



Sustainable intensification & Sub-Saharan Africa

Peter Carberry
Brian Keating

SUSTAINABLE AGRICULTURE FLAGSHIP
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Outline

The food demand challenge

Intensification through closing yield gaps

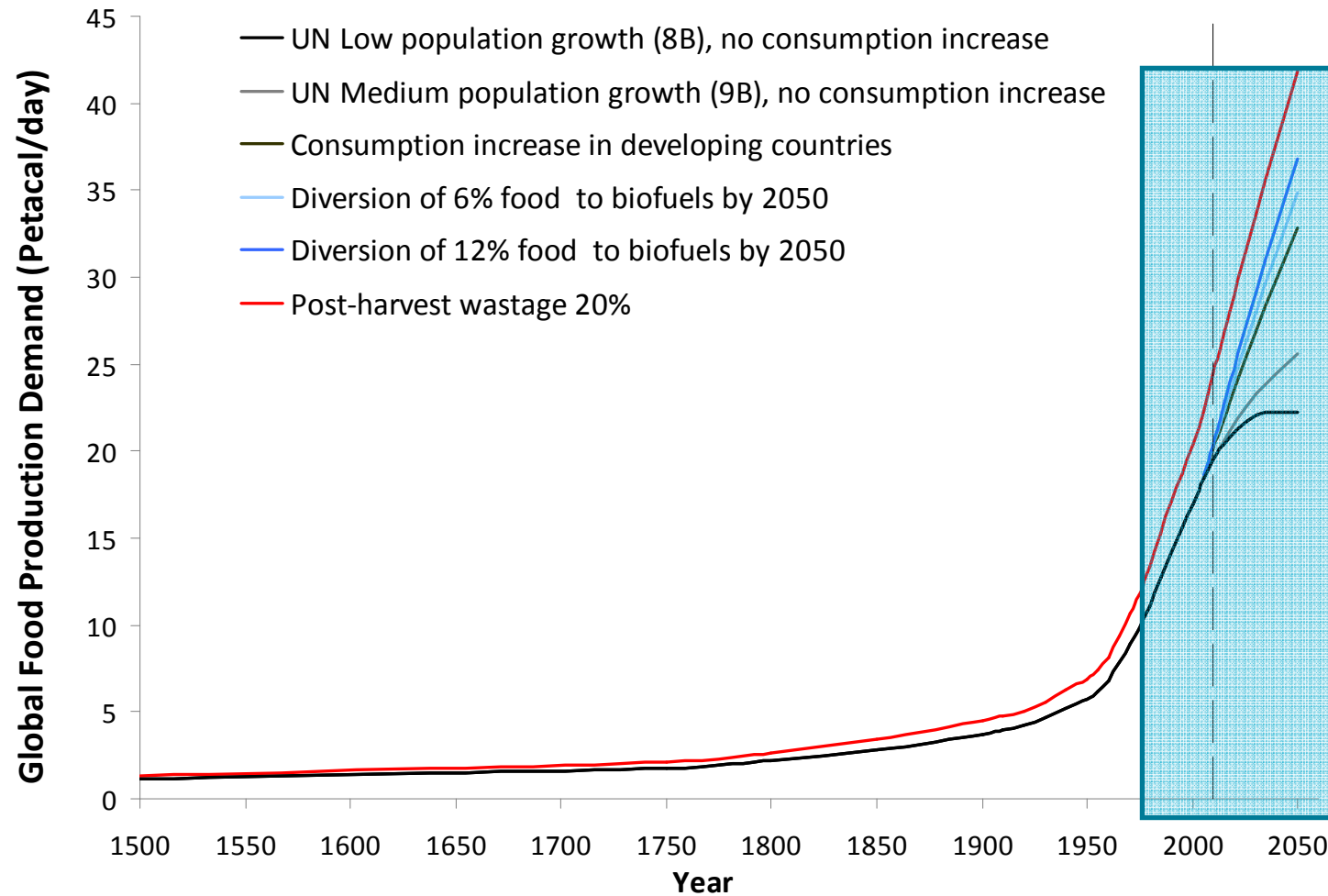
- Dryland maize in Zimbabwe
- Dryland wheat in Australia
- Irrigated wheat-maize double crops in China

