Nutrient management challenges in Africa

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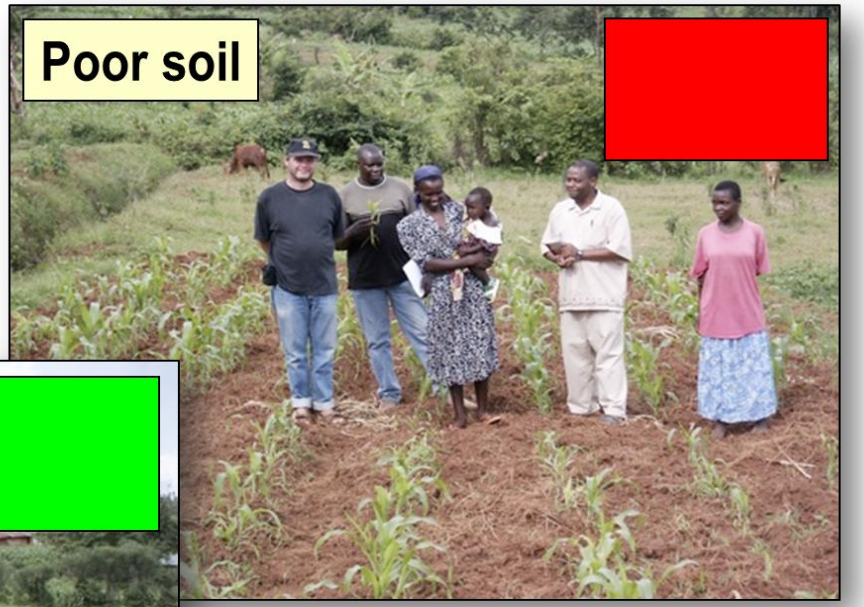
Variability in soil fertility

