Waking up the sleeping giant finding the best fit & thinking in pathways

21 June 2010

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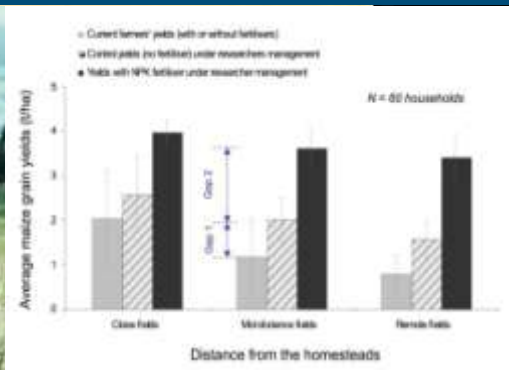
Plant Production Systems Group



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An ‘uniquely’ African green revolution

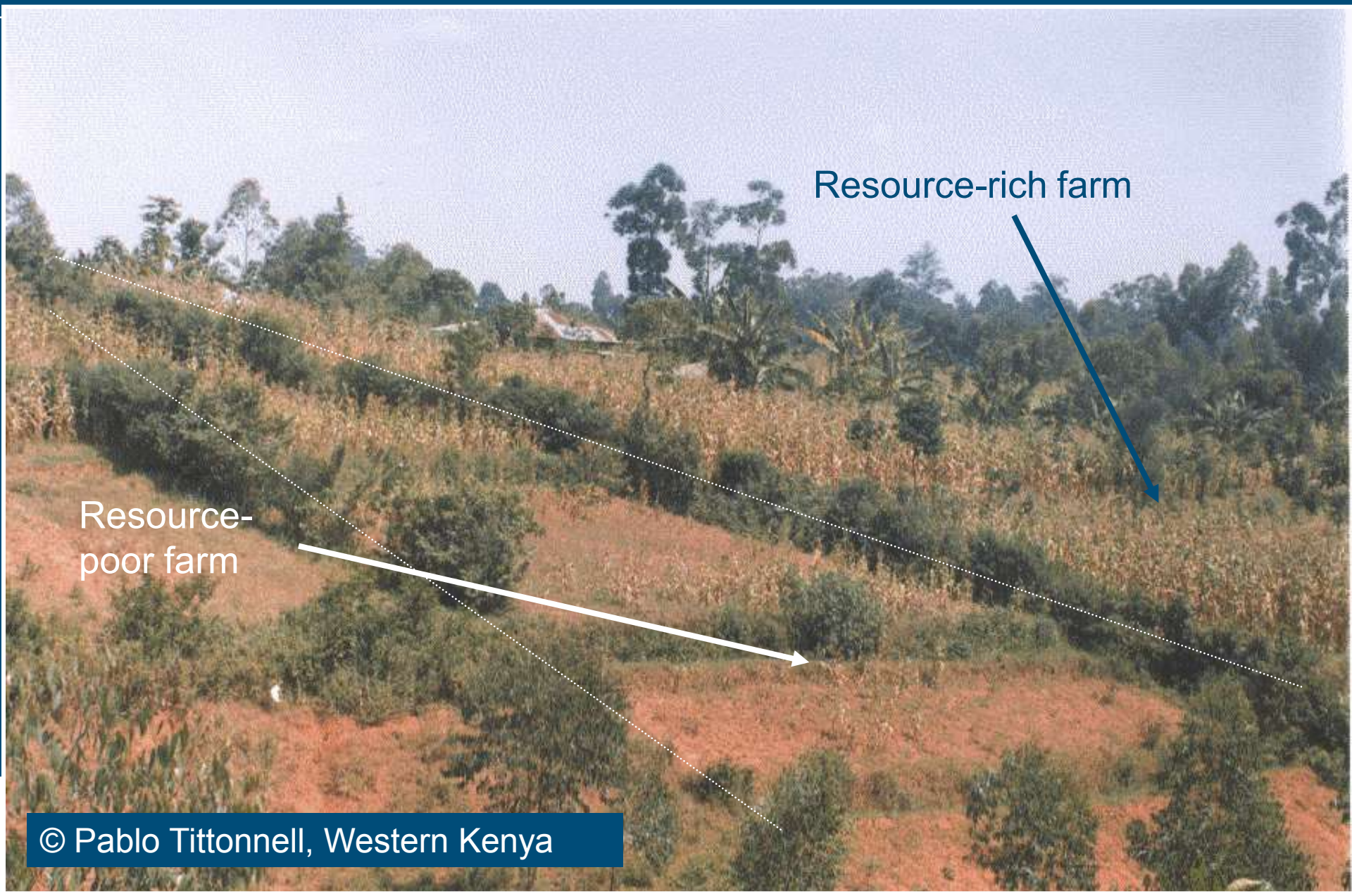
Kofi Annan called for ‘*an uniquely African green revolution in the 21st Century’*

Recognising:

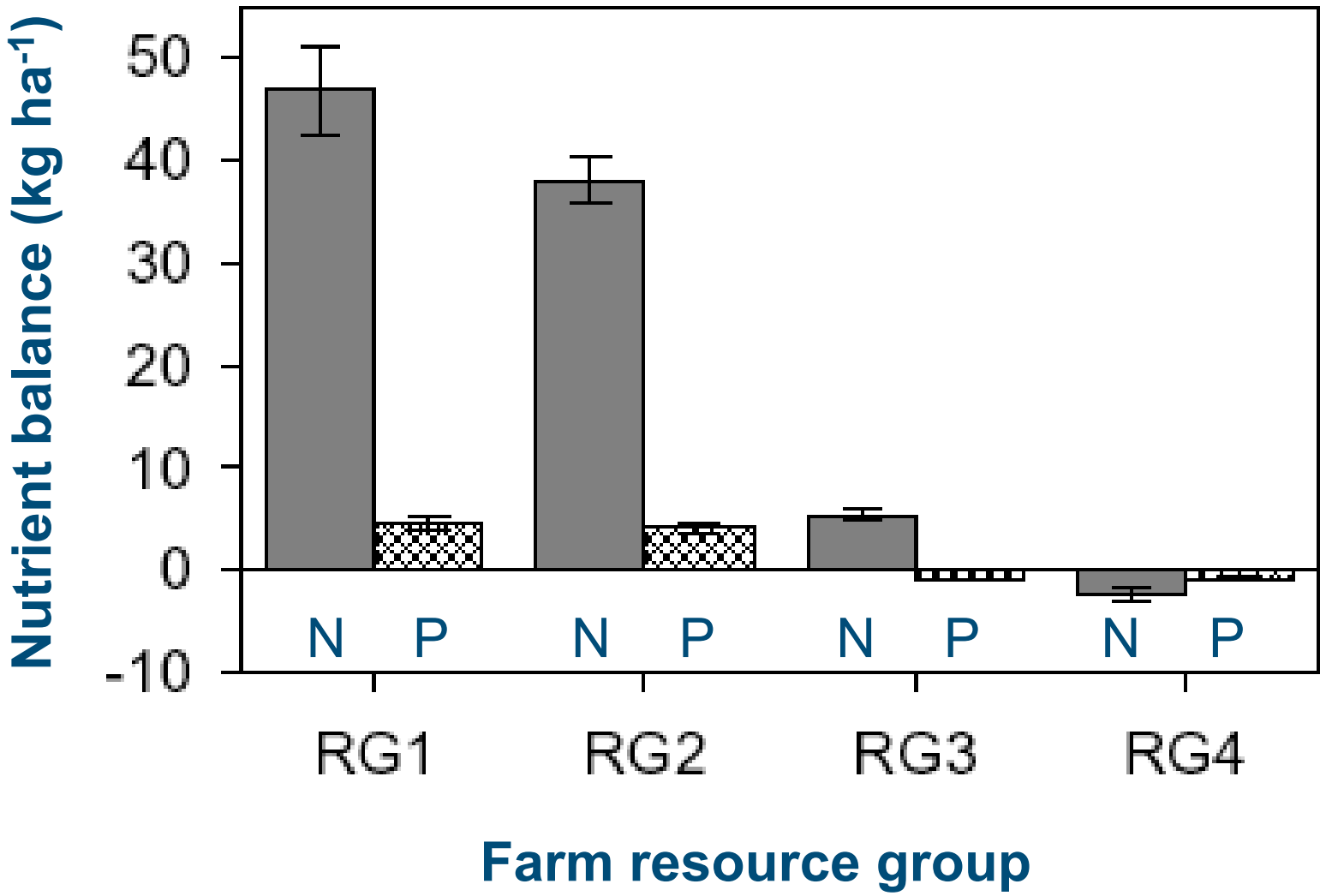
- the rich diversity of Africa’s people, soils and farming practices
- the urgent need to increase agricultural productivity

