Consortium
of the CGIAR Centres

What science and capacity building for emerging challenges in food security and natural resources management?

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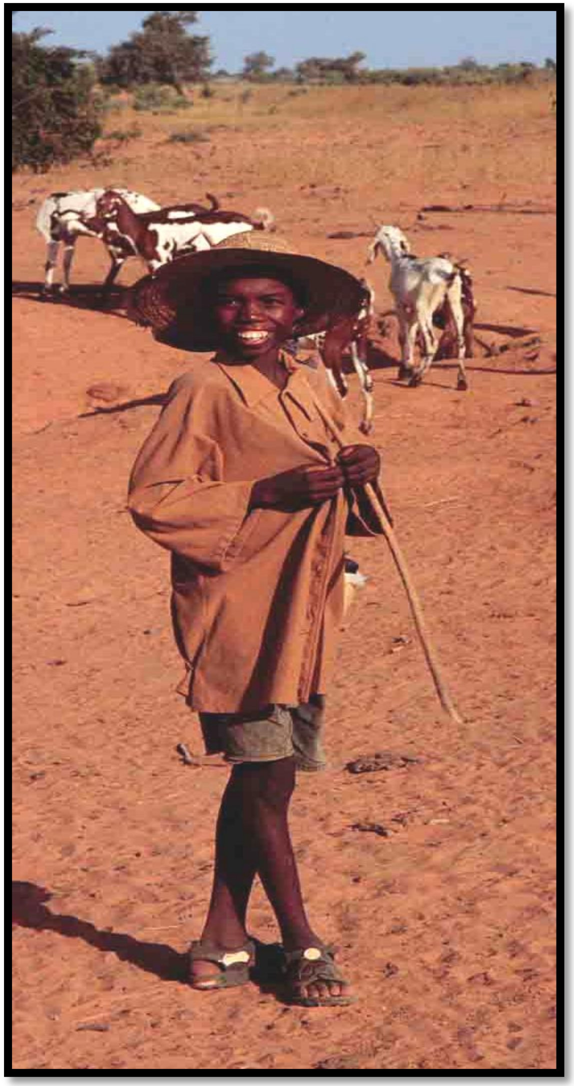
Presentation outline

- **The challenges – present and emerging**
- Which science to address these challenges?
- Is science sufficient?
- Key messages

