Sustainable development: the role of agriculture

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

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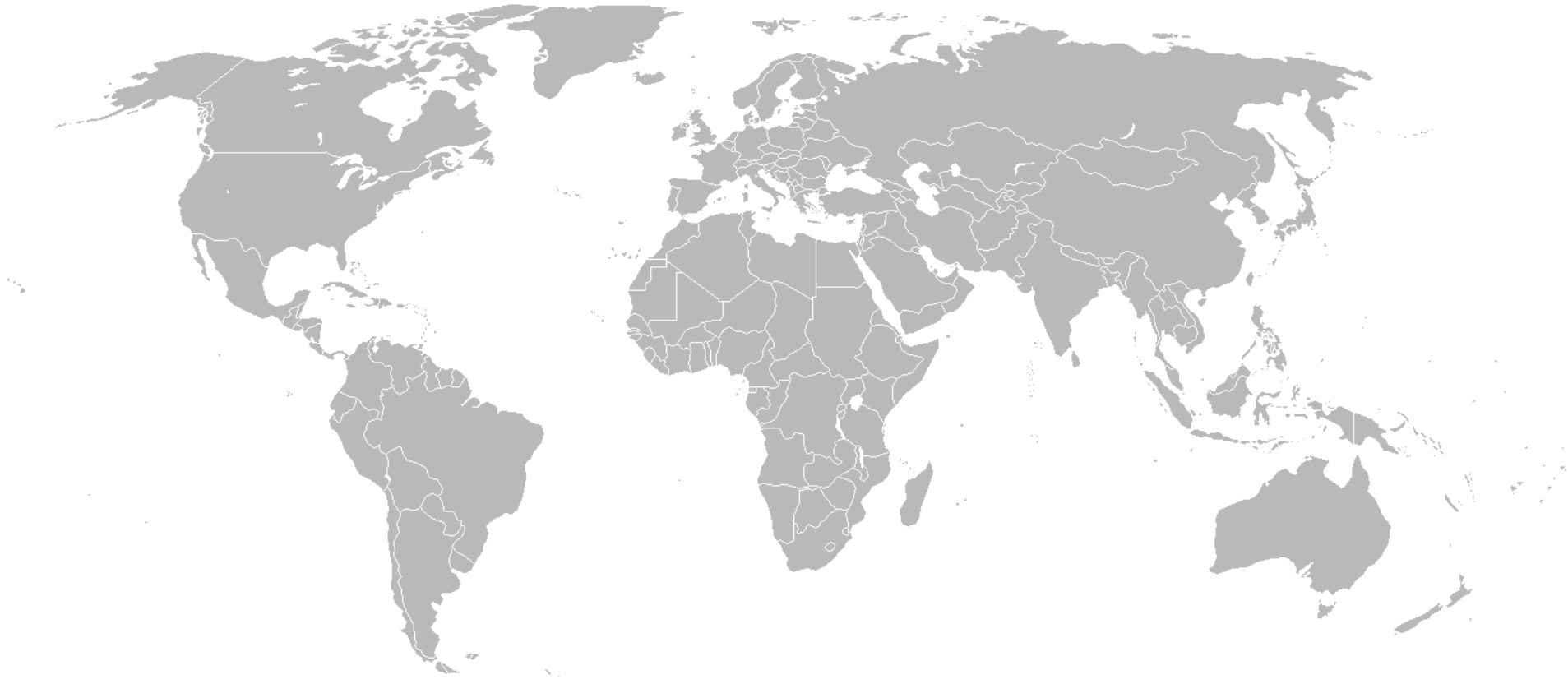


…Sustainability …

Sustainable agriculture

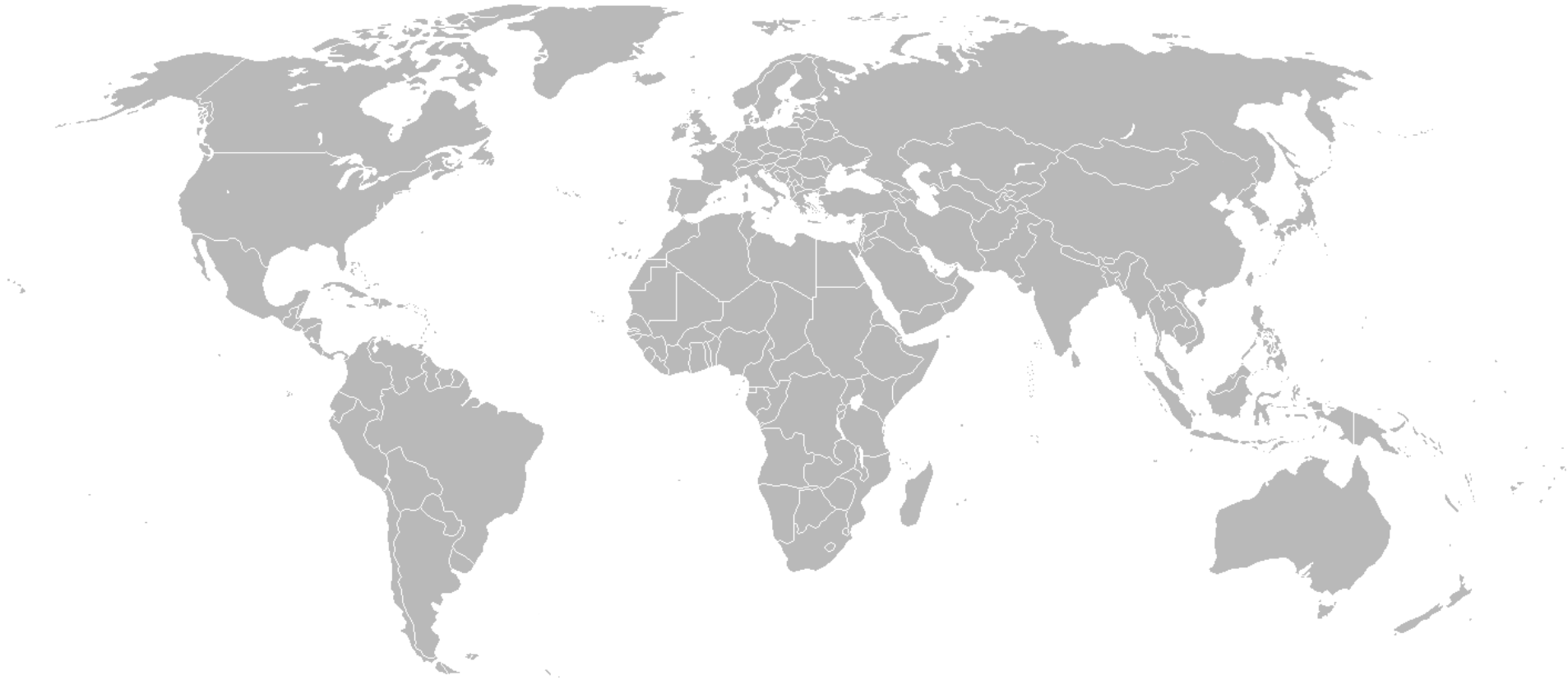
- Water use, land use, food security, energy security and rural development are closely related
- In this context, sustainable agriculture plays a pivotal role
- Broad support for increased productivity
- Broad political commitment for sustainable agriculture
- No clear consensus on what sustainable agriculture is

Sustainable agriculture

- Plant and animal production systems that in the long run make the most efficient use of limited resources to fulfill the needs of mankind
- Needs of mankind
  - Food security and bio-products
  - Economic viability
  - Environmental quality
  - Social equity
- Limited resources
  - Land
  - Water
  - Nutrients
  - Genetic resources
  - Labour

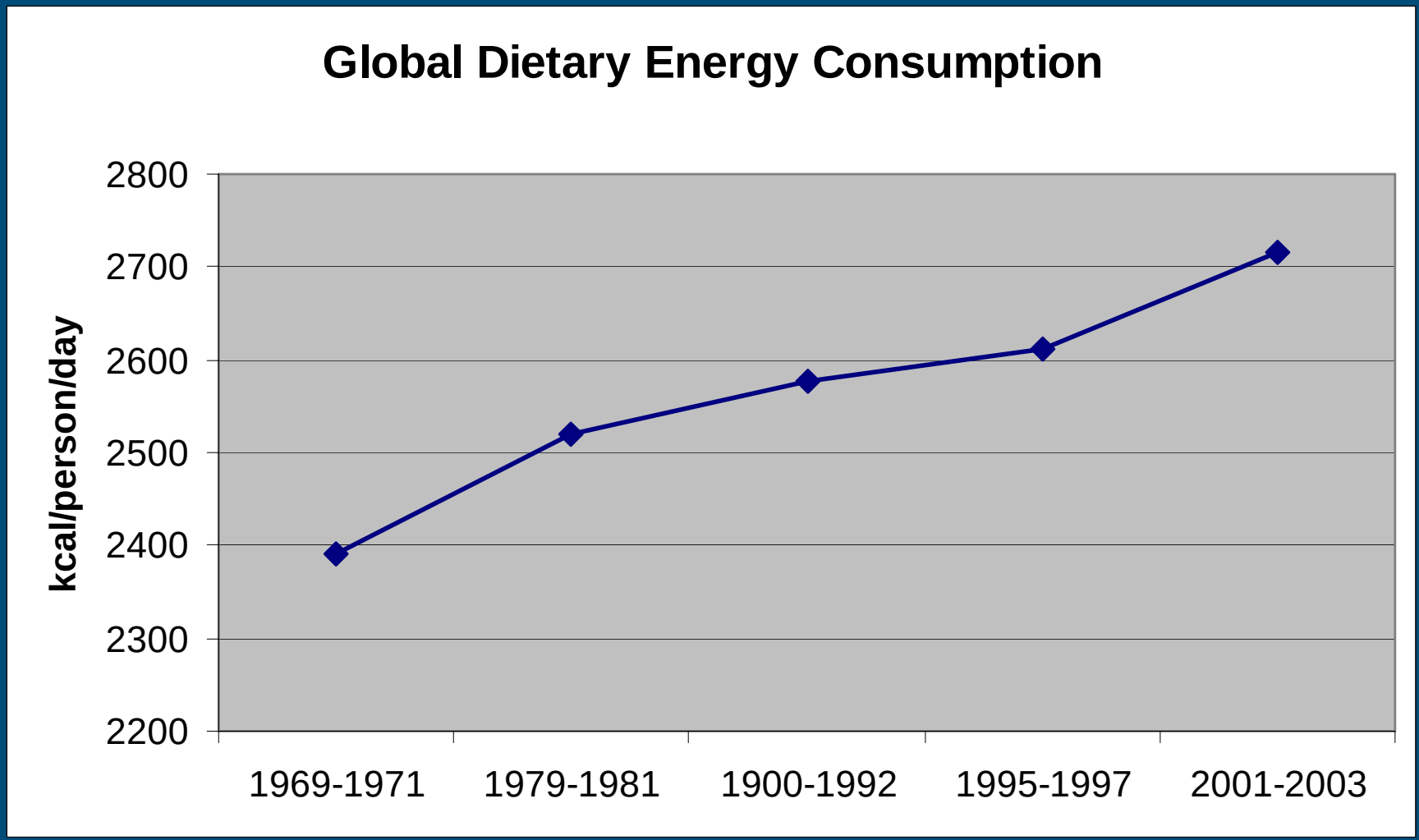
Agriculture in a dynamic environment

- Food security
  - Growing population
  - Shift in diets
- Climate change
  - Desertification
  - Invasive species and pathogens
- Biobased economy
  - Bio fuels
  - Bio products