We need to understand diversity & heterogeneity and try to find patterns to target intervention

Farmer(s) are not all the same!!



Partial nutrient balances at farm scale (in Murewa Zimb)



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Zingore, Murwira, Delve & Giller (2007)
Agric Ecosyst Environ. 119, 112-126.

Fields are not all the same !! (soil fertility)

Soi fertility status for agroecologcial zones & fields within farms in Burkina Faso

Table 1. Soil fertility status for different agroecological zones (Windmeijer and Andriesse, 1993) and for various fields within a farm in Burkina Faso (Prudencio *et al*, 1993). Home gardens are near the homestead, bush fields furthest away from the homestead and village fields are at intermediate distances.

Area	Organic C (g kg^{-1})	Total N (g kg^{-1})	Available P (mg kg^{-1})	Exchangeable K (mmol kg^{-1})
Agroecozones (0–20 cm):				
Equatorial forest	24.5	1.6	NA	NA
Guinea savanna	11.7	1.4	NA	NA
Sudan savanna	3.3	0.5	NA	NA
Fields within a village:				
Home garden	11–22	0.9–1.8	20–220	4.0–24
Village field	5–10	0.5–0.9	13–16	4.1–11
Bush field	2–5	0.2–0.5	5–16	0.6–1

NA = not applicable.

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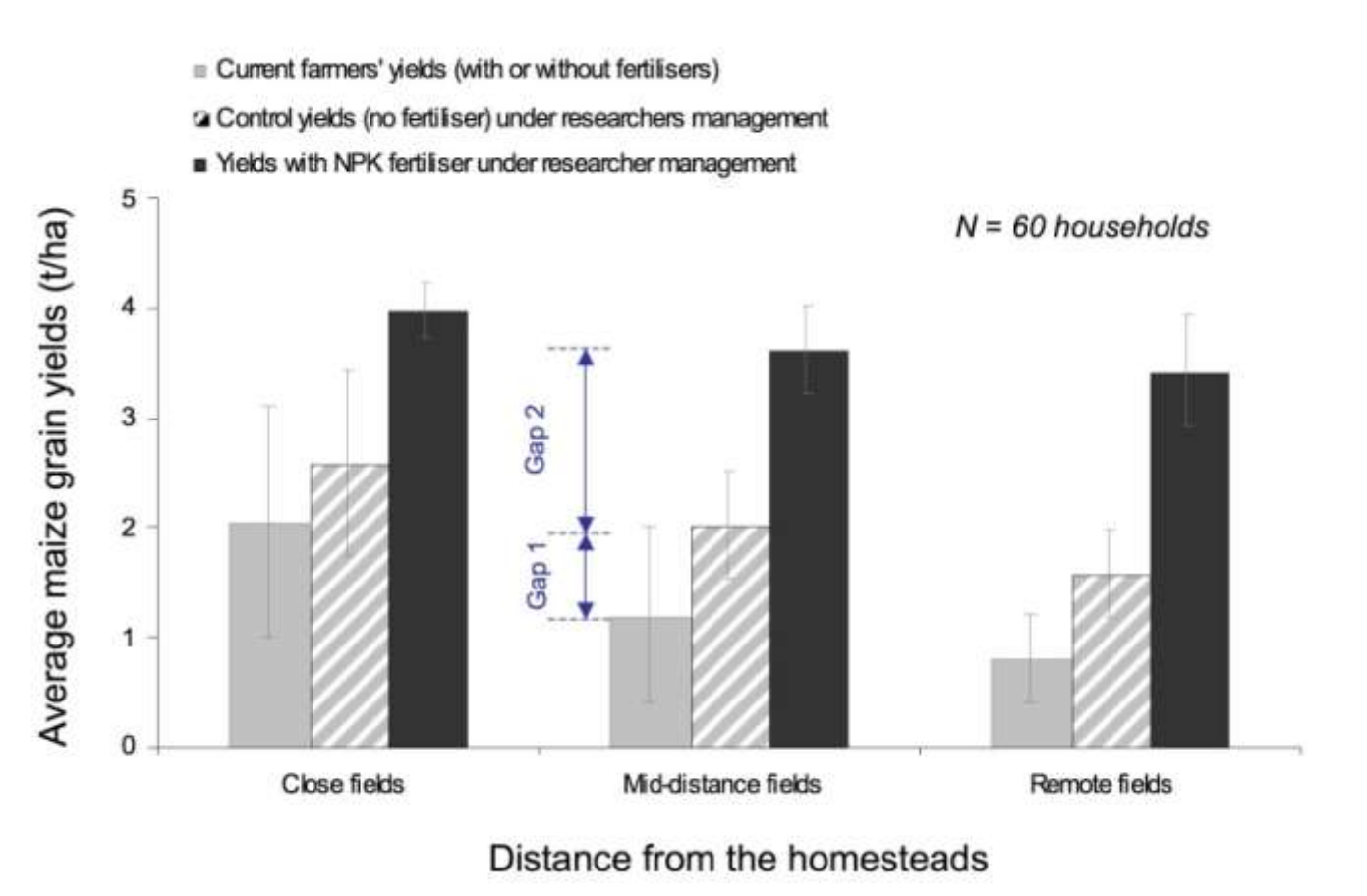
VanLauwe et al. Outlook on **Agriculture** Vol 39 no1, 2010 pp. 17-24

Effects of management & fertilizers on-farm



Tittonell, Vanlauwe, Corbeels, Giller (2008) Plant Soil DOI: 10.1007/s11104-008-9676-3

