Toward a Rice Green Revolution in Africa

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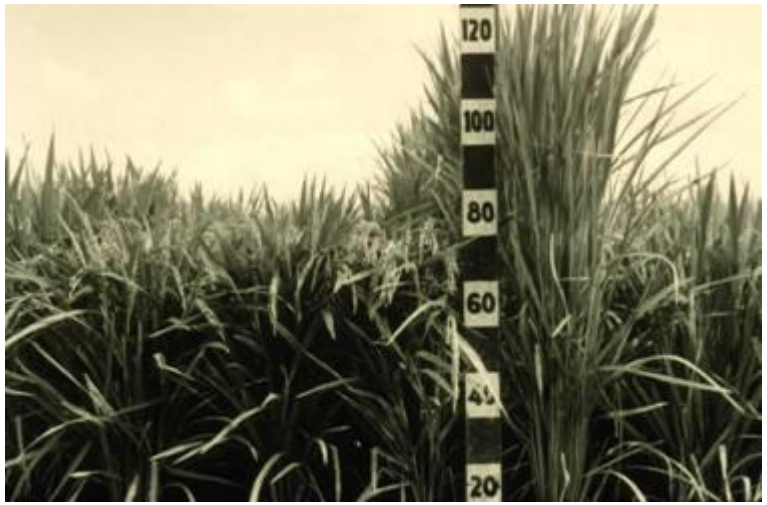
Major Purposes

1. Examine to what extent a rice Green Revolution has taken place in irrigated areas of sub-Saharan Africa (SSA)
2. Inquire whether it is possible to realize a Green Revolution in rainfed areas of SSA
3. Explore to what extent technology and management training programs are effective in disseminating rice Green Revolution technology
4. Propose strategy to realize a rice Green Revolution in SSA

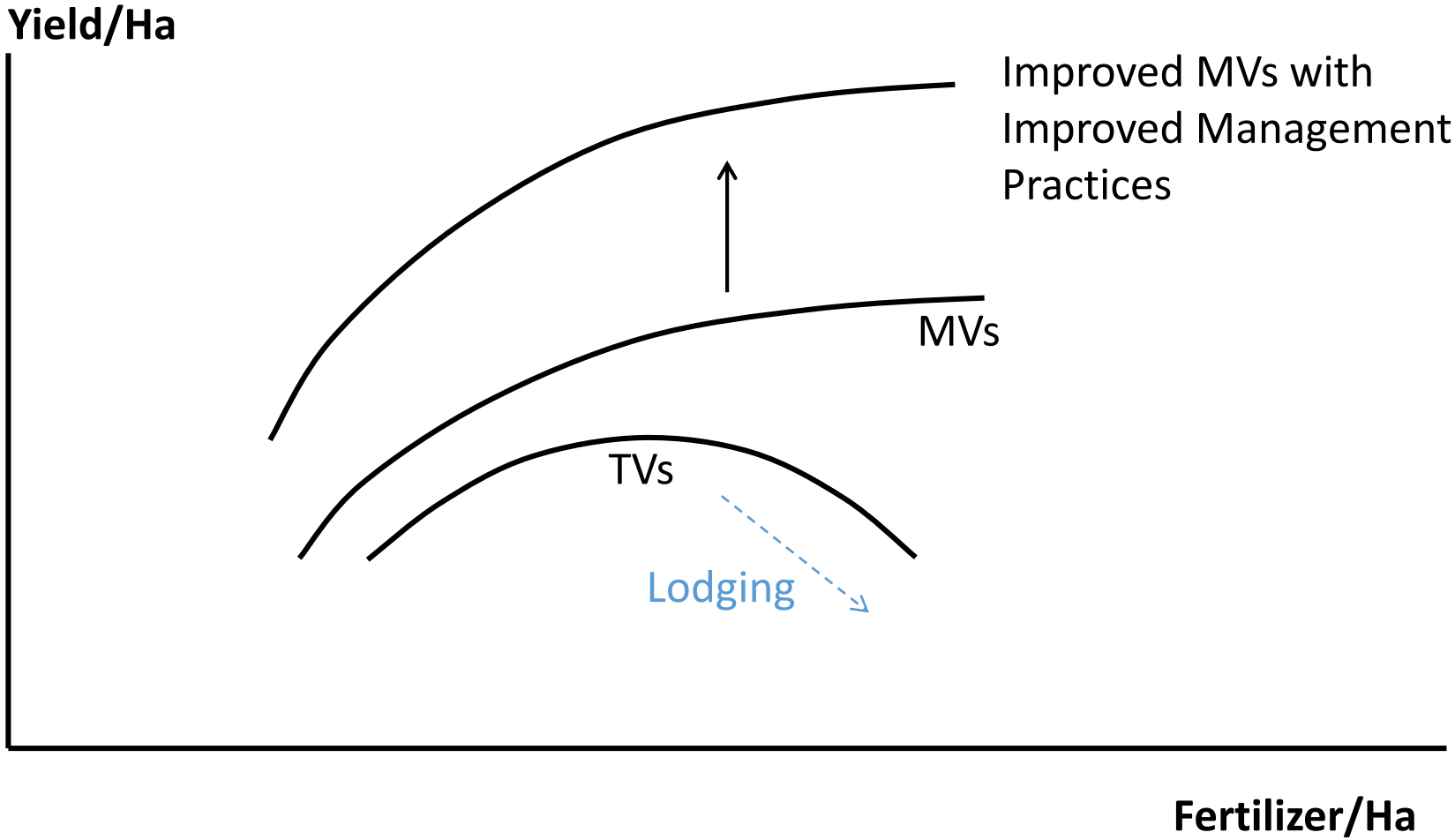
What is the Green Revolution in Asia?