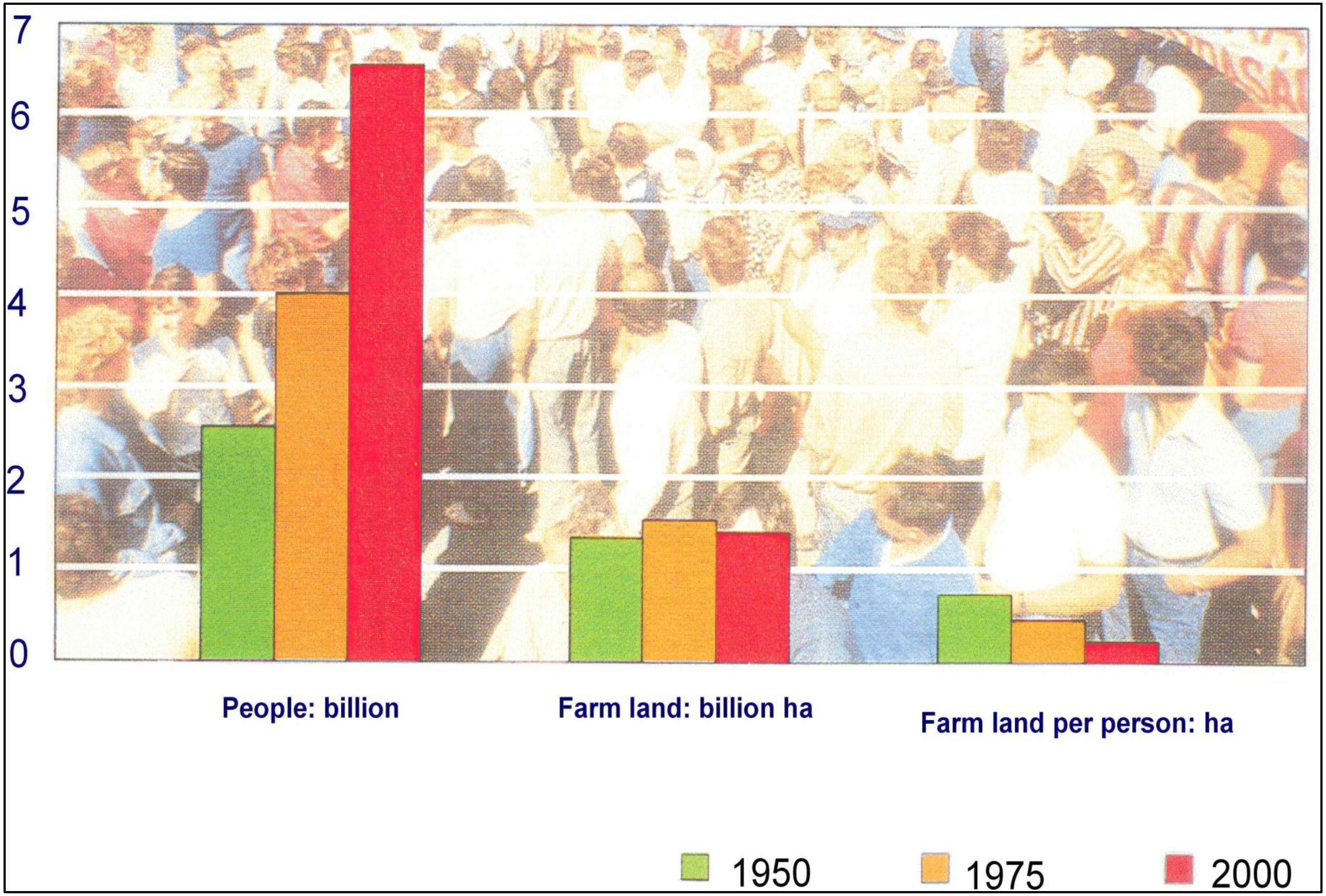
Today's situation

- **Advances in agricultural research** over past 30 years: food production x 3 in developing countries
- **Poorest and most marginalised farmers** continue not to benefit
- **Negative impacts of enhanced production** (e.g., polluted water, decreasing aquifers, soil degradation, deforestation, …) **are now prominent**
- **Global food, economic, financial crises**



Global population and agricultural land

(source: IAASTD,2008)



Long-term trends in food prices (1990-2011)

Intractable natural resources management issues?

FAO 2011, State of land and water in Africa:

- **land degradation, e**rosion, desertification, ↓ productivity of soil and water, ↑ water scarcity
- **Climate change**: ↑ crop failures, ↑ intensity and incidence of floods, ↓ flows of water in rivers, ↓ buffer role of aquifers,
  sea-level ↑
- ↓ biodiversity and **environmental services**, health-related problems
- large-scale land acquisition, ↑ **conflicts,** accelerated out-migration, high poverty and food insecurity

Future challenges by 2050

- **World population**: 9 billion
- **Food demand** : more than double
- **30% of irrigated lands** are degraded now, will increase further
- **Water use** expected to increase by 50%
- **Climate change** predicted to increase vulnerability of agricultural sector in most developing countries

...and global trends

- **Globalisation of resources**: land, water, biodiversity
- **Accelerated change** (climate, economic, population, political)
- **Globalisation of challenges:** food security, food sovereignty, climate change, degradation of ecosystem services. Interrelated, to be addressed simultaneously
- **More difficult** than maximising productivity, or water use efficiency, or biodiversity

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Implications of these challenges: key question for research