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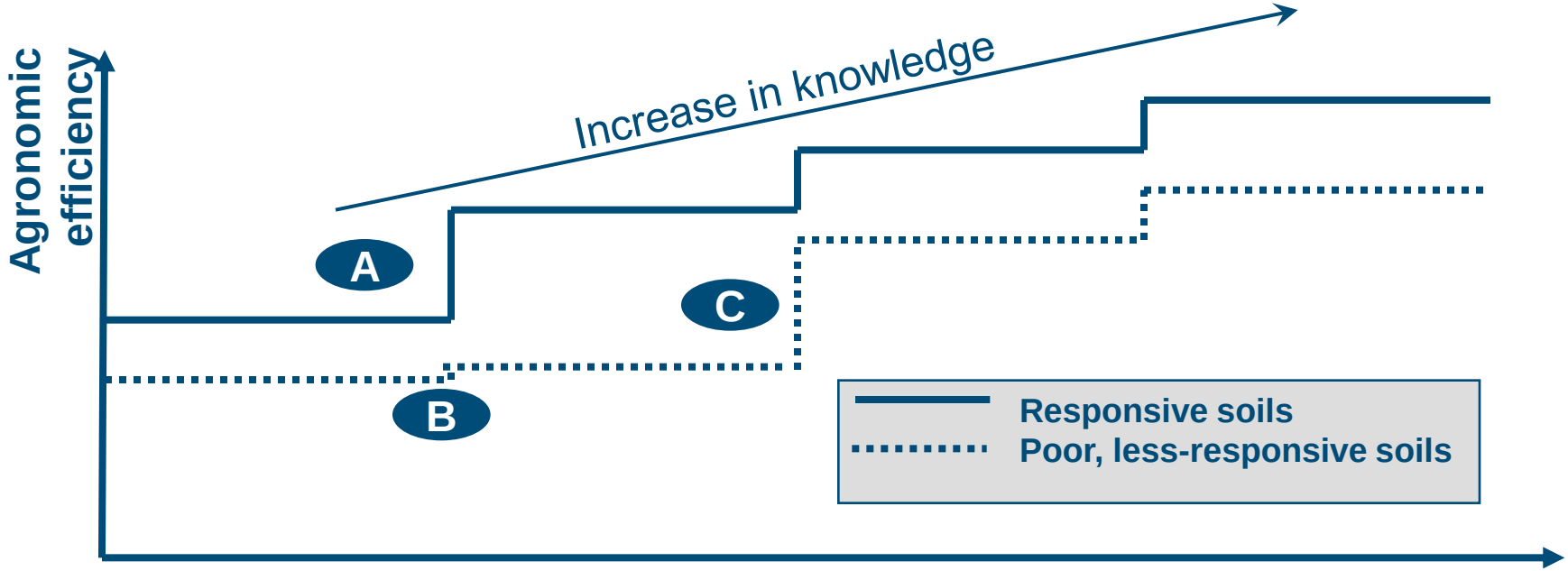

Current practice

Germplasm & fertilizer

Germplasm & fertilizer'

+ Organic resource mgt

Germplasm & fertilizer

+ Organic resource mgt

+ Local adaptation

Move towards ISFM

'Full ISFM'

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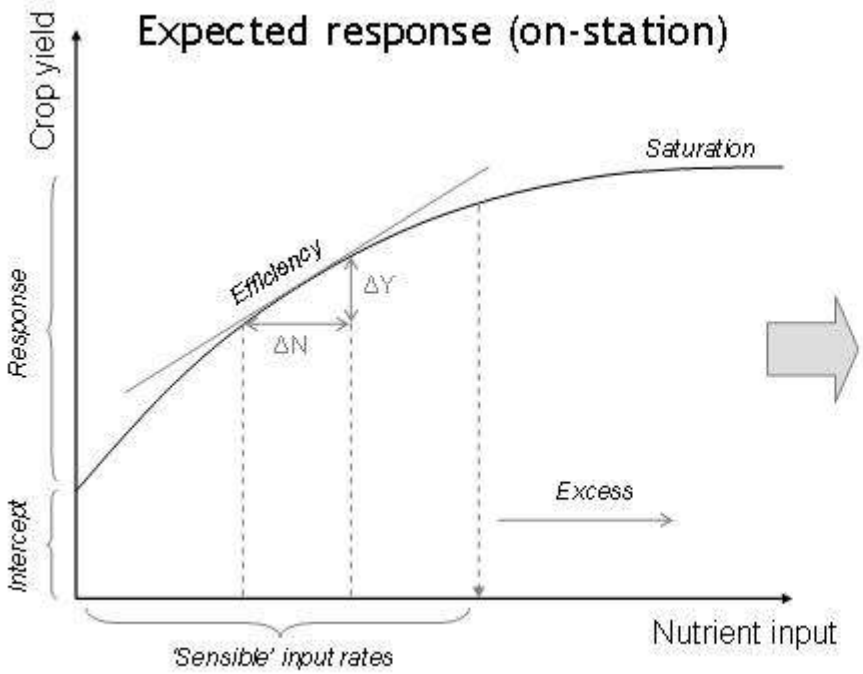
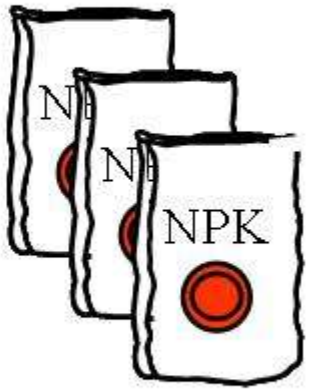
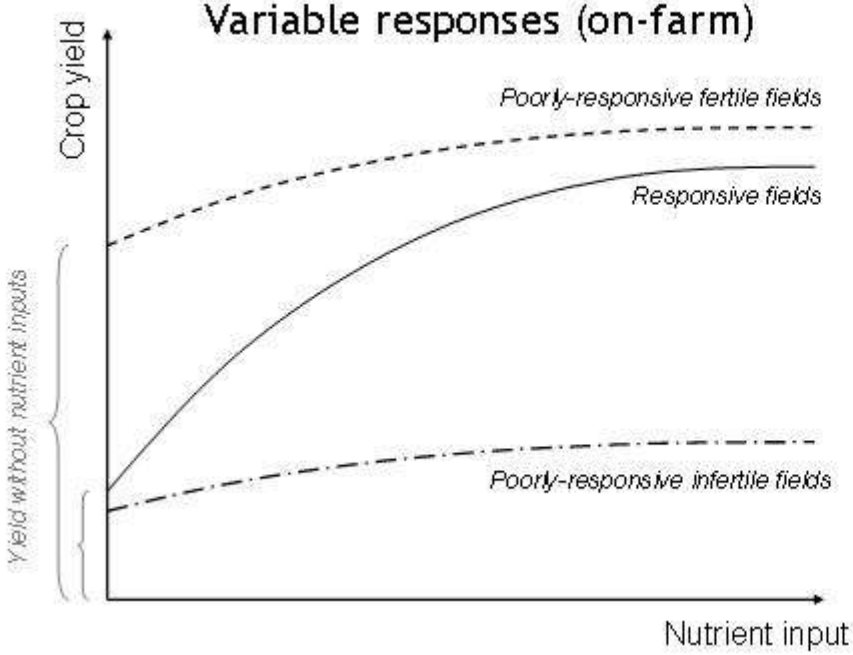
VanLauwe et al, Outlook on AGRICULTURE Vol 39, No 1, 2010, pp 17–24