Same farm…
Same variety…
Same inputs…
Same management…
Same weather…

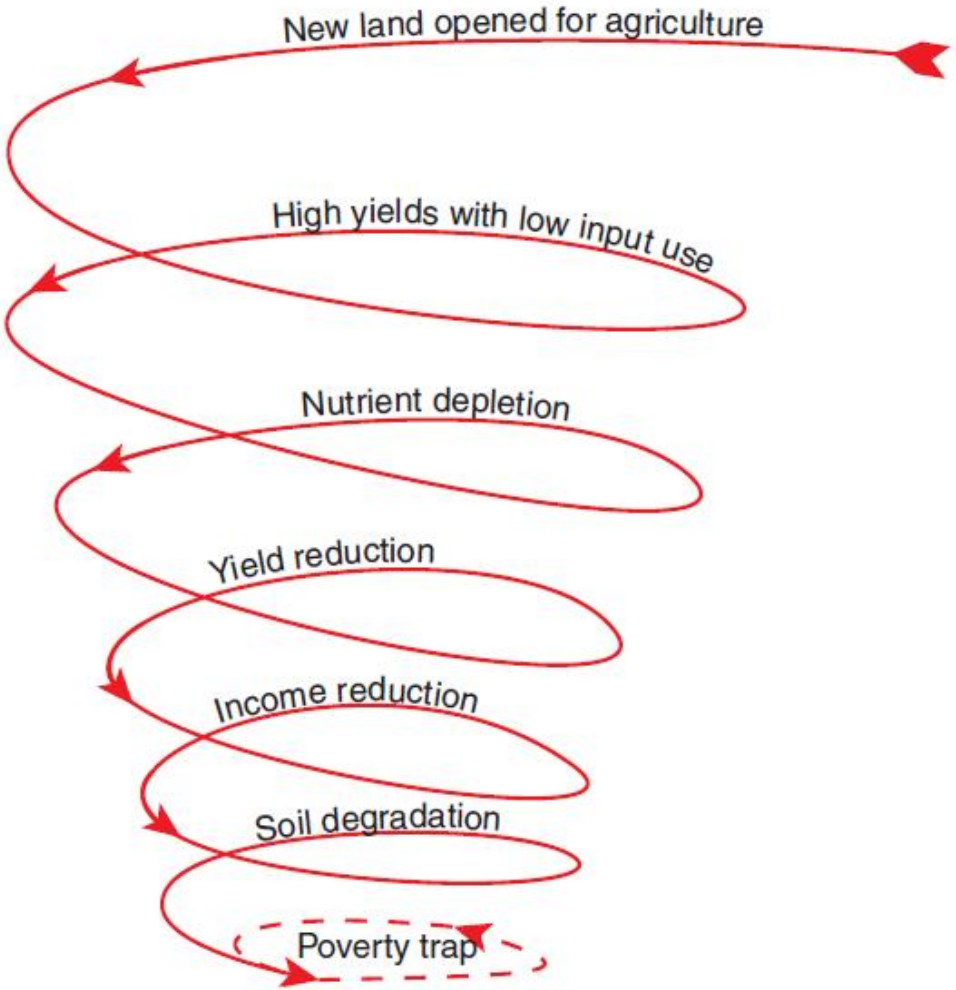


Impacts of poor land, water, and nutrient management on water bodies

Degraded area of selected African regions (IITA, 2012)

Region	Countries	Degraded area (%)	Key factors of degradation
Western humid lowlands	Ivory Coast, Ghana, Nigeria, Cameroon	58	-Soil erosion -Nutrient and organic matter depletion -Loss of nutrient to the environment
Central humid lowlands	Angola, DRC	40	
Southern humid lowlands	Madagascar	64	
East and Central highlands	Burundi, DRC, Ethiopia, Kenya, Rwanda, Uganda	49	
Western moist savannas	Benin, Ghana, Nigeria, Togo	90	
Southern moist savannas	Malawi, Mozamique, Tanzania, Zambia	43	

Soil mining (ASHC., 2012)



Nutrient loss in Africa due to land degradation (Stocking 1986, Stoorvogel et al., 1993, UNEP, 1994)

Nutrient	Loss (kg/ha/yr)
Nitrogen (N)	22
Phosphorus (P)	3
Potassium (K)	15

- Average for 38 countries in SSA
- Cost-equivalent of N & P loss in Zimbabwe: US$ 1.5 billion per year

Water erosion on agricultural lands

Same site (Upper East, Ghana)

Minimum cover

Control (Minimum ISFM intervention)

