

# Towards Rice Green Revolution in sub-Saharan Africa

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October 2, 2018

# What must be done next?

- We should be proud of (almost) achieving the CARD's goal of doubling rice production in sub-Saharan Africa (SSA) from 2008 to 2018.

Doubling rice production = 50% increase in harvested area x 30% increase in yield per hectare =  $1.5 \times 1.3 \approx 2.0$

- New goal of CARD is to achieve another doubling of rice production from 2018 to 2030.

Doubling rice production = 30% increase in harvested area x 50% increase in yield per hectare =  $1.3 \times 1.5 \approx 2.0$

- 50% increase in yield means change from 2.2 tons/ha to 3.3 tons per hectare. The question is if it is possible to achieve yield of 3.3 tons per hectare.

- **We need African Rice Green Revolution comparable to Asian Rice Green Revolution.**

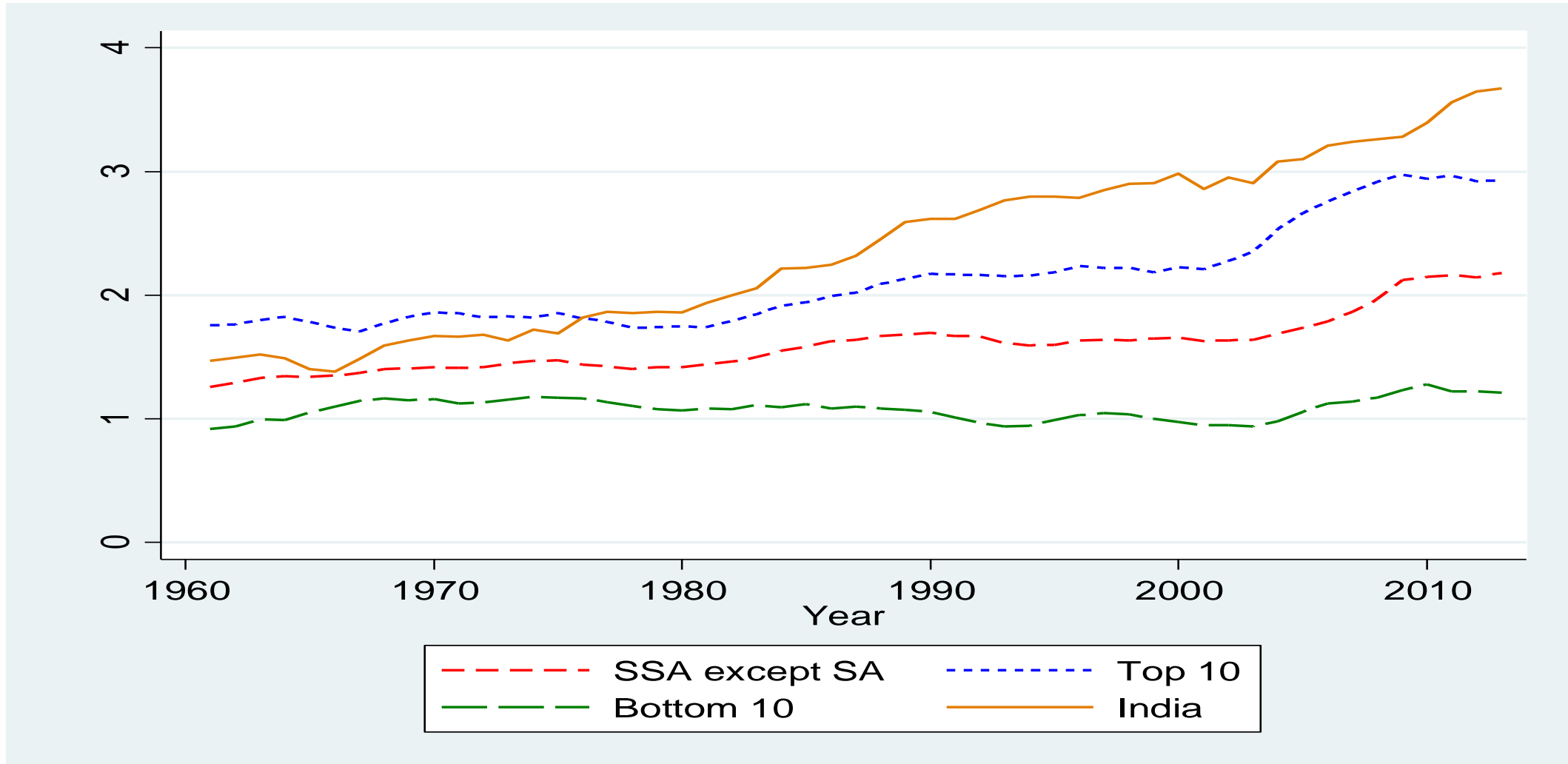
# What is the Asian Green Revolution?