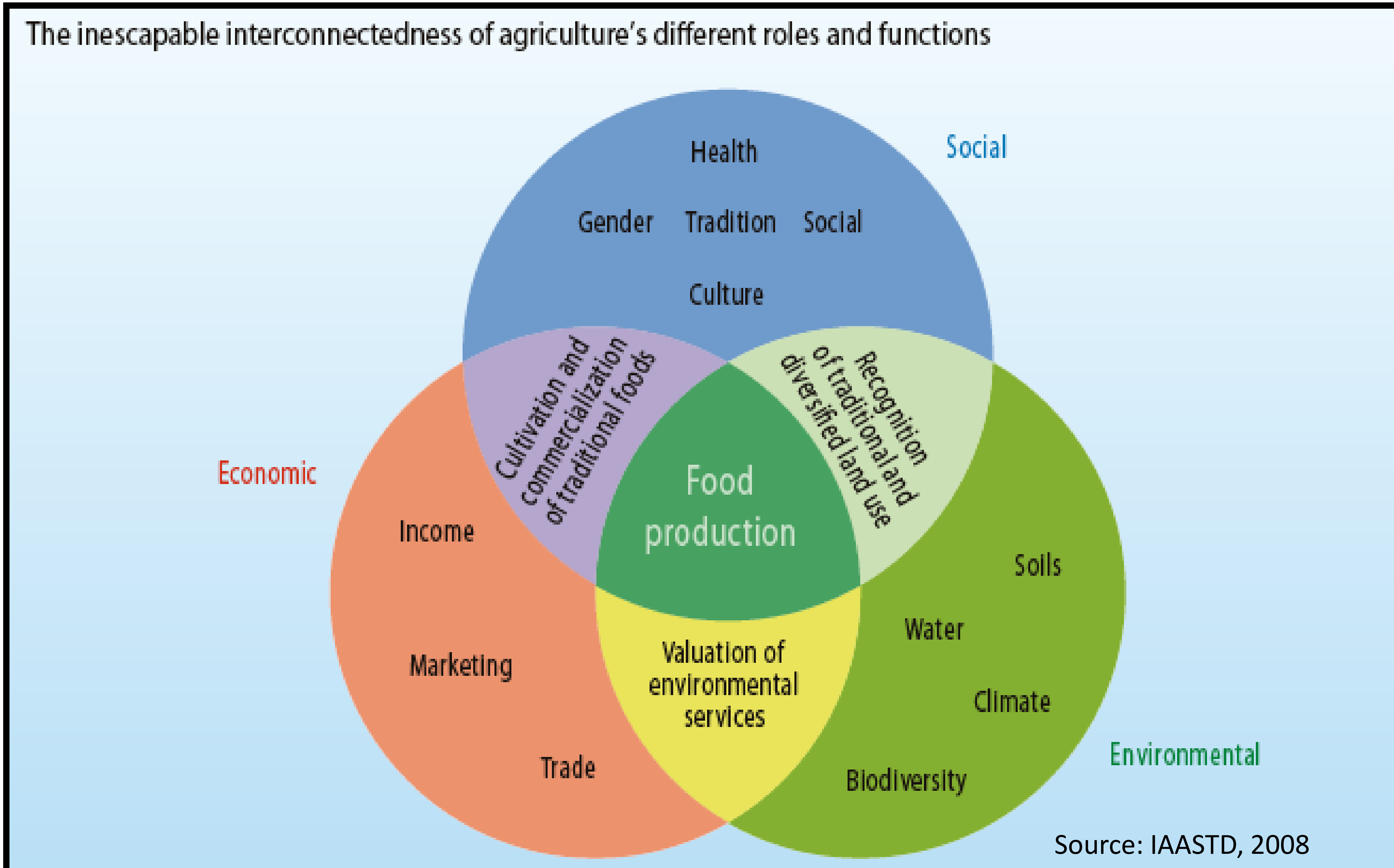
- **Improving agr. productivity and profitability** for small-scale, vulnerable producers in a **sustainable** manner. Decreasing **environmental footprint** of agriculture and adapting to climate change

- **How to increase productivity**, **profitability** and **environmental integrity and resilience** in a sustainable manner for small-scale farmers in less well endowed areas?

Which science today?