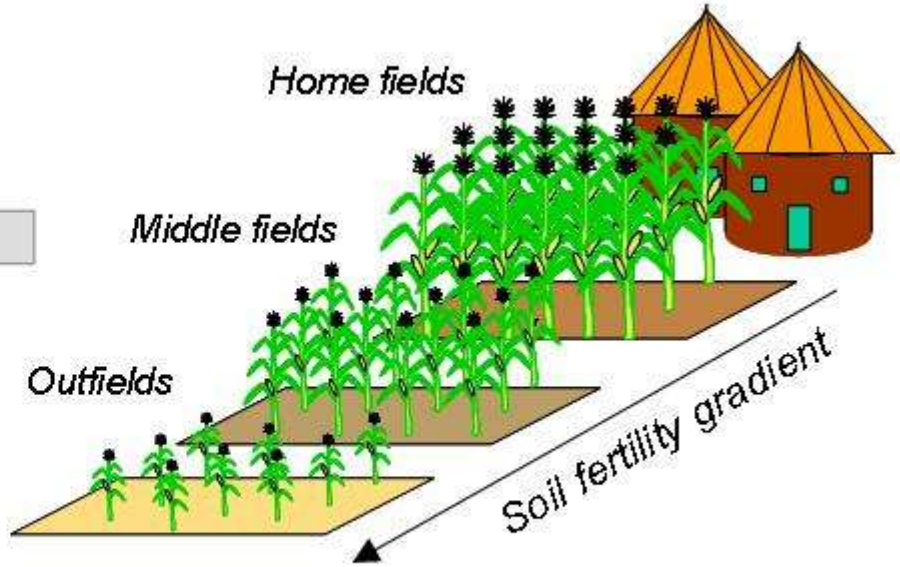

Expected response (on-station)
Crop yield
Response
Intercept
Saturation
Efficiency
ΔY
ΔN
Excess
'Sensible' input rates
Nutrient input


Market


Decision rule
Yield response > cost of fertiliser


NPK


Variable responses (on-farm)
Crop yield
Poorly-responsive fertile fields
Responsive fields
Poorly-responsive infertile fields
Yield without nutrient inputs
Nutrient input


Home fields
Middle fields
Outfields
Soil fertility gradient

Infield

Fertilizer N use efficiency
= 50 kg grain/kg N

Fertilizer N use efficiency
= 50 kg grain/kg N
(after 3 years of FYM application)

Fertilizer N use efficiency
<5 kg grain/kg N

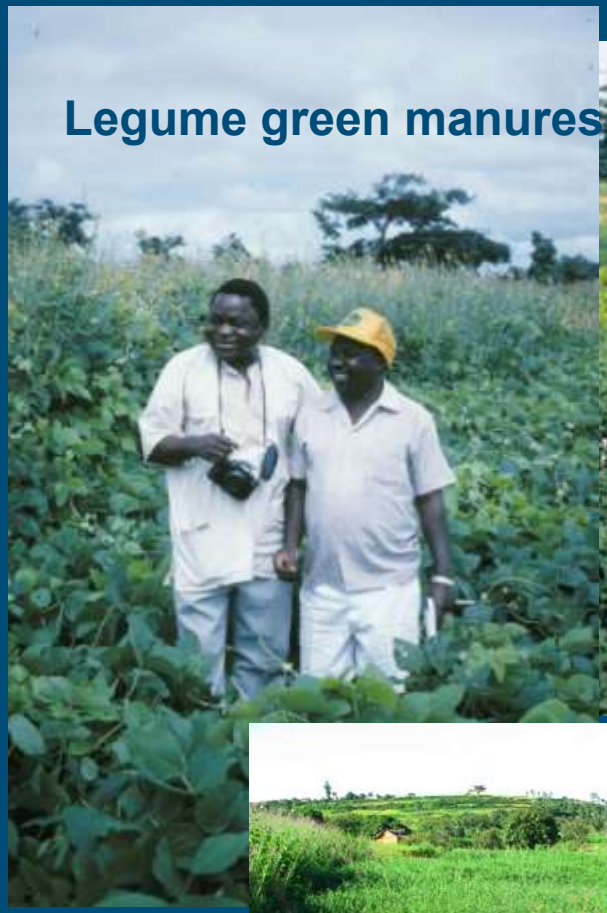
Nitrogen fixing Legumes

Look promising

Many existing technologies

Reality?

Potential solutions - Nitrogen fixing legumes



Legume green manures on smallholder farms

Participatory evaluation of legume technologies

- First choice – grain legumes
- Second choice – multi-purpose grain legumes
- Third choice – fodder legumes, fodder trees
- Fourth choice – woody legumes

- …very last choice – green manures, cover crops and fertilizer trees
- 'pseudo-adoption' due to artificial market for seed of green manures or trees

Evaluations conducted in Ghana (Adjei-Nsiah), Kenya (Ojiem), Uganda (Ebanyat), Rwanda (Bucagu), Zimbabwe (Chikowo)

Benefits of Soyabean Residues to Maize

Soyabean variety	Stover N added (kg ha^{-1})	Maize Grain Yields (t ha^{-1}) - stover	+ stover
Magoye	50	1.1	1.5
Nyala	29	0.8	1.0
Maize-Maize		0.4	

Maize yield almost quadripled but it is not enough !!

