Why Can't We Transform Traditional Agriculture in Sub-Saharan Africa?

Keijiro Otsuka

Foundation for Advanced Studies on International Development (FASID)

Figure 1. Changes in Grain Yield (ton per ha) in Sub-Saharan Africa and South/South-East Asia

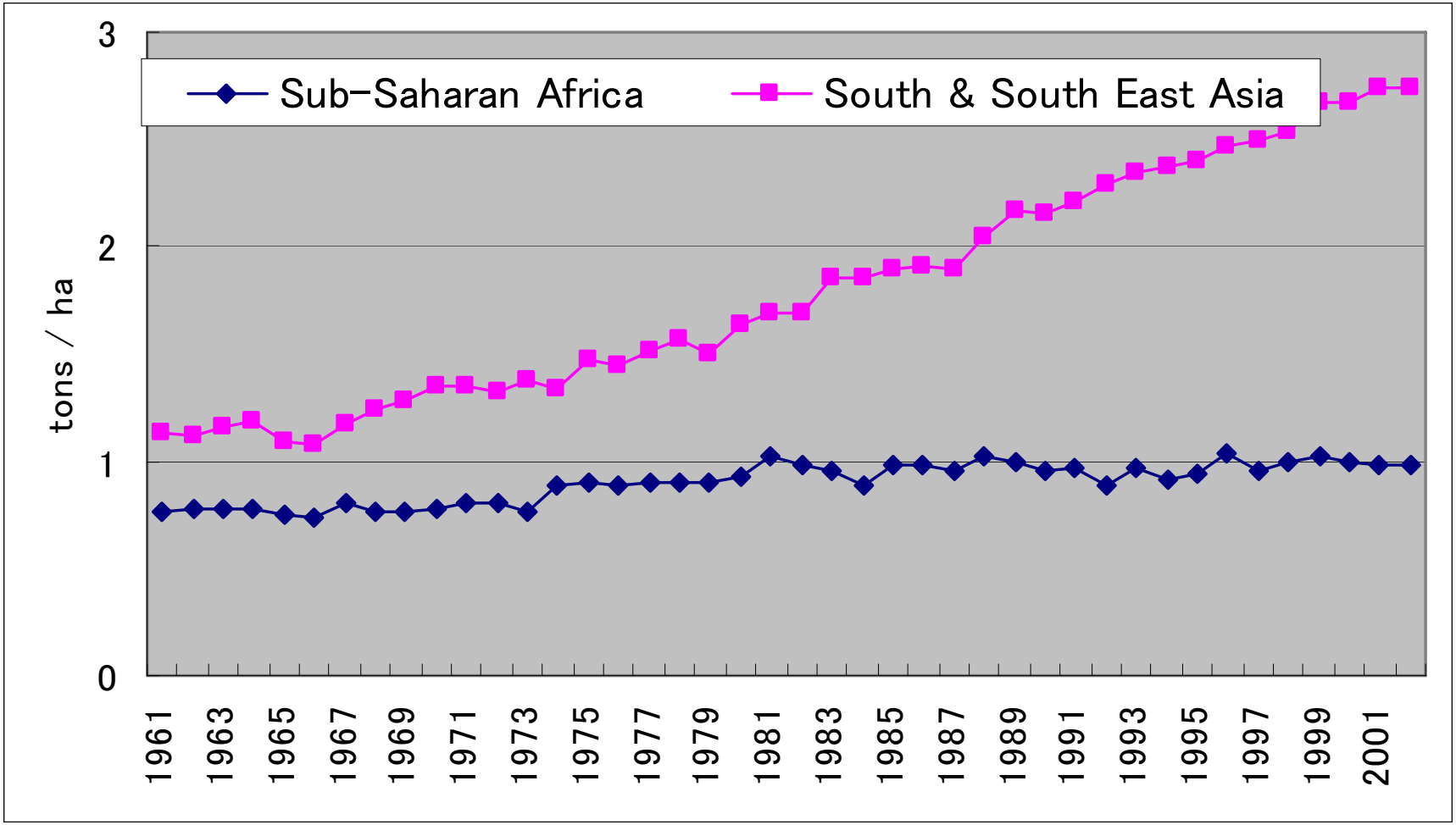
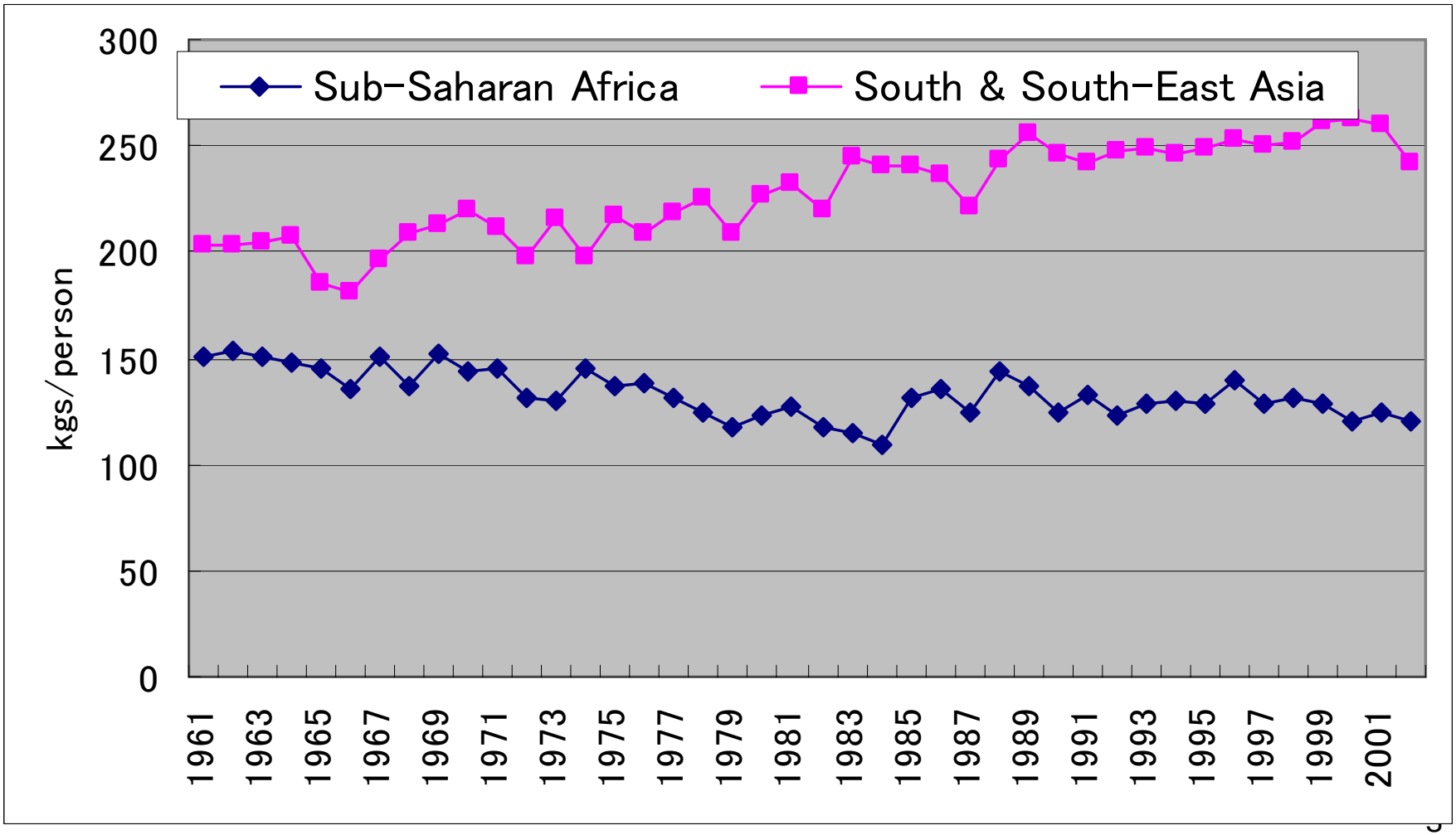


Figure 2. Grain Production per Person (Total Population) in Sub-Saharan Africa and South/South-East Asia



Contents

1. What is the essence of the Asian Green Revolution?
2. Why has it been so difficult to realize a GR in SSA?
3. Is it possible to realize a GR in SSA?
4. Is there any encouraging evidence in SSA?