- **No general theory of agriculture**
- **Cannot explain -** different trajectories of ag. sector in different countries
- **Cannot predict** - consequences of complex interventions (e.g., bio-fuels, GMOs, green revolution in Asia)
- **Applied branches** of economics, hydrology, soils science, entomology, genetics, botany...
- **Piece meal, reactive approach** to agric. problems
- Science-based results often largely ignored by policy-makers, not adopted by farmers

Complex, multidimensional issues

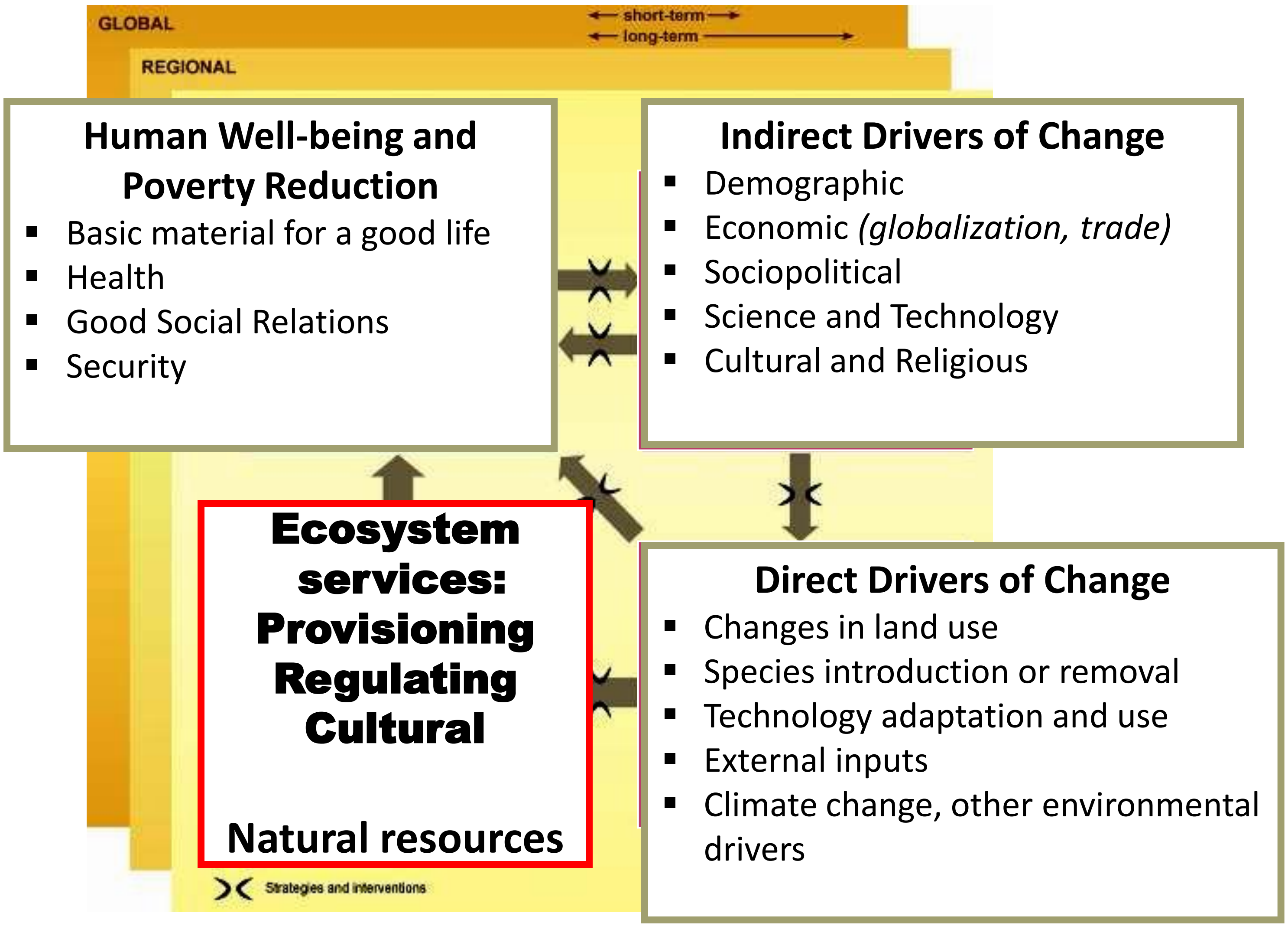


Source: IAASTD, 2008

Science for complex problems

- **Need** to design more integrative scientific approaches:
  - interactions among dimensions, including policies;
  - processes at different temporal and spatial scales;
  - To identify acceptable tradeoff between productivity goals and environmental integrity (policy-making as implementation mechanism)
- **Recent recognition of** this need (e.g., US Congress, Special Rapporteur to the UN on the right to food, FAO); approaches based on ecology and ecosystem theory, agroecology. Ecological economics.