ISFM package

Water erosion: effect on water bodies

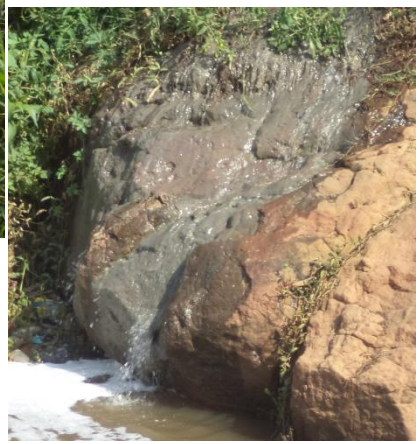
No buffer zone

Various Sections of Nairobi River

Inadequate drainage

Eutrophication

Waste of nutrients and organic matter in wastewater



Discharge of wastewater and litter in streams

Eutrophication

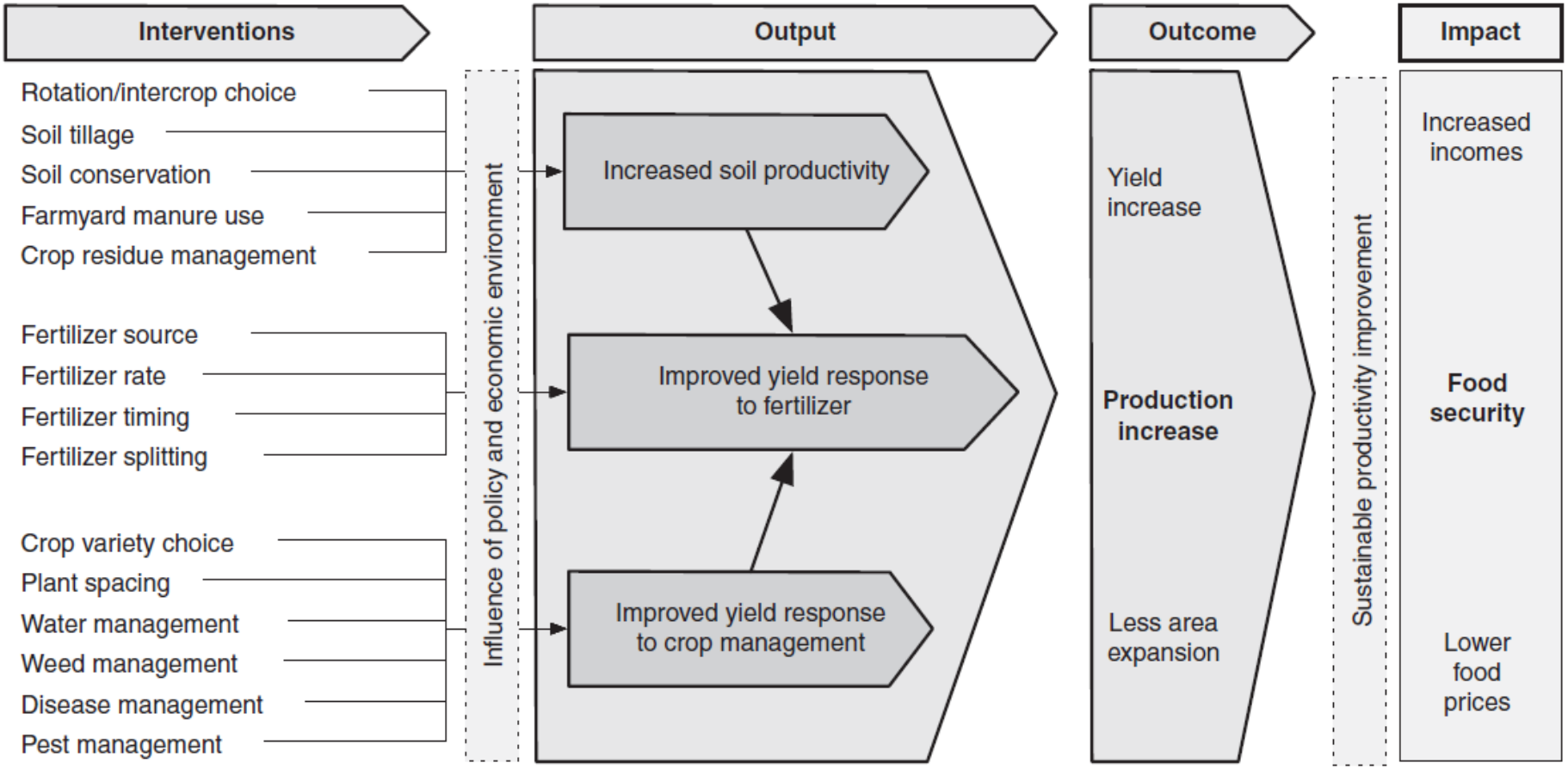
Eutrophication is an increasing problem in SSA (Nyenje et al. 2009)

Solutions to poor land, water, and nutrient management in agricultural area

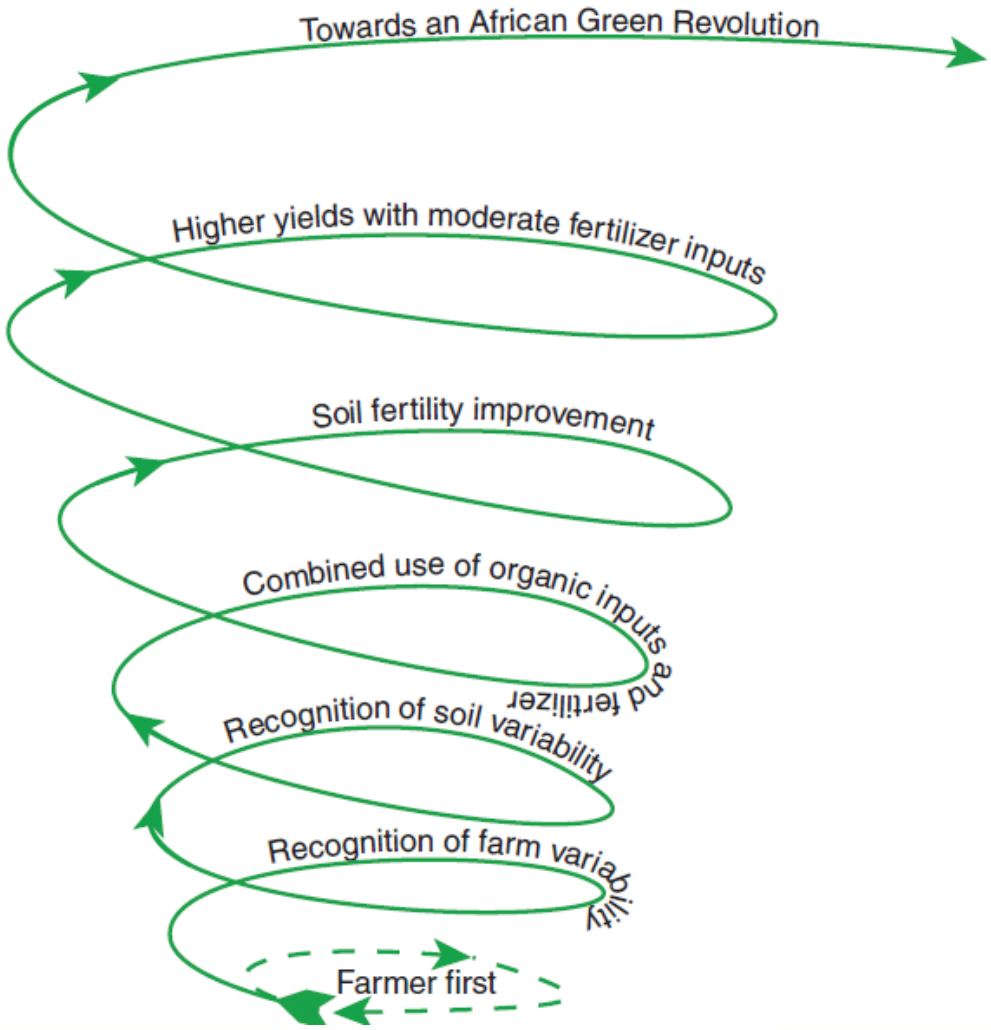
Integrated soil fertility management (ISFM)