CSIRO Sustainable Agriculture Flagship

Australian Africa Food Security Initiative

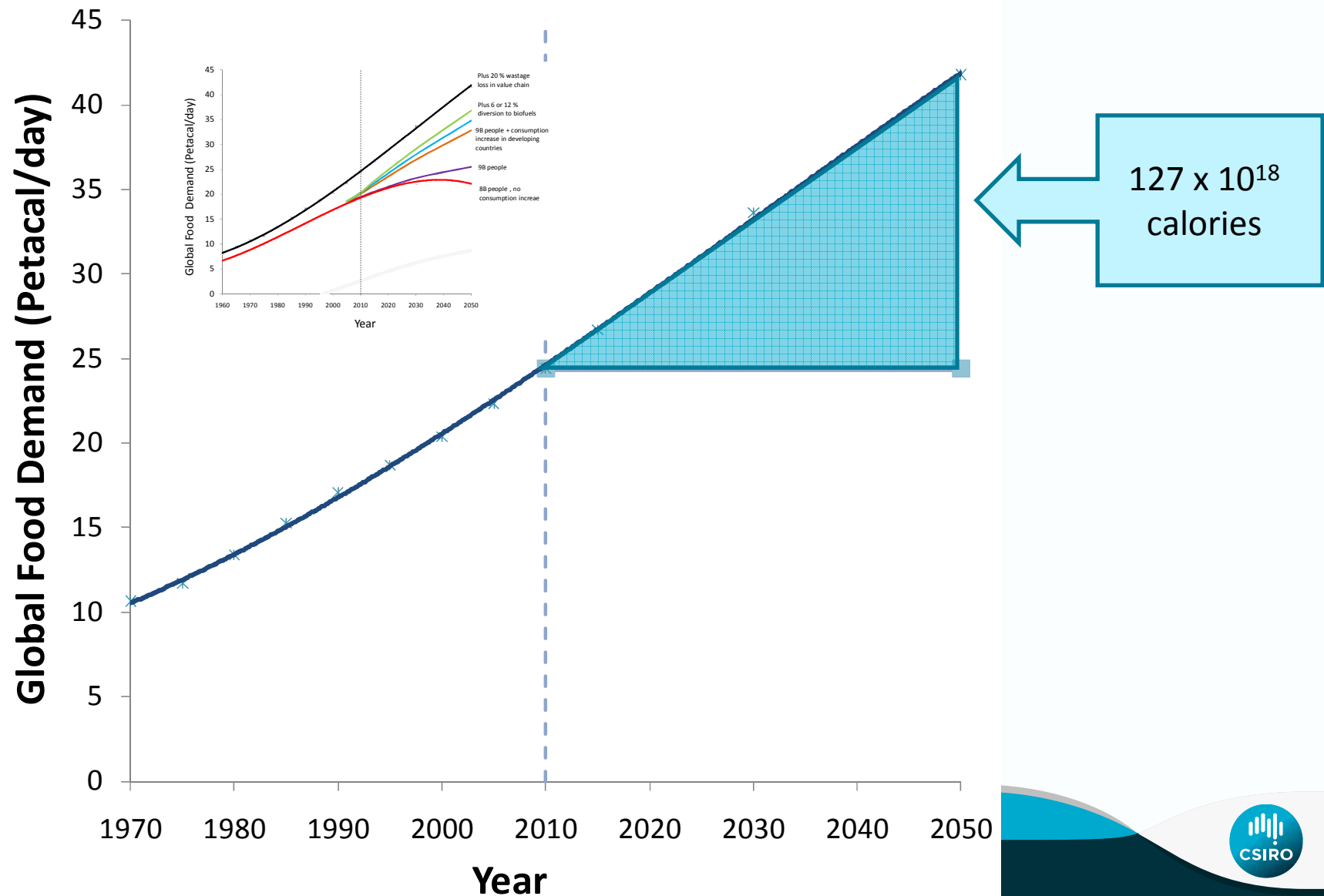
Participatory research

The food demand challenge – in perspective

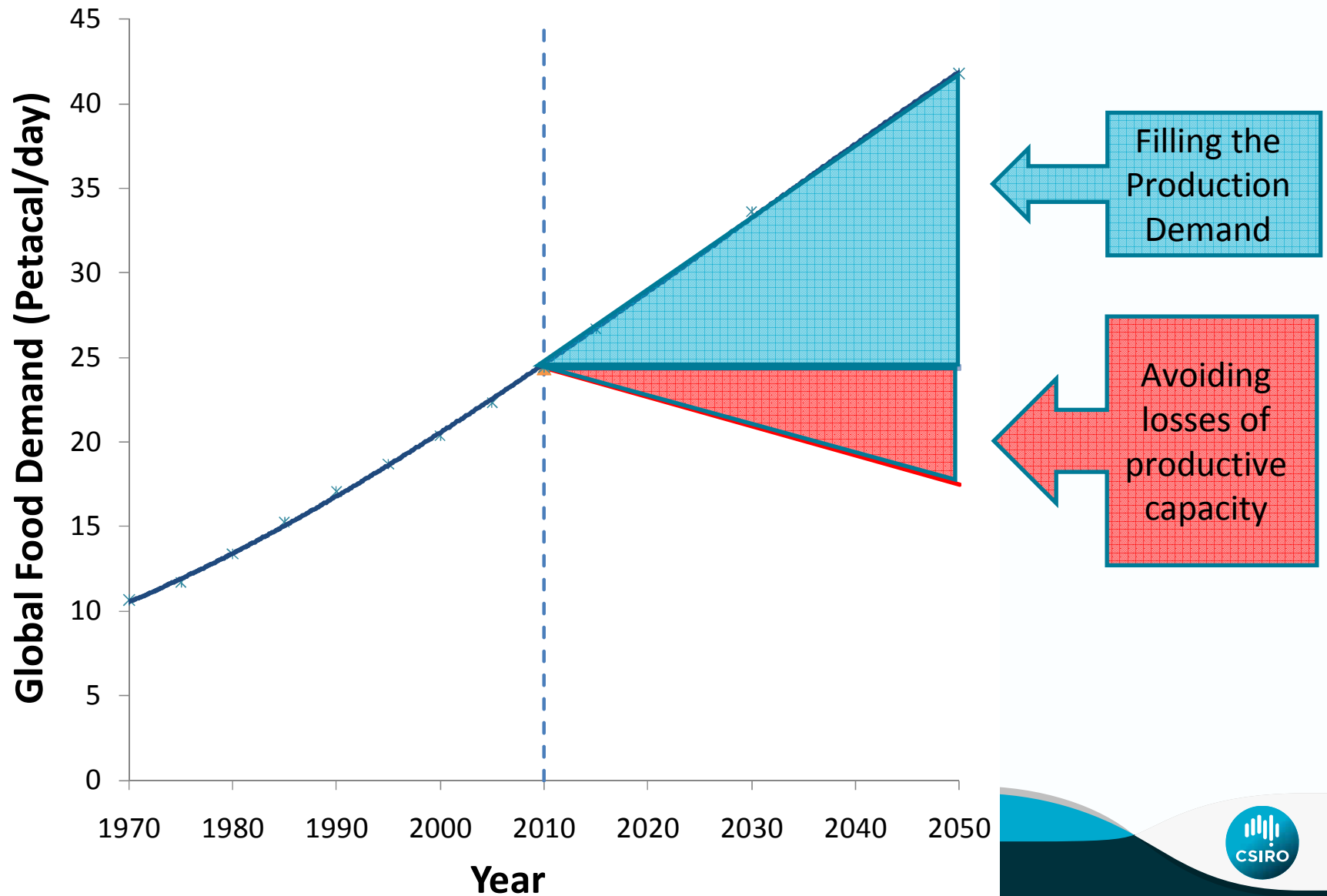


From Keating and Carberry (2010) Sustainable production, food security and supply chain implications. *Aspects of Applied Biology*, 102, 7-20.

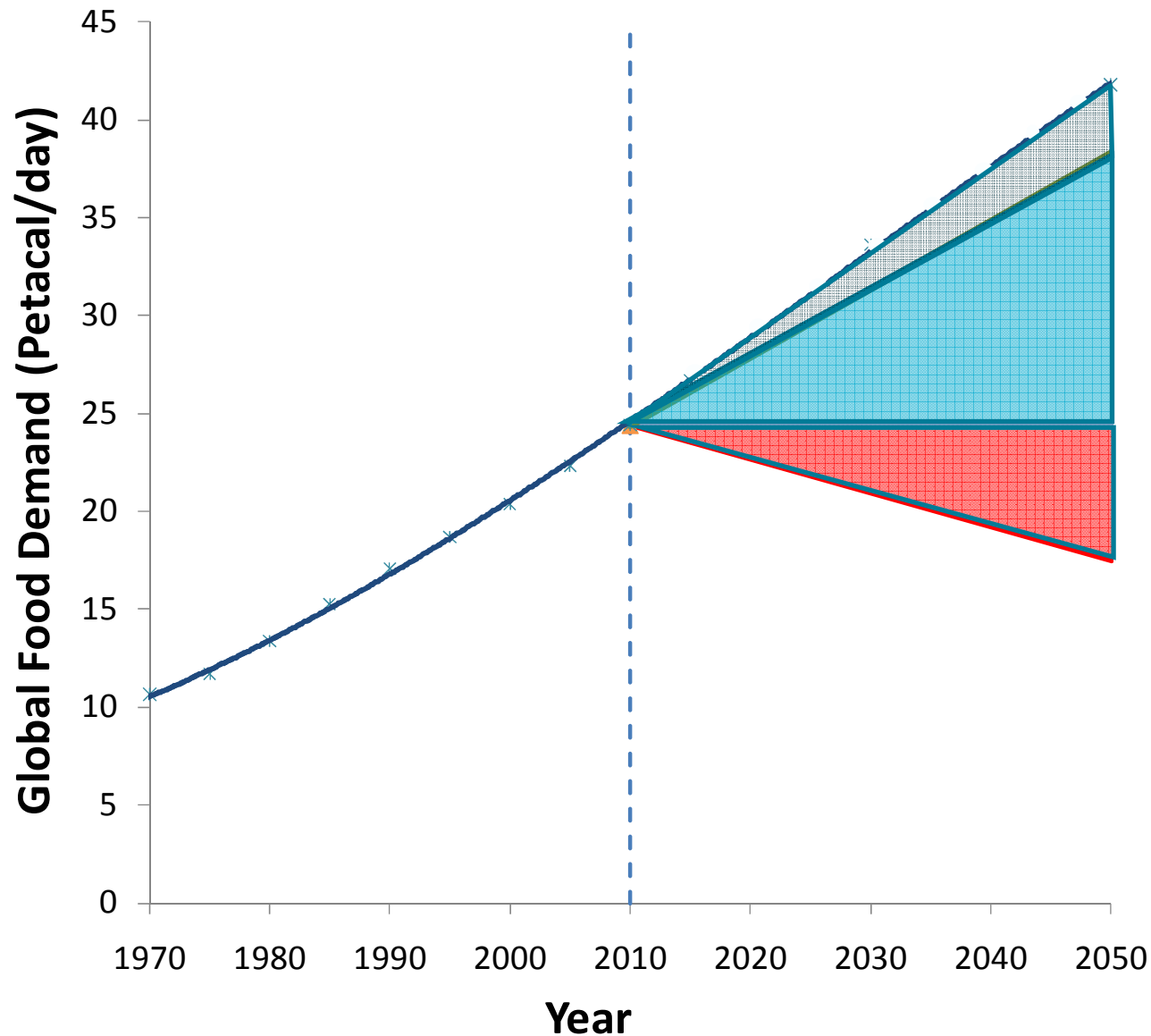
A “mega-wedge” of food demand ?



Other “mega-wedges” of food demand ?



Other “mega-wedges” of food demand ?



Reducing the Demand

Filling the Production Demand

Avoiding losses of productive capacity

Pathways to address the food security challenge ?

- Reducing the demand trajectory

- Reduce waste along the food value chain
- Develop “smart biofuel” policies and technologies
- Improve food, nutrition and health outcomes

- Filling the production shortfall

- Expanding the land footprint
- Expanding the irrigation footprint
- Raising resource use efficiency and better managing risks

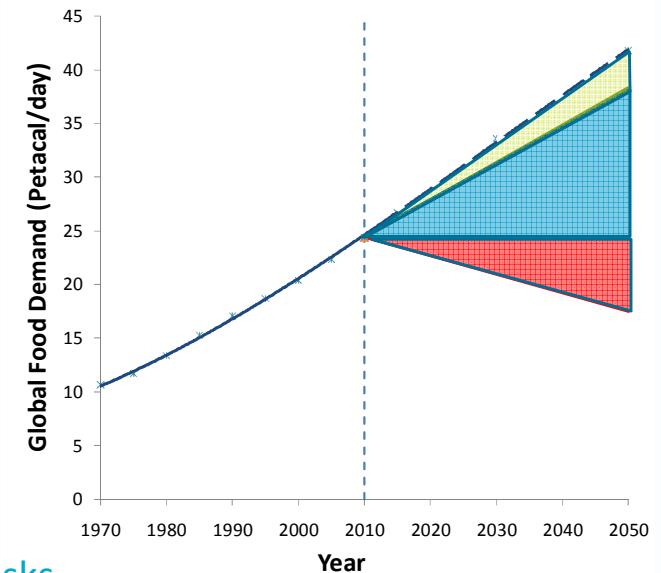
Increasing cropping intensity

Closing yield gaps

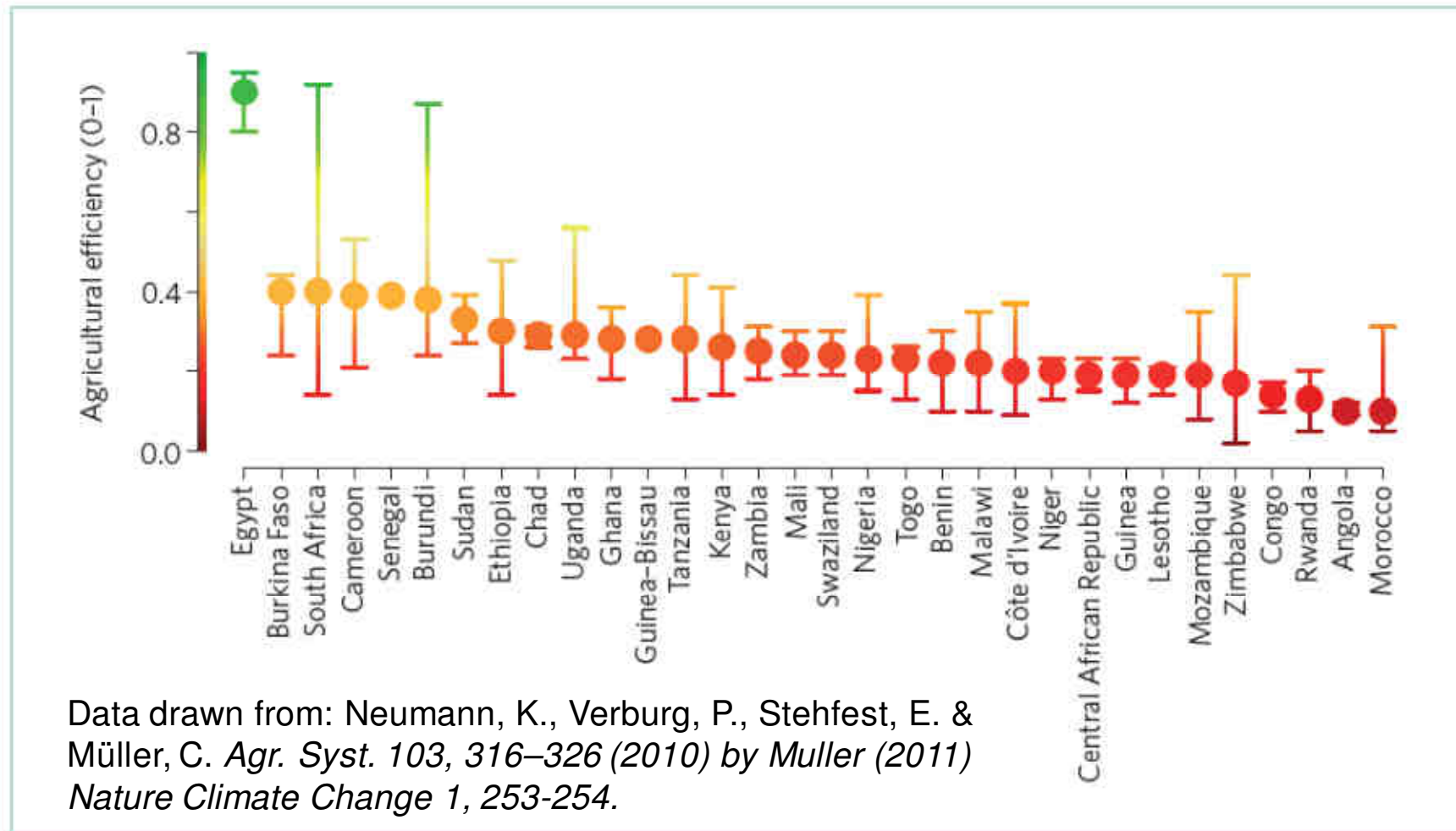
Raising the yield ceiling through new technologies