On farmer's field at Tapera, Hurungwe East 1997/8

Genotype × Environment × Management

$$(G_L \times G_R) \times E \times M$$

G_L = legume genotype

G_R = rhizobial strain

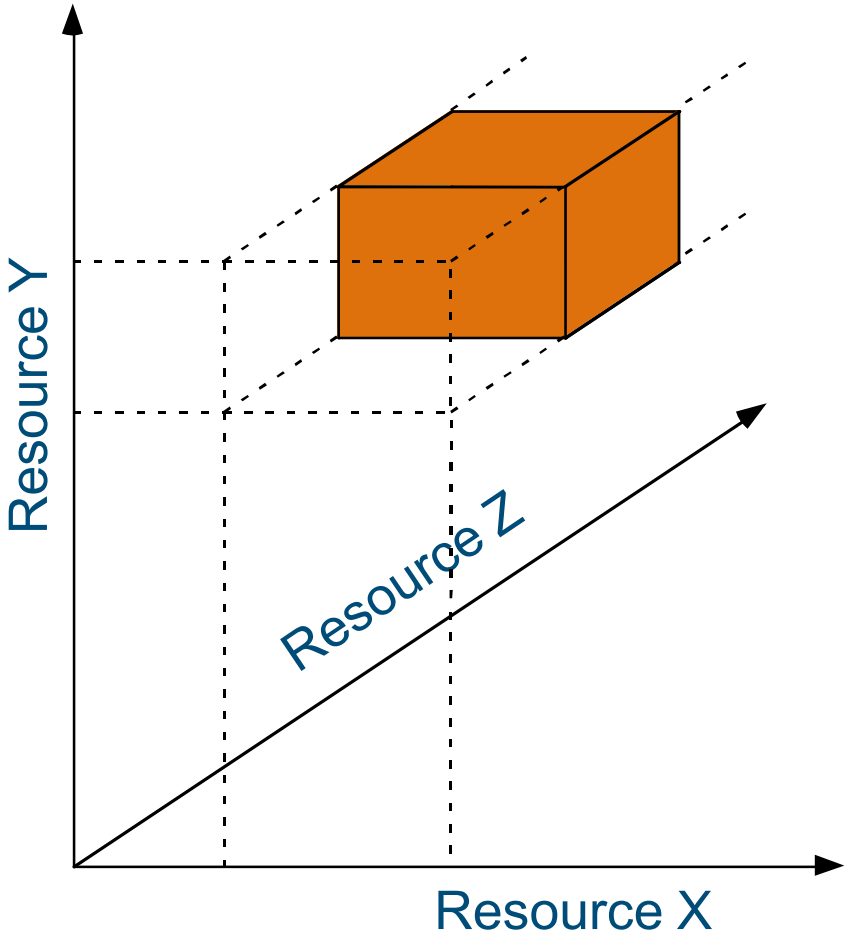
E = environment

- climate (temperature x rainfall x daylength etc) - to encompass length of growing season etc

- soils (nutrient limitations, acidity and toxicities)

M = management

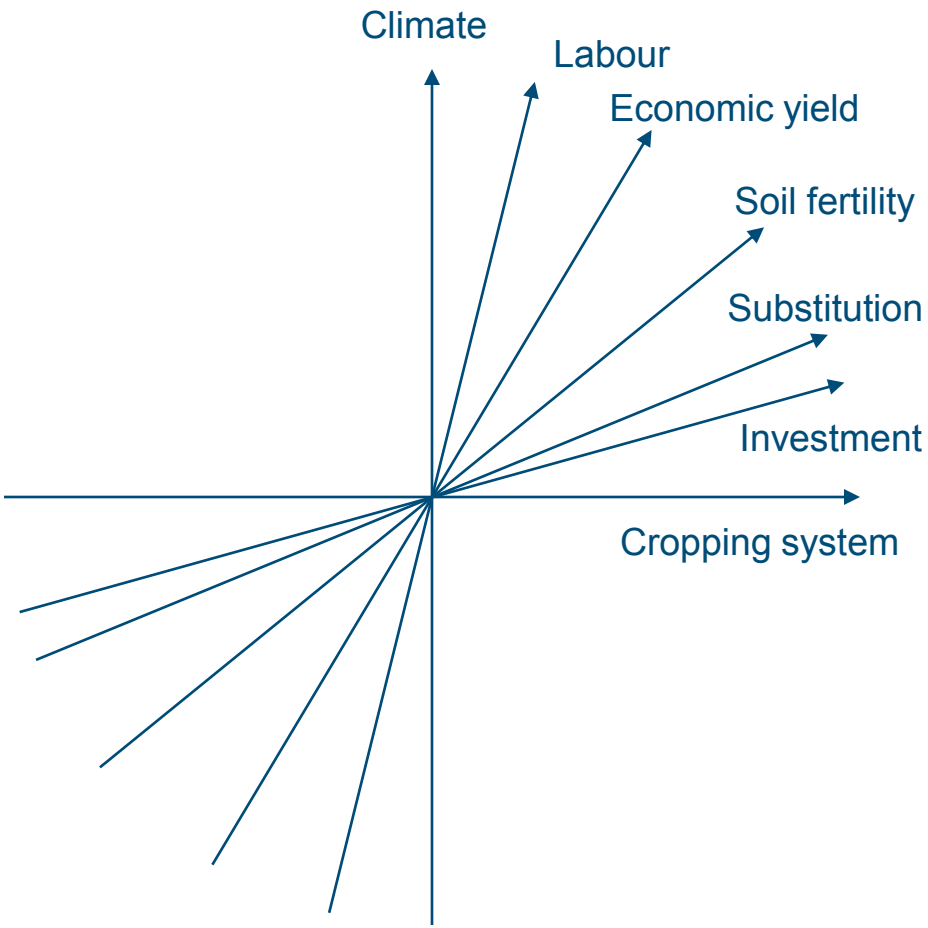
The ‘niche’ for legumes



The niche as an ‘n’-dimensional hyperspace

Hutchinson (1957)

The socio-ecological niche



The legume ‘niche’ has agroecological and socioeconomic dimensions

Ojiem, de Ridder, Vanlauwe & Giller (2006) *I*
J. Agric. Sust. **4**, 79-93.

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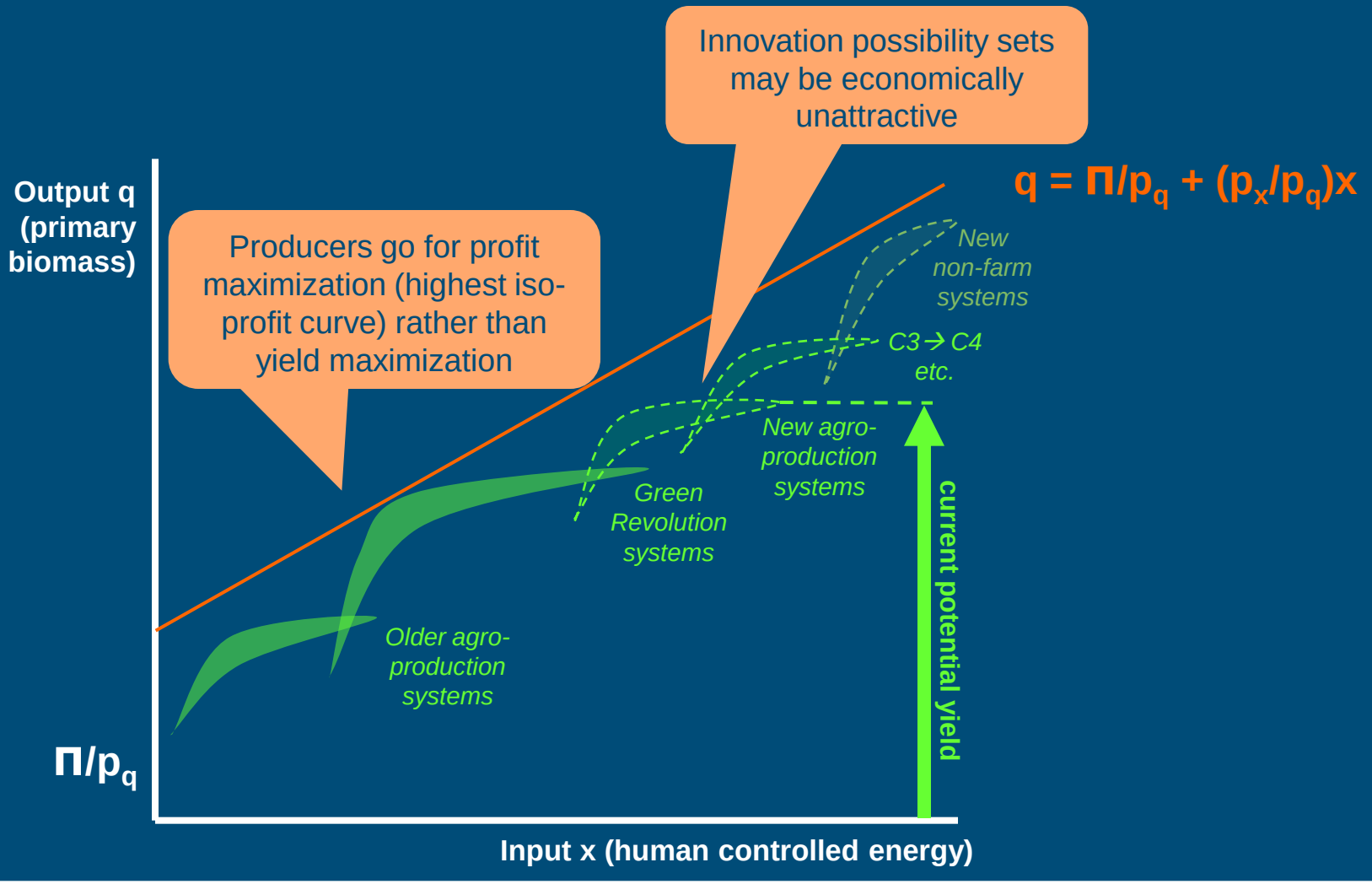
Economic constraints (in agrosystems)