- Development and diffusion of a series of semi-dwarf, fertilizer-responsive, high-yielding modern varieties (MVs) in irrigated and favorable rainfed areas.
- Asian Green Revolution is alternatively called “seed-fertilizer revolution,” which is very misleading. Asian Green Revolution technology is management intensive.
- 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 to the 1990s in tropical Asia.

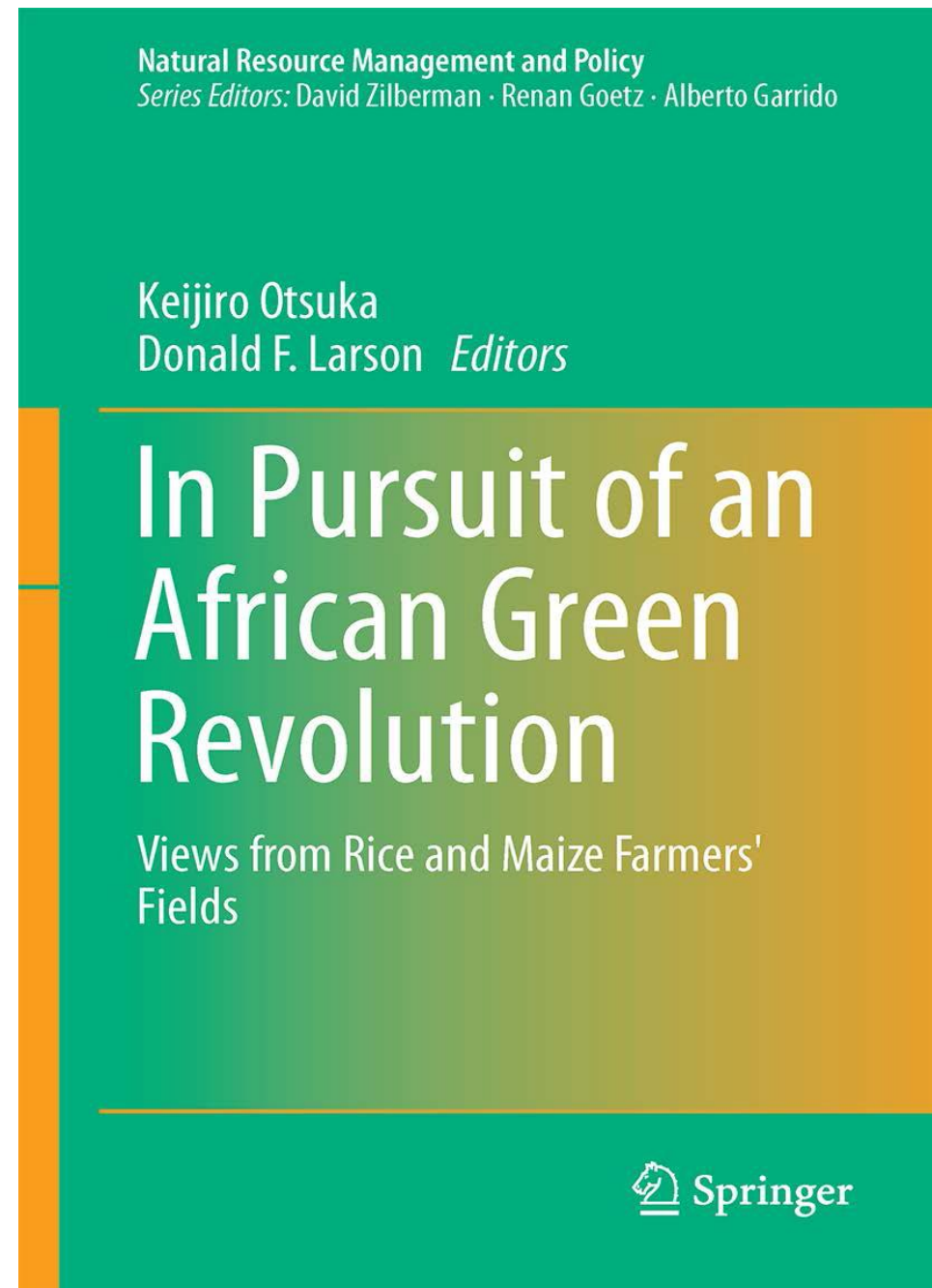
# Is Rice Green Revolution Possible in SSA?