How can we increase crop yield?

1) Shift yield function upward.
2) Apply more inputs, particularly fertilizer.

Essence of the Green Revolution in Asia:

Development and diffusion of a series of fertilizer-responsive, high-yielding modern varieties (MVs). GR is also called seed-fertilizer revolution.

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

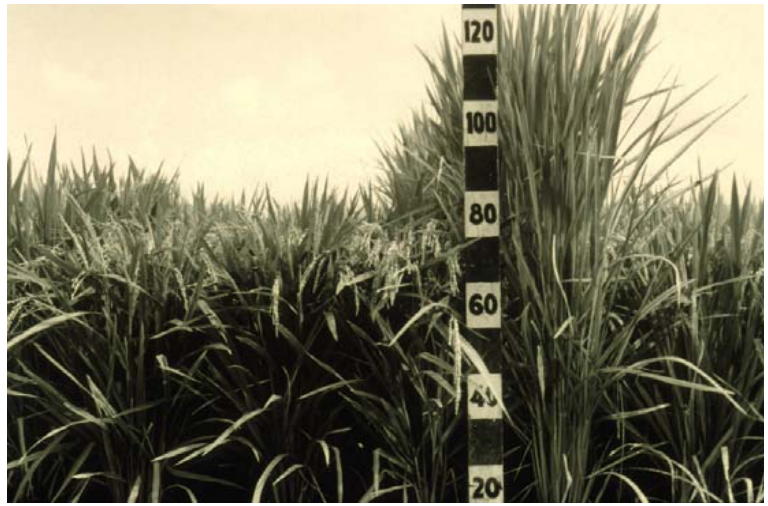
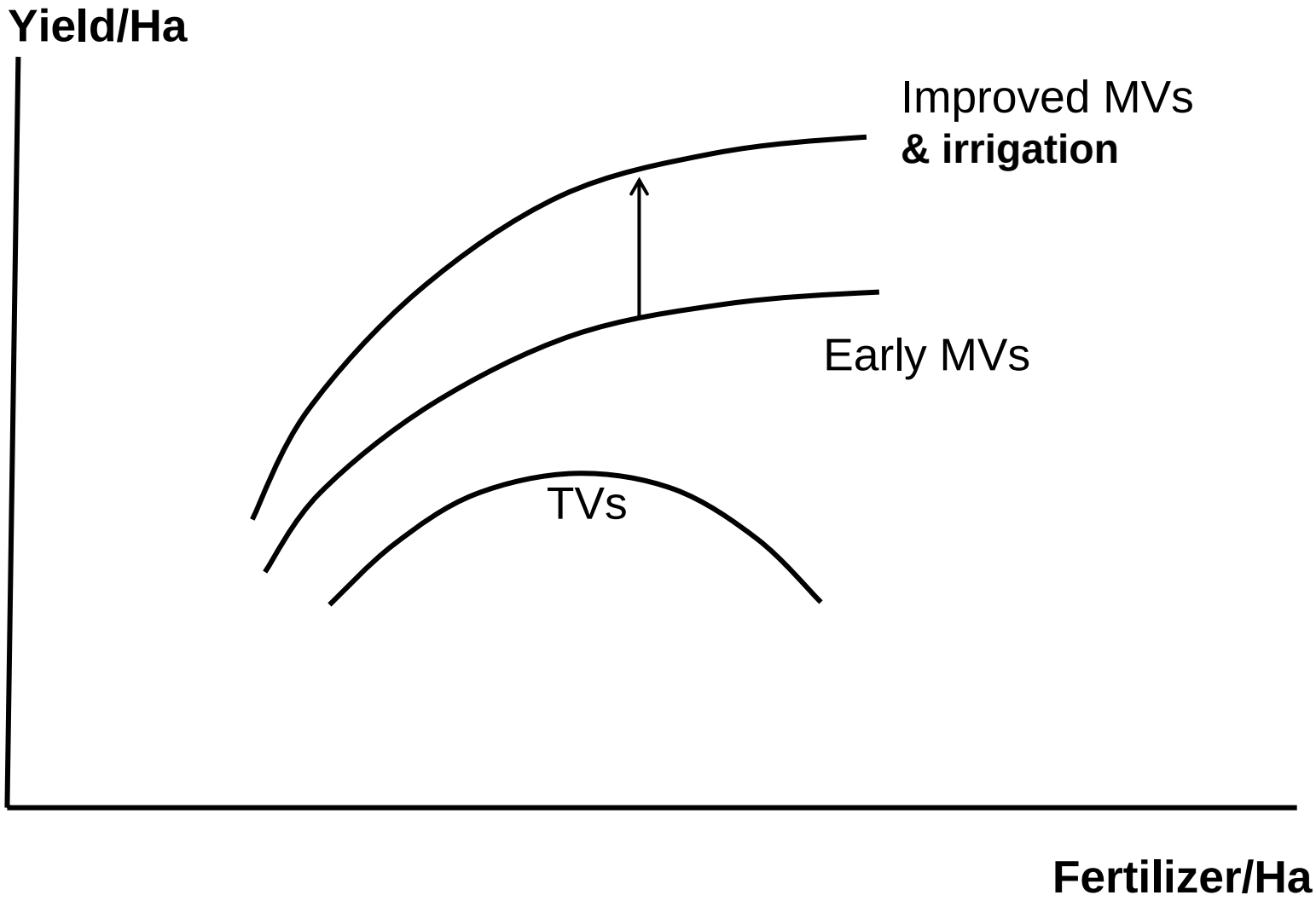