Niek Koning et al, NJAS 55-3:2008, p. 229-292

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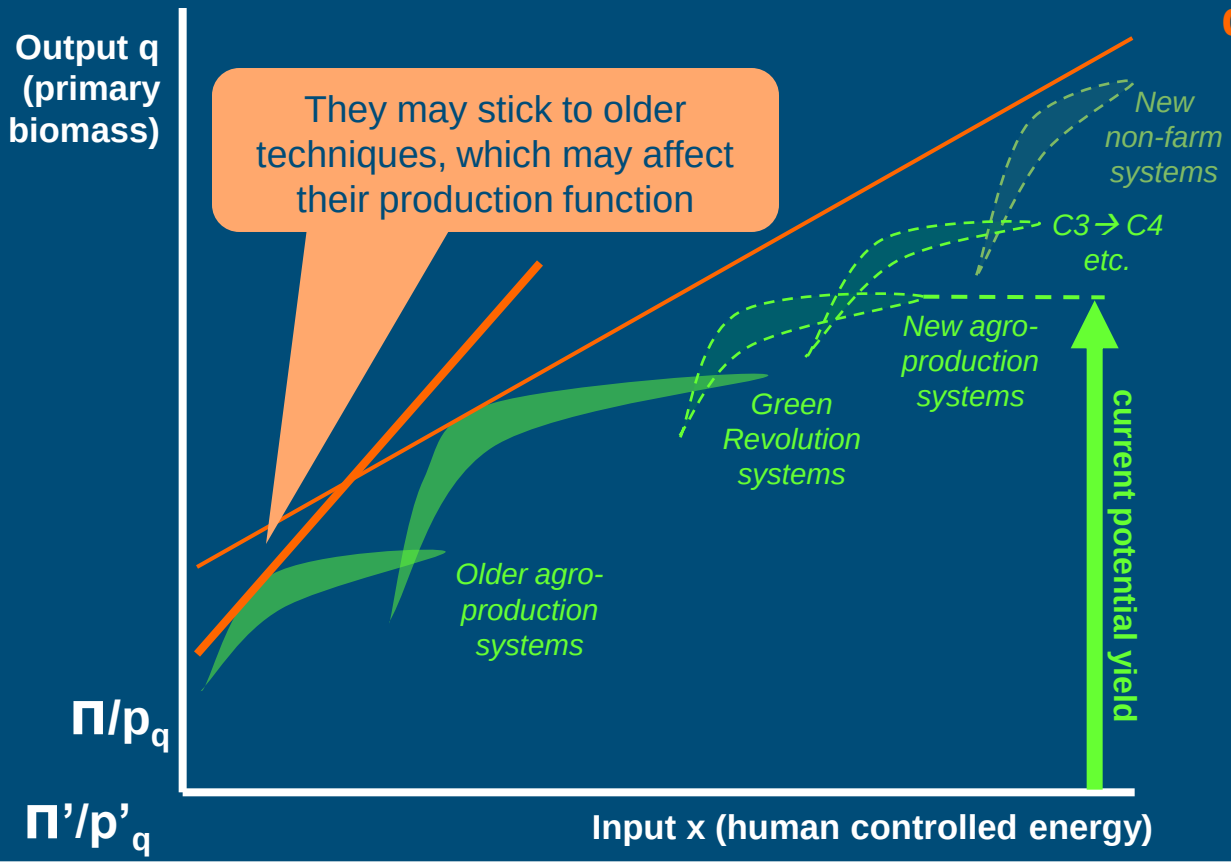
Economic constraints (in agrosystems)

Farmers in less-favoured areas have less-favourable price ratios, higher transaction costs, and higher risk

They may stick to older techniques, which may affect their production function

$q = \Pi/p_q + (p_x/p_q)x$



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Niek Koning et al, NJAS 55-3; 2008, p. 229-292

