ROLES OF AGRICULTURAL RESEARCH FOR ACHIEVING DEVELOPMENT GOALS

Prof. dr. ir. Rudy Rabbinge
Chair, Science Council Consultative Group on International Agricultural Research (CGIAR)

ABSTRACT

During the 20th century the world population has increased from 1.2 billion to more than 6 billion, but the food production has increased even more. The per capita availability of food has increased in that period. The increased productivity per ha explains 80% of the increased agricultural production. That productivity rise per ha is based on good insight in the functioning of agricultural systems, and better use of external inputs.

Agricultural research has played a pivotal role in the mega-trends of the 20th century that characterize agriculture and management of natural resources. These trends are:

1. Increased productivity per ha, per man-hour and counter intuitively per kg of external inputs such as nitrogen or crop protection measures.
2. Broadening of the objectives of agriculture. Natural resource management, minimization of environmental side effects, and maintaining the landscape are additional objectives.
3. Change in the character of agriculture production and farming. Skills and traditional customs are replaced by industrial way of production, guaranteeing quality of products and production processes.
4. Vertical integration is fully adopted. From the soil to the shelf, from the spade to the plate are nowadays the buzzwords. Supply driven character has increased and in the same time the lateral relations were not neglected. That has increased efficiency and efficacy of use of natural resources and external inputs.
5. The attention for food, nutrition and other aspects have increased considerably. That has led to more attention for functional foods, but also to more research on micro nutrients that play a major role in strengthening the food situation in the developing world.

Those mega-trends take place everywhere and are most visible in the developed world but affect the development processes in the developing world intensively. The universities and knowledge institutes of the south and north play an important role in these developments. The Consultative Group on International Agricultural Research has contributed the last 40 years to the further development of agriculture and has laid the basis for increased agricultural productivity and food security.

The institutes of the CGIAR have gone through an evolution of change. The original institutes were dominated by plant breeding, but through various stages they are now oriented to global challenges making use of the best of agricultural sciences at fundamental and applied levels. The 15 centers function as nodes in a network of international agricultural research and played a major role in the green revolution in Asia and Latin America and see it as their major task to fulfill the promise and potential of African agriculture. Increased agricultural productivity and food security in Africa are the major tasks for agricultural research in the coming decade. That is possible but it requires an enabling environment, appropriate investments and removal of many limiting factors and inertia.

The way that may be achieved is described by the InterAcademy Council in its report of 2004 and the Hunger Taskforce of the United Nations.

Roles of agricultural research for achieving development goals

Prof. Dr Ir Rudy Rabbinge
University Professor Sustainable Development & Food Security
Chair of the CGIAR Science Council
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Contents

- Development and the role of agriculture
- Science and technology and green revolutions
- Mega-trends
- Africa's agriculture
- The position of CGIAR during the last decades
- The role of knowledge institutions

Agriculture and economic development

- **Almost all countries started their economic development with agricultural development**
- **R&D is kick-starting agricultural development**
- **Investing in agricultural R&D is investing in its own future**

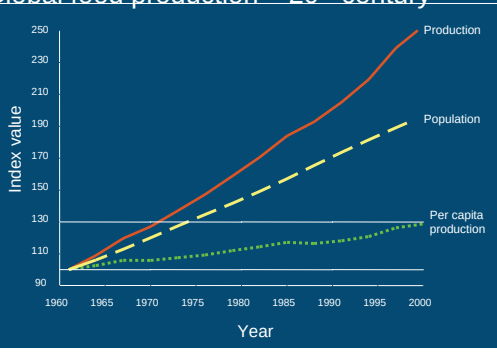
Table 2 Returns to government investments in rural Uganda

Investment	Benefit/cost ratio	Reduction in numbers of poor per million shillings
Agricultural research and extension	22.7	107.2
Education	2.7	12.8
Feeder roads	20.9	83.9
Murram roads	n.s	40.0
Tarmac roads	n.s.	41.4
Health	0.6	2.6

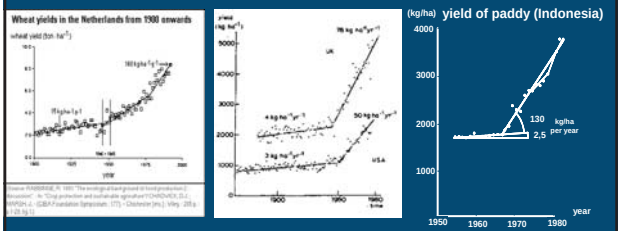
Agriculture in the industrial revolution