- Development and diffusion of a series of semi-dwarf, fertilizer-responsive, high-yielding modern varieties (MVs) in irrigated and favorable rainfed areas.
- Early MVs are susceptible to pests and diseases, whereas improved MVs are more resistant to pest and diseases as well as drought and submergence.
- Asian Green Revolution is alternatively called "seed-fertilizer revolution."
- Rice production tripled, yield per hectare more than doubled, and double cropping increased appreciably as MVs are photo-period insensitive and short-growth duration, from the end of the 1960s in Asia.

Comparison of IR8, the original shorter modern rice variety, with Peta, a traditional tall variety and one IR8's parent (1st two photos); lodging (bottom photo)



Yield Curves of Traditional Varieties (TVs) and Modern Varieties (MVs) with and without Improved Management Practices



Why is rice so important in SSA?

- Consumption has been rising faster than production. As a result, import of rice from Asia increased accounting for more than 1/3 of consumption. SSA is self-sufficient in foods except for rice and wheat.
- Rice is the most promising crop in raising productivity on small farms in SSA because of the high transferability of Asian rice technologies.
- Production environments are more favorable in SSA than in Asia:

  Irrigated areas: Fertile soil, full of sunshine, dry climate free of pests and diseases

  Rainfed areas in valley bottom: Fertile and moist soil
- CARD seems very promising.