'The application of soil fertility management practices, consideration of improved germplasm, and the knowledge to adapt these to local conditions, which maximize fertilizer and other agro-input use efficiency and crop productivity (Vanlauwe et al., 2011)

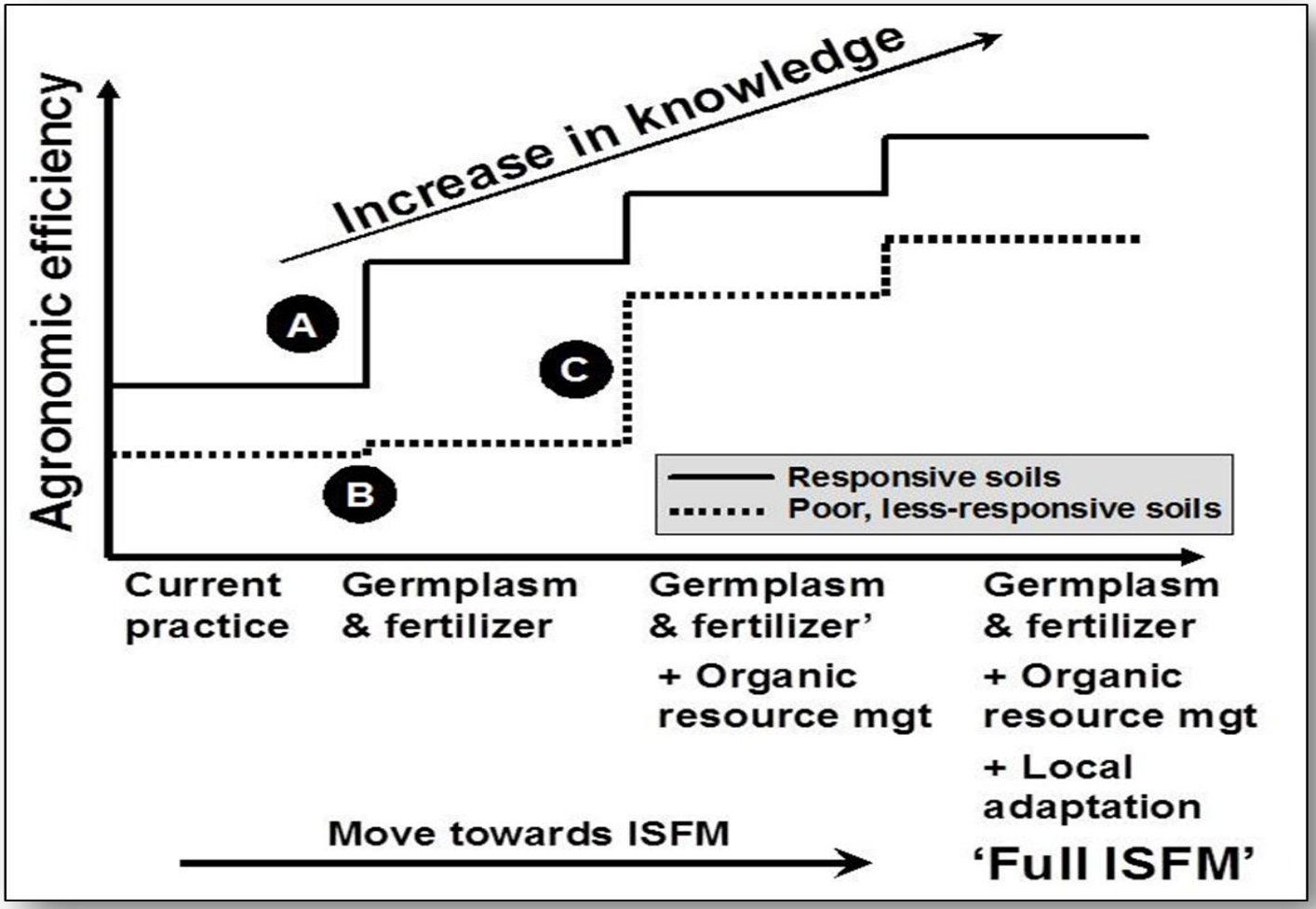
Solution: soil recapitalization (ASHC, 2012)



