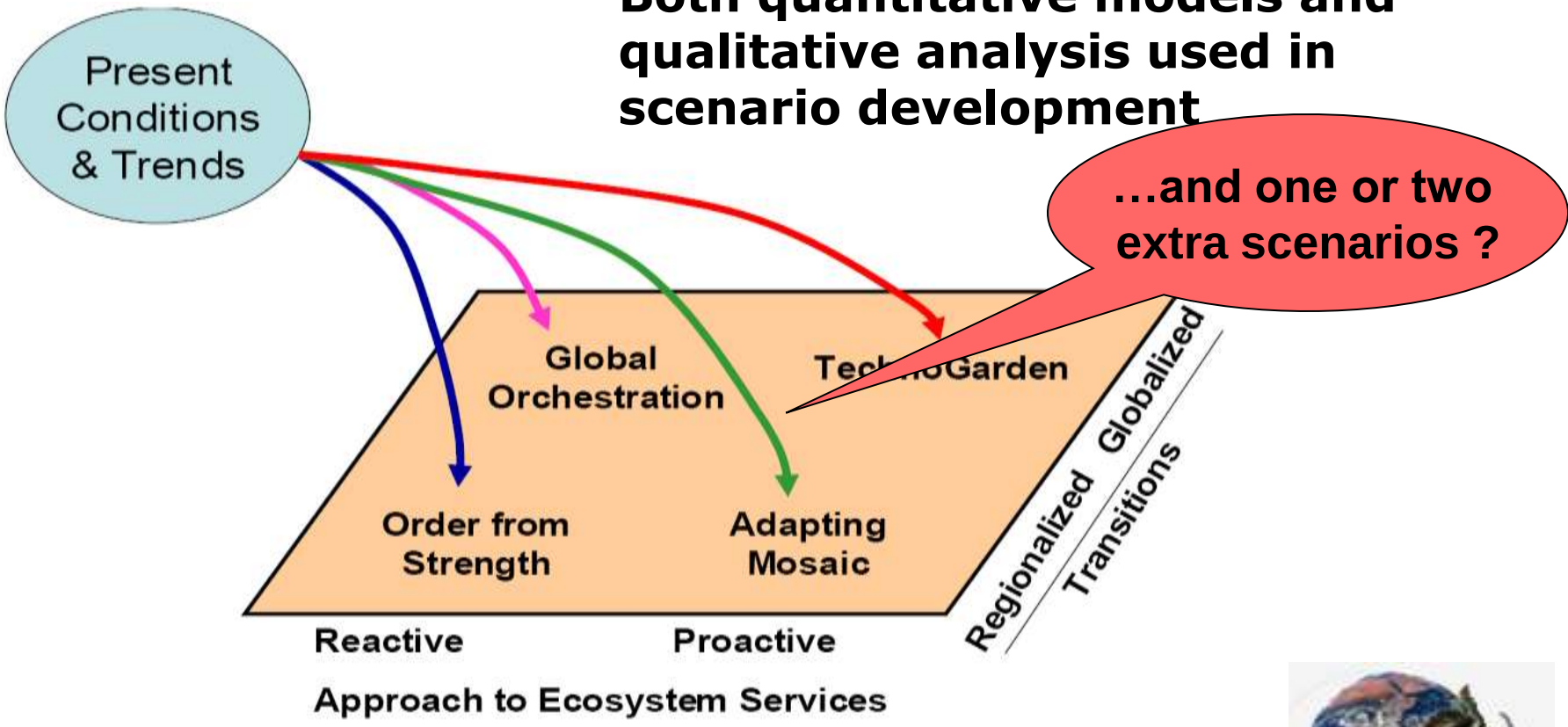
**World Food Prize Symposium**

**Hans R. Herren and Robert Watson**

October 2006

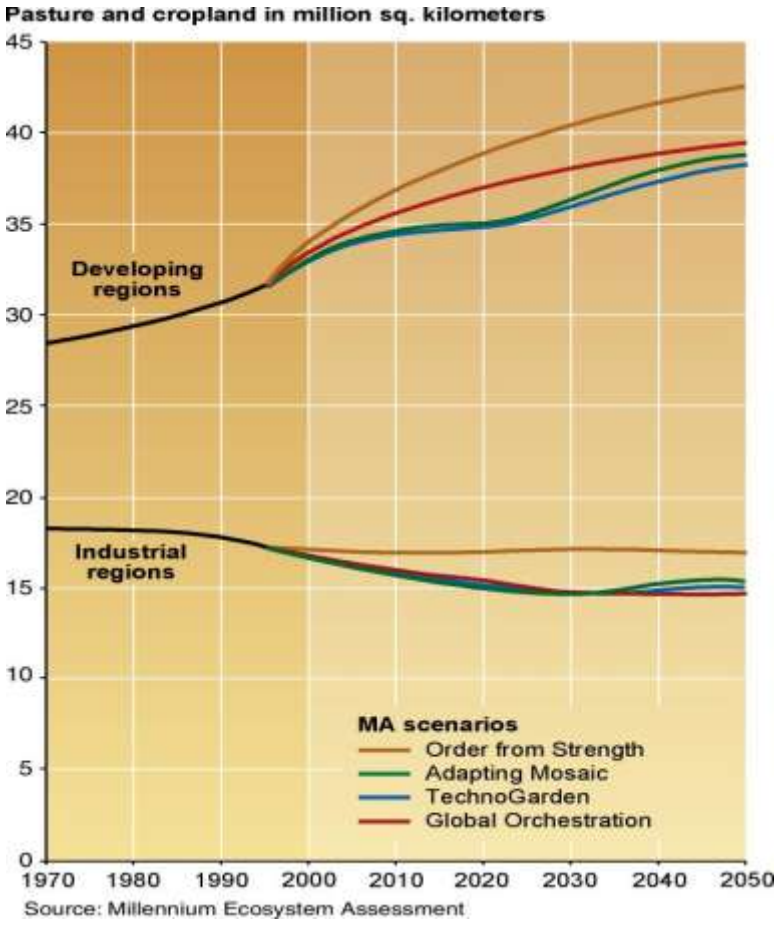
# IAASTD Scenarios

- **Not predictions – scenarios are plausible futures**
- **Both quantitative models and qualitative analysis used in scenario development**