1. Our research team has been conducting detailed case studies in Mozambique, Tanzania, Kenya, Uganda, Ghana, Cote d'Ivoire, and Senegal.
2. We found extremely high yield per hectare of more than 5 tons per hectare in Tanzania, Kenya, and Senegal, which is higher than average yield of 4.2 tons per hectare in tropical Asia.
3. In other words, Rice Green Revolution has already taken place in advanced areas in SSA (see next page).
4. Good news is that improved rice production technology is highly transferable from tropical Asia to SSA.

# Average rice yield has been increasing in SSA and yield of top 10 countries is similar to India



**We have shown  
evidence for  
importance of  
rice production  
management  
training in our  
2016 book**



## 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, fertilizer, bunding, leveling, straight-row planting, etc.) even in rainfed areas.

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

# Impacts of “Modified” System of Rice Intensification (MSRI) in Rainfed Areas in Kilombero Valley, 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
MV adoption 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



# We now have new evidence that impact of training is not only **sustainable** but also **spreading!**

- Impact of TANRICE training in irrigated areas in Tanzania:  
Key farmers were intensively trained for 12 days in 2009, and they were supposed to train 5 intermediary farmers who also took training for 3 days. Ordinary farmers were assumed to learn from both key and intermediary farmers.
- JICA training in rainfed areas in Uganda in 2009/10: It has not only lasting impact but also impact on non-participants of training.
- JICA training in irrigated areas in Cote d'Ivoire: Training participants in 2016 gained but non-participants caught up with participants in 2017.

# Impact of training in 2009 is sustainable and pervasive in Tanzania

	2008	2010	2012
<b>Yield (ton/ha)</b>			
Key farmers	3.1	4.8	4.7
Intermediary farmers	2.5	2.8	3.9
Ordinary farmers	2.6	2.5	3.7
<b>MV adoption (%)</b>			
Key farmers	46	66	67
Intermediary farmers	30	41	50
Ordinary farmers	27	26	33
<b>Fertilizer Use (kg/ha)</b>			
Key farmers	63	138	131
Intermediary farmers	22	79	95
Ordinary farmers	47	70	83
<b>Leveled plots (%)</b>			
Key farmers	46	81	77
Intermediary farmers	44	74	63
Ordinary farmers	55	69	67
<b>Straight-row transplanting (%)</b>			
Key farmers	23	94	92
Intermediary farmers	13	65	58
Ordinary farmers	11	26	37