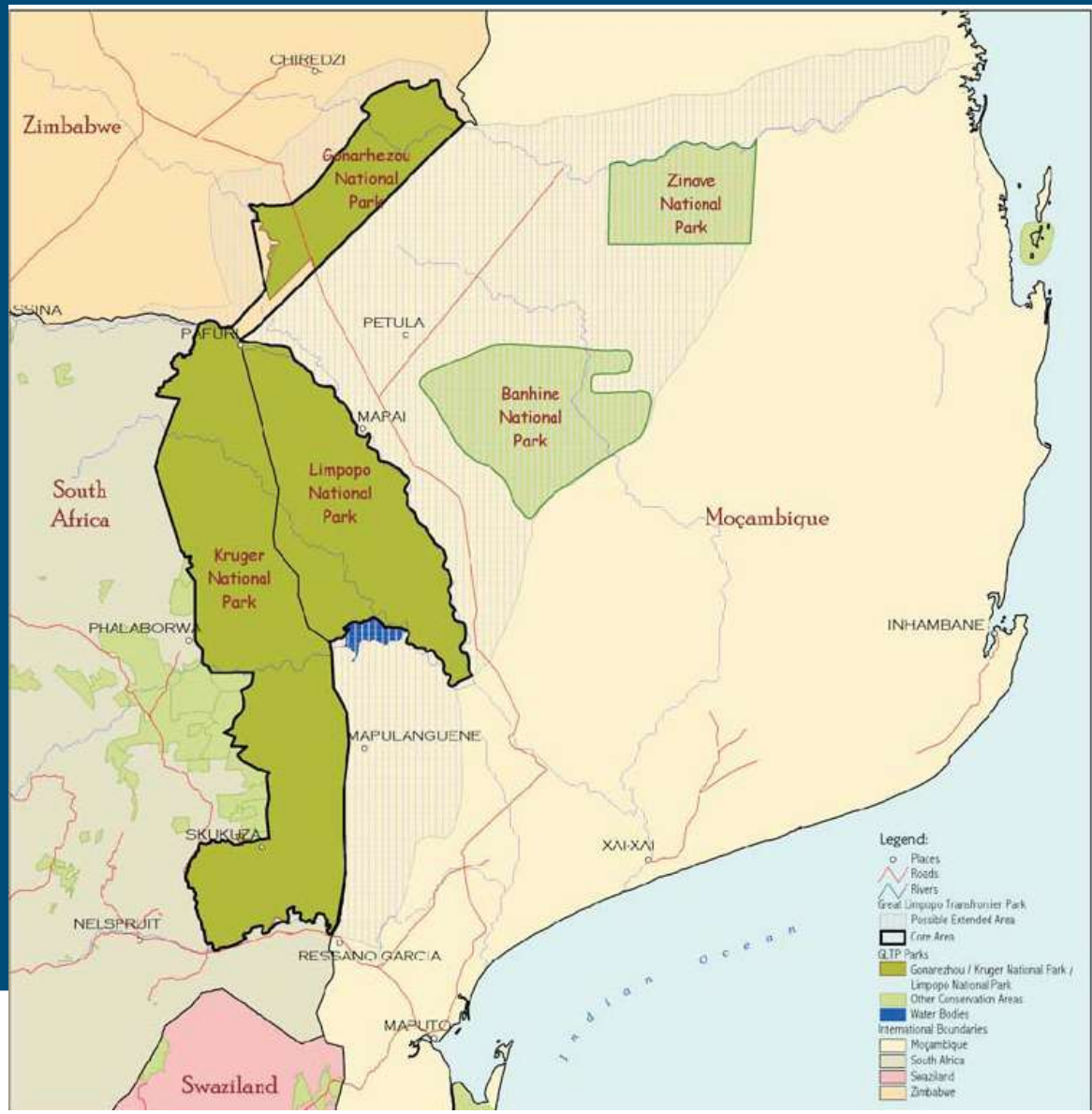
Important remaining questions

- How to identify (un)responsive soils
  - farmer dependent?
  - location dependent?
- Where to get the organic materials
  - Low food production/ha →low production of crop residues (with HYV →HI high →relatively less residues)
  - Residues have alternative uses: animal feed, building
  - Animal diseases → no manure
- How to find the niches for N fixing legume crops
- Economic feasibility?

Some additional issues

- Competition for land AND water
- Animal production as part of the pathway

Competition for land and water in Mozambique



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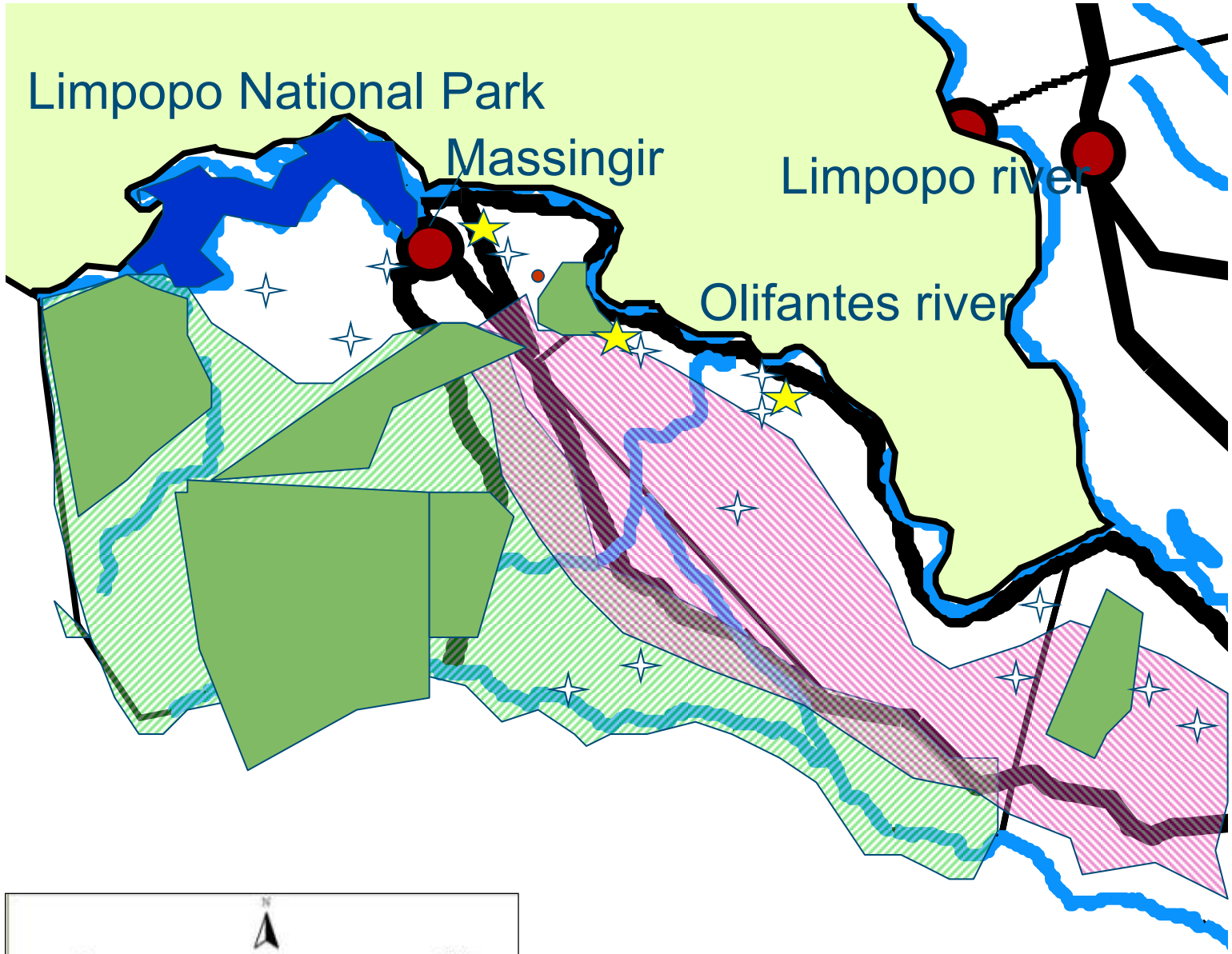
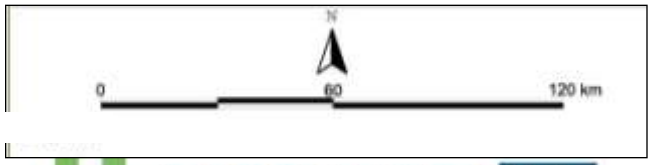


Ledgend

- PROCANA
- AWF
- Existing concessions
- Existing villages
- Resettlement area from dam
- Some Resettlement sites from LNP
- Massingir dam
- LNP
- rivers
- roads
- District boundaries