- At the end of the 19th century, the (old) world faced for the first time large-scale agricultural competition
- Europe reacted in various ways
  - Liberalization (England)
  - Protection (Germany, France)
  - Innovation (The Netherlands, Denmark)
- This still is reflected in national policies

Global food production – 20th century



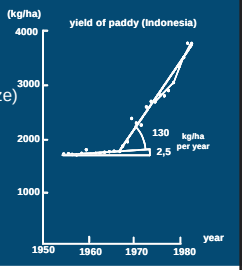
Discontinuation in production trends



Green revolutions

Achievements in Agriculture

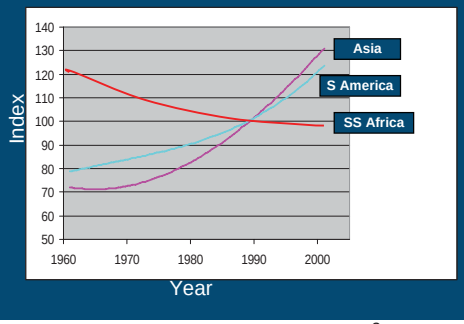
- Food production per person increased by 30% over past 5 decades, despite doubling of population
- Discontinuous productivity rise
- Major role for technology
  - Fertilizers
  - Variety improvement (rice, wheat, maize)
  - Mechanization
  - Irrigation
  - Biocides
- Proper institutions in place



Role Science and Technology vital for 6 mega-trends

1. Increased productivity per ha, per man-hour, per kg external input
2. Character of agriculture is changing from skillfulness to industrialization
3. Chain and chain management
4. Multiple objectives for agriculture: food, environment, landscape, nature etc.
5. From linear to participatory interactive knowledge model
6. Food, nutrition, health

Food availability per caput



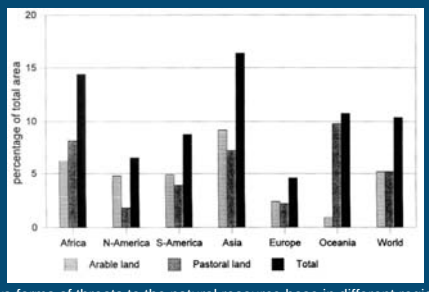
Source: FAOstat

Agriculture in Africa

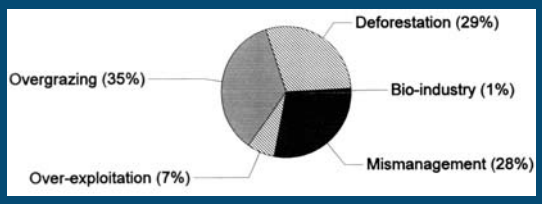
- The Green Revolution did not set off in Africa
- Agricultural growth is good for the poor
  - 1% increase in per capita agricultural output leads to a 1.6% increase in the incomes of the poorest 20% of a population *(Gallup et al, 1997)*
  - On average, every 1% increase in agricultural yields reduces the number of people living on less than 1 $ a day by 0.83% *(Thirtle et al, 2001)*

Unsustainable development

- Due to wealth
- Due to poverty



Two forms of threats to the natural resource base in different regions



Causes of threats to the natural resource base

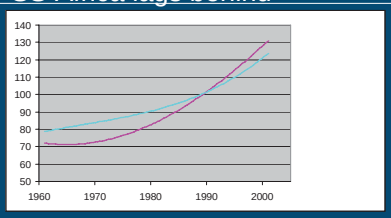
Decline in natural ecosystems and increase of nature conservation area

1. - Tropical rainforest
   - Other vulnerable ecosystems, wetlands, etc.
2. Nature conservation areas
   - Western world
   - Globally

Use of natural resources and external inputs

- Agro-ecosystems
- Food production globally and in Africa

SS Africa lags behind



Population: 600 M
Birth rate: 2.7%
Malnourished: 180 M

Increase labor productivity (1960-2000)
- World 160%
- Sub Saharan Africa 121%
- Europe (15) 634%

GDP: $474
Growth 1988 - 2000: – 0.6%

Kofi Annan

"I request the IAC to present to me, within a year, a report providing a technological strategic plan for harnessing the best science and technology to provide substantial increase in agricultural productivity in Africa"

"I would also welcome specific action proposals that could contribute to food security in Africa through a global collaboration of governments, civil society and the corporate sectors"

VISION

- The Panel affirms its belief in an African future where increasing agricultural productivity, improved food security and enhanced sustainability of agro ecosystems have been realized.
- Towards 2015 the number of food-insecure people in Africa should be reduced by at least 50 percent and the number of malnourished children decreased by at least 30 percent.
- This is achievable as productivity of agro-ecosystems can be increased.