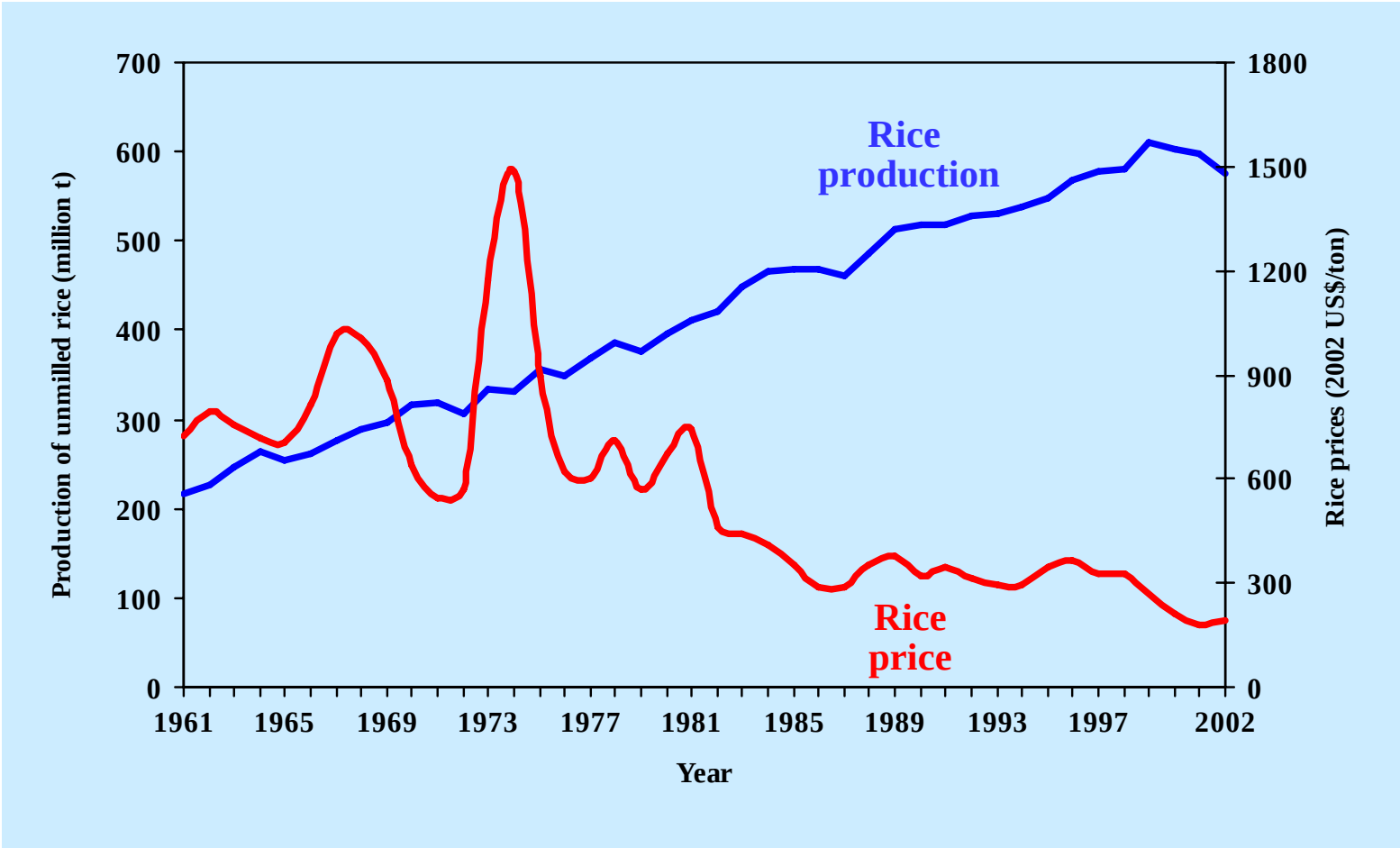
Figure 1. Yield Curves of Traditional Varieties (TVs) and Modern Varieties (MVs)