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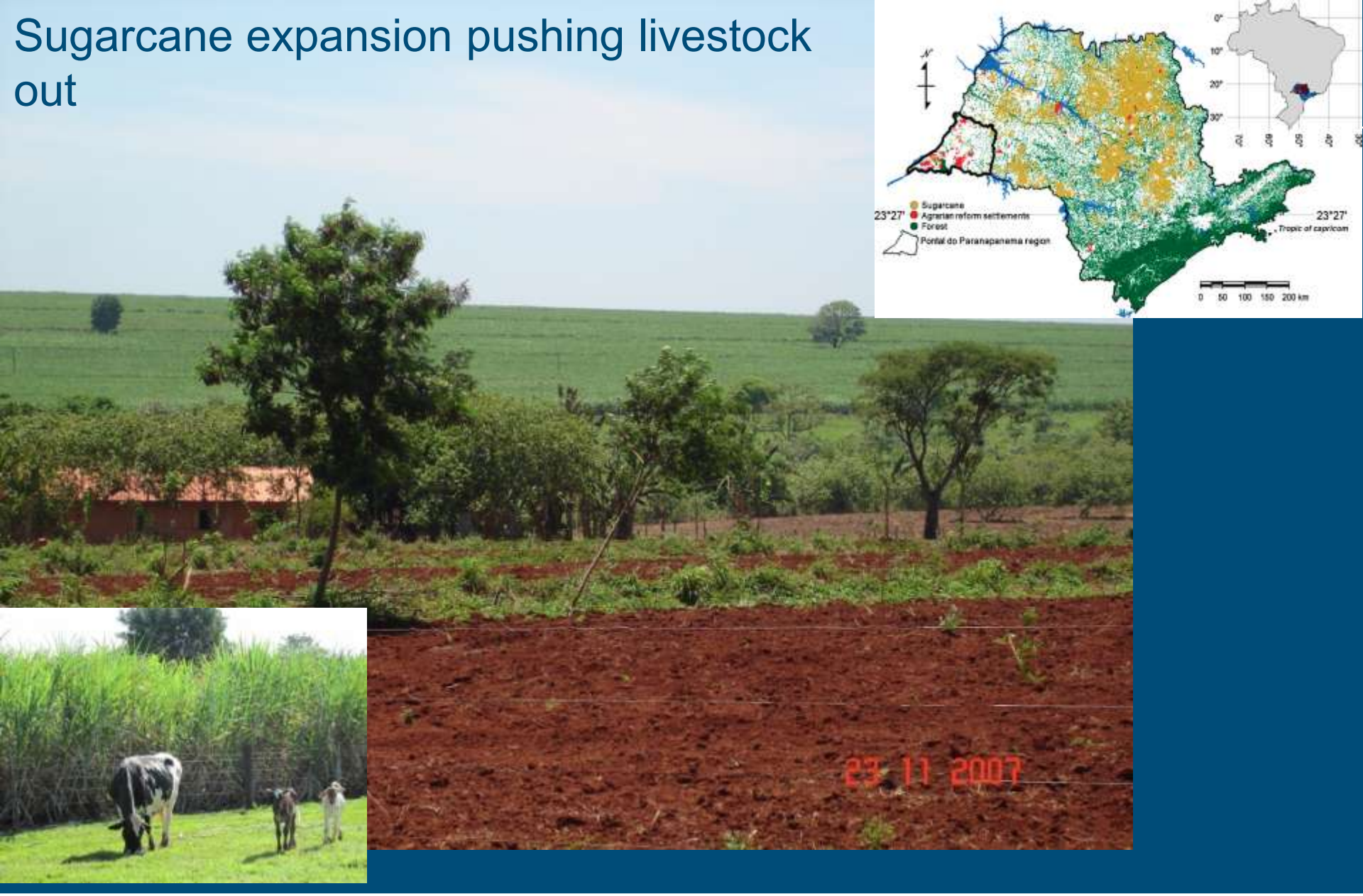
Sugarcane expansion pushing livestock out



Intensification of dairy = motor for devt













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Role of livestock in Africa

- Animal power for transport
- Animal power for plowing, weeding etc.
- Saving account
- Investment
- Buffer against problems (e.g. droughts)
- Beef
- Milk (near cities: in highlands: zero grazing based in napier in Kenya; milk production on crop residues and cottonseed in South Mali)

Soil fertility (patterns)

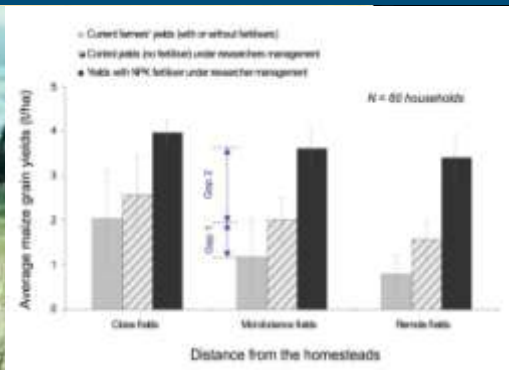
- Large heterogeneity of farms and of farmers fields
  - Access, sequence, profitability of technology
  - Infields over outfields; responsive soils
- Soil fertility management needs integrated approach
  - ISFM → varieties, fertilizer & organic amend. add up
- N fixing legume crops
  - Farmers go for direct profit not for soil fertility
  - Niches
- Soil fertility and technology should provide return on investments
  - Farmers make economically sound decisions → input/output efficiency and prices matter

Some additional conclusions

- Competition for land AND water is part of the dynamics→ water adds value to land
- Animal production can be part of the development pathway (occupy land in Brazil; DAP & risk mitigation in Africa)

- Instead of “bulk” that has low quality requirements but also low return to labor and low margins why not go for high return to labor: milk, vegetables or spices

Thank you for your attention



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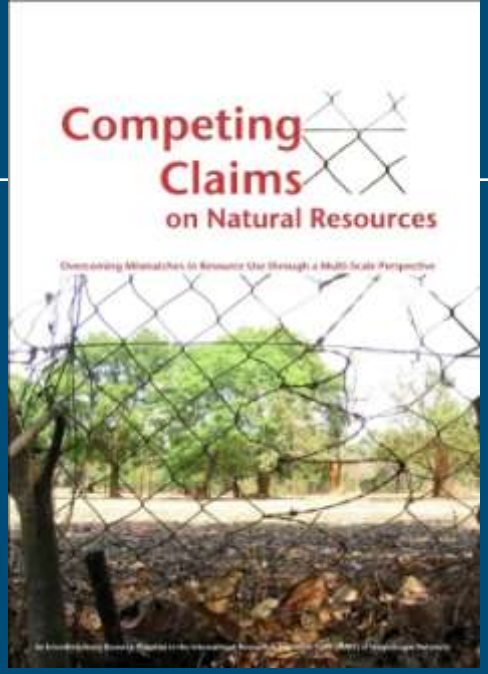
Programs



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Claims

Across Africa Across Africa Southern Africa

& Brazil

Information on these programs can be found on:

www.pps.wur.nl