Imported rice accounts for one-third of rice consumption in SSA

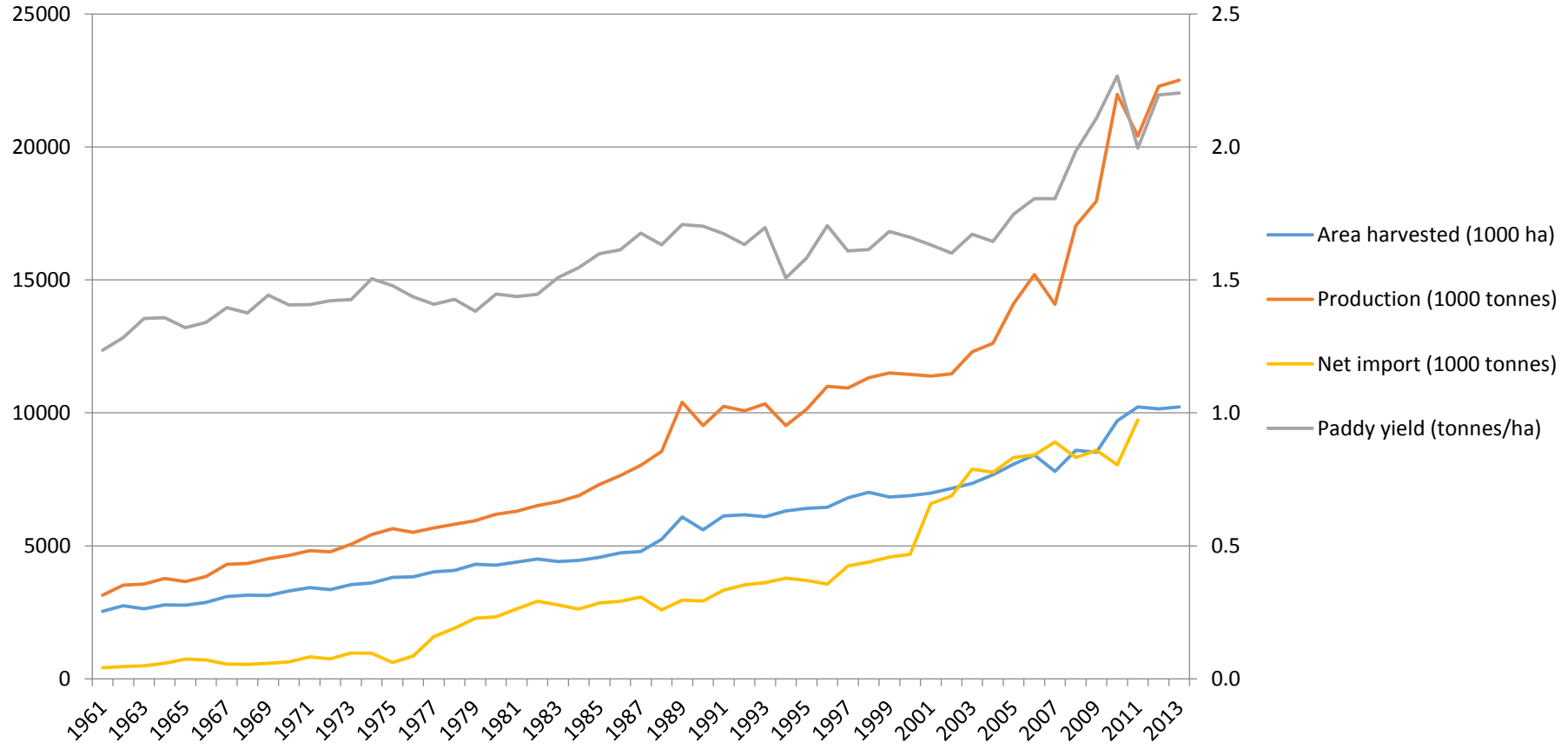


Figure 9.1 Changes in harvested areas of major cereals in SSA (million hectares)