# Impact of training in 2009/10 is long-lasting and spreading in rainfed areas in Uganda

	2008/09	2011/12	2015/16
<b>Yield (ton/ha)</b>			
Training participants	1.2	1.9	2.1
Non-participants in project village	1.4	1.6	2.0
Non-project villages	1.6	1.8	1.9
<b>Chemical fertilizer use (%)</b>			
Training participants	0.0	15.4	22.2
Non-participants in project village	3.0	8.5	28.3
Non-project villages	0.9	1.7	16.7
<b>Transplanting (%)</b>			
Training participants	66.7	79.5	91.7
Non-participants in project village	63.7	66.1	77.4
Non-project villages	51.7	47.2	54.6
<b>Bund construction (%)</b>			
Training participants	51.1	89.7	88.9
Non-participants in project village	60.9	67.8	62.3
Non-project villages	48.3	68.0	54.6

Training participants and non-participants were requested not to communicate in project year of 2016 but encouraged to communicate in 2017 in Cote d'Ivoire

	2015	2016	2017
<b>Yield (ton/ha):</b>			
Participants	3.4	4.0	3.4
Non-participants	3.9	3.7	3.7
<b>Fertilizer use (Kg/ha):</b>			
Participants	214	248	233
Non-participants	254	261	255
<b>Leveled plots (%):</b>			
Participants	77	86	87
Non-participants	79	68	81
<b>Straight-row transplanting (%):</b>			
Participants	5.4	37.8	34.9
Non-participants	1.9	10.8	17.9

# A Summary of the Impacts of Rice Production Management Training Programs

- Improved rice production is not only “seed-fertilizer intensive” but also “management intensive.”
- Rice production management training has significant impacts on rice cultivation practices and rice yield in both short run and longer runs, even if no other support measures are provided.
- Furthermore, improved production practices are diffused by farmer-to-farmer networks.
- Thus, a critically important step towards Rice Green Revolution in SSA is to provide rice production management training programs widely by nurturing competent extension workers and constructing effective extension systems.

# What else must be done to improve rice yield?

- Irrigation investment
  - Mechanization
  - Strengthening rice value chain, particularly rice milling sector
- \*\* These are the issues our research team is currently addressing.

# Photo of Mwea rice fields in Kenya



Photo of upland fields adjacent to Mwea Rice Irrigation Scheme in Kenya, which are similar to Mwea before irrigation facilities were built.





# Impacts of Mechanization

- Asian Experience: Use of tractor → Substitution for draft animals and saving of labor without significantly improving rice yield per hectare.
- African case: Use of tractor → Saving of labor with no effect on rice yield? This is because draft animals are seldom used.
- Hypothesis in SSA: The use of tractor expands cultivation area, induces the adoption of improved management practices by thoroughly preparing paddy fields, increases total labor use per hectare, and leads to higher rice yield, if tractor substitutes for manual cultivation.

# Comparison of performance between two-wheel tractor users and manual cultivators in Cote d'Ivoire

	Tractor Users	Manual Cultivators
Yield (ton/ha)	4.4	3.6
Cultivated paddy size (ha)	0.91	0.65
Chemical fertilizer use (kg/ha)	252	149
Leveled plots (%)	80	64
Bund construction (%)	85	41
Canal construction (%)	84	66
Family labor use (days/ha)	78	89
Hired labor cost (1000 FCFA/ha)	252	149

The use of tractor seems to promote intensive cultivation of larger paddy fields. This point, however, needs to be tested further in other areas.

# Need for Training Rice Millers

- African rice millers, in general, just rent out milling machines and charge milling fees without undertaking marketing and offering credits to farmers.
- Moreover, milling machines are not capable of removing stones or do not have destoning function, which is a main reason why African rice cannot compete with imported Asian rice.
- In contrast, rice millers in Asia and South America use milling machines with destoners, and often provide inputs on credit and production information and instruction to farmers, which may be called “contract farming.”
- I propose that governments and aid agencies should provide training programs to rice millers in SSA.

# Common simple rice milling machine



Stones remain



# A Summary

- The most important strategies are investments in human capital of farmers, extension workers, and rice millers. With adequate human capital investments, dream of Rice Green Revolution in SSA will come true.
- Some supports for mechanization and irrigation investments are also desirable.

Thank you very much for your attention