A conceptual Framework (adapted from MEA)



Regulating ecosystem services in agroecosystems

- Air Quality Regulation
- Climate Regulation
  - Regional and local
  - Global (CO_2 sequestration)
- Erosion regulation
- Water purification
- Disease regulation
- Pest regulation
- Pollination
- Natural Hazard regulation

Spatial and temporal scales and ecosystem services

Farm scale

(short-term)

All provisioning services (food, fibber, wood, genetic resources) + some regulating (erosion control, soil fertility) and cultural (religious, knowledge)

Provisioning services have been enhanced at expense of regulating & cultural services

Region/ landscape scale

Most regulating services (pest and disease control, pollination, water regulation, climate and hazard regulation) plus some cultural (aesthetic, sense of place, recreation, inspiration)

Global scale

(long-term)

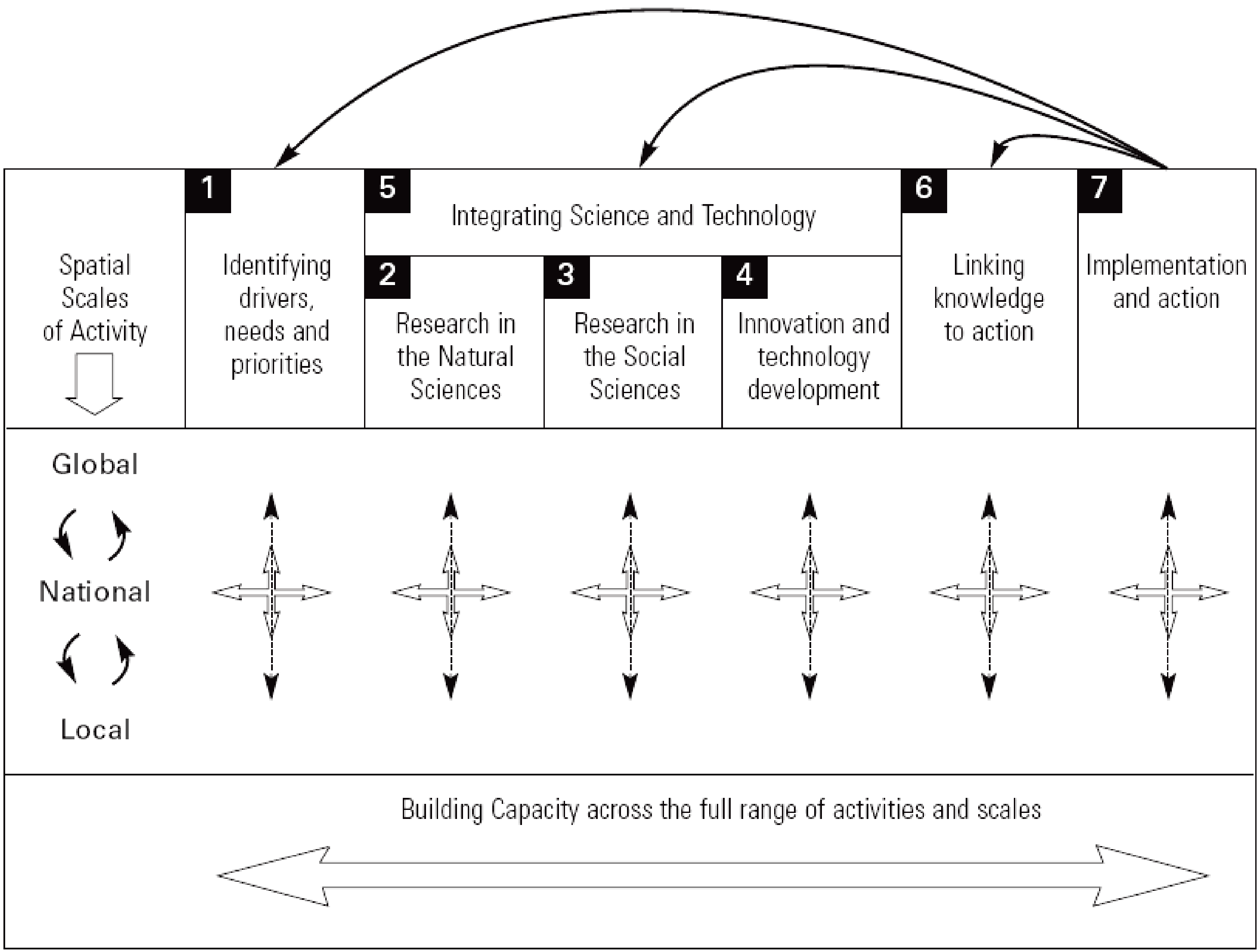
Cultural and regulating services

Food security and resilience

- To create more productive and resilient agricultural systems:

  more productive, stress-resistant **varieties** + **new options for** managing biological processes and **NRs** more effectively under climate change + new integrated **options for policy-makers** + **new partnerships/networks** for options to be profitable for small-scale farmers
- Combination of key requirements:
  - new tools from molecular biology + evaluation of genetic resources in genebanks
  - more integrated approaches for managing ecosystem services, resilience, adaptation to climate change, soil, water, biodiversity – e.g., improved agroforestry systems; improved crop-livestock combinations; better techniques for water and groundwater management in irrigated and rainfed agriculture; integrated soil fertility management
  - Beyond participatory research: innovation systems for long-term sustainability

More integrative approaches



Source: Izac et al,06

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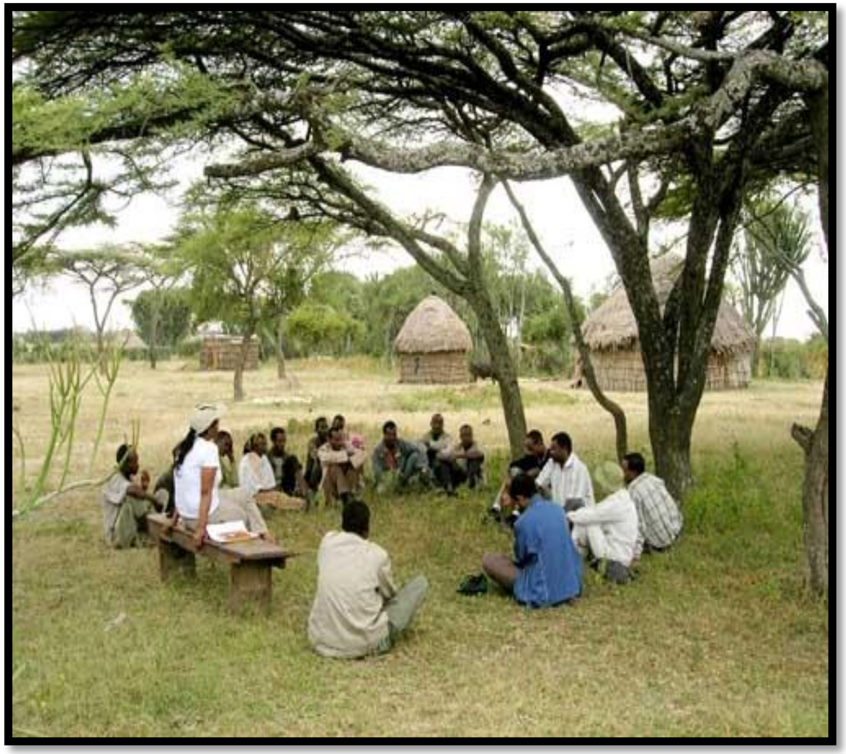
Is science sufficient?