Significance of Asian Green Revolution

- Rice yield per ha doubled, rice cropping intensity increased roughly by 50%, and, as a result, rice production tripled since the mid-1960s. This is undoubtedly historical revolution.
- If rice yields today were the same as in 1965, more than 135 million additional hectares of land, roughly the same as actual paddy fields, would need to be devoted to rice. This would mean large-scale deforestation and wide-spread famine.

Trends in world rice production and price adjusted for inflation, 1961-2002



Source: Production: FAOSTAT Electronic Database, FAO.10June2003
Rice Price: Relate to Thai rice 5%-broken deflated by G-5 MUV Index deflator (adjusted based on 2002 data update)
Source: World Bank Quarterly Review of Commodity Markets

Summary of the Asian Green Revolution

- Continuous development and diffusion of fertilizer-responsive and pest- and disease-resistant MVs made revolution possible.
- IRRI took leadership followed by national agricultural research systems, as IRRI's research outputs were international public goods.
- MVs are particularly high-yielding in favorable areas, such as irrigated areas and shallow rainfed areas.
- There is, however, a strong sign that the GR is ending.
- MV adoption rate now is 70-75% in Asia, implying that nearly 25% of areas has been bypassed by the GR.
- Such unfavorable areas are primarily drought-prone areas, where people are particularly poor.

Lessons of Asian Green Revolution for SSA

1. Need fertilizer-responsive varieties for areas where rainfall is low and unpredictable.
2. Need fertilizer, where chemical fertilizer is often prohibitively expensive.
3. The use of cow manure is recommended.
4. For manure production, stall-feeding and cultivation of feed crops are essential, as the Agricultural Revolution in 18th century England clearly attested.