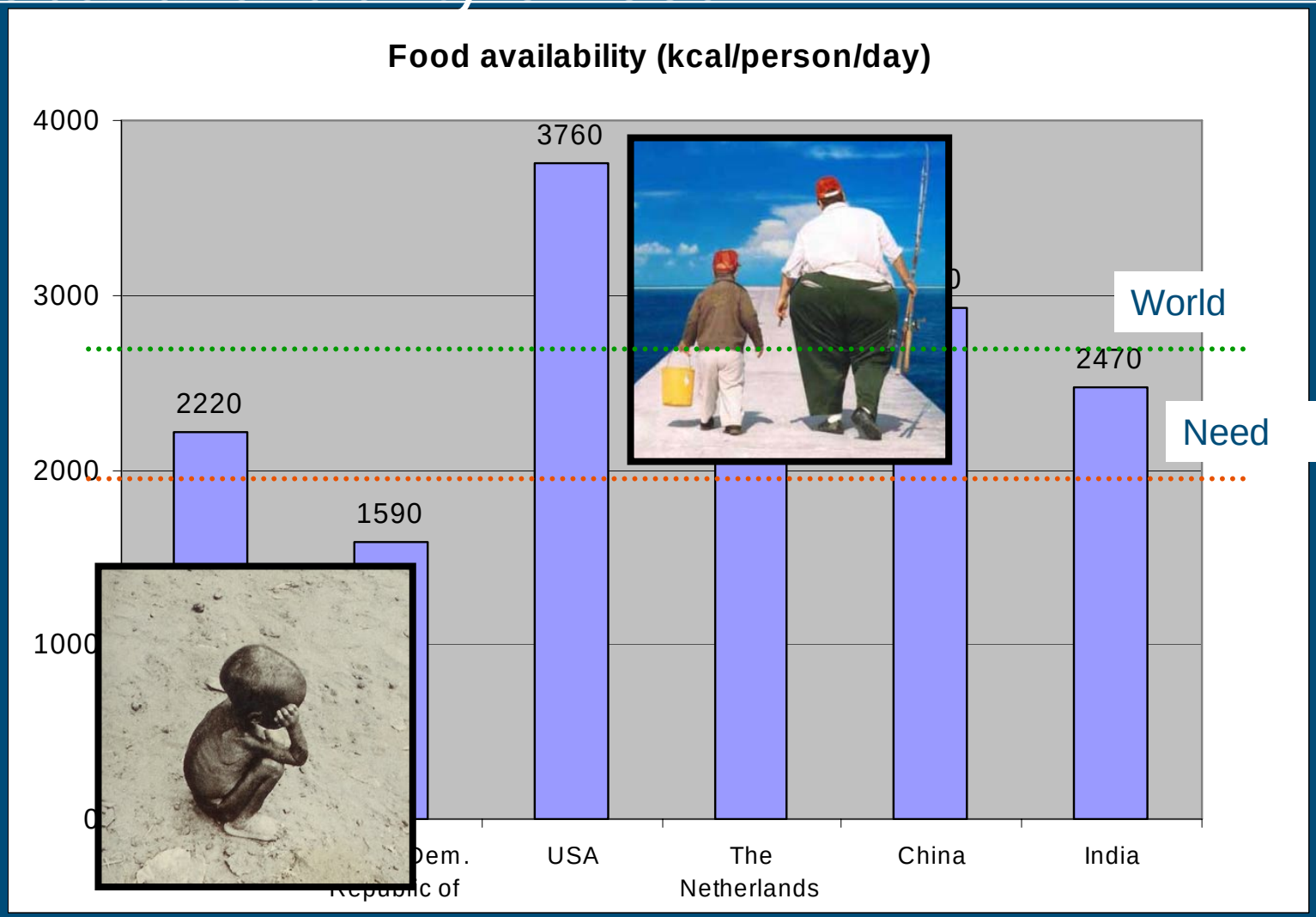


…Food Security …

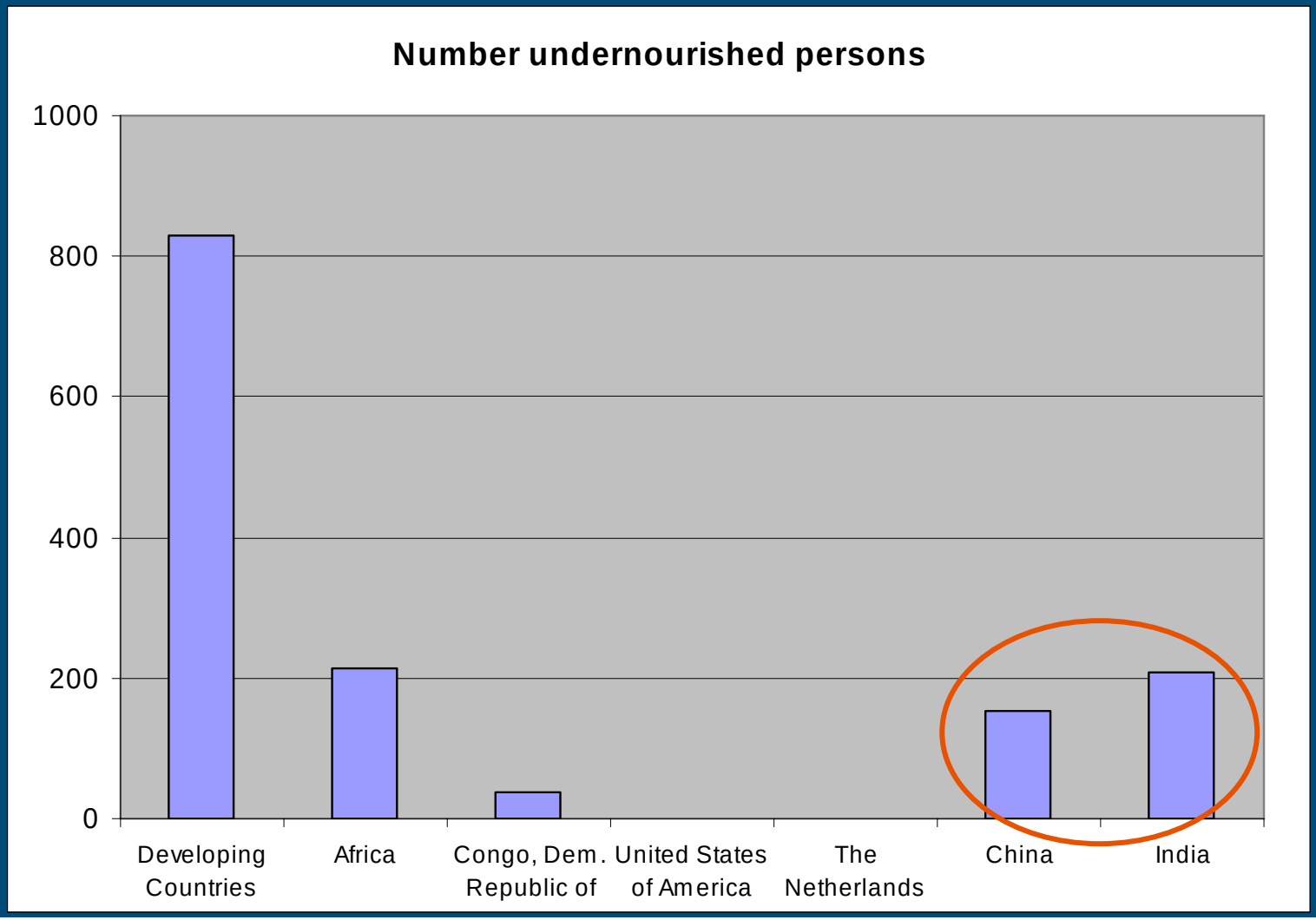
Global availability of food



Global availability of food



Hunger in the world (data 2008)



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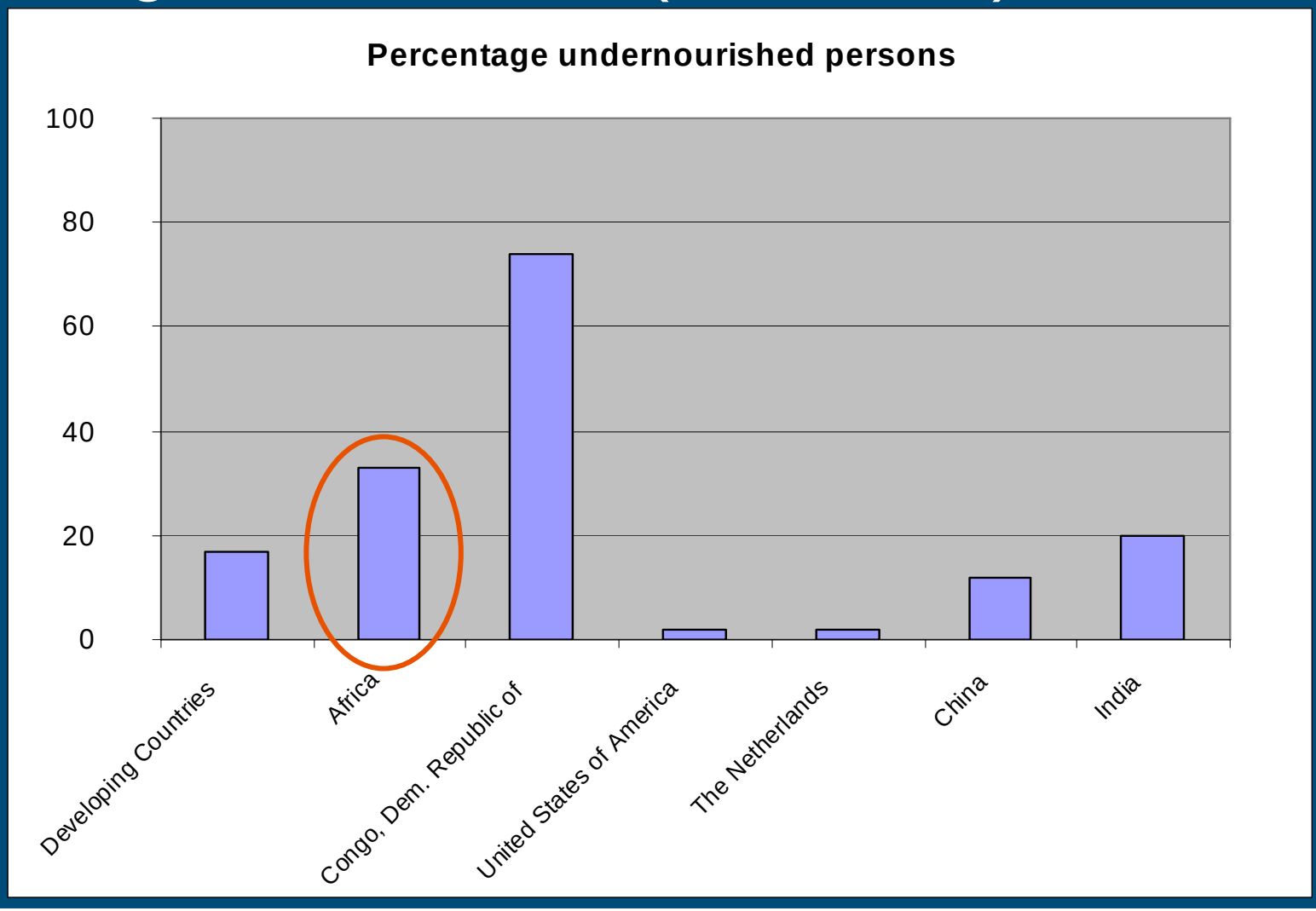
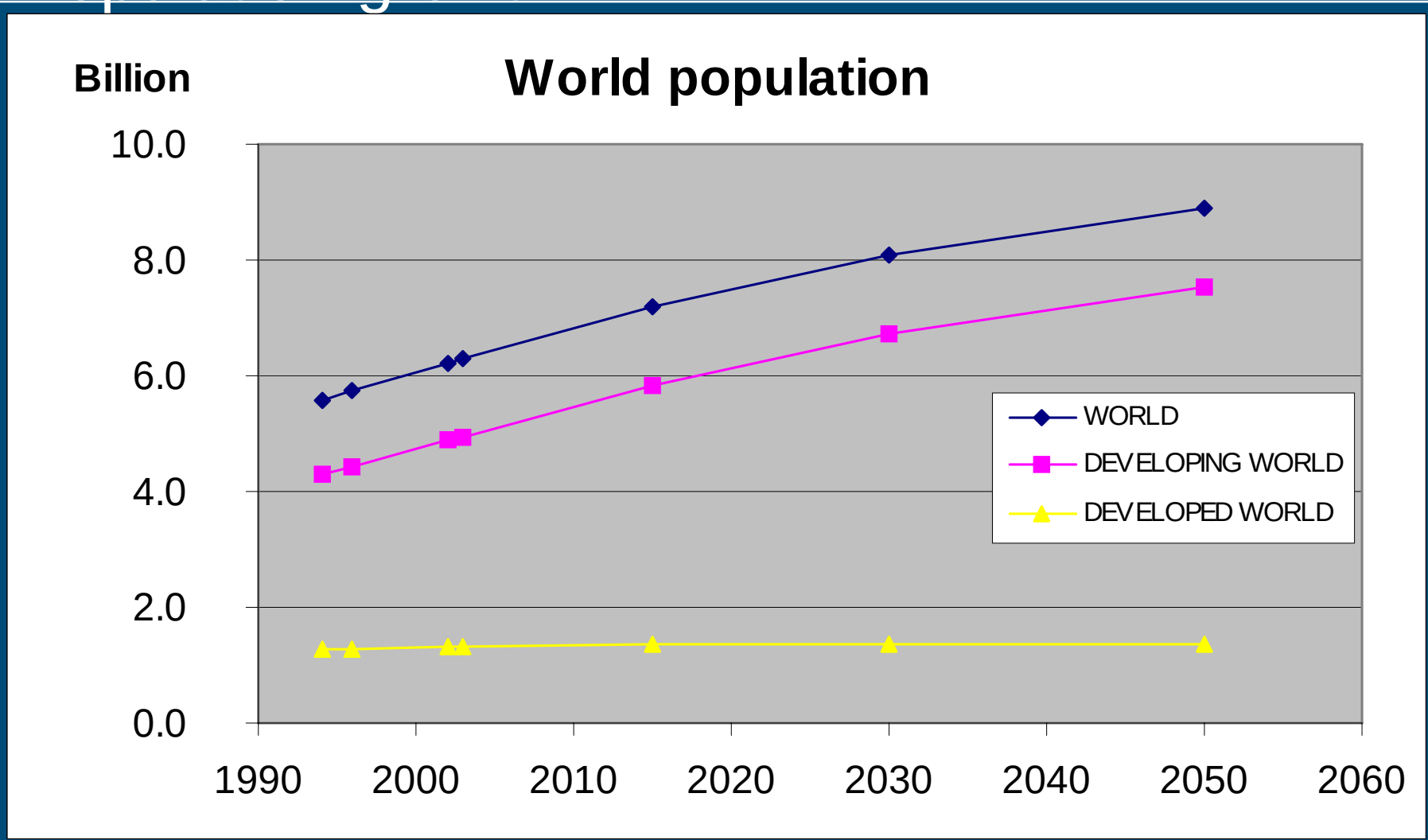