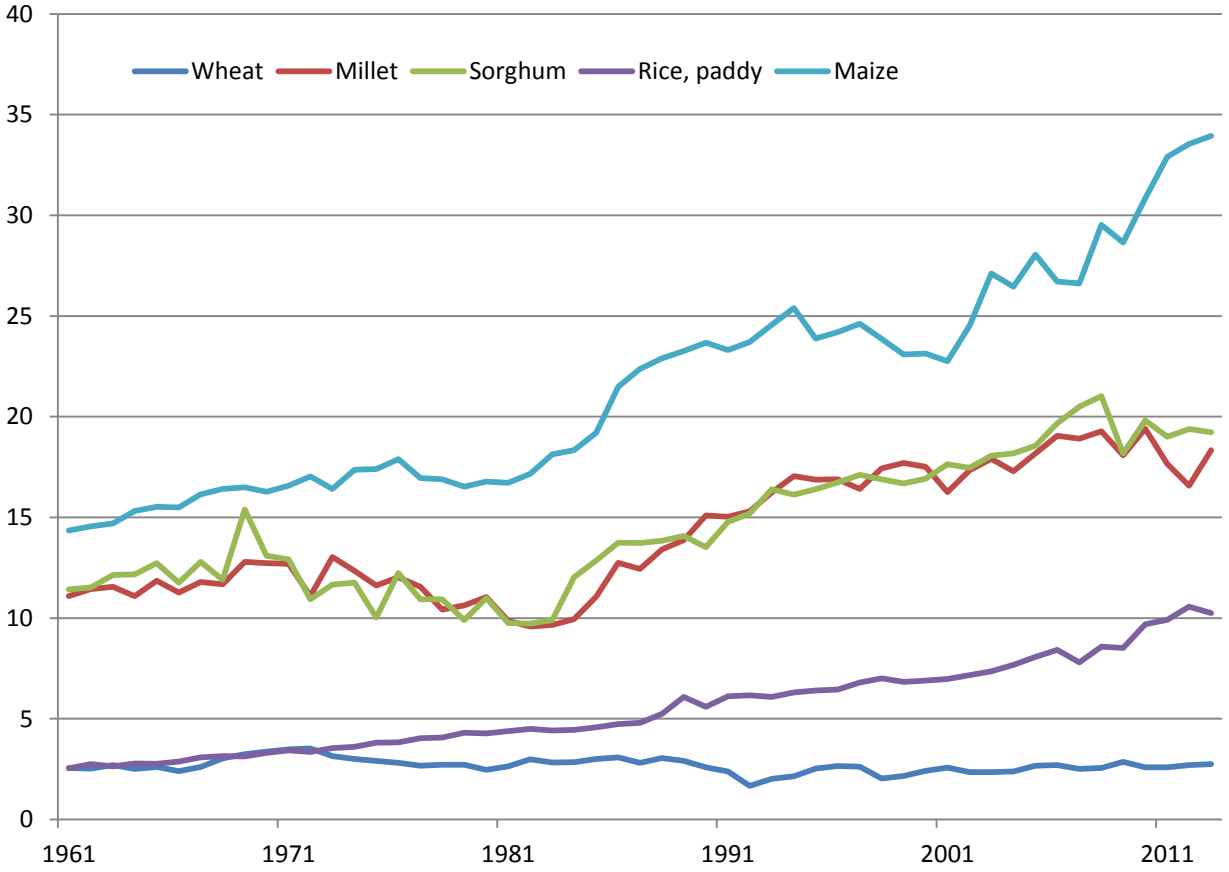


Figure 9.2(a) Changes in Rice Yield in Tropical Asia and SSA

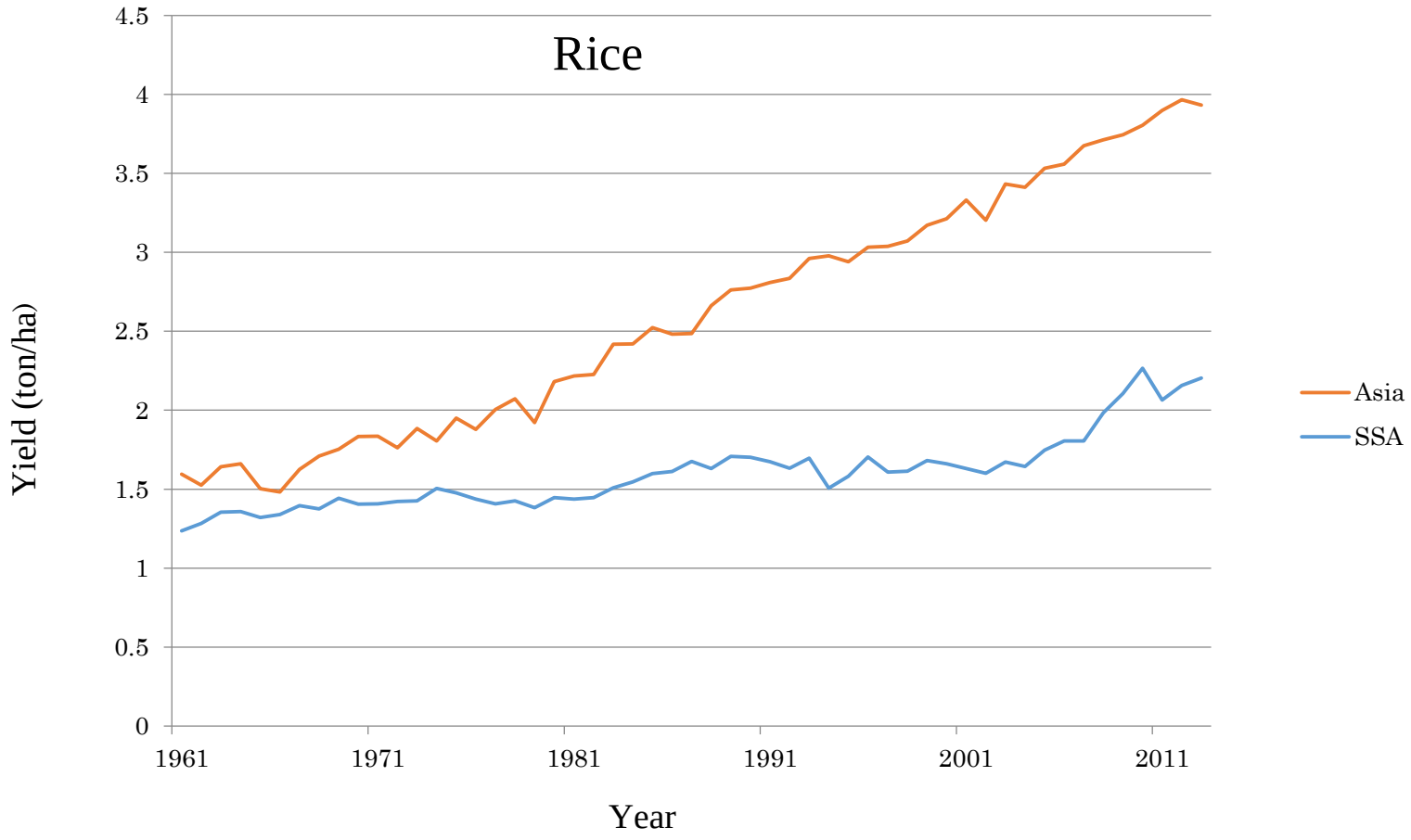