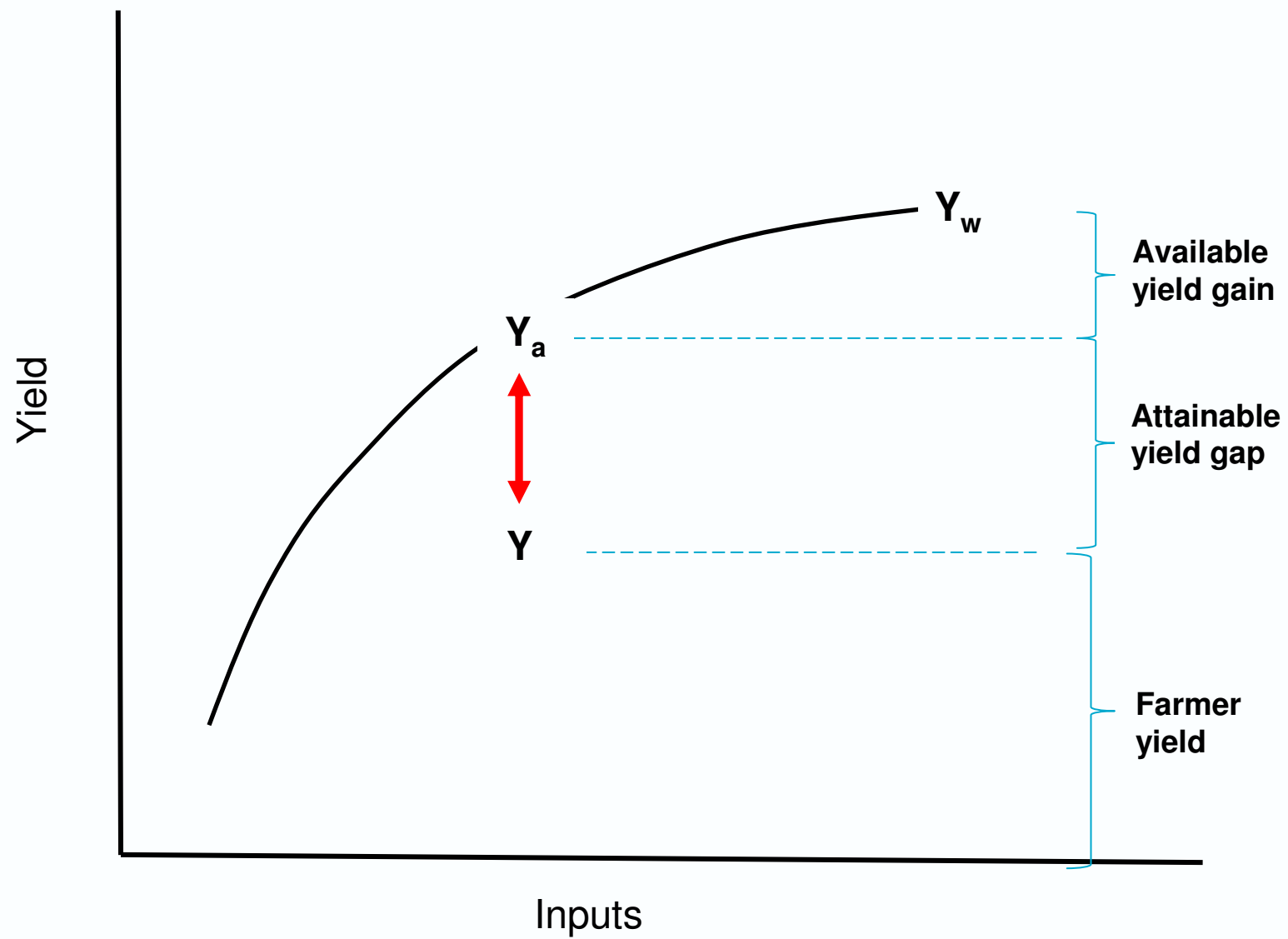
- Avoiding losses from the current production level

- Maintaining pest and disease resistance
- Avoiding soil and water degradation
- Adapting to unavoidable climate change
- Limiting the loss of existing agricultural land (e.g. to urbanisation)



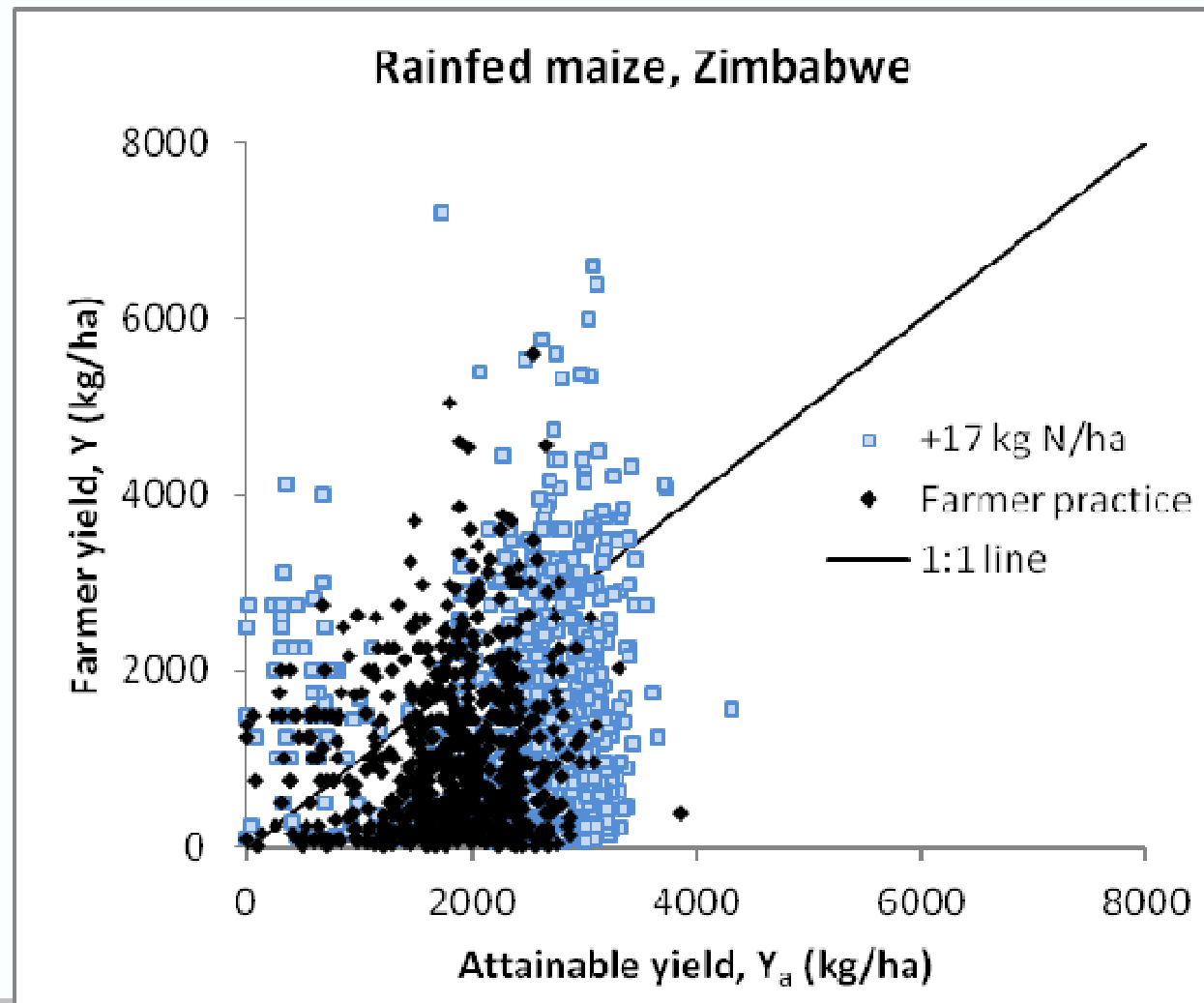
Assessment of yield gaps suggests they can be large – eg. maize in SSA