Population growth

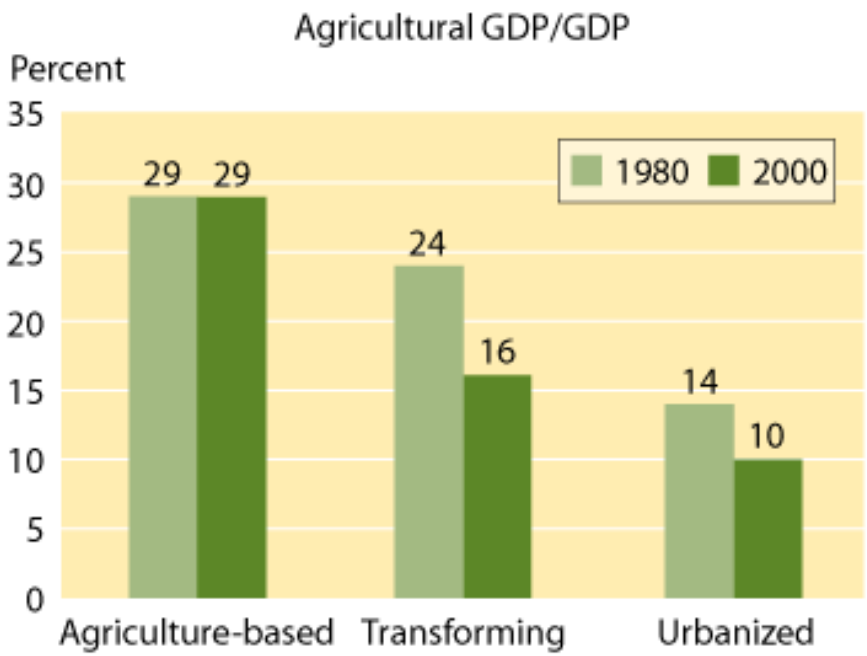


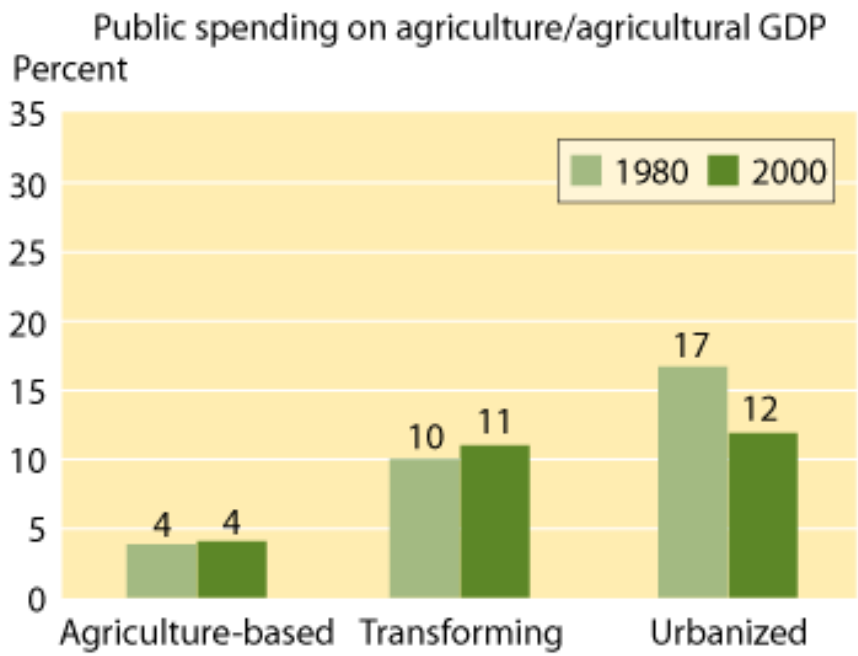
Shifting diet

Dietary Energy Consumption (2001-2003) per person				
Population (billion)	Developed 1.65	%	Developing 4.35	%
Cereals	1020	31	1391	52
Oils & Fat	566	17	267	10
Animal Products	712	21	311	12
Sugar	427	13	194	7
Pulses	286	9	198	7
Fruits, vegetables and roots	308	9	295	11
	3319	100	2656	100

Invest in agriculture

Public spending on agriculture is lowest in the agriculture-based countries, while their share ofagriculture in GDP is highest