Figure 9.2 (b) Changes in Maize Yield in Tropical Asia and SSA

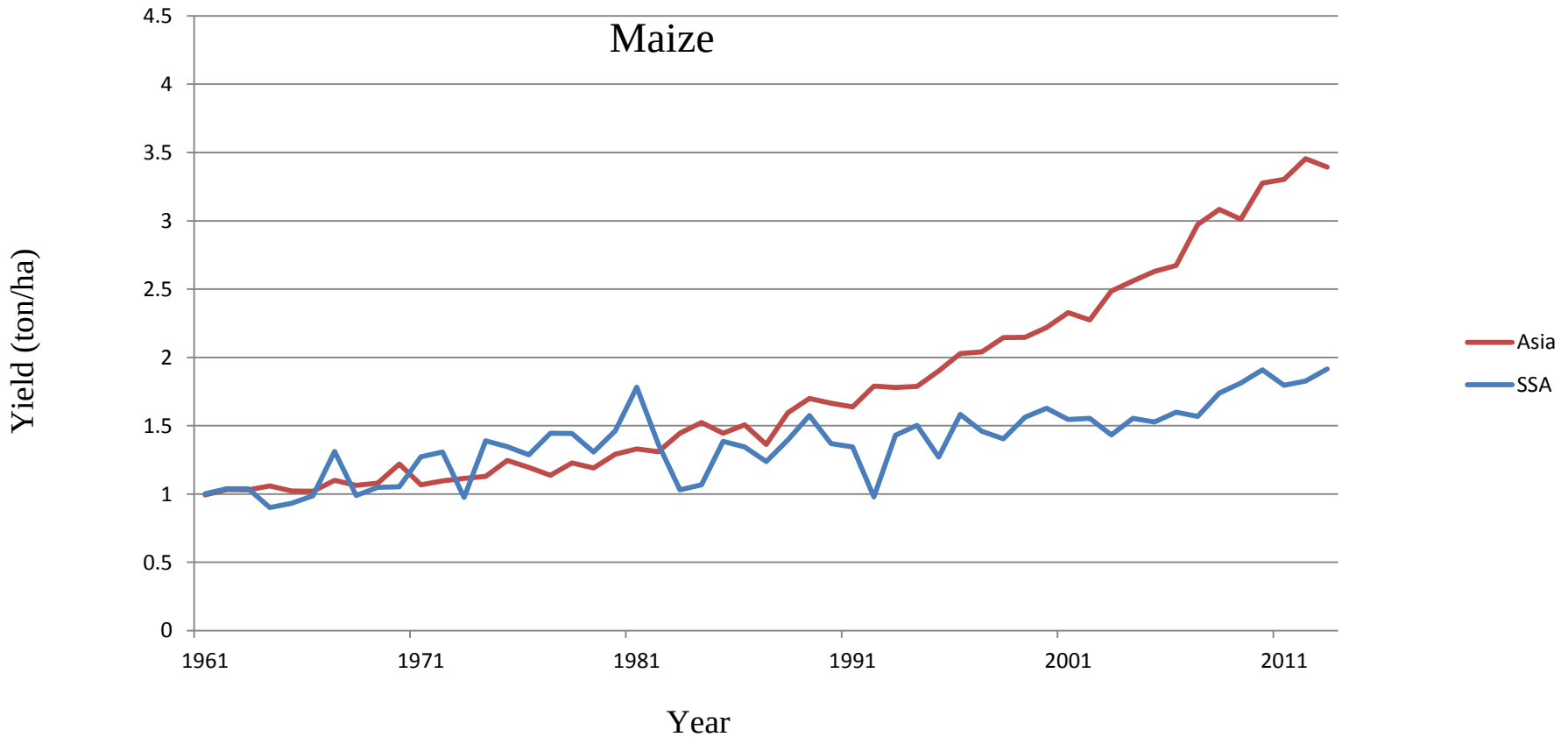