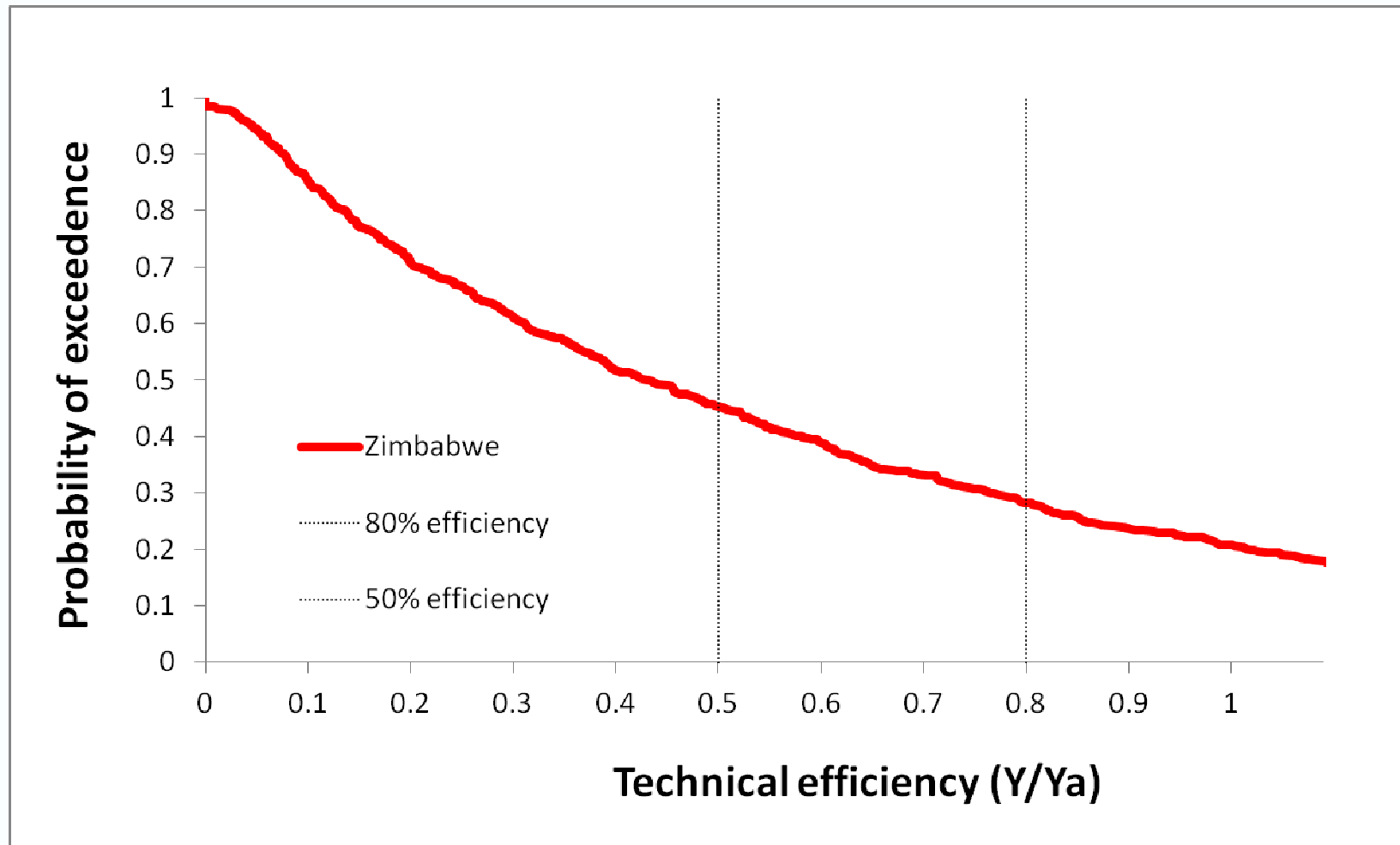
Zimbabwe - Farmer yields v's simulated (attainable) yields

Observed data for 1450 smallholder maize crops monitored between 2003-06 (Twomlow et al., 2008). Simulated yields used APSIM.



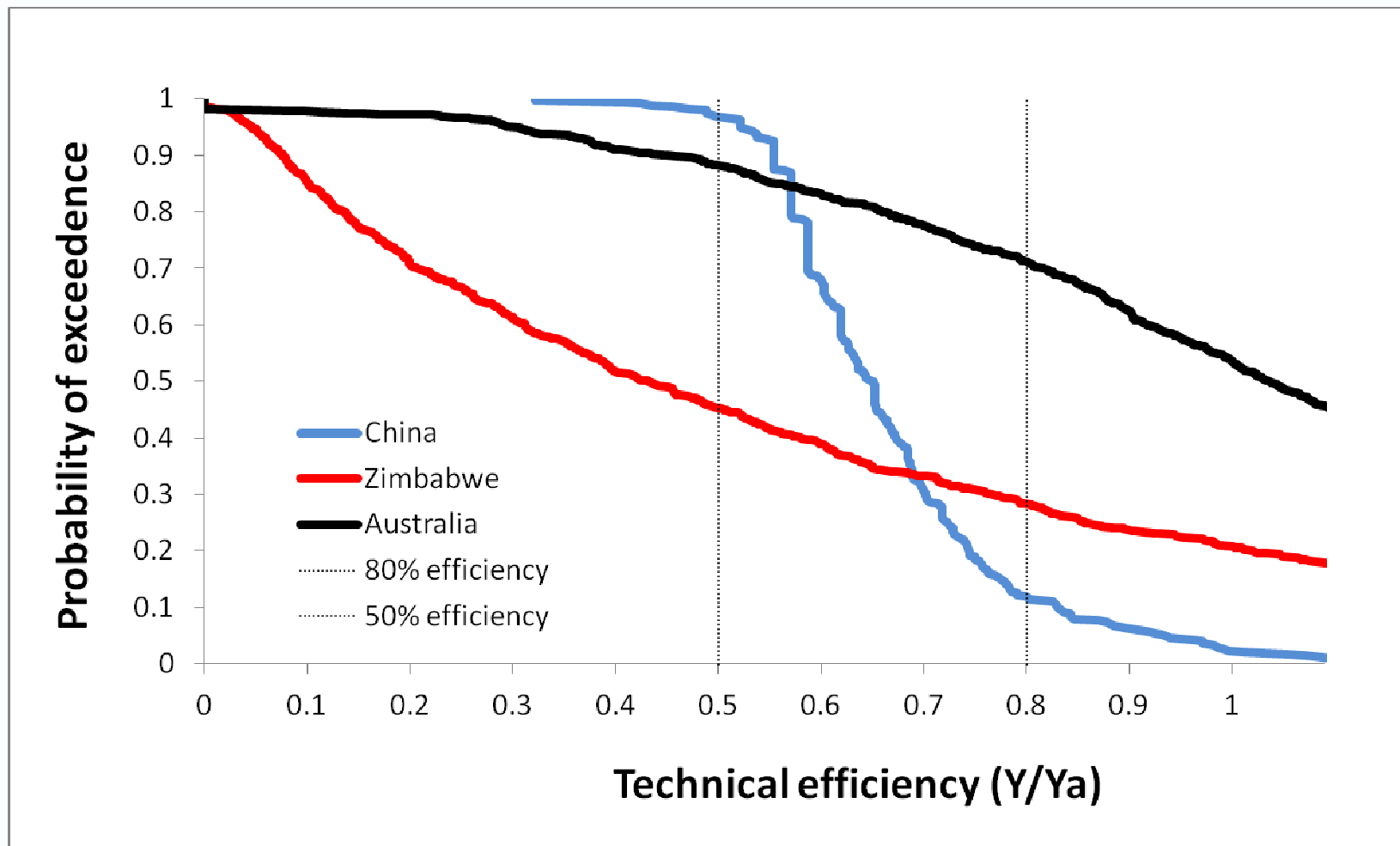
Probability of exceedence for technical efficiency

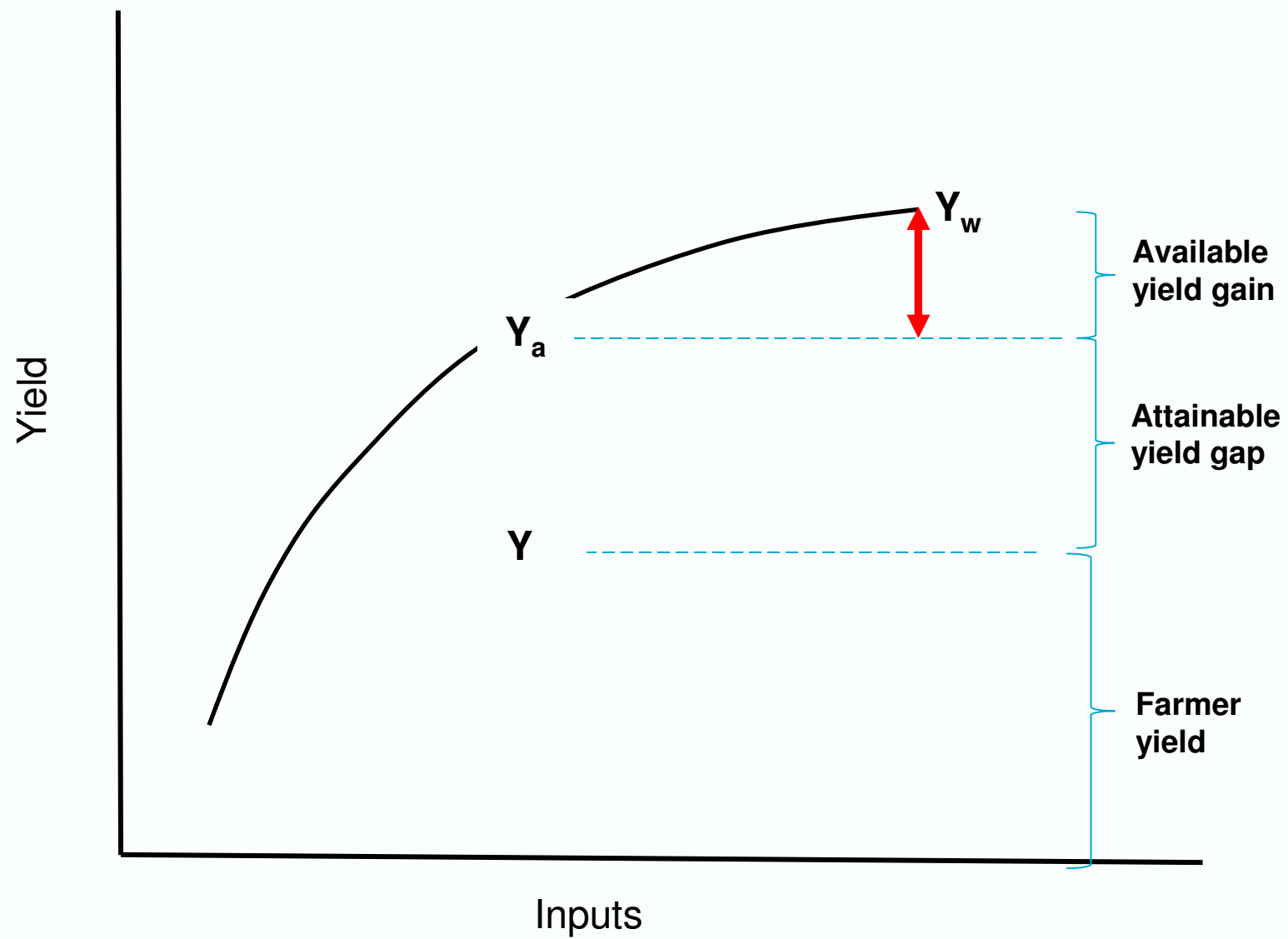
How close are farmers to producing the yield they should expect given their N input?