- **Cannot resolve complex challenges** by only creating new scientific knowledge
- Need to also weave research into **innovation systems** in which farmers and decision-makers function
- **Innovation systems**: innovation process and role of research within it; different worldviews of 'useful' knowledge
- **Strengthen capacities** of communities, farmers, stakeholders to negotiate/ adapt



New roles for scientists

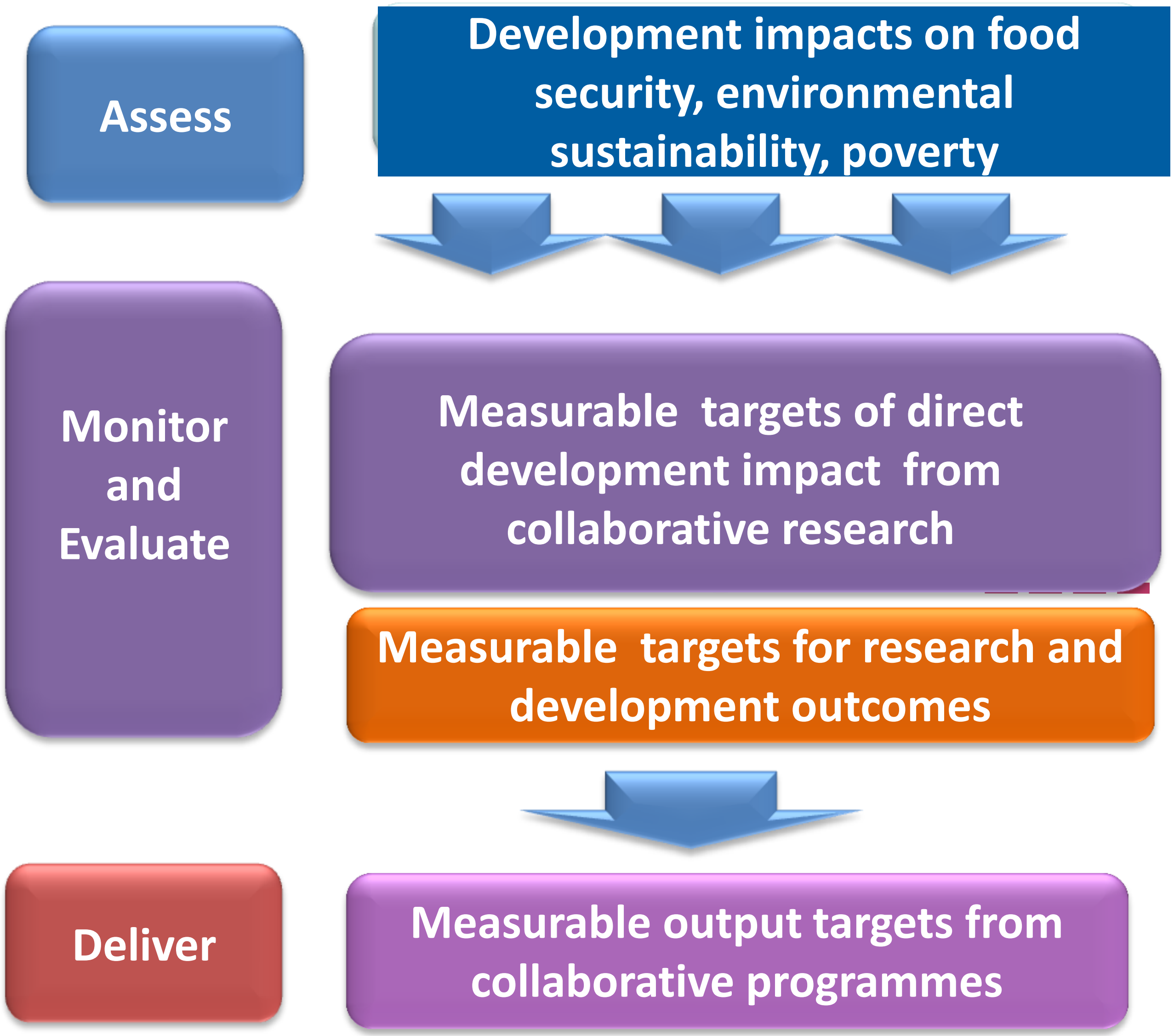
- Scientists as **negotiators**, **facilitators** of knowledge exchange + **originators** of new knowledge
- To provide options at multiple scales, need **a large range of partners** along impact pathways