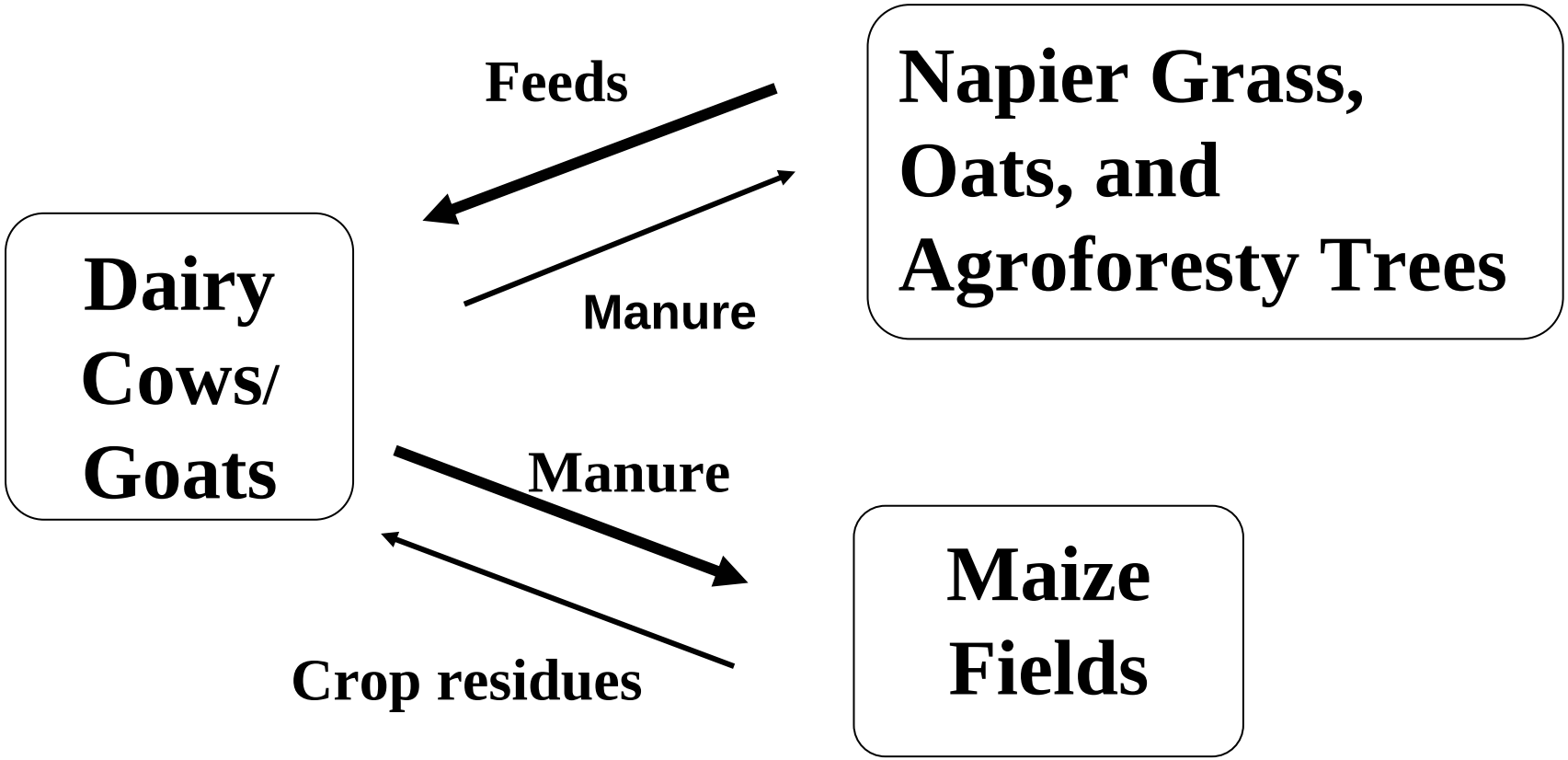
Organic Green Revolution in East Africa

- Stall-feeding of highly productive *dairy cows*, which are cross-breeds between European cows and local cows
- Use of manure and compost
- Cultivation of napier grass as feeds, as well as use of leaves of agroforestry trees for fodders
- Use of high-yielding hybrid maize varieties


Dairy Cows in Kenya

Agroforestry (Gliricidia)