Diagnosis

1. Absence of dominating food crops
2. Weathered soils
3. Erratic rainfall
4. Endemic plant and animal diseases
5. Multitude of farming systems
6. Land / Labor productivity low
7. Dominant role for women – limited access to resources
8. Lack of investment in agricultural research

Diagnosis (cont)

9. Lack of knowledge infrastructure
10. Brain drain
11. Lack of functioning academic institutions
12. Not functioning local and regional markets
13. Land entitlement inappropriate
14. No stimulating political and economic environment
15. Inadequate capacity to impact global policy formulation
16. Lack of good governance

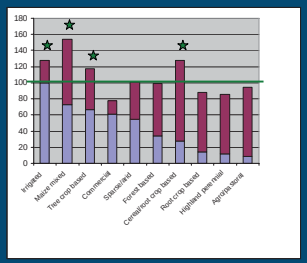
Strategic recommendations in 4 domains

1. Technology options that can make a difference (11)
2. Building impact-oriented research, knowledge and development institutions (5)
3. Creating and retaining a new generation of agricultural scientists (5)
4. Markets and policies to make the poor prosperous and food secure (5)

Domain 1

Technology options that can make a difference

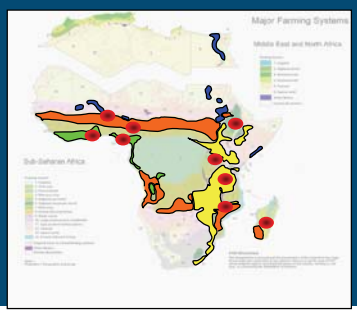
Priority farming systems



Underweight children (CIESIN)
Agricultural value added (worldbank)

- *Irrigated system*
- *Maize mixed system*
- *Tree-crop system*
- *Cereal-root crop mixed system*

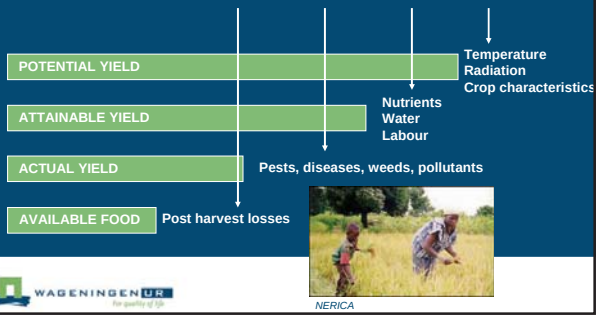
Hunger hotspots and farming systems



Irrigated system
Maize mixed system
Tree crop based system
Cereal root crop mixed system
Hunger Hotspot (CIESIN)

Production Ecological Approach

Key-technology: Plant Breeding including GMO



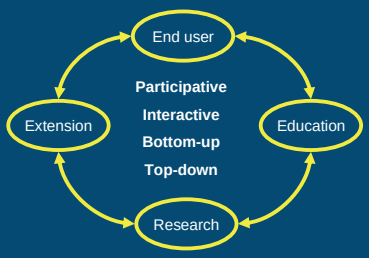
NERICA

Domain 2

Building impact-oriented research, knowledge and development institutions

Changing knowledge model

From a *linear* model towards an *interactive* model

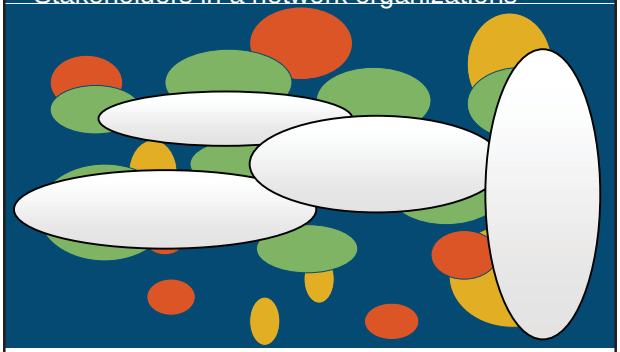


Changing knowledge model

ICT leads to *network organizations*

From *within* organizations to *between* organizations

Stakeholders in a network organizations



Characteristics of a network organization

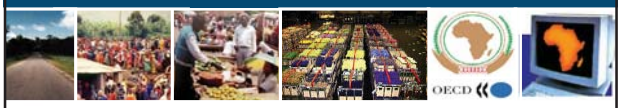
- Expertise *and* competences
- Quadrangle approach
- Cooperation