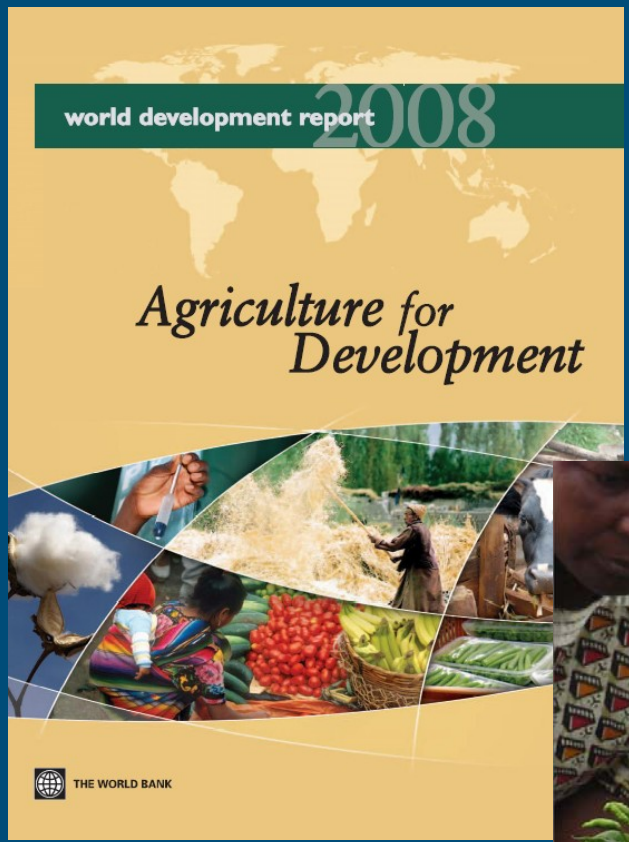


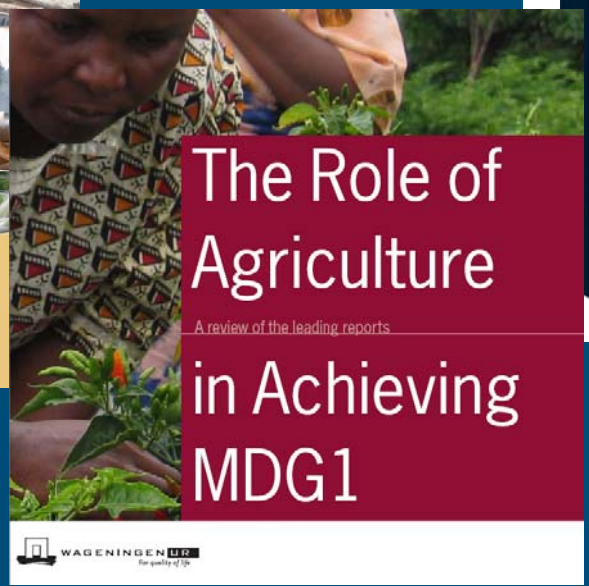


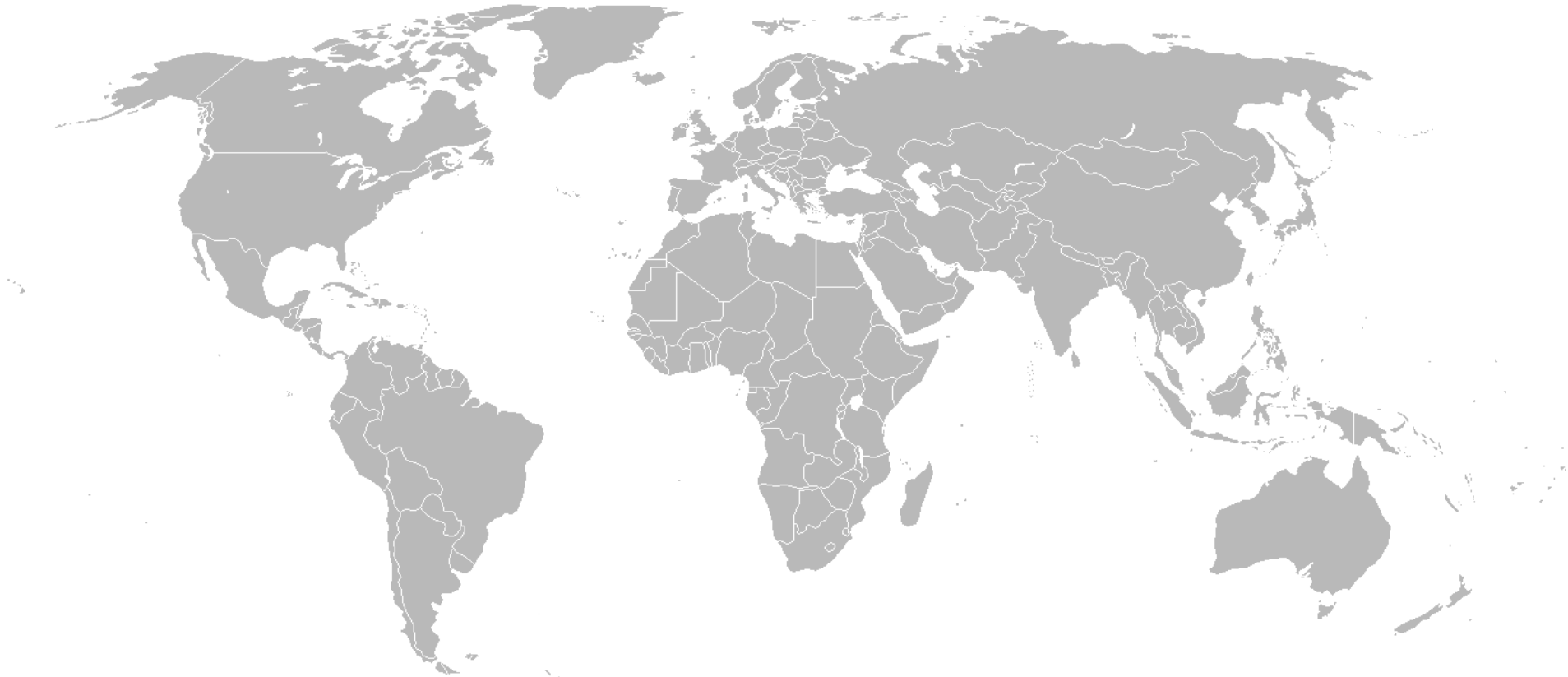
Source: Fan, forthcoming.

World development report 2008

A central role of agriculture







…Africa …

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"

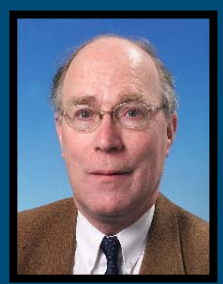
Study Structure

Co-chairs

Speciosa Wandira Kazibwe

Rudy Rabbinge

M.S. Swaminathan



Panel members

Mohamed Besri
Maria Manuela Chaves
Avílio Antonio Franco
Oron Gideon
Jikun Huang
Ryuichi Ishii
Renald Lafond
Peter Matlon
Ahmadou Lamine Ndiaye
Bongiwe Njobe
Emmanuel Odigboh
Per Pinstrup-Andersen
E.N. Sabiiti
José Sarukhan
Jennifer Thomson

Directorate

Jim Ryan

Prem Bindraban

Huub Löffler

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Process

4 Regional consultative workshops

Expert consultation

Proceedings

Resource documents

Study Panel meetings

Presentation, consultation, review

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Diagnosis

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

Diagnosis (cont)

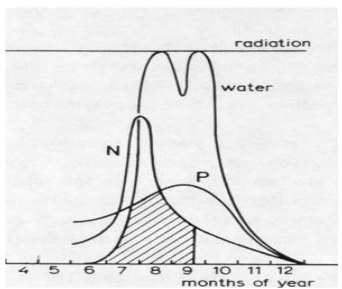
8. Lack of investment in agricultural research
9. Lack of knowledge infrastructure
10. Lack of functioning academic institutions
11. Brain drain
12. Not functioning local and regional markets
13. Land entitlement inappropriate
14. No stimulating political and economic environment
15. Inadequate capacity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

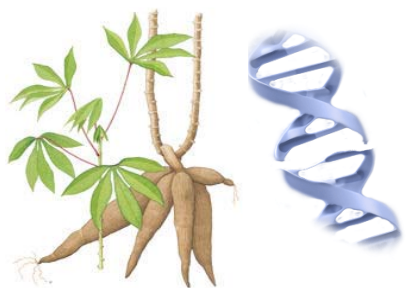
Strategic recommendations – four domains

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

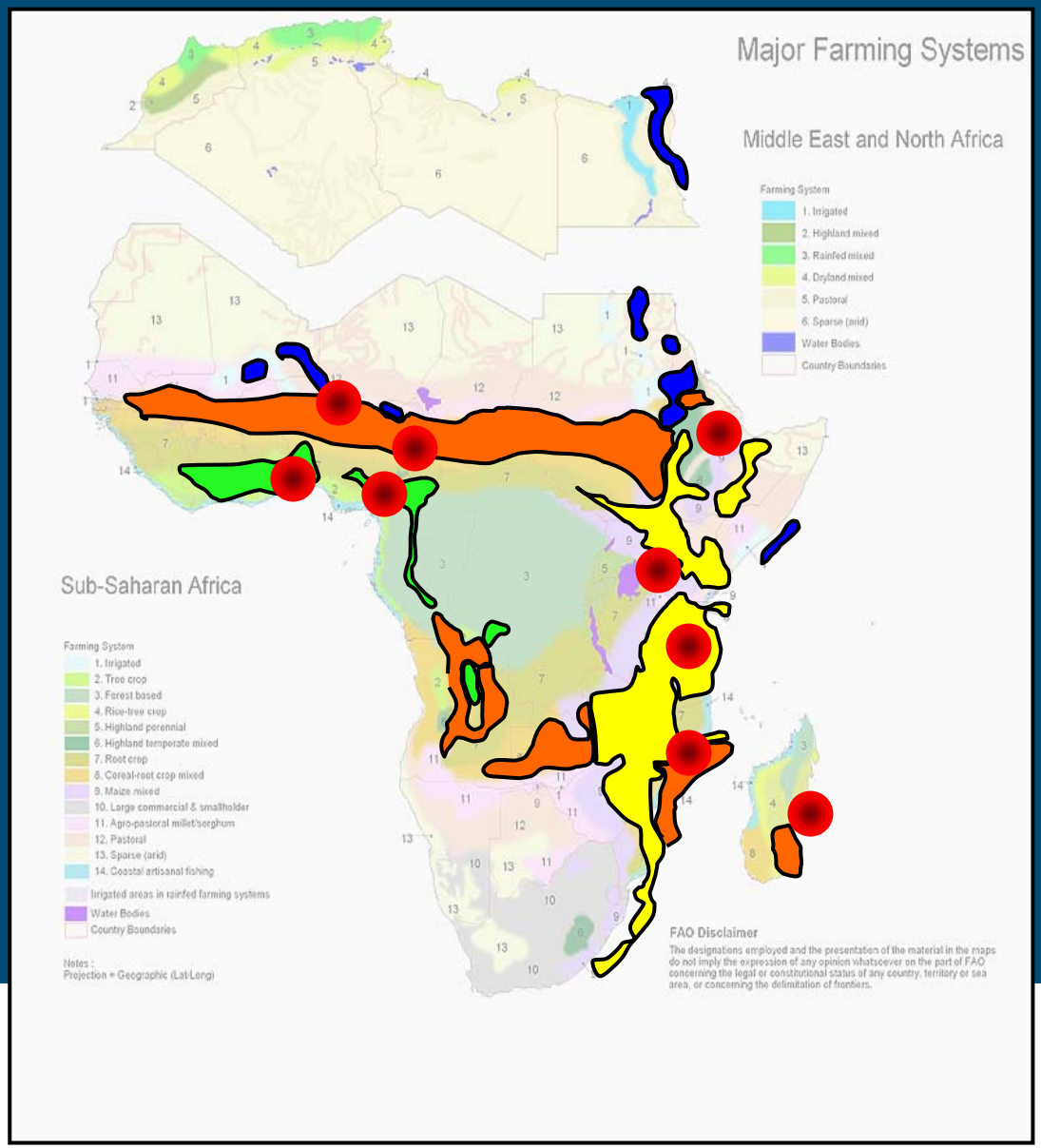
Technology options that can make a difference

- Adopt a market-led productivity improvement strategy
- Adopt a production ecological approach with a primary focus on identified continental priority farming systems
- Pursue a strategy of integrated sustainable intensification
- Bridge the genetic divide
- Embrace information and communication technology at all levels
- Improve the coping strategies of farmers in response to environmental variability and climate change



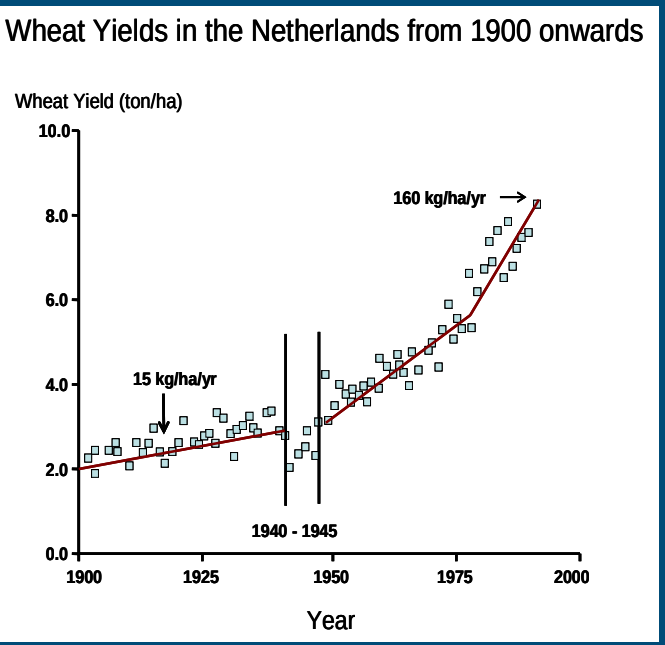


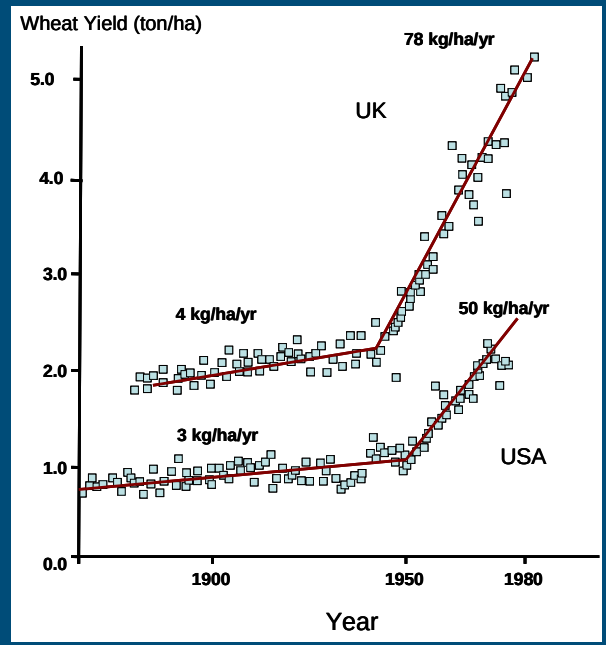
Priority farming systems

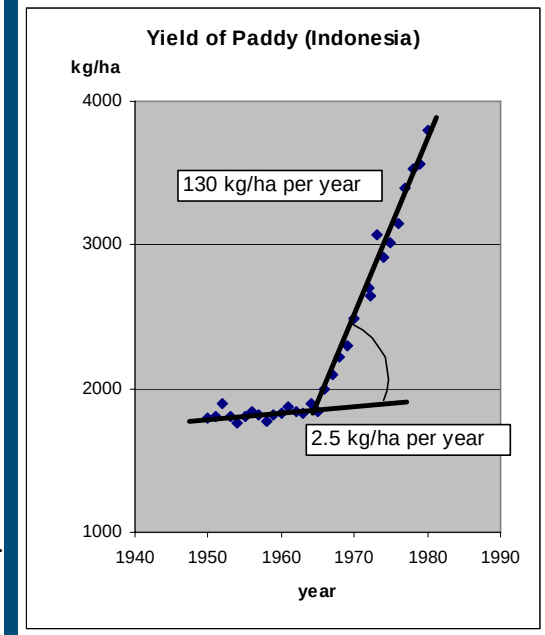


- Irrigated system
- Maize mixed system
- Tree crop based system
- Cereal root crop mixed system
- Hunger Hotspot (CIESIN)