Soil recapitalization (ASHC, 2012) (con't)



Implementation of ISFM



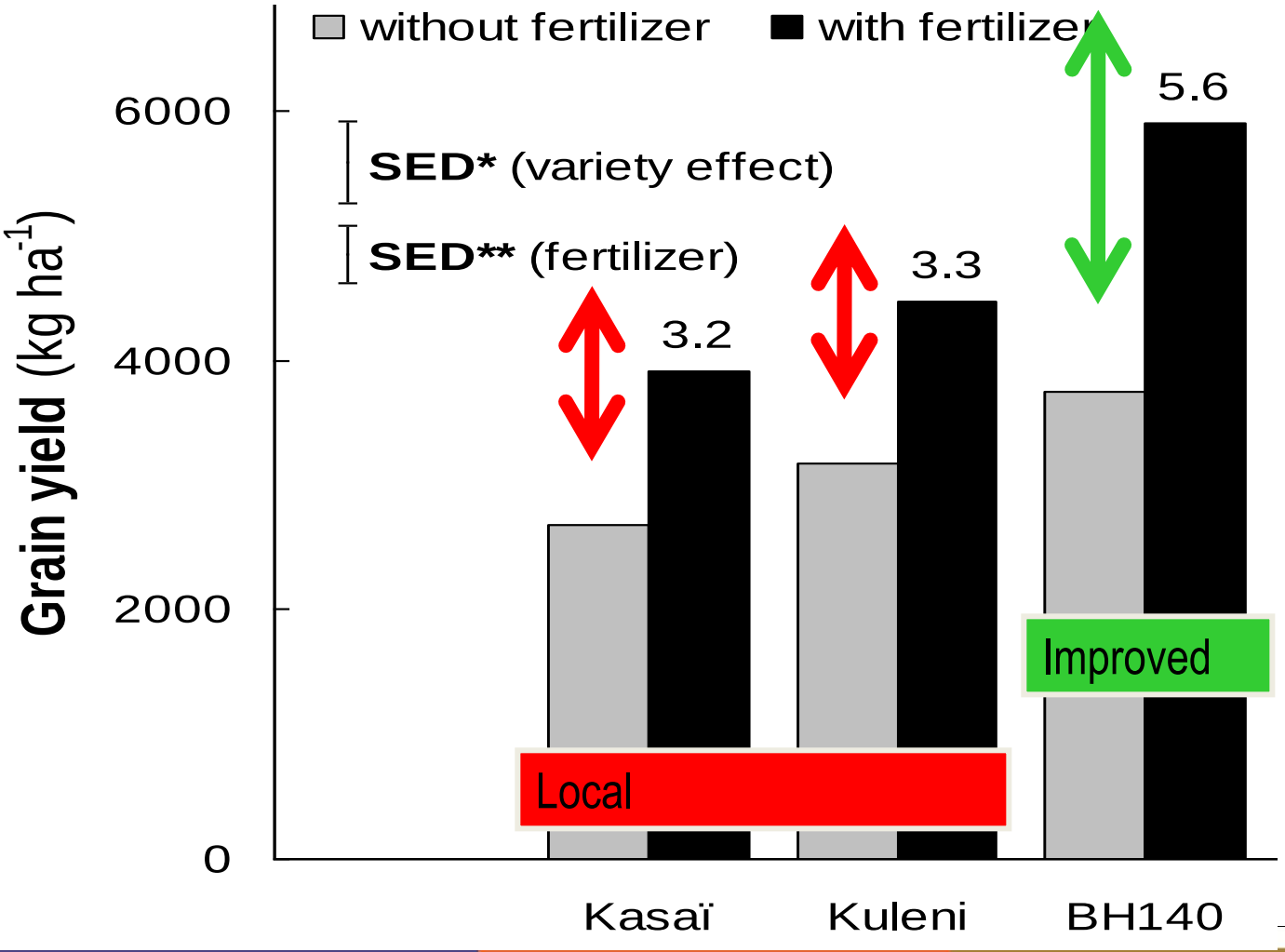
Key considerations to implement ISFM

(Verchot et al., 2007)