Probability of exceedence for technical efficiency

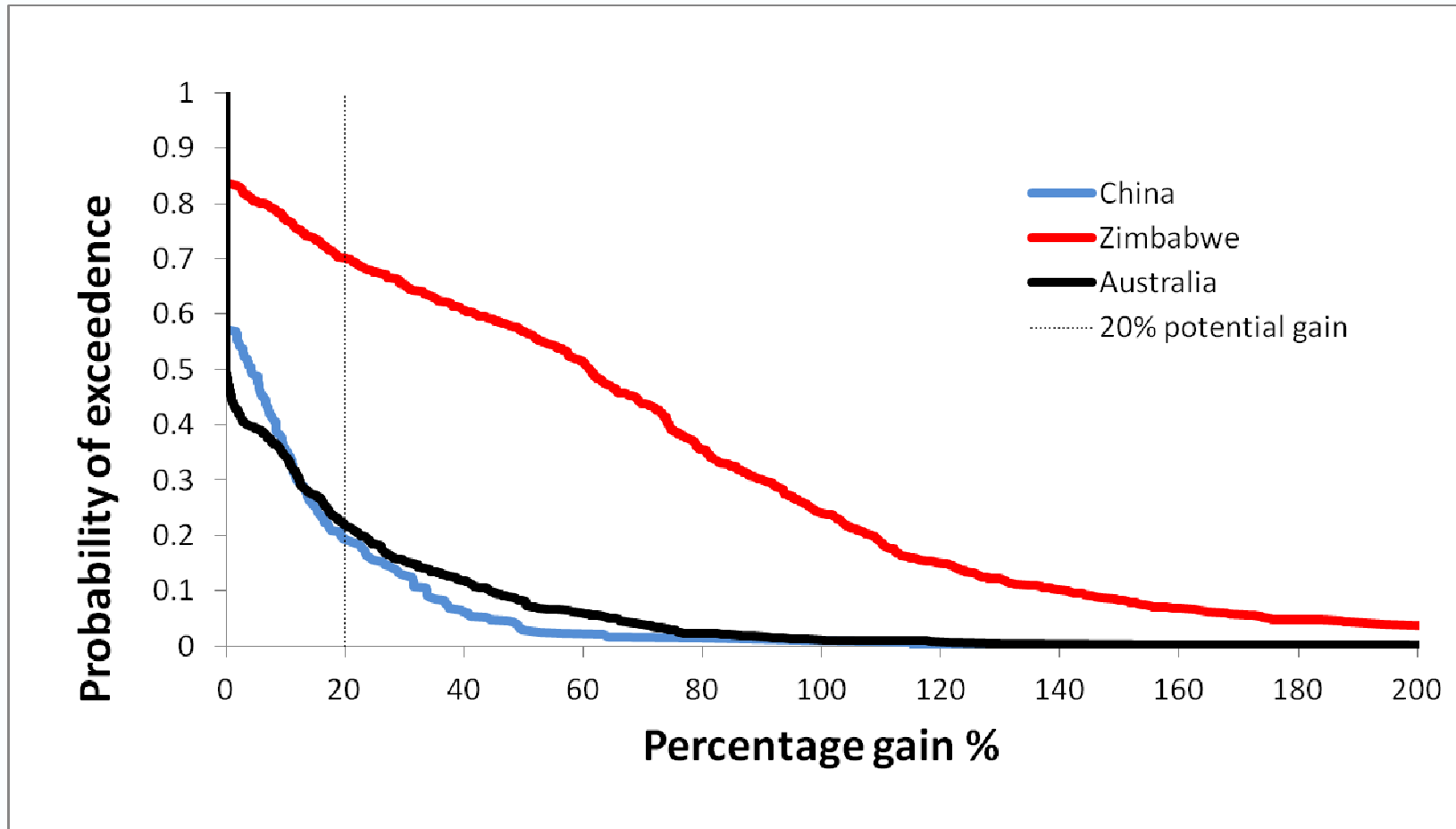
How close are farmers to producing the yield they should expect given their N input?



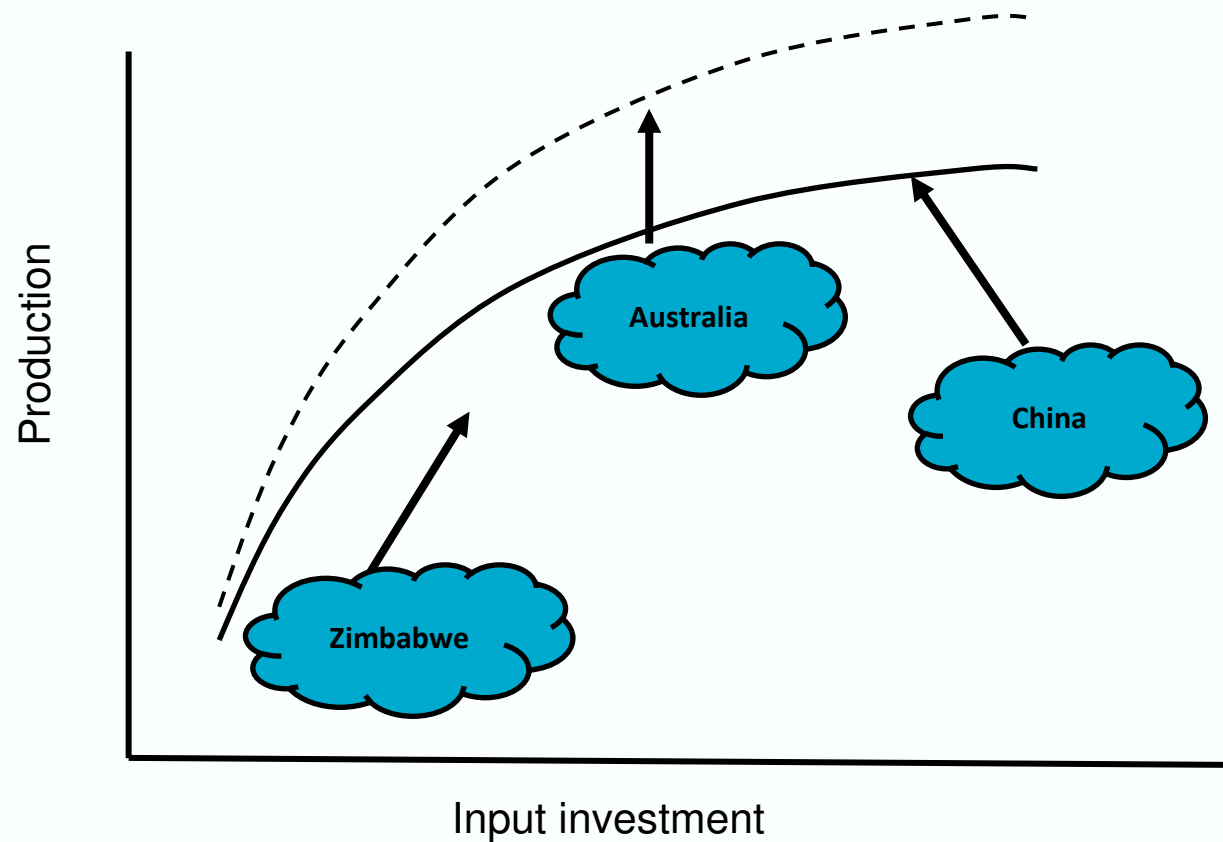


Probability of increased production by increasing N rate

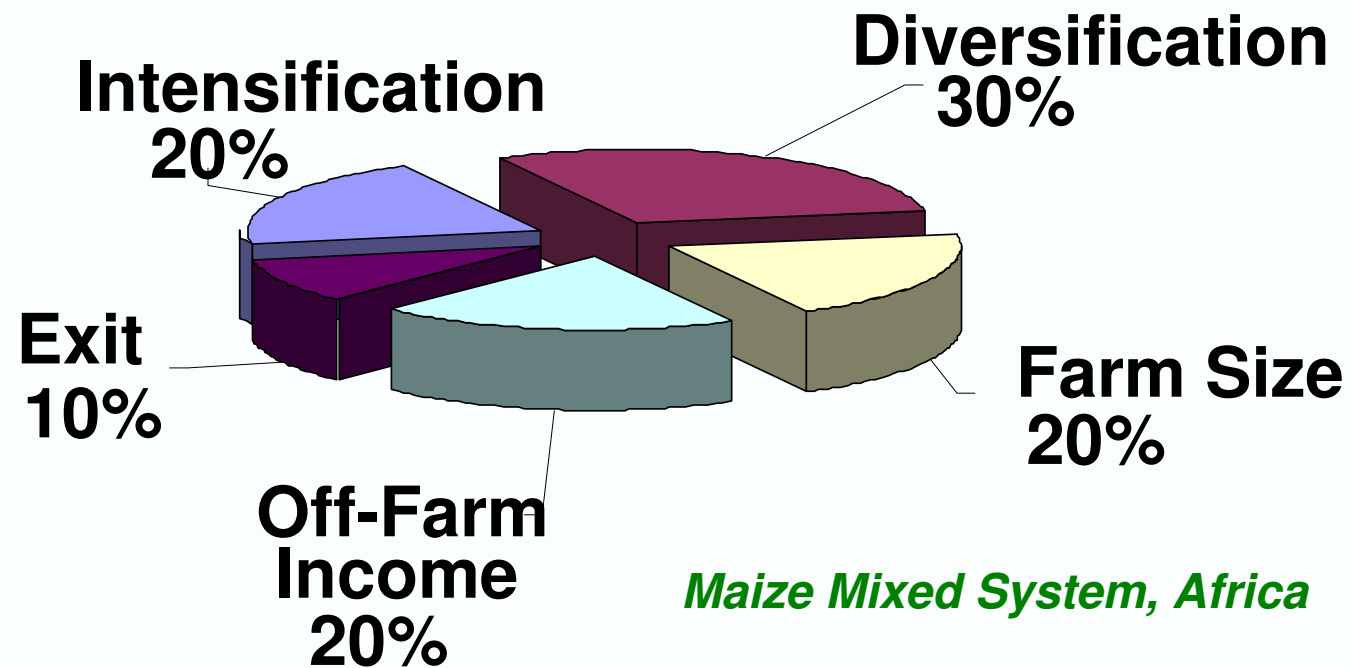
How many farmers would benefit from higher fertilizer rates irrespective of N cost?