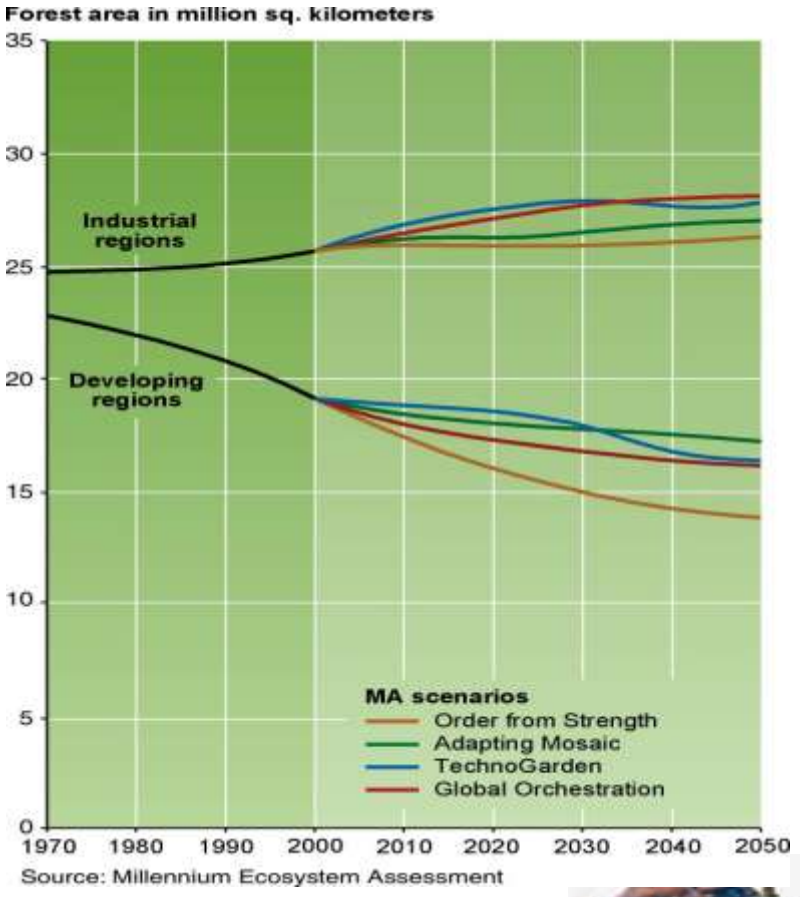



# Changes in direct drivers

Changes in crop land and forest area under MA Scenarios



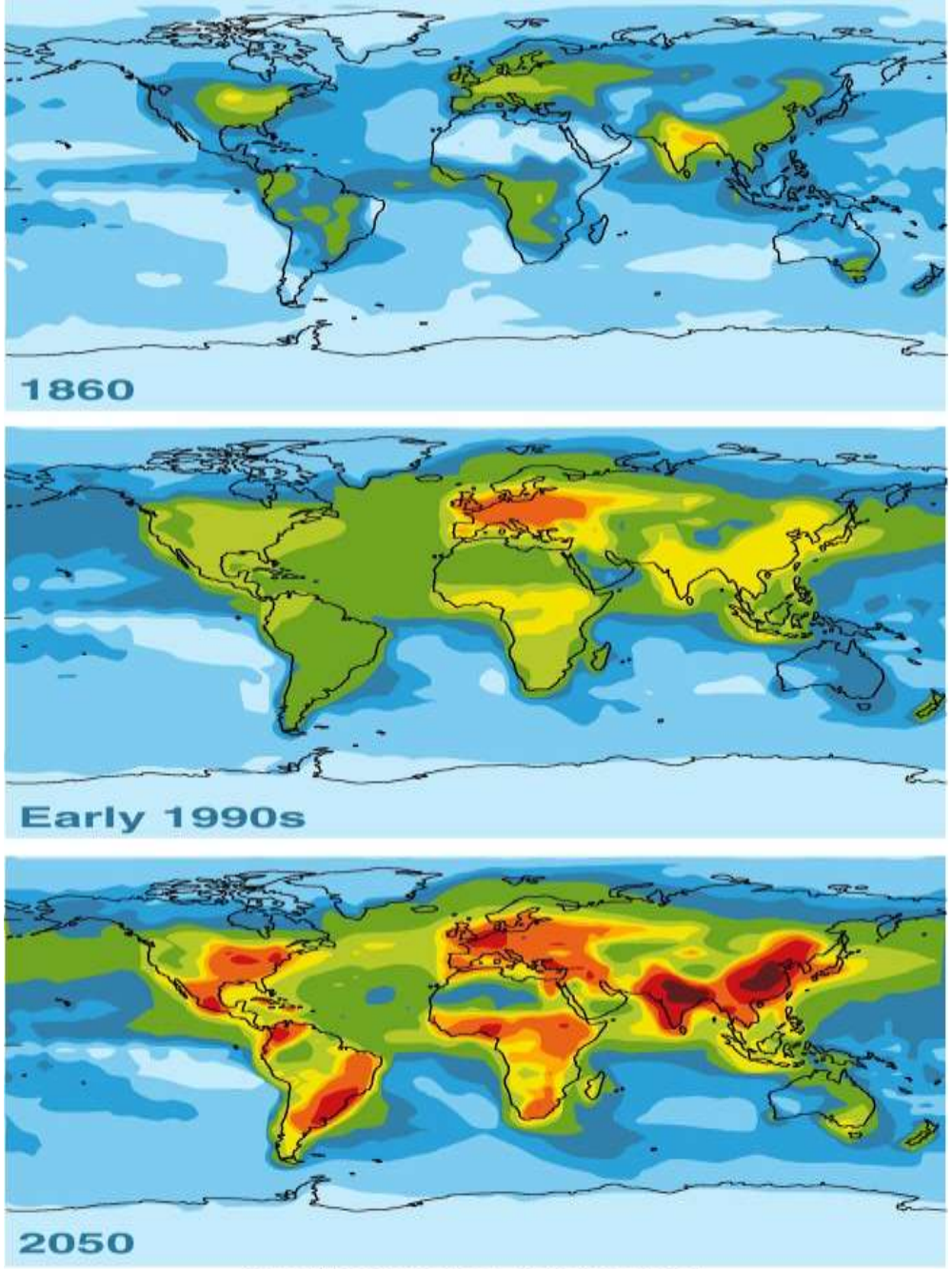

**Crop Land**




**Forest Area**

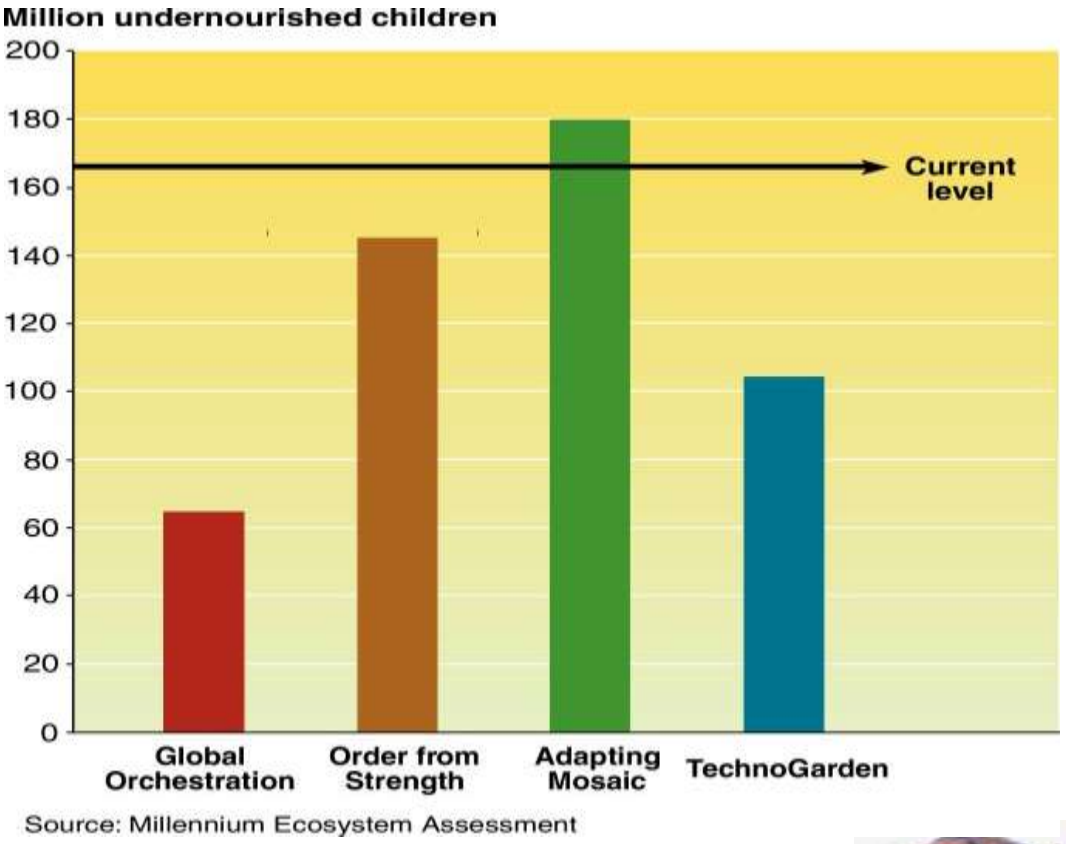
# Changes in direct drivers: Nutrient loading

- Humans have already doubled the flow of reactive nitrogen on the continents, and some projections suggest that this may increase by roughly a further two thirds by 2050