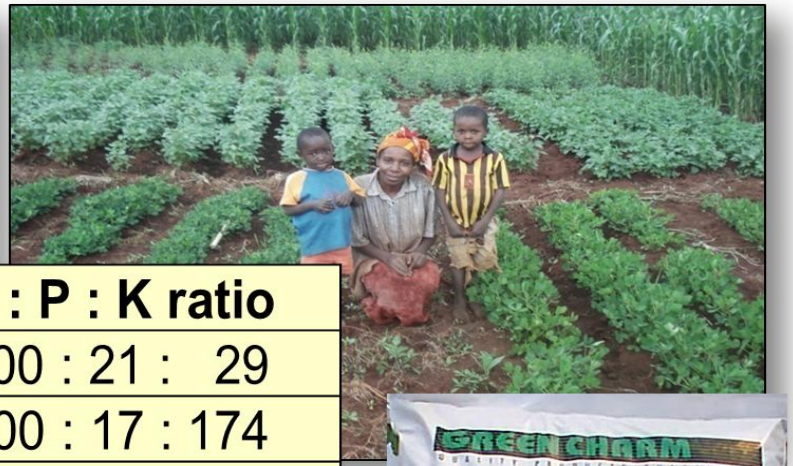
- Understanding of soil fertility problems and management options
- Empowering farmers to scale up research and results.
- Linking advances in ISFM into national soil fertility programs, development planning, and policies.
- Communication with policy makers on the importance of improved research capacity in soil fertility

ISFM assessment in soybean production (Gh)

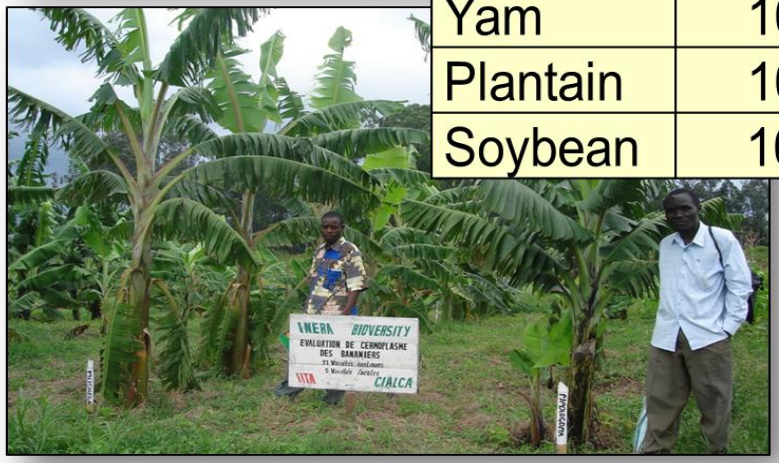
ISFM assessment in maize production (DRC)

