TICAD VI Side Event on CARD
In Pursuit of an African Green Revolution
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In Pursuit of an African Green Revolution: Views from Rice and Maize Farmers’ Fields

Kei Otsuka (edited with Don Larson), Springer Nature

1. **Introduction:** Why an African Green Revolution is Needed, Donald F. Larson and K. Otsuka

2. **Mozambique:** Pathways to Intensification, Kei Kajisa

3. **Tanzania:** An Assessment of Management Training and Credit Programs, Y. Nakano, K. Kajisa, and K. Otsuka

4. **Uganda:** Impact Evaluation of a Management Training Program and Guidebook Distribution, Yoko Kijima


6. **Senegal:** Efficiency of Large-Scale vs. Small-Scale Irrigation Schemes, T. Sakurai

7. **On the Possibility of Maize Green Revolution in Highlands of Kenya,**
   Rie Muraoka, Tomoya Matsumoto, Songqing Jin, and Keijiro Otsuka

8. **On the Determinants of Low Productivity in Maize Farming in Uganda,**
   Donald F. Larson, Sara Savastano, Siobhan Murray, and Amparo Palacios-López

9. **Conclusions:** Strategies towards a Green Revolution in sub-Saharan Africa
Major Purposes of the Book

1. Explore to what extent a Green Revolution has already taken place in irrigated areas in sub-Saharan Africa (SSA).

2. Examine whether it is possible to realize a Green Revolution in rainfed areas in SSA, which occupies vast rice areas in SSA.

3. Identify to what extent technology and management training programs are effective in disseminating Green Revolution technology.

We focus on rice in order to build a successful model useful for Green Revolutions in other crops 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,” which is very misleading.

• 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 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

- **Yield/Ha**
- **Fertilizer/Ha**

- **Improved MVs with Improved Management Practices**
- **MVs**
- **TVs**
- **Lodging**
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.

- Rice is the most promising crop in raising productivity on small farms in SSA because of the high transferability of Asian rice technologies.

- I believe that rice production environments are more favorable in SSA than in Asia:
  
  Irrigated areas: Fertile soil, full of sunshine, and dry climate free of pests and diseases

  Rainfed areas in valley bottom: Fertile and moist soil
Changes in average paddy yields in SSA, top 10 and bottom 10 countries, and India
Findings from rice yield

• Average yield has been increasing, particularly in recent years.

• Yield of top 10 countries has been growing substantially and it is only moderately lower than in India now, indicating that rice Green Revolution has taken place in these advanced countries, where average irrigation ratio is about 50%.

• Yield of bottom 10 countries has been stagnant roughly at 1 ton per hectare, as much of rice area in these countries is upland.

• It seems that the average rice yield can increase by transferring technology from India, or more generally from Asia, to SSA and from advanced areas to less advanced areas within SSA.
Possibility of Rice Green Revolution 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 lowland 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
Yield increases with increased adoption of improved technology and management practices (MV$s$, fertilizer, bunding, leveling, straight-row planting, etc.) even in rainfed areas, supporting Hypothesis 2.

<table>
<thead>
<tr>
<th></th>
<th>Uganda\textsuperscript{a}</th>
<th>Ghana\textsuperscript{b}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Training villages</td>
<td>Non-training villages</td>
</tr>
<tr>
<td>All improved practices</td>
<td>3.7</td>
<td>0.8</td>
</tr>
<tr>
<td>Almost all improved practices</td>
<td>3.0</td>
<td>1.5</td>
</tr>
<tr>
<td>One improved practice only</td>
<td>2.1</td>
<td>1.6</td>
</tr>
<tr>
<td>No improved practices</td>
<td>0.8</td>
<td>1.0</td>
</tr>
</tbody>
</table>
Table 9.4  Income and profit per hectare of rice cultivation (USD/ha) by status of irrigation, management training participation, and technology adoption

<table>
<thead>
<tr>
<th></th>
<th>Income per ha</th>
<th>Labor cost per ha</th>
<th>Profit per ha</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tanzania</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigated area</td>
<td>1,011</td>
<td>421</td>
<td>590</td>
</tr>
<tr>
<td>Rainfed area</td>
<td>453</td>
<td>300</td>
<td>153</td>
</tr>
<tr>
<td><strong>Uganda (rainfed)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training participants</td>
<td>1,327</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>Non-participants</td>
<td>905</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td><strong>Ghana (rainfed)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full adopters</td>
<td>374</td>
<td>114</td>
<td>260</td>
</tr>
<tr>
<td>Non-adoptors</td>
<td>228</td>
<td>169</td>
<td>59</td>
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Impacts of “Modified” System of Rice Intensification (MSRI) in Rainfed Areas in Kilombero Valley, Tanzania

<table>
<thead>
<tr>
<th></th>
<th>MSRI Training Villages</th>
<th></th>
<th>Non-Training Villages</th>
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<tbody>
<tr>
<td></td>
<td>Trainees</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MSRI Plots</td>
<td>Non-MSRI Plots</td>
<td>Non-Trainees</td>
</tr>
<tr>
<td>Yield in 2013 (t/ha)</td>
<td>5.1</td>
<td>2.8</td>
<td>2.6</td>
</tr>
<tr>
<td>Yield before training in 2009-10 (t/kg)</td>
<td>2.7</td>
<td>2.6</td>
<td>2.3</td>
</tr>
<tr>
<td>% MVs in 2013</td>
<td>97</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Chemical fertilizer use (kg/ha)</td>
<td>92</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>% Straight-row planting</td>
<td>90</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>% 25cm x 25 cm spacing</td>
<td>59</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
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Concluding Remarks

1. Suprisingly high lowland rice yields are achieved in many areas in SSA by adopting Asin-type technology and improved management practices. In other words, rice Green Revolution has been taking place in a number of areas in SSA.

2. Unlike lowland rice, surprisingly high yields of other crops are seldom found in SSA.

3. The main conclusion of our study is that not only “improved technology” but also “improved management or agronomic practices” are keys to rice Green Revolution in SSA.

4. The seond conclusion is that improved technology and management practices for rice production can be introduced and disseminated 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