local → regional →national →sub-regional →global

Two examples from the CGIAR

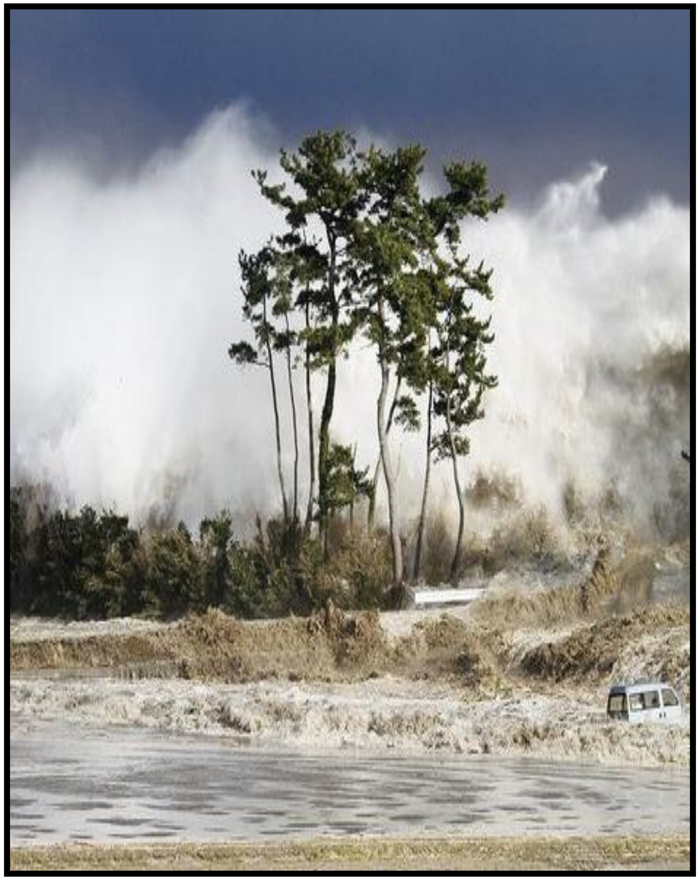
- Like UNU, a global institution, research in agr.
- Operate at local and regional scales, focus on global challenges
- Same challenge as UNU-INRA: how to balance efforts from local to global scale

New approach to design research programmes in CGIAR



New CGIAR Research Program on climate change, agriculture and food security

- **> 400 partners,** including climate change research community
- **Identify and test pro-poor** adaptation and mitigation practices, technologies and policies for food systems, adaptive capacity and rural livelihoods
- **Provide diagnosis and analysis for** cost-effective investments, inclusion of ag. in climate change policies, and climate change in ag. policies, from sub-national to global level in a way that benefits rural poor.
- **By 2020, reduce poverty by 10 percent,** lower number of malnourished rural people by 25 percent in East and West Africa. Reduce greenhouse gas emissions by equivalent to 1,000 million tons of CO_2



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Key messages

- **Food security and natural resources management** challenges becoming global, rapid rate of change
- **Complex socio-economic-ecological** problems and systems
- **Research challenge:** increasing production, profitability and NR integrity, particularly for resource-poor farmers: not single linear solution but ranges of options at multiple scales
- Agric. Sciences not sufficiently integrated
- Huge, **exciting challenge** for scientists: new type of science needed, and new way of conceiving role of research in society

Key messages

- **New type of science:** more integrative, interdisciplinary, focused on systems (ecology, economics), understanding interactions, system dynamics
- **Recognising** different types of 'useful' knowledge, building capacities of stakeholders, partners, scientists to facilitate negotiation
- With **a range of partners**, local to global

TALL ORDER BUT FUTURE OF AGRICULTURE DEPENDS UPON IT