Discontinuities in production trends



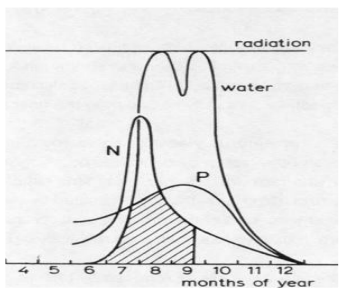


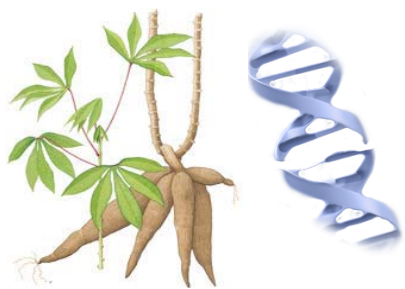


Green revolutions

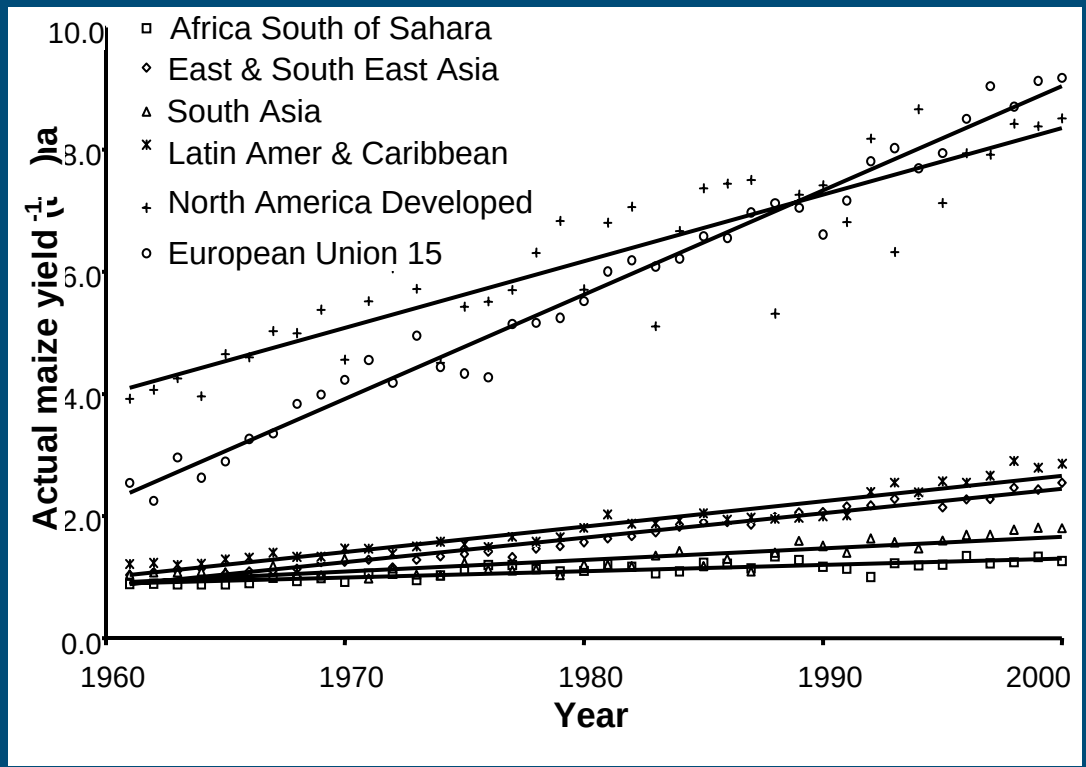
Technology options that can make a difference

- Recognise the potential of rainfed agriculture and accord it priority
- Reduce land degradation and replenish soil fertility
- Explore higher scale integrated catchment strategies for natural resource management
- Promote the conservation, sustainable and equitable use of biodiversity as a component of future biotechnology initiatives
- Enhance use of mechanical energy and power





Mechanization



Labor productivity increase from 1960-2000 (%)

- World 160
- SubSaharan Africa 121
- East&Souteast 203
- South Asia 165
- Latin Amer.& Car. 246
- North America 360
- Europe (15) 634

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Building impact-oriented research, knowledge and development institutions

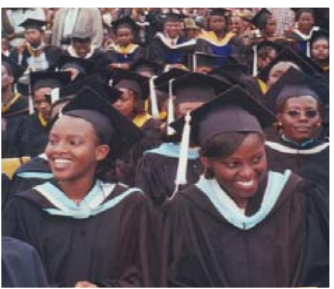
- Design and invest in national agricultural science systems that involve farmers in education, research and extension
- Encourage institutions and mechanisms to articulate S&T strategies and policies
- Cultivate African centres of agricultural research excellence
- Increase support for agricultural R&D
- Strengthen international agricultural research centres (IARCs)





Creating and retaining a new generation of agricultural scientists

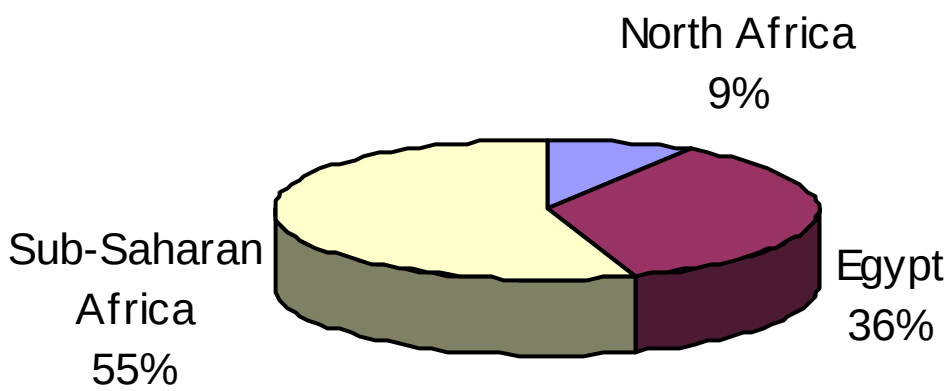
- Focus on current and future generations of scientists in Africa
- Broaden and deepen political support for agricultural science
- Reform university curricula
- Mobilize increased and sustainable funding for higher education in S&T, minimizing dependence on external donor support
- Strengthen science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





Research Capacity

(a) Estimated number of full-time equivalent (FTE) agricultural researchers: 18700



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





Impact of investments

Table 7.2 Returns to government investments in rural Uganda

Investment	Benefit/cost ratio	Reduction in numbers of poor per million Ush
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

Source: Fan et al. (2003).
Note: n.s. denotes effects were not statistically significant.

Fan, S., X. Zhang, and N. Rao. 2003. Public expenditure, growth and poverty reduction in rural Uganda. Discussion paper. Development Strategy and Governance Division. International Food Policy Research Institute. Washington, DC

Conclusion

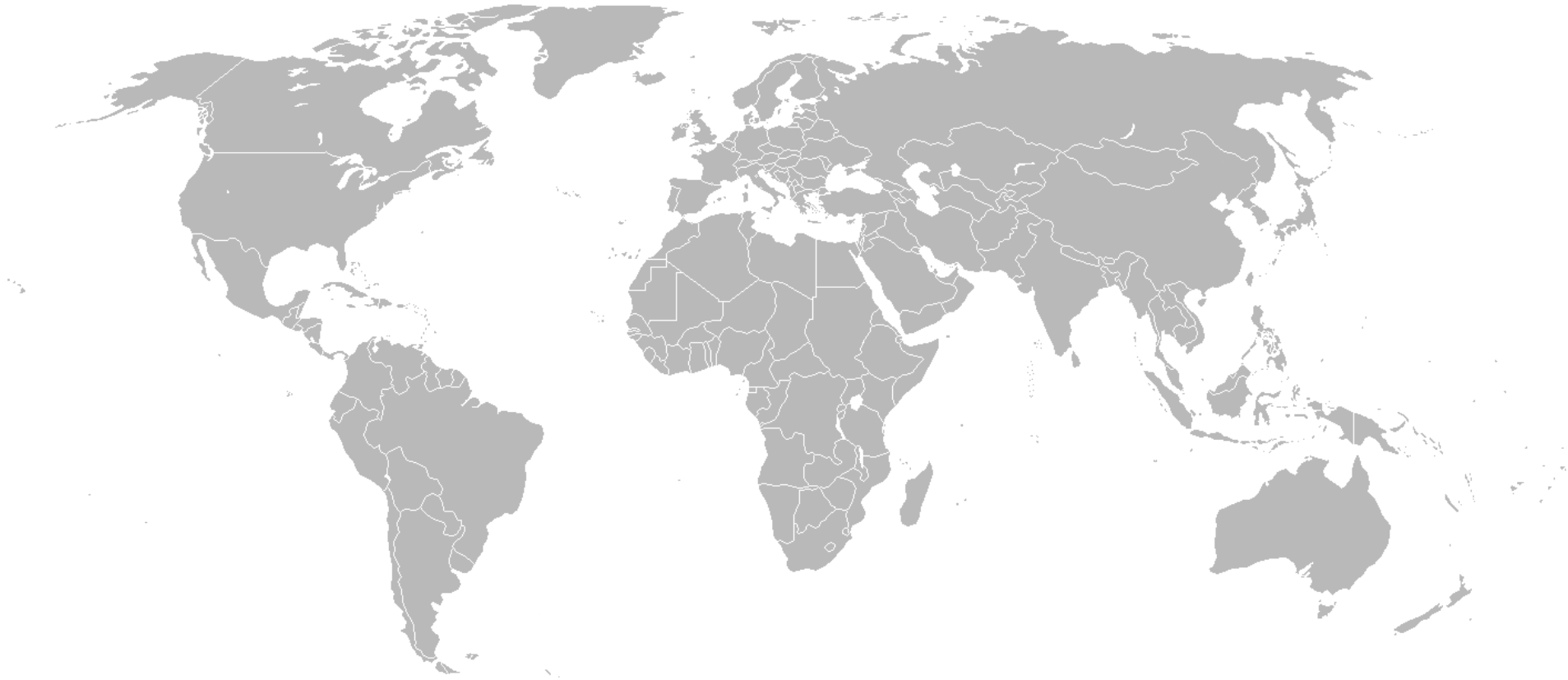
- There are ample opportunities for Science and Technology to increase food security and to alleviate hunger.
- Rainbow Evolutions rather than a Green Revolution is the best option for increased Agricultural Productivity in Africa,
- Technology on the shelf is not sufficient for the African situation
- Agricultural S&T is powerful but will only work in a conducive socio economic and political environment