Figure 9.2 (c) Changes in Sorghum Yield in Tropical Asia and SSA

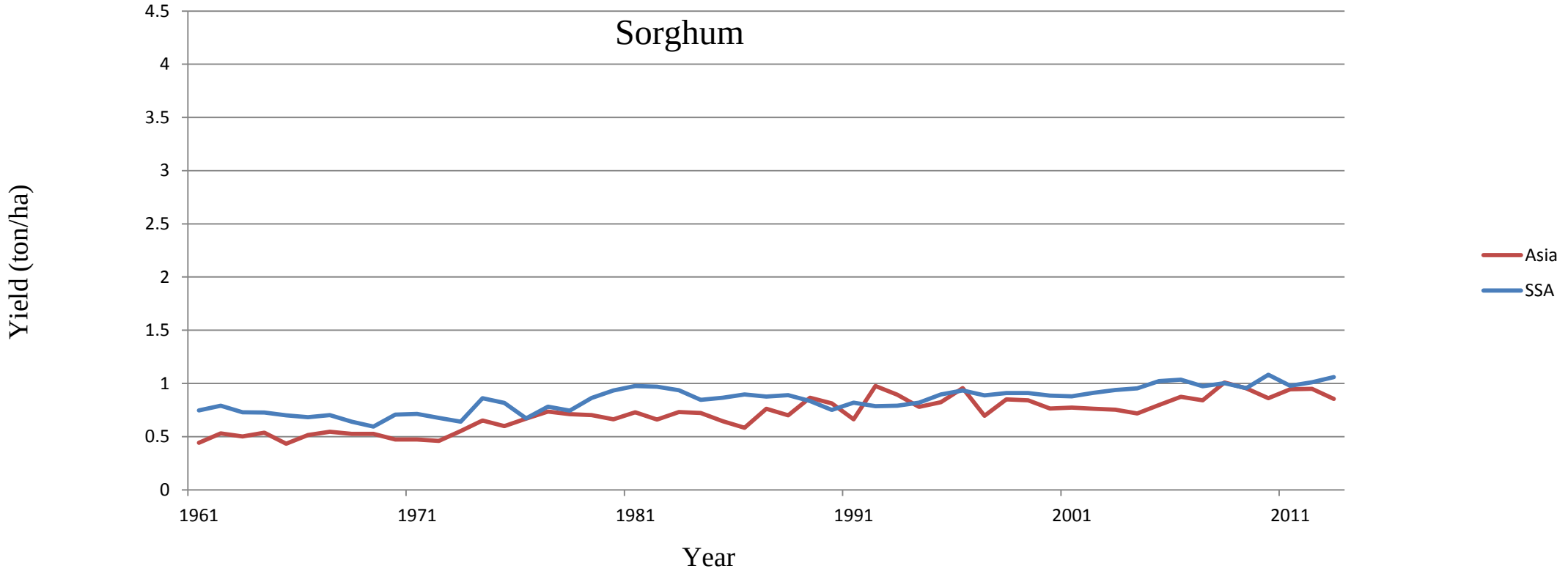
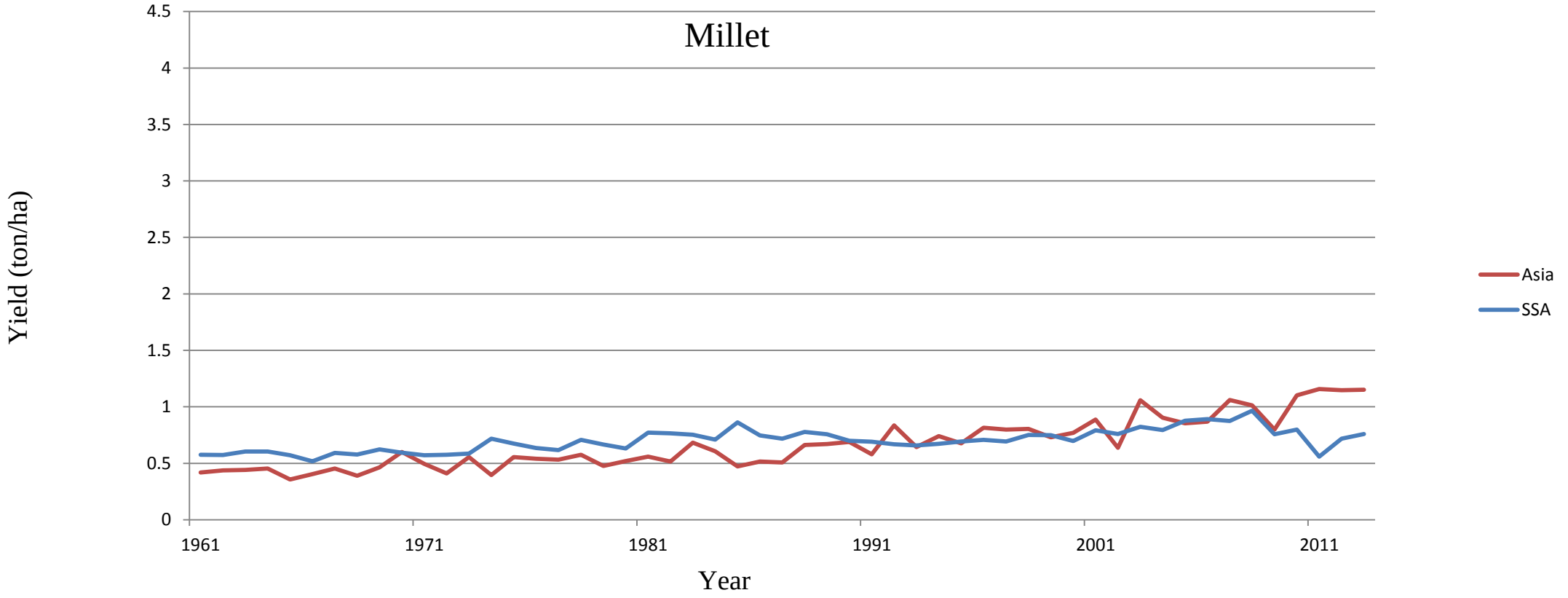