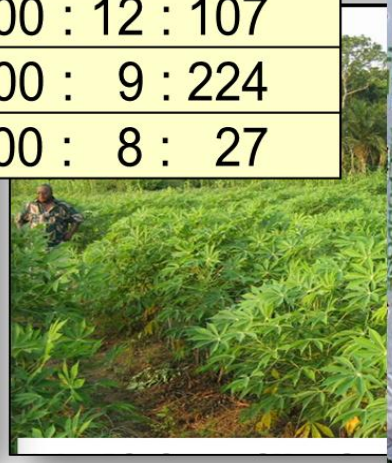


ISFM requires integrated knowledge

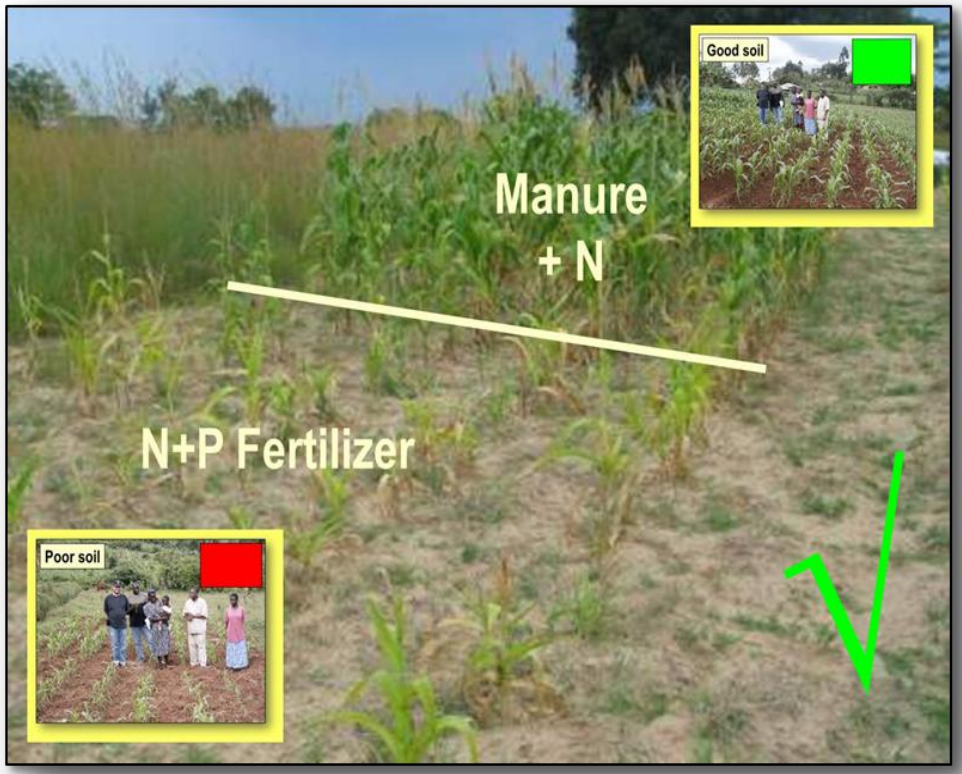


Crop	N : P : K ratio
Maize	100 : 21 : 29
Cassava	100 : 17 : 174
Yam	100 : 12 : 107
Plantain	100 : 9 : 224
Soybean	100 : 8 : 27





ISFM requires integrated knowledge (cont'd)



Nutrients and organic matter recovery from wastewater (Nikiema et al. 2013)

Pond system (Ghana)

Activated sludge system (Tunisia)

Nutrients and organic matter recovery from wastewater (Beecher. 2013)