Impact of the study

- Millenium Development Goals
  - MDG has eclipsed the IAC in most recommendation areas
- The global report of the Science Council of the CGIAR
- Sub-Saharan Africa Challenge Program
- The World Bank Report
- Programme for Dissemination of New Agricultural Technologies in Africa (DONATA)
- Multi-country Agricultural Productivity Program (MAPP)
- Comprehensive Africa Agricultural Development Program (CAADP)

Impact of the study

- African Centres of Agricultural Research Excellence (ACAREs): Biosciences East and Central Africa (BECA)
- Network of African Science Academies (NASAC)
- 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



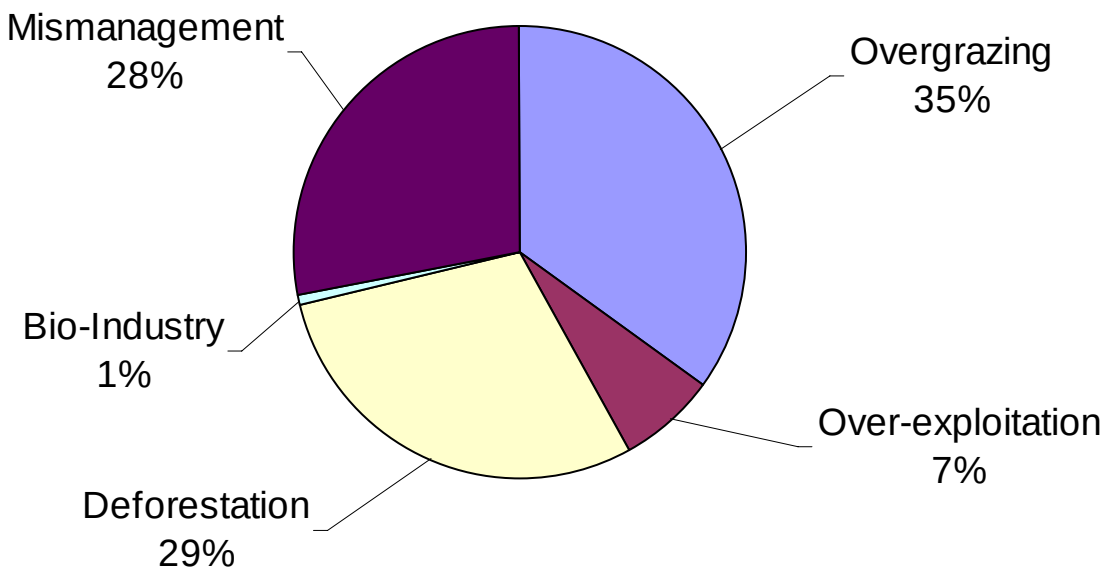
…Unsustainability spirals …

Unsustainable development

- Desertification
- Deforestation
- Decreased production caused by
  - Wealth (Polution)
  - Poverty (Outmining soils)
- Fertilizer consumption
  - phosphate
- Bio fuels

Unsustainable development

1. Due to *wealth*
2. Due to *poverty*



Oldeman et al, ISRIC

Phosphorus

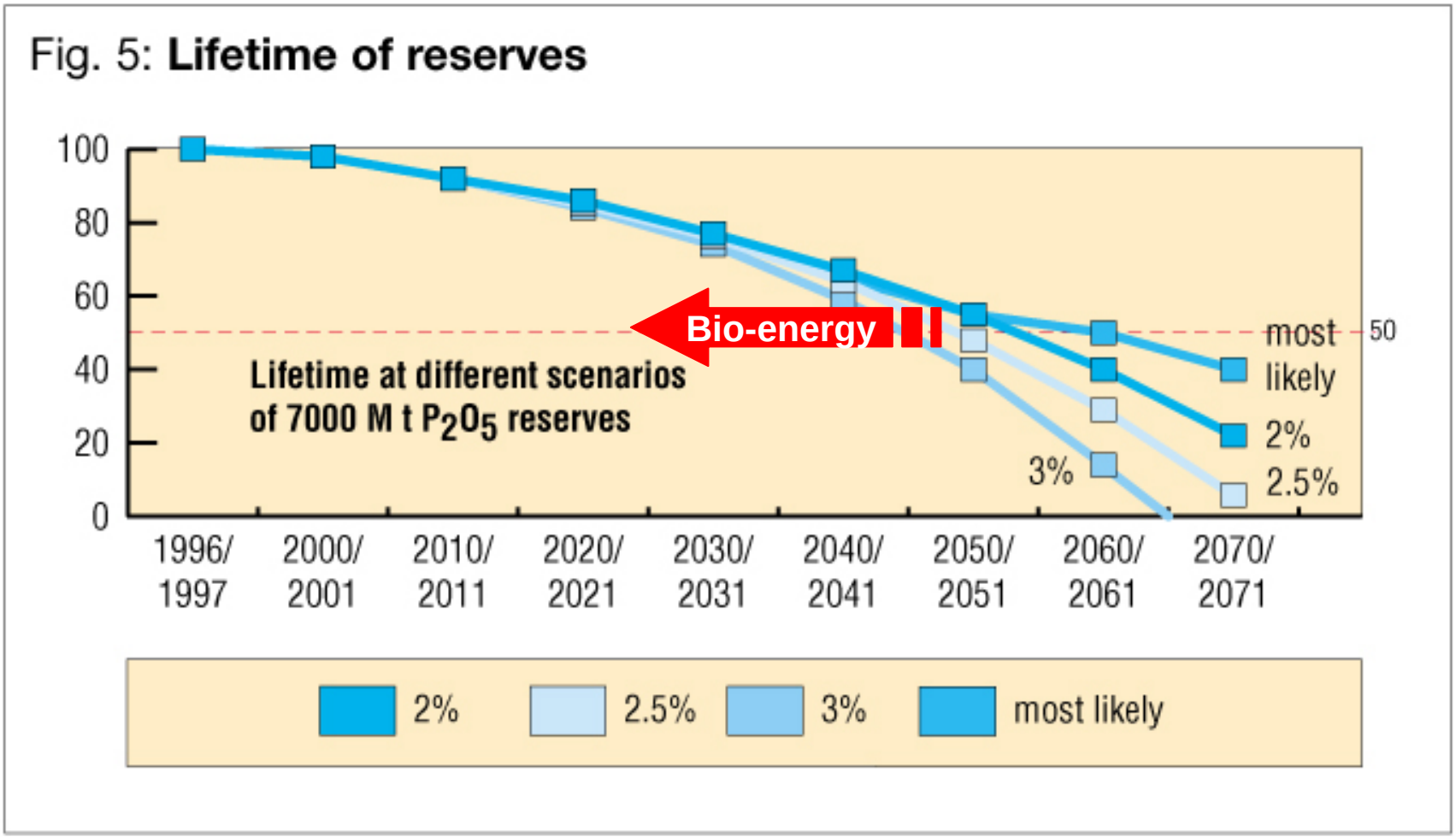
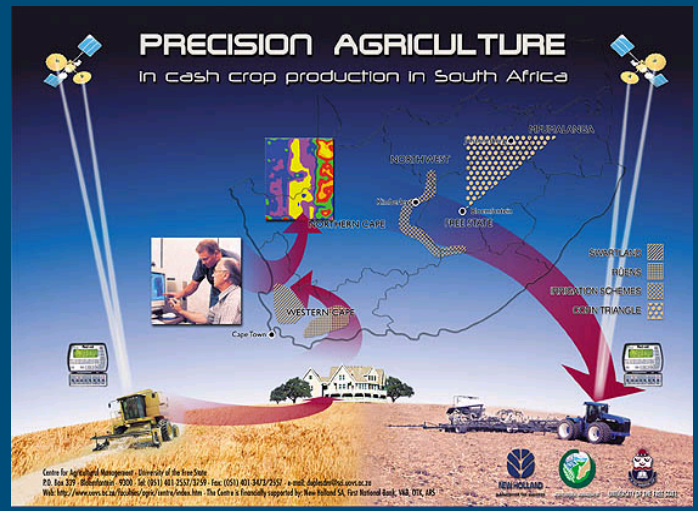


Fig. 5: Lifetime of reserves
100
80
60
40
20
0
Bio-energy
Lifetime at different scenarios
of 7000 M t P_2O_5 reserves
most likely
50
2%
2.5%
3%
1996/ 1997
2000/ 2001
2010/ 2011
2020/ 2021
2030/ 2031
2040/ 2041
2050/ 2051
2060/ 2061
2070/ 2071
2%
2.5%
3%
most likely

Sustainable use of Phosphorus

Recycling



Efficient application

Plant, Cell and Environment (2007) 30, 1557–1565 doi: 10.1111/j.1365-3040.2007.01733.x

Banksia species (Proteaceae) from severely phosphorus-impoverished soils exhibit extreme efficiency in the use and re-mobilization of phosphorus

MATTHEW D. DENTON[1]*, ERIK J. VENEKLAAS[1], FLORIAN M. FREIMOSER[2] & HANS LAMBERS[1]

[1]*School of Plant Biology, The University of Western Australia, 35 Stirling Hwy, Crawley WA 6009 Australia and* [2]*Institute of Plant Sciences, Plant Biochemistry and Physiology ETH Zürich, LFW D46.1 Universitätsstr. 2, CH-8092 Zürich, Switzerland*

Breeding

Phyto mining: algae from sea

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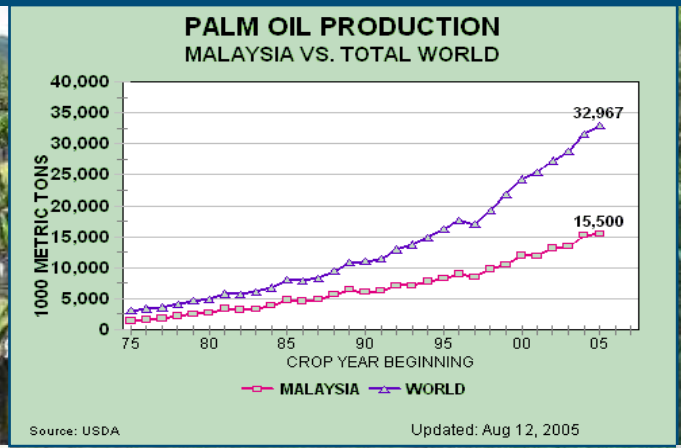
Energy: Competing claims