Pathways differ in different systems



A “rural livelihoods” lens on agricultural intensification



Intensification not the only pathway out of poverty for smallholders

From: Dixon et al 2001. Farming Systems and Poverty

CSIRO Sustainable Agriculture Flagship

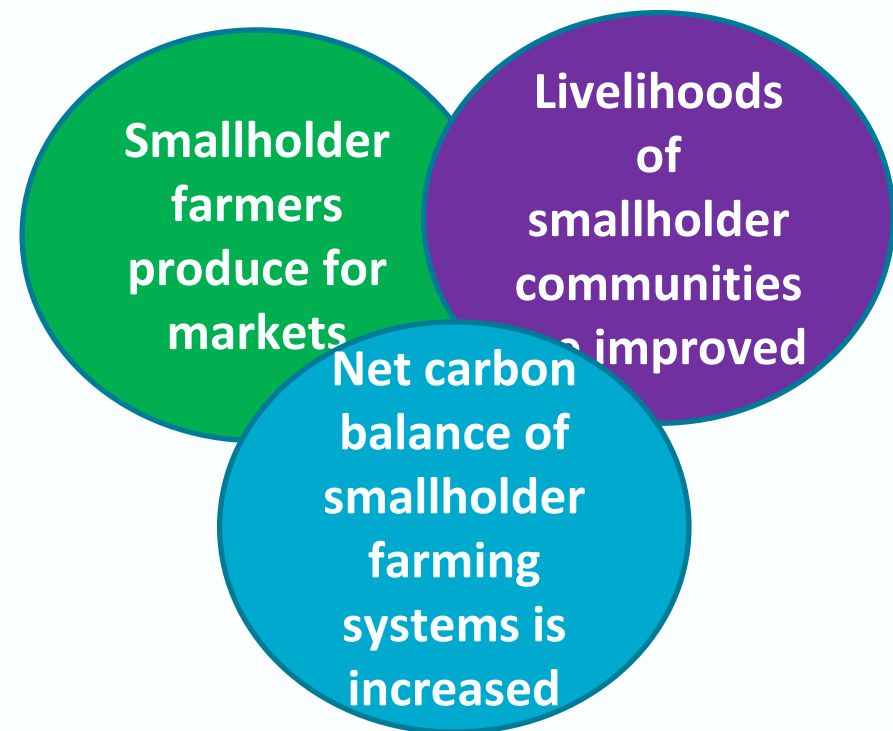
To secure Australian agricultural and forest industries by increasing productivity by 50% and reducing net carbon emissions intensity by at least 50% between now and 2030.

Themes

1. **Agricultural productivity & environmental health**
2. **GHG mitigation & C sequestration**
3. **Landuse systems & trends**
4. **Research for Development**

To address the global challenges of food, fibre and carbon security through international research partnerships which both increase the capacity of participants and identify pathways to develop and improve sustainable livelihoods

R4D Theme



Australian RDE expertise highly relevant to dryland agriculture in Africa

Similarity in environments

- Shared constraints to biological productivity

Agricultural research and extension

- Systems science and modelling
- Conservation agriculture
- Livestock/crop integration
- Water management (droughts and flooding)
- Eucalypt and Acacia based forestry
- Participatory extension models including private sector and NGOs

Natural resource management

- Community based approaches to NRM
- Rangelands and biodiversity science

Climate science

- Seasonal climate forecasting

Economic and policy research

- Analysis of market and trade liberalisation

Research infrastructure and institutional arrangements

- Collaborative research centres
- Australian scientists with overseas research experience



Participatory research in Australian industry

Carberry et al., 2002

Farmers
Advisers
Researchers
Monitoring
Simulation
Communication
And
Performance
Evaluation



1. Learning is most effective in a **participatory** process
2. Be able to place **context** on one's own farm
3. Simulator has to be **credible** and flexible
4. Simulation is effective as a way of 'gaining experience'
5. Farmers are most interested in simulation when they are contemplating a **change**
6. Service providers are obvious candidates to participate
7. Formal **evaluation** is an essential process
8. Learn from mistakes and conflicts
9. A systems approach needs a systems research team

Doing things differently: the R,D&E revolution - Woods, E.J., Cox, P. and Norrish, S., 1997

“...the apparent unconcern of scientists to bring about purposeful change.”

“...raised questions about the ethics and values ...the willingness and capacity of RD&E workers...”

“...perceived failure of traditional R,D&E to impact on farm practice...”

“...apparent inability to bridge the gap between the world of professional science and that of practical agriculture...”

“...current emphasis on the development of DSS ...reflect a traditional preoccupation with outputs as opposed to outcomes.”

McCown RL, Carberry PS, Hochman Z, Dalgliesh NP, Foale MA (2009) Re-inventing model-based decision support with Australian dryland farmers. 1. Changing intervention concepts during 17 years of action research. Crop & Pasture Science 60, 1017–1030

Participative modelling & on-farm trials (1997-2006) in southern Africa (Zimbabwe, Malawi, RSA) – Whitbread et al., 2010



AIM to explore intervention options for smallholder and emerging farmers

- Farmers, NARES, Unis, NGOs, Farmer unions, Input suppliers, Milling Companies, Banks, Insurance cos
- Participants act in the role of smallholder farmers faced with crop investment decisions
- Task to manage a smallholder farm over a twenty years period based on specified resources (field numbers and size, soil type, labour and finances)
- Use the APSIM systems model to simulate the performance of each farming system

"I was more impressed by the simulation effort than the participatory methods" Christy Gladwin

Review of participative modelling & on-farm trials in Zimbabwe & RSA – van Rees & Connor 2012



- ... systems modelling led to the identification of cost effective, reduced risk and yield improving techniques of applying small doses of N fertiliser (also called micro-dosing) to maize during crop development.
- The practice has been accepted by Agritex (Zimbabwe Agricultural Extension Agency) and NGOs
- ... outcomes of the micro-dosing work had a positive outcome ... when private sector companies such Progress Milling, Sasol Nitro (fertiliser manufacturer and distributor) and Pannar Seeds collaborated in the distribution of small packs of fertiliser suited to micro-dosing on small farms, and by purchase of maize production from smallholders.

Food Security through Rural Development Initiative (2009)

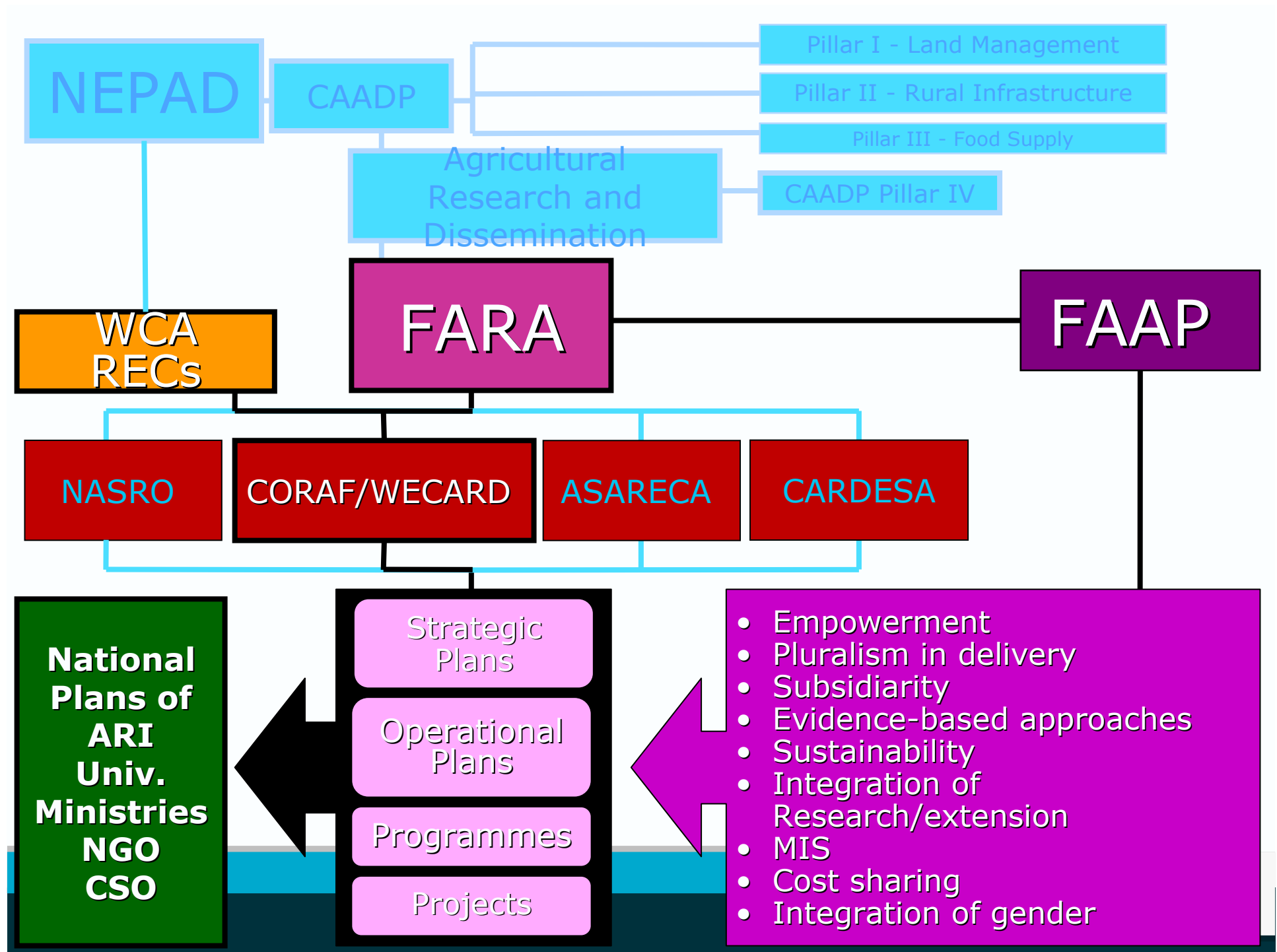
Australian Government commitment

- \$464 million to encourage greater food security globally
- \$100 million for Africa
- 4 years (but re-occurring)