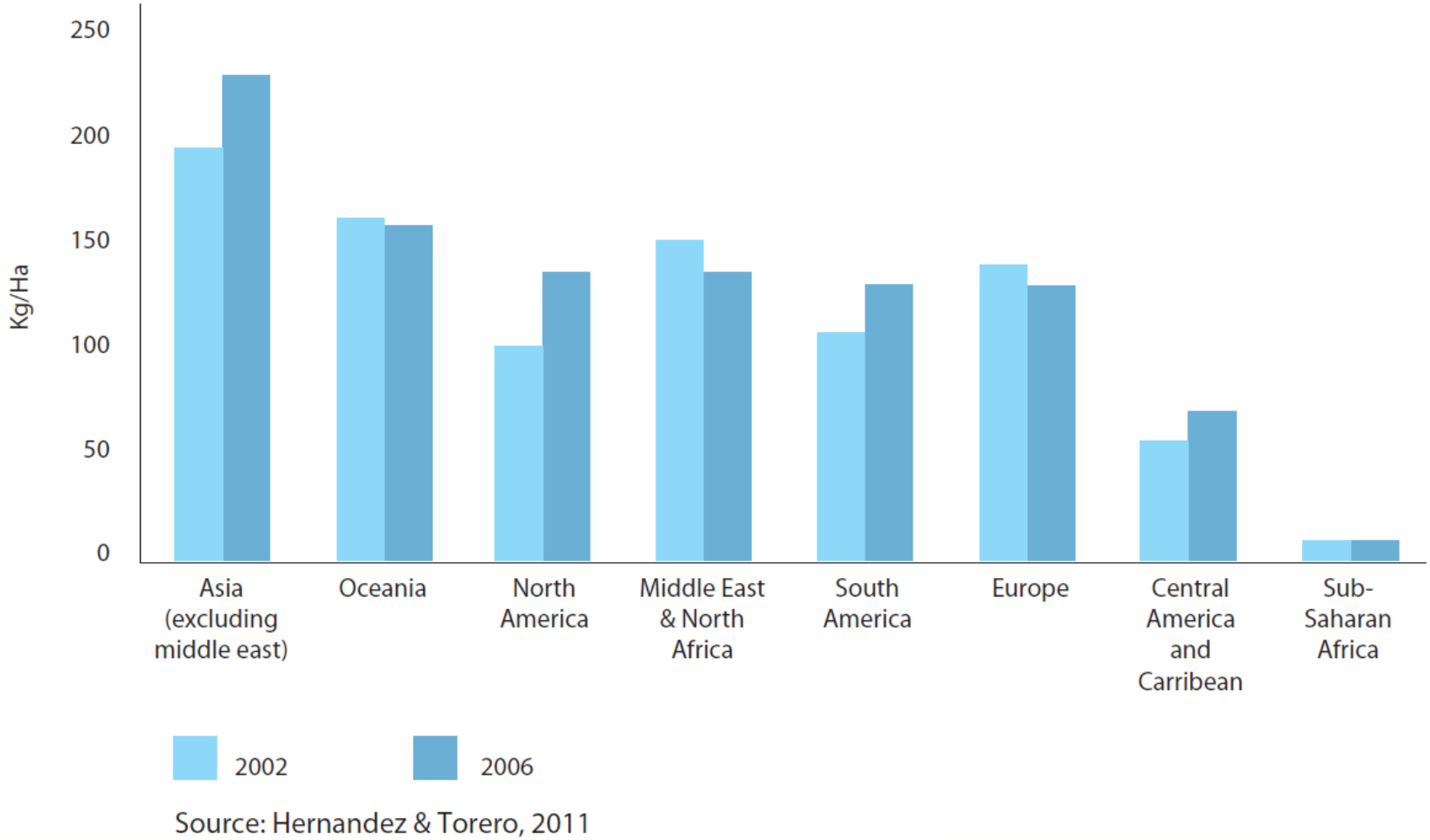
Biosolids

Without biosolids

With biosolids

Constraints to ISFM implementation and potential solutions

Fertilizer use in SSA (Dettoh et al., 2012)



Source: Hernandez & Torero, 2011

Reasons for never applying chemical fertilizer (n=43) (Minde et al., 2008)

Reason	% of farmers citing reason	Ranking
Fertilizer is too expensive/cannot afford it	90.7	1
Do not know enough about fertilizers	34.9	2
Fertilizer is not available locally	18.6	3
Fertilizer is too risky	9.3	4
User alternative organic fertilizers	7.0	5
Soil is fertile, don't need it	7.0	5

Fertilizer negative side-effects (Weight and Kelly, 1998)

- Inappropriate fertilizer use
  - Acidification (in the absence of liming)
  - Loss of SOM (in the absence of organic matter return)

Economic consideration (Weight and Kelly, 1998)

- Issue
  - Smallholder farmers: focus on immediate return to fertilizers
  - Poor agricultural credit systems in SSA
  - Minimum focus on environmental benefits
- Potential solutions
  - Reduced direct and indirect taxes on fertilizer imports
  - Reduced transport costs
  - Promotion of trade and introduction of new cash crops
  - Efficient fertilizer use

Technical consideration (Weight and Kelly, 1998)

- Fertilizer use-efficiency
  - Fine-turn recommendation
  - Strengthen the capacity of the extension systems
  - Taking advantage of farmer knowledge to understand the history of their land's soil fertility
  - Economic optimum fertilizer rates

Case of phosphorus (Kisinyo et al., 2011)

- Issues
  - Fixation
  - Inherently low P
- Potential solutions
  - Direct use of rock phosphates
  - Organic material with significant level of P
  - Al tolerant and P use-efficient crop varieties
  - Liming
  - Education of farmers and extension agents

Conclusion: Policy Options

- Development, implementation and enforcement of policies intended to:
  - Minimize land degradation due to erosion and/or organic matter depletion
  - Promote ISFM interventions to prevent nutrient depletion
  - Promote the 5 R to minimize negative impacts of fertilizers and supplements to the environment [i.e. right (i) source, (ii) placement, (iii) dose, (iv) timing, and (v) field management]
  - Make ISFM interventions affordable and profitable to resource-disadvantaged smallholder farmers in Africa
  - Promote wastewater treatment in urban areas to prevent discharge of excessive nutrients and organic matter in water bodies

THANK YOU