…Fuel for the Rich or Food for the Poor…

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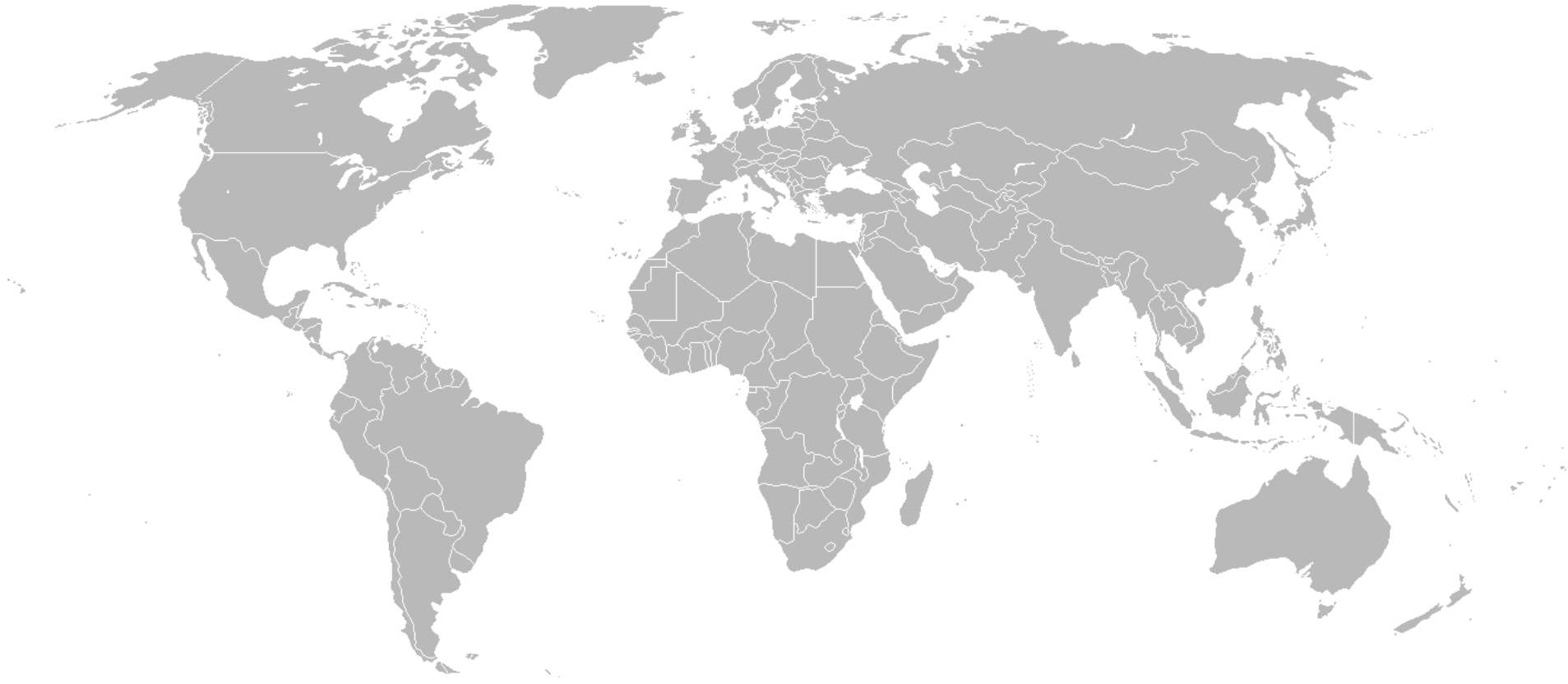
Jatropha on marginal soils



…A new paradigm …

Sustainability: a new paradigm

- Long-term objectives are high production systems
- Optimize the use of scarce resources (land, water, labor, inputs and energy) for maximal productivity
- Stimulate agro-technological and ecological literacy
- Adopt the agro-ecological approach
- Jump start from just government to Public Private Partnerships
- Involve farmers (quadrangle approach)

Production Ecological Approach

POTENTIAL YIELD

Temperature
Radiation
Crop characteristics

ATTAINABLE YIELD

Nutrients
Water
Labour

ACTUAL YIELD

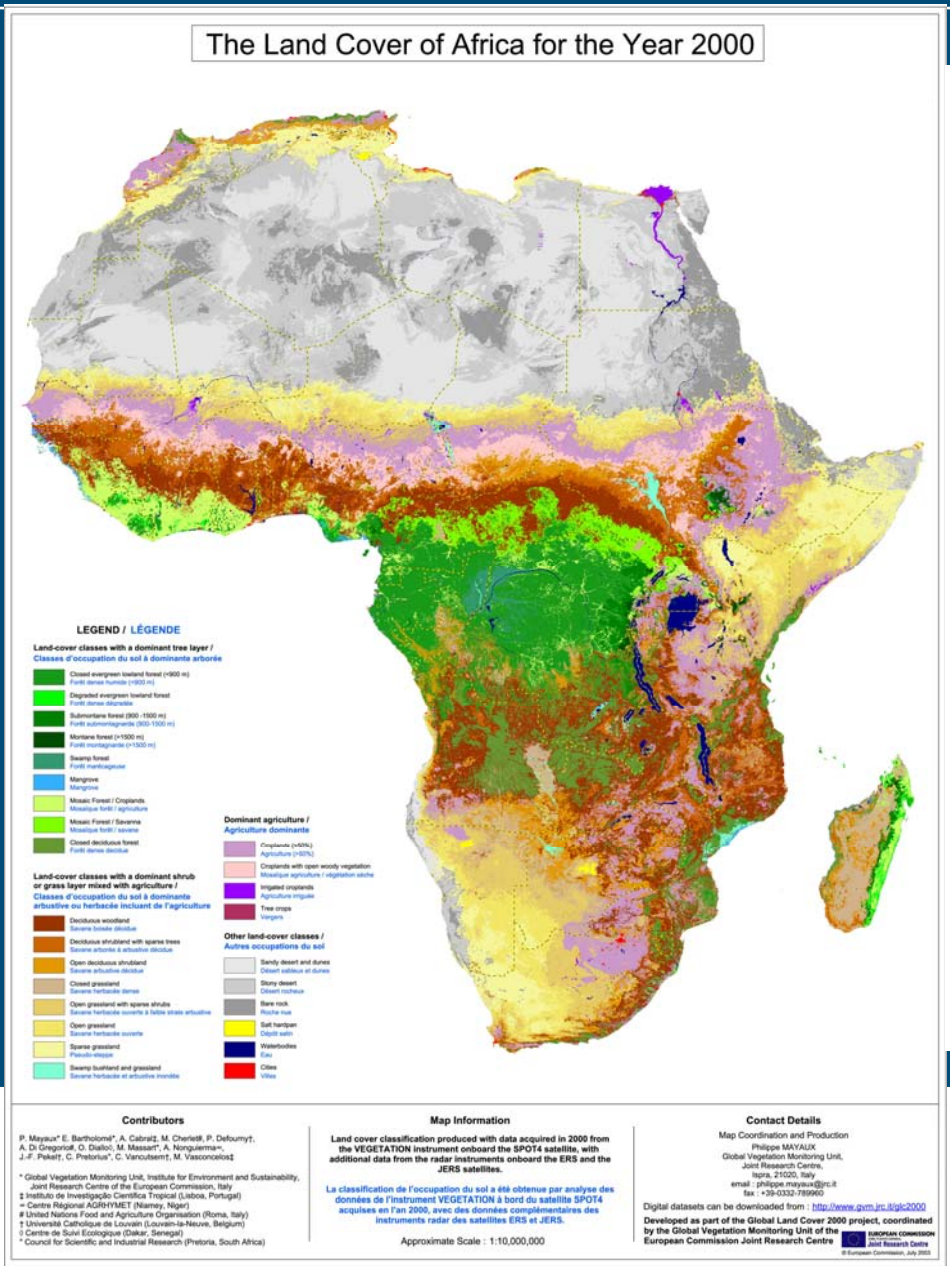
Pests, diseases, weeds, pollutants

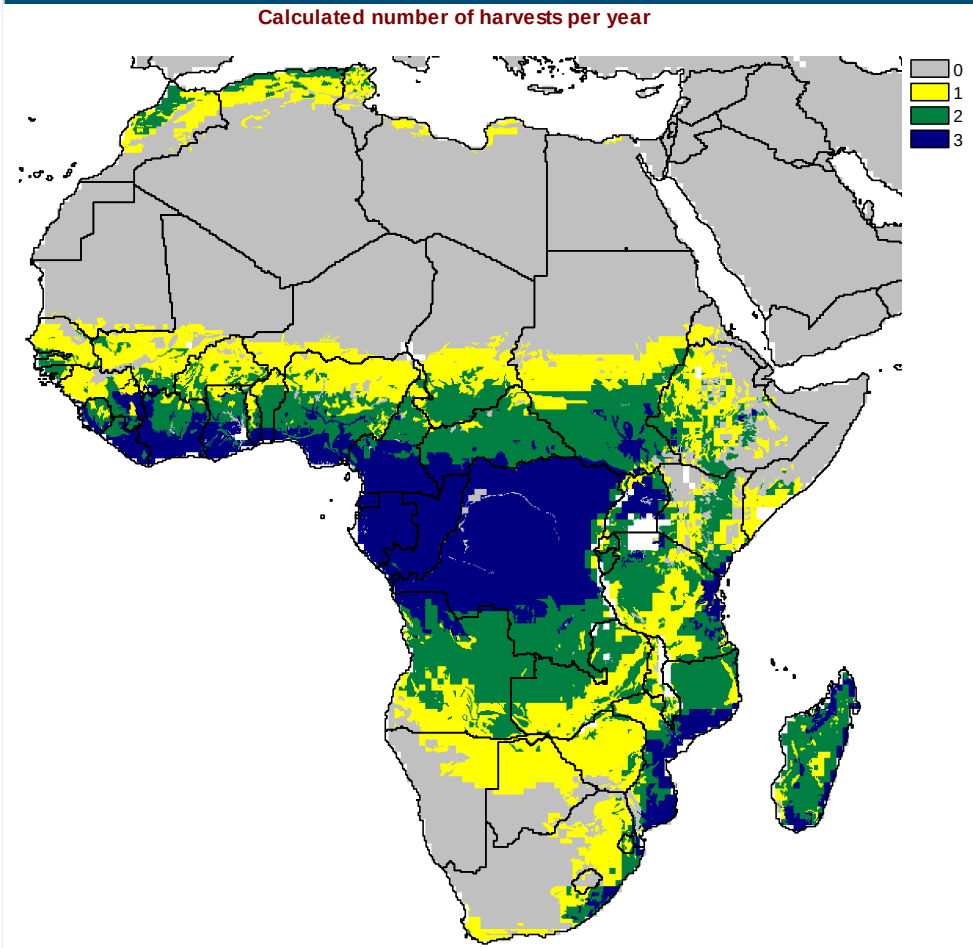
AVAILABLE FOOD

Post harvest losses

NERICA

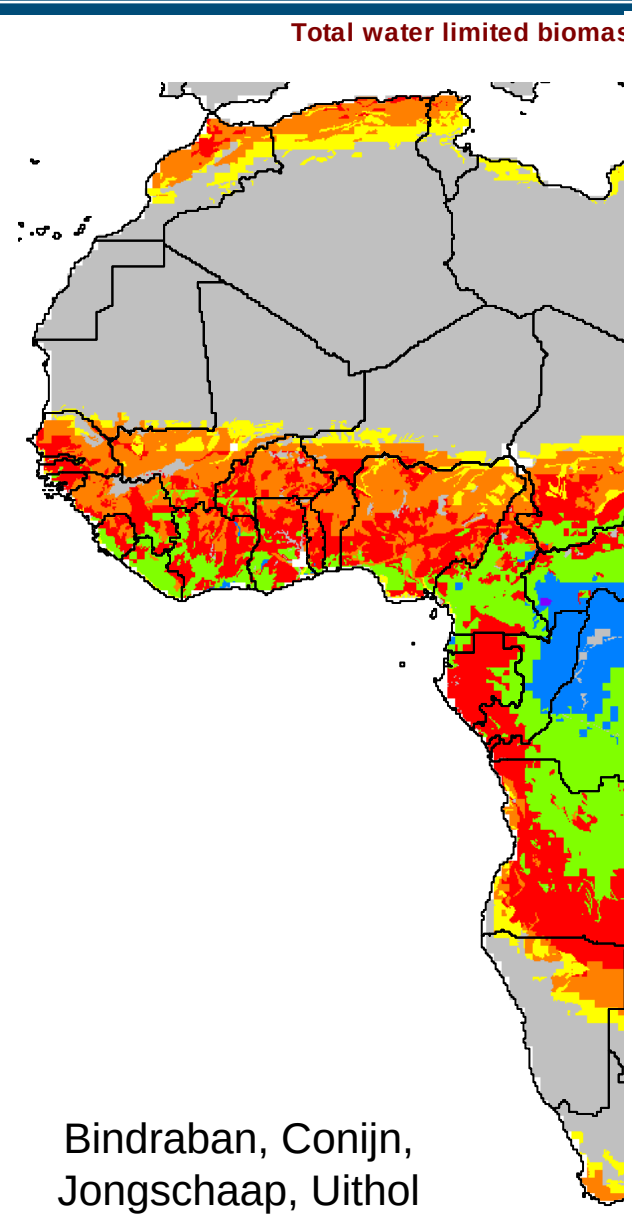
Modified (preliminary) calculations Africa