African Food Security Initiative

1. Increasing agricultural productivity through increased investments in agricultural research and development;
2. Improving rural livelihoods by helping to address market failures that hinder economic development in rural areas; and
3. Building community resilience by supporting social protection mechanisms that enable vulnerable people to withstand shocks.

Administered through AusAID



AusAID/CSIRO African Food Security Initiative

CORAF/WECARD

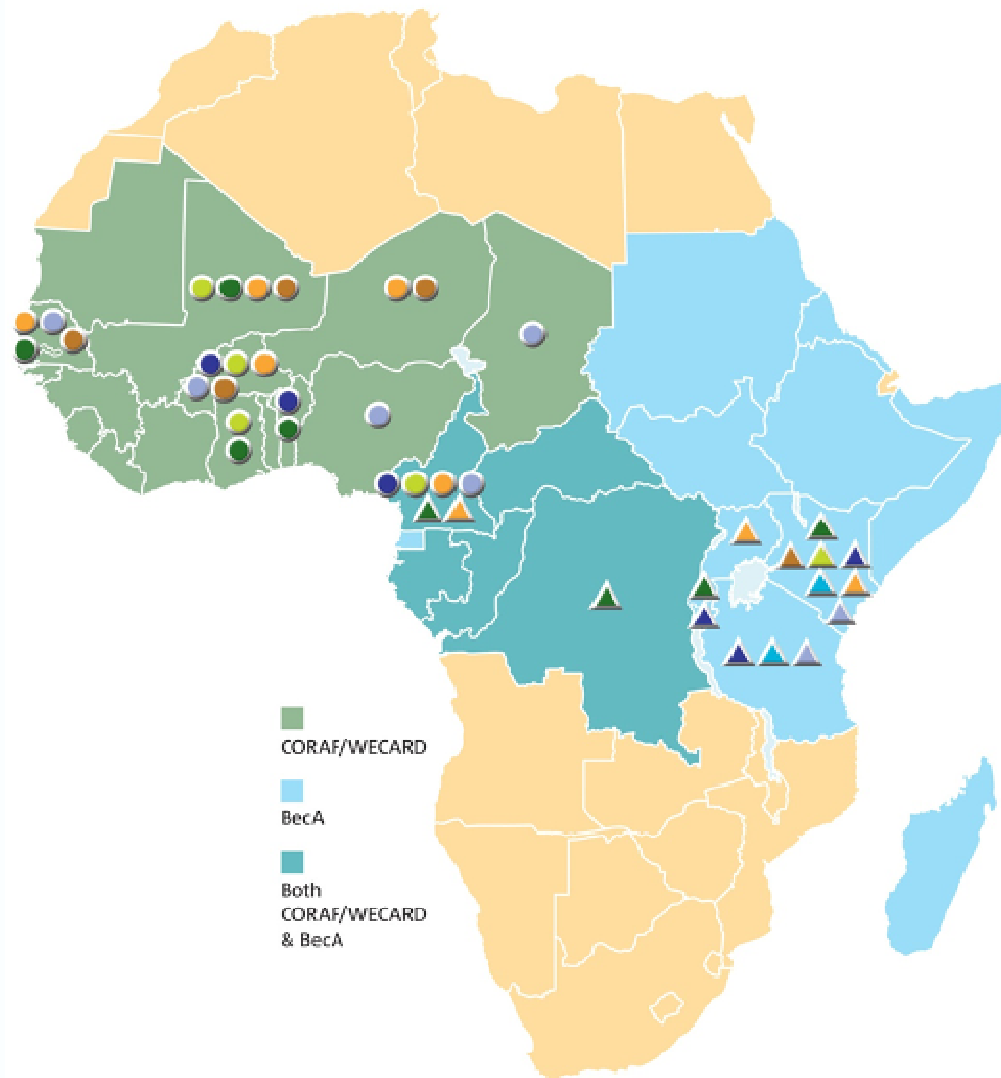
- Dakar, Senegal
- 22 member States
- Mandated to coordinate the implementation of CAADP Pillar IV in West and Central Africa

BecA

- Nairobi, Kenya
- Managed by ILRI (International Livestock Research Institute)
- Shared agricultural research and biosciences development platform



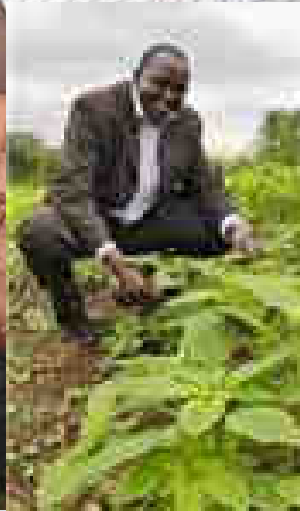
\$30M Africa Food Security Initiative



- CSIRO partnering with more than 30 research institutes and farming organisations across 15 countries in Africa
- Six projects in west-central Africa examining crop-tree-livestock farming systems
- Seven projects in east-central Africa on animal health and food quality (safety and nutrition)
- Learning project to elicit and report learnings from this R4D program



Amaranth



Mushrooms



Aflatoxin in maize



Cavies

More food available in markets and poor households

Net income of poor women and men increased

Agricultural productivity of poor women and men increased in a sustainable way

Better returns on goods sold by poor women and men

Innovation platforms

Diagnosis of biophysical & socio-economic constraints
Identification of intervention options & consequences

Evolving how systems R4D is designed
Increasing capacity for systems R4D implementation

Stimulation of market-led innovations
Enabling institutional development

Research Project

Research Project

Research Project

Research Project

Research Project

Research Project

Africa Food Security Initiative (AFSI) review recommendations

CORAF

iii. A stronger focus on enabling learning on use of research for development - A stronger focus is required on systematically learning how to use research for development to help CORAF/WECARD better operationalise IAR4D as a way of helping transform research practice in the region

BecA

4. Embed learning in projects as both a monitoring and research task.

5. Organise learning in the Partnership to identify and document high-performing research approaches that lead to impact by creating a specific learning project for the Partnership's work with a well-defined set of learning objectives

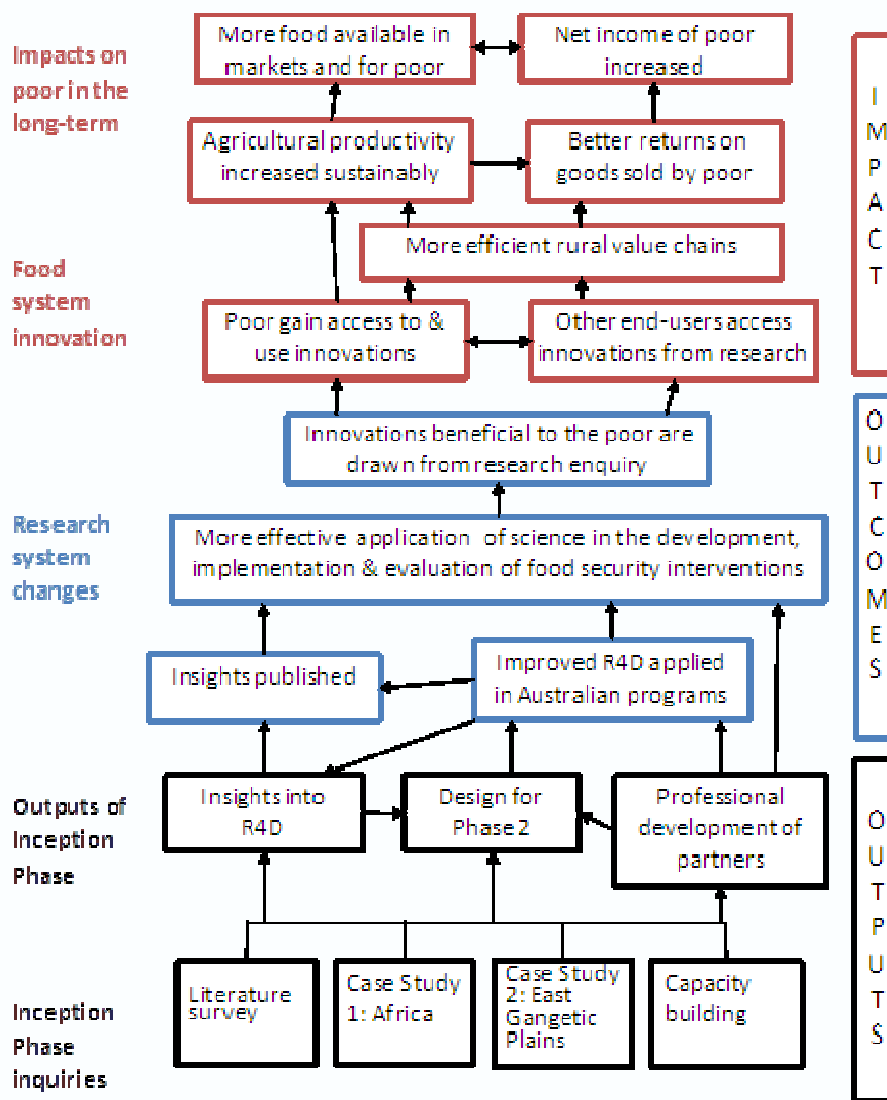
Food Systems Innovation for Food Security