Figure 9.2 (d) Changes in Millet Yield in Tropical Asia and SSA



Often asked question: Why hasn't rice Green Revolution taken place in SSA?

Hypothesis 1: Owing to high transferability of Asian rice technology, rice Green Revolution has already taken place in many irrigated areas as well as some rainfed areas where rice production management training has been offered.

Hypothesis 2: Green Revolution did not take place in a large scale due to the failure to transfer Asian technology to rainfed areas, which account for 85% of rice cultivation area in SSA.

Hypothesis 3: Not only improved seeds and fertilizer but also improved management practices (e.g., bunding, leveling, straight-row planting, proper timing of transplanting, …) are critically important for productivity growth.

“Asian” Rice Green Revolution in the Senegal River Valley

The importance of bund
No bund→ lack of water → a lot of weeds

The importance of leveling and straight-row planting to avoid uneven growth and to facilitate weeding

Table 9.1 Comparsion of paddy yield per hectare (ton/ha) between irrigated and rainfed areas across study sites, *In Pursuit of a Green Revolution in Sub-Saharan Africa*, K. Otsuka and D. Larson (eds.), 2016

It is clear that irrigation is decisively important.

Country	Irigated area	Rainfed area
Mozambique (Table 2.2)	2.0 (2007) 1.6 (2011)	1.0 (2008) 0.8 (2011)
Tanzania (Table 3.1)	3.7 (2009)	1.8 (2009)
Uganda (Table 4.3)	n.a.[b]	2.5 (2009) 2.3 (2011)
Ghana (Table 5.4)	n.a.[b]	2.0
Senegal (Table 6.9)	4.5 (2011)	n.a.[b]

Figure 9.3 Relationship between paddy yield and fertilizer use per hectare in selected irrigated areas in Asia and SSA

There does not seem to be appreciable difference in production function between irrigated areas in Asia and SSA.