Domain 3: *Creating and retaining a new generation of agricultural scientists*

- Focus on current and future generations of scientists in Africa
- Broaden and deepen political support for agricultural science
- Reform university curricula
- Mobilize increased and sustainable funding for higher education in S&T, minimizing dependence on external donor support
- Strengthen science education at primary and secondary school levels
- Make better use of CGIAR centers

Domain 4: *Markets and policies to make the poor income and food secure*

- Increase investments in rural infrastructure
- Strengthen capacity to expand market opportunities
- Institute effective intellectual property rights (IPR) regimes to encourage the private sector and facilitate public-private partnerships
- Reduce barriers to increased African trade with OECD countries
- Improve data generation and analysis related to agriculture, food and nutrition security, and vulnerability



CGIAR

Development of the system and the research agenda

1. Seven phases in the history of the CGIAR
   1) - plant breeding and serving disciplines
   2) - agrotechnology, including breeding
   3) - farming systems research
   4) - broadened goals, including environment and socio-economic conditions, sustainable development
   5) - ecoregional approaches
   6) - global challenge programs
   7) - global partnerships

CGIAR

Development of the system and the research agenda

2. Nature of research
   - From: technology push to technology pull
   - From: end products such as varieties to methodologies, concepts, approaches
   - From: mono disciplinary activities to inter-disciplinary approaches
   - From: research activities with potential for development specific research to development policies asking questions
   - From: broad goals to more explicit and well defined goals, with a clear market orientation

Positioning CGIAR at this moment

1. Dilemmas on the future role
   - "back to basics" such as the original institutes

   OR
   - making use of the evolution of national and international knowledge centers, in a reoriented research agenda
2. The roles of CGIAR in a changing world
   - different in various regions
   - changing role of development collaboration
3. Well defined niche for the CGIAR
   - intermediate knowledge institutes with a clear role in bringing advanced universities and knowledge centers together with various stakeholders including NARS and private sector in order to contribute to development and MDGs
   - empower research capacity in developing world
   - provider of strategic agricultural research for development on global 'public good type' issues

Role of the Science Council

1. Crucial role in driving dialogue on the research and policy agenda
2. Authority and respect, with corresponding world leadership
3. Responsibility to lead the policy discussions and to reach transparent and well accepted research agenda on the role of science and technology for development
4. Examples
   do and don't

Do

- Embed science in development
- Focus on strategic research
- Work in diverse partnerships

Don't

- Don't do science for the sake of science
- Don't prescribe the research agenda
- Don't become too consultancy and "development implementation" orientated
- Don't be limited to experimental stations

Universities

- Capacity Building (Expertise *and* Competences)
- Building African Scientific and Institutional Capacity Building (BASIC)
- Regional Universities Forum for Capacity Building in Agriculture (RUFORUM)
- Global Open University
  - Economics of Agriculture and Natural Resources
  - Agro-ecology
- Aligning with ARIs
  - Sandwich programmes
  - Convergences of Science
  - Dual degrees

SROs

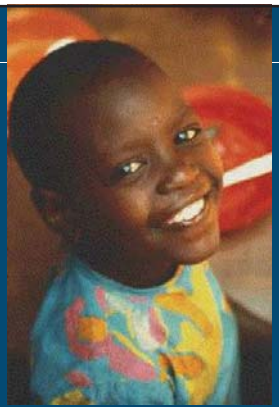
- Stake-holders platform
- Challenge Programme
- Programme for Dissemination of New Agricultural Technologies in Africa (DONATA)
- SROs competitive grants
- Multi-country Agricultural Productivity Program (MAPP)
- Comprehensive Africa Agricultural Development Program (CAADP)

Role of universities and knowledge institutions

- Entire knowledge chain
  - Vocational BSc, BSc, MSc, PhD, Mid-career training, Practical training
- Research
  - Interdisciplinary, Multi-stakeholder, Multi-scale, "Contextual"
  - Fundamental – Strategic – Applied
  - Thematic (production ecology, biotechnology, socio-economic science
- Policy Support
  - Policy process (PRSP, Strategy development)
  - Thematic: Trade, Sustainable development, climate change, biodiversi

Conclusions

- Ample opportunities for S&T to increase food security, to alleviate hunger and to strengthen development
- The African situation requires specific instead of generic S&T solutions
- Not one green revolution, but multitude of rainbow evolutions
- Full power S&T unlocked only when scientific development is accompanied by adequate enabling conditions (including the international community)



Thank you