Outcome

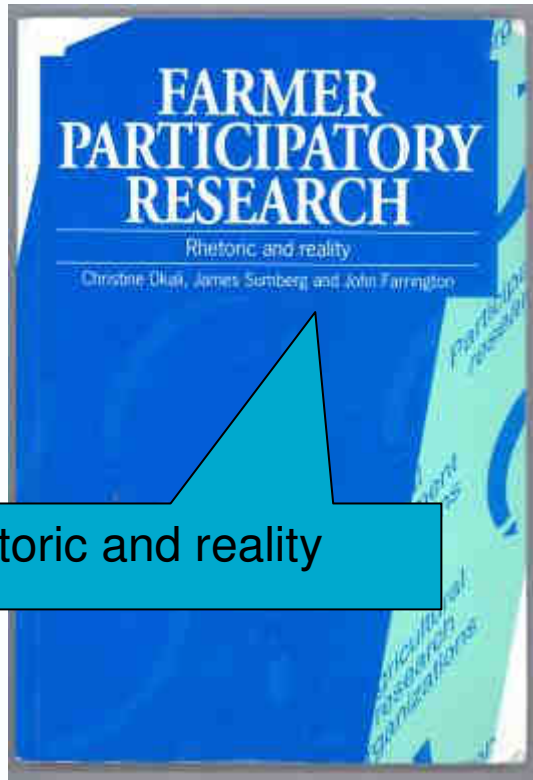
More effective application of science and evidence-based approaches to the development, implementation and evaluation of food security interventions

Key initial outputs

1. Insights gained of how to improve design & implementation of food security R&D
2. Design for Phase 2
3. Increased professional capacity of staff in AusAID, CSIRO & other partners



Participatory research (1994)



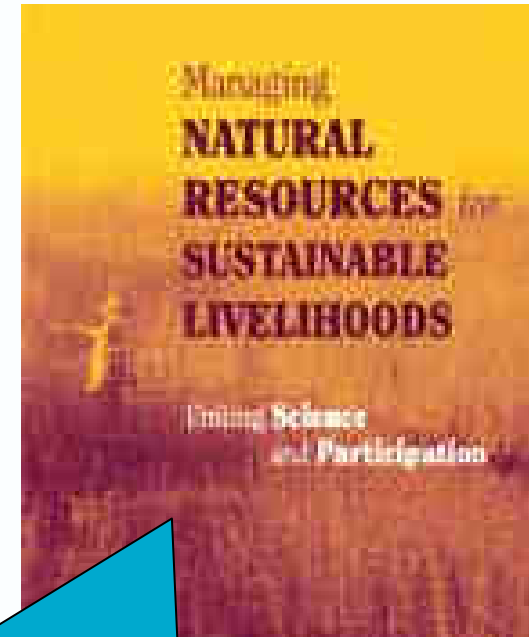
Rhetoric and reality

Okali, Sumberg and Farrington,
1994

- Honest in admitting to being long on rhetoric and short on achievements
 - High time costs of participation
 - Dependence on qualitative data
 - Difficulties in data & analysis
 - Poor evaluation
 - Difficulties in publication
-
- 11 case studies ... on-ground impacts mostly promises

Participatory research (2003)

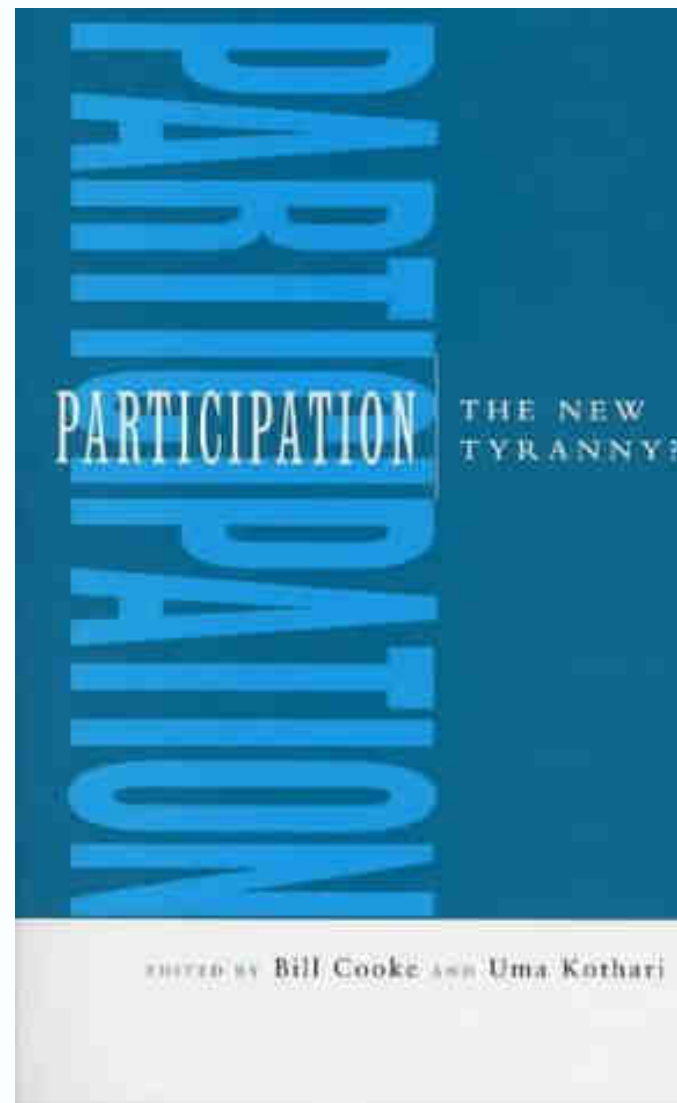
- Now lots of participatory methodologies promoted (>30)
 - The promise of bringing “*practical reality to bear on generalised concepts*”
 - Problems of evaluation, data analysis & publication persist
 - A call for organisational learning & change
-
- 23 case studies ... the rhetoric continues?



Uniting science & participation

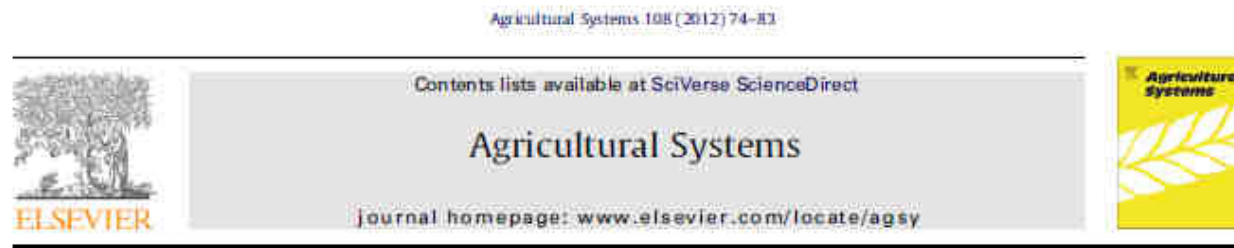
Pound, Snapp, McDougall and
Braun (eds) 2003

Participatory research (2005)



The new tyranny!

Participatory research (2012)



An innovation systems approach to institutional change: Smallholder development in West Africa

Dominique Hounkonnou^{a,b,c,1}, Dansou Kossou^{d,2}, Thomas W. Kuyper^{e,3}, Cees Leeuwis^{f,4}, E. Suzanne Nederlof^{g,5}, Niels Röling^{h,*}, Owuraku Sakyi-Dawson^{i,6}, Mamoudou Traoré^{j,7}, Arnold van Huis^{k,8,9}

^aCentre International d'Etudes pour le Développement Local, Lyon, France

^bFondation Rurale de l'Afrique de l'Ouest, Dakar, Senegal

^cBP 3030, Cotonou 03, Benin

^dEntomology and Crop Protection, Graduate school at the Université d'Abomey-Calavi (UAC), 01 BP 256, Benin

^eFungal Ecology and Diversity, Department of Soil Quality, Wageningen University, Bodemkwaliteit, Drievendaalsesteeg 4, 6700 HB Wageningen, The Netherlands

^fCommunication and Innovation Studies, Wageningen University, Hollandseweg 1, 6700 KN Wageningen, The Netherlands

^gRoyal Tropical Institute (KIT), P.O. Box 95001, 1090 HA Amsterdam, The Netherlands

^hCommunication and Innovation Studies, Wageningen University, De Dellen 4, 8473 MD Arnhem, The Netherlands

ⁱAgricultural Extension Department, College of Agriculture and Consumer Science, P.O. Box LG 68, University of Ghana, Legon, Ghana

^jInstitut Polytechnique Rural de Formation et Recherche Appliquée de Katibougou, BP 06 Koulakoro, Mali

^kLaboratory of Entomology, Wageningen University, P.O. Box 8031, 6700 EH Wageningen, The Netherlands

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ABSTRACT

Sustainable intensification of smallholder farming is a serious option for satisfying 2050 global cereal requirements and alleviating persistent poverty. That option seems far off for Sub-Saharan Africa (SSA) where technology-driven productivity growth has largely failed. The article revisits this issue from a number of angles: current approaches to enlisting SSA smallholders in agricultural development; the history of the phenomenal productivity growth in the USA, The Netherlands and Green Revolution Asia; and the current framework conditions for SSA productivity growth. This analysis shows that (1) the development of an enabling institutional context was a necessary condition that preceded the phenomenal productivity growth in industrial and Green Revolution countries; and that (2) such a context is also present for successful SSA export crop production, but that (3) the context is pervasively biased against SSA's smallholder food production. The article traces the origins of technology supply push (TSP) as a dominant paradigm that hinders recognition of the role of enabling institutions. The article then reviews the literature on institutional change and zooms in on Innovation Platforms (IPs) as a promising

Thank you



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