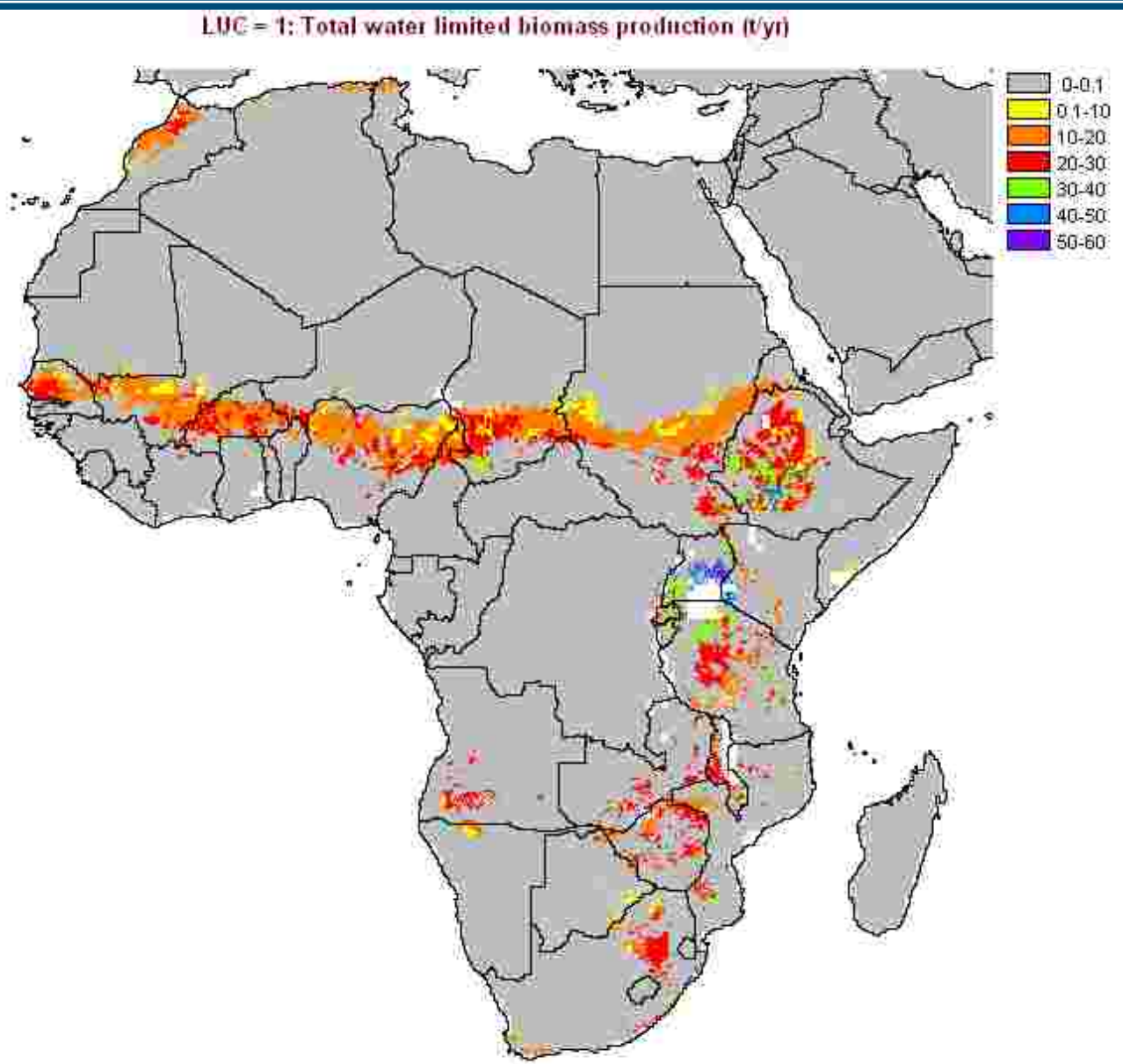




Bindraban, Conijn, Jongschaap, Uithol

Production potentials African continent





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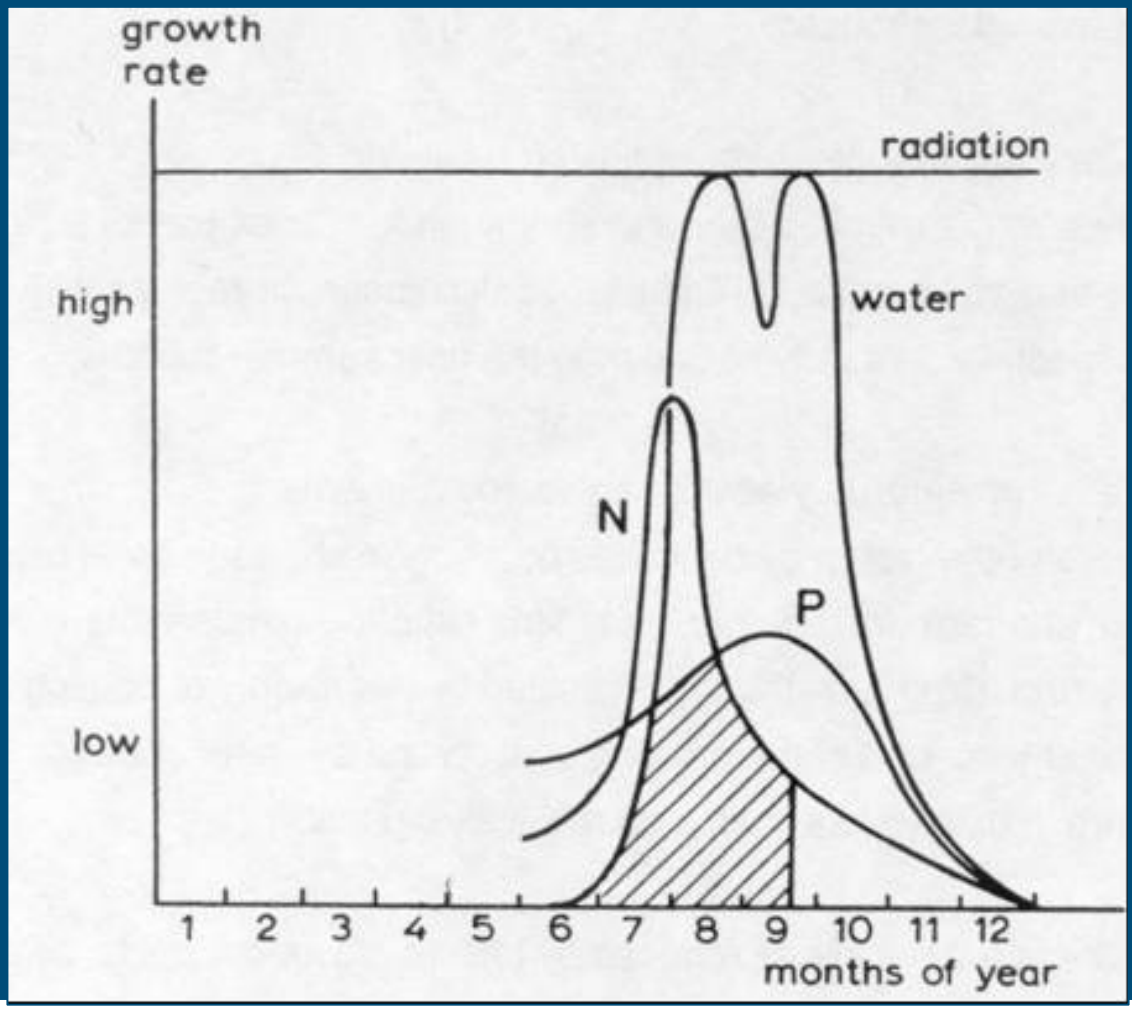
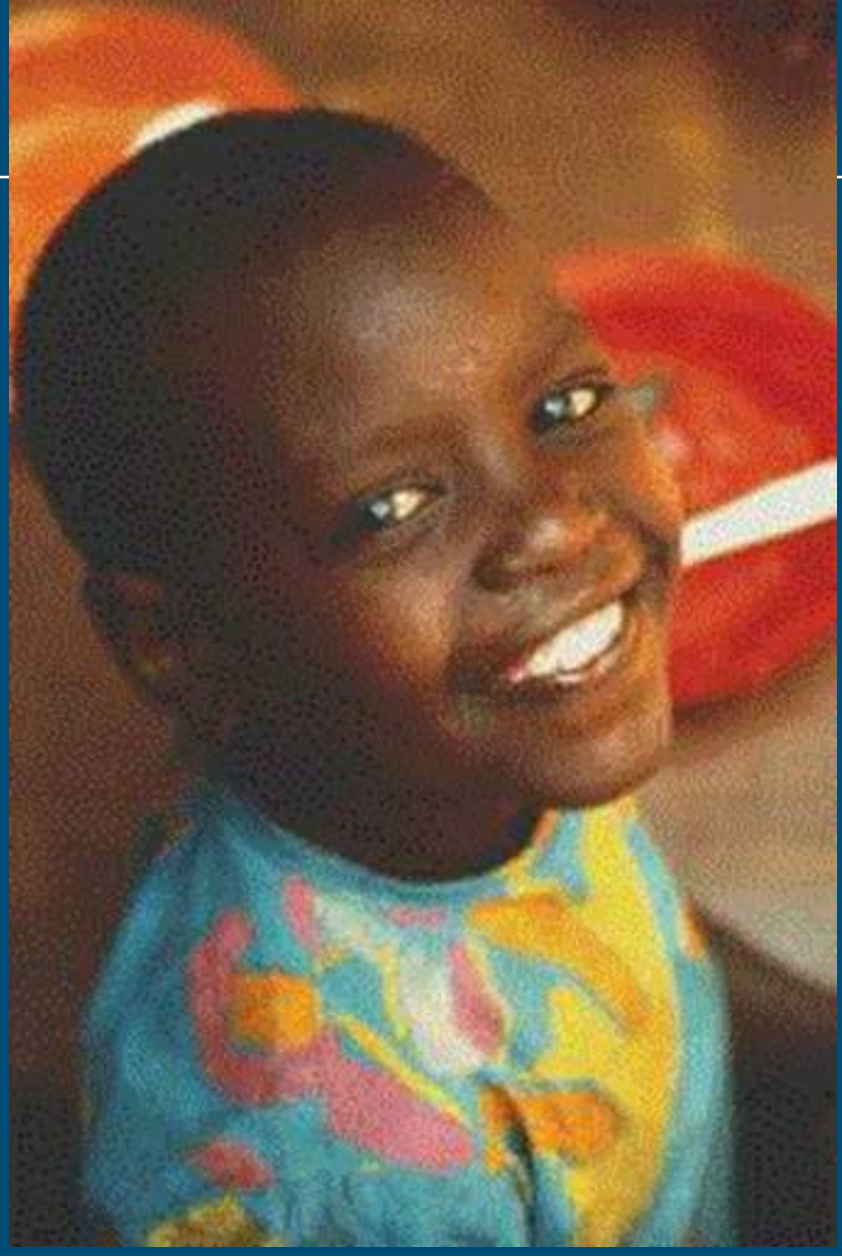
Limiting factors



Priority action points

1. Leap frog to advanced agro-production systems
2. Focus on high-tech for smallholders
3. Public Private Partnerships
4. Address land use changes in view of competing claims
5. Specific attention for the bio fuel issue



Thank you

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