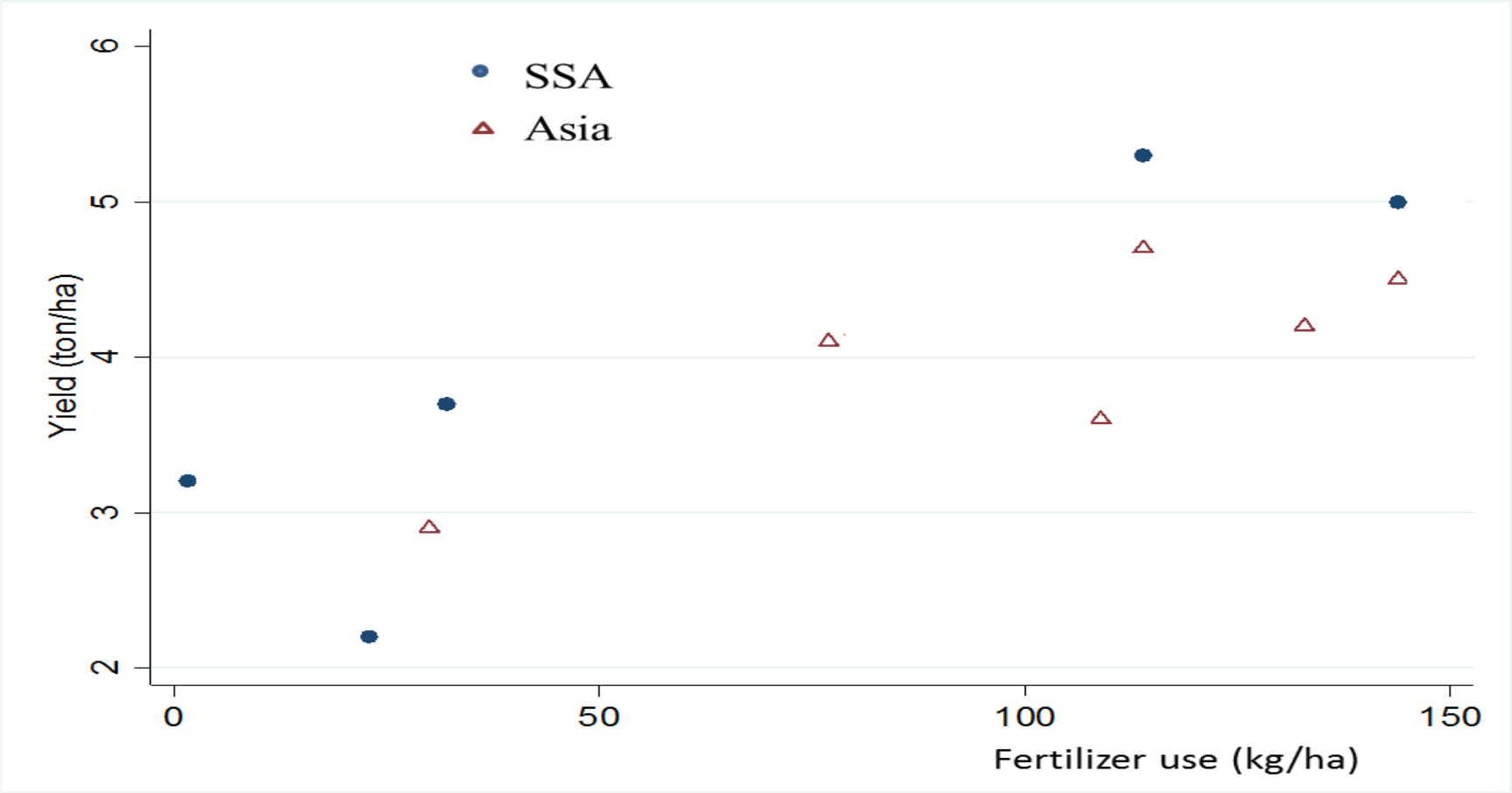


Table 9.2 Paddy yield (ton/ha) and adoption of improved technology and management practices in rainfed areas in Uganda and Ghana

Yield increases with increased adoption of improved technology and management practices (MVs, fertilzier, bunding, leveling, straight-row planting, etc.) even in rainfed areas.

	Uganda[a]		Ghana[b]
	Training villages	Non-training villages	
All improved practices	3.7	0.8	2.6
Almost all improved practices	3.0	1.5	2.3
One improved practice only	2.1	1.6	1.7
No improved practices	0.8	1.0	1.5

Table 9.3 Changes and differences in paddy yield (ton/ha) over time by training status in irrigated area in Tanzania: Key farmers, intermediary farmers, and ordinary farmers

	2008	2009	2010	2011	2012
Key farmers	3.1	4.4	4.8	5.3	4.7
Intermediary farmers	2.5	2.6	2.8	4.6	3.9
Ordinary farmers	2.6	2.7	2.5	3.6	3.7

It seems very clear that rice production training has significant impacts on rice yields in both irrigated and rainfed areas.

Table 9.4 Income and profit per hectare of rice cultivation (USD/ha) by status of irrigation, management training participation, and technology adoption

	Income per ha	Labor cost per ha	Profit per ha
Tanzania[c]:			
Irrigated area	1,011	421	590
Rainfed area	453	300	153
Uganda (rainfed)[d]:			
Training participants	1,327	n.a.	n.a.
Non-participants	905	n.a.	n.a.
Ghana (rainfed)[e]:			
Full adoptors	374	114	260
Non-adoptors	228	169	59

Impacts of "Modified" System of Rice Intensification (MSRI) in Kilombero Valley in Tanzania

	MSRI Training Villages			Non-Training Villages
	Trainees		Non-Trainees	
	MSRI Plots	Non-MSRI Plots		
Yield in 2013 (t/ha)	5.1	2.8	2.6	2.9
Yield before training in 2009-10 (t/kg)	2.7	2.6	2.3	2.3
% MVs in 2013	97	9	6	2
Chemical fertilizer use (kg/ha)	92	11	3	3
% Straight-row planting	90	1	2	4
% 25cm x 25 cm spacing	59	1	2	2

Concluding remarks

1. Suprisingly high lowland rice yields are achieved in many areas in SSA by adopting Asin-type technology and production practices, e.g., Senegal River Valley (4.5 tons/ha), Mwea Irrigation Scheme in Kenya (5 tons/ha), and rainfed areas in Kilombero Valley in Tanzania (5 tons/ha). In other words, rice Green Revolution has been taking place in a number of areas in SSA.
2. The main conclusion of our study is that Green Revolution technology is not only "seed and fertilizer intensive" but also "management intenisve."
3. The seond conclusion is that improved management practices for rice production can be introduced and disseiminated to SSA by the management training programs. Thus, rice Green Revolution is possible if sufficient resources are allocated to capacity building for effective extension systems.

Thank you very much for your attention