# Changes in ecosystem services under MA Scenarios

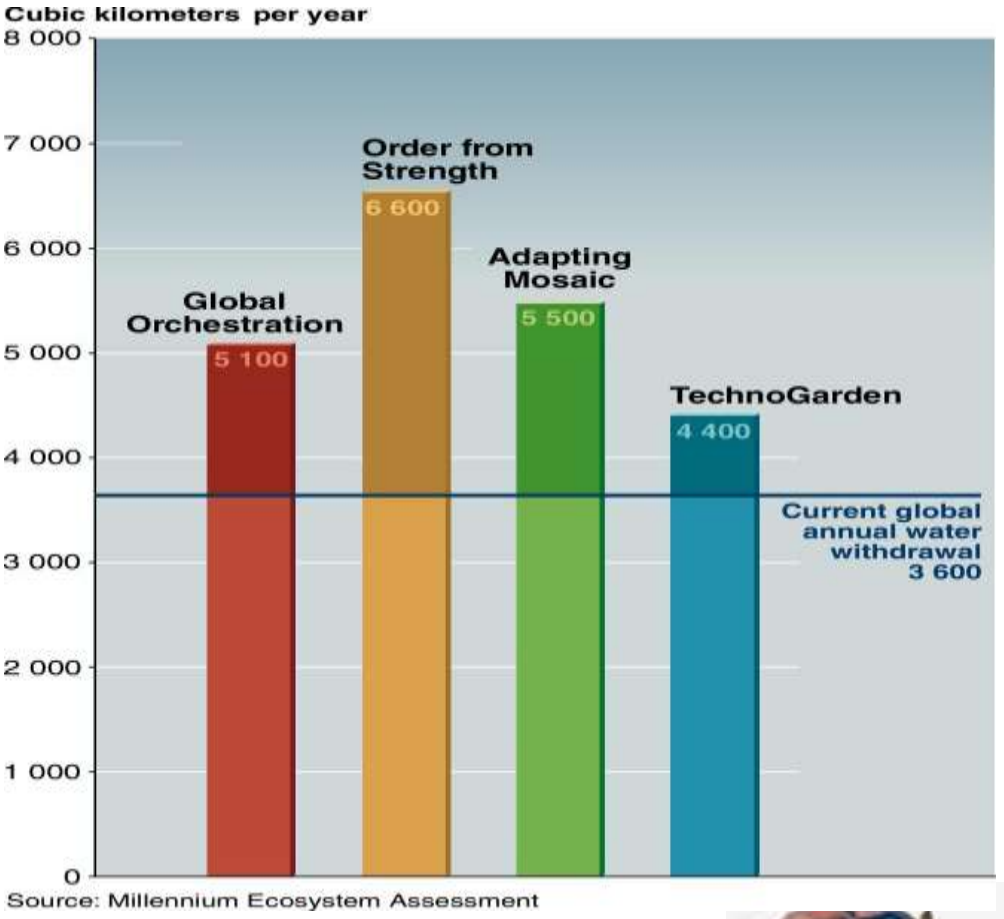
- Demand for food crops is projected to grow by 70–85% by 2050, and water withdrawals by 30-85%
- Food security is not achieved by 2050, and child undernutrition would be difficult to eradicate (and is projected to increase in some regions in some MA scenarios)




**Child undernourishment in 2050 under MA Scenarios**

# Changes in ecosystem services under MA Scenarios

- Water Availability
  - Global water availability increases under all MA scenarios. By 2050, global water availability increases by 5–7% (depending on the scenario)
  - Demand for water is projected to grow by between 30% and 85%




**Water Withdrawals in 2050 under MA Scenarios**

# Key Cross-cutting Issues to Address

A major macro question for this Assessment is:

– What are the consequences (with particular focus on effects on women and small-scale farmers) of agricultural/food systems, agricultural technologies (e.g., conventional/organic farming, on-farm conservation of local genetic resources, irrigation, transgenics, processing) for hunger, poverty, human health, social equity, the environment and the economy?

# Key Cross-cutting Issues to Address

**Three issues will cross-cut the global and sub-global assessments:**

- How has **natural resource availability, access and management** (particularly water resources) **affected the development and sustainability goals**, and how will projected changes in natural resource availability, access and management affect the development and sustainability goals in the future?

- How have changing **markets** and changing access to markets affected the development and sustainability goals? What are the projected implications of market changes in the future?

- What have been, and what are projected to be, the implications of **institutional and policy change and funding** (private vs. public investment, IPR, legislative frameworks) **on the generation, access to, dissemination and use of AKST?**

# Key Challenges

- Integrating local (traditional/indigenous) and institutional knowledge
  - **Designing a peer-review system for local knowledge**
- Ensuring scientific rigor and differentiating between evidence-based findings and different value systems and ideologies
- How to address cross cutting issues
- How to deal with uncertainties (I.e., how well may certain facts be established)

# Overall Structure for the Assessment

- **Global Assessment**
  - **Ten chapters, each with an executive summary**
  - **A Summary for decision Makers**

- **Five Sub-global assessments**
  - **Five chapters each, each with an executive summary**
  - **A Summary for decision Makers**

- **An Overall Synthesis Summary**

1. The chapters should be defensible to our colleagues
2. The executive summaries should be defensible to our colleagues and understandable to the technical advisors to policymakers
3. The Overall Synthesis Report should be understandable to decision-makers and address their policy needs

…We have done well, AKST have made a huge difference in the way the people live today (for better or worse), and we need to learn from these lessons and do a lot better..now How we will do that is the question. AKST can help, but just like With nuclear fission…we can do good or bad….

**You cannot solve the problem with the same kind of thinking that created the problem**

***Albert Einstein***

# ….thank you


**You cannot solve the problem with the same kind of thinking that created the problem. *Albert Einstein***

**You have to be the change you want to see**
***Mahatma Gandhi***

**World Food Prize Symposium**
**Hans R. Herren and Robert Watson**

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