Illustration of OGR in E. Africa



Dairy-Crop Integration in Kenya

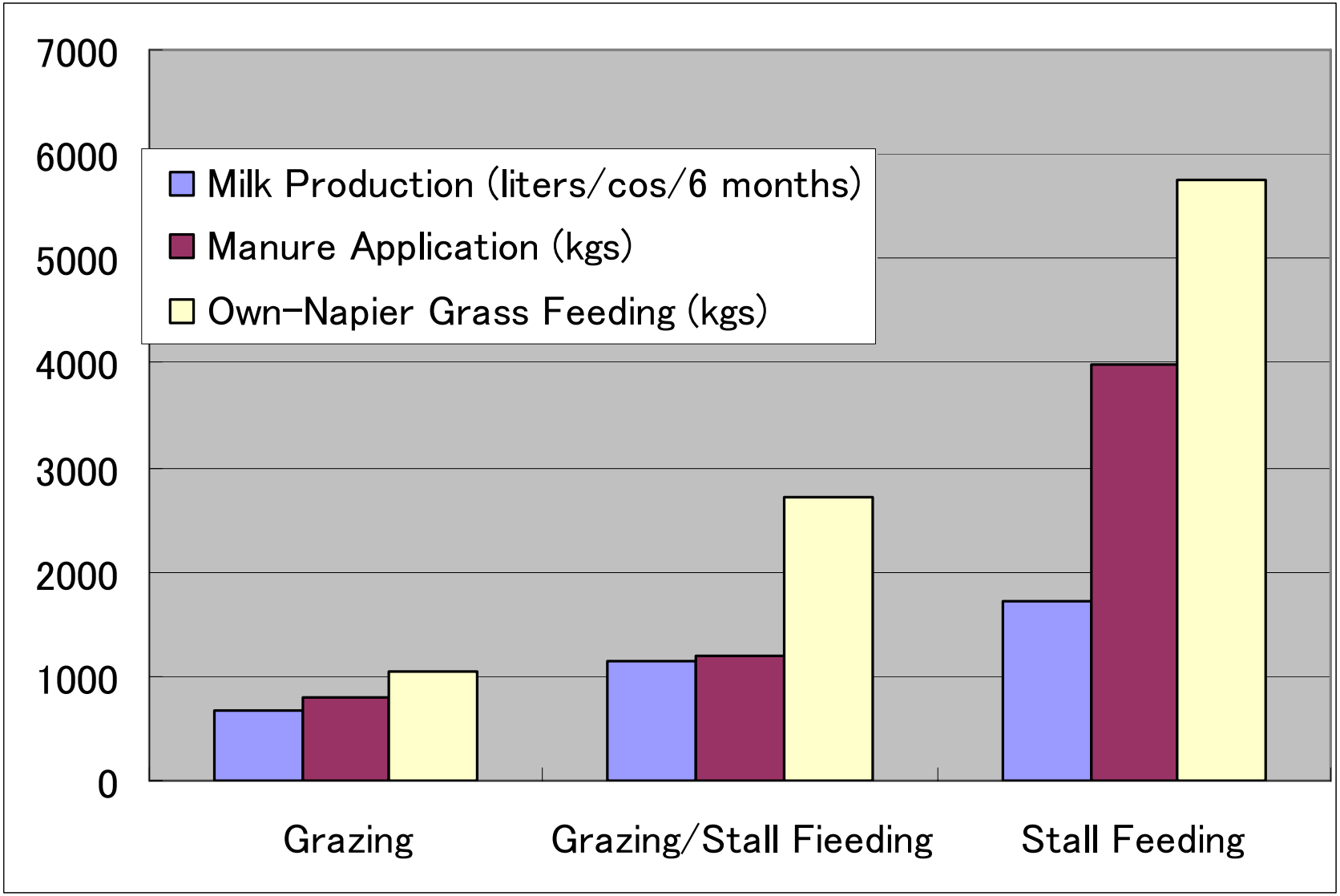


Table 2. Maize Yield and Fertilizer Application by Seed Type in Kenya

	Number of Maize Plots	Yield	Organic Fertilizer		Chemical Fertilizer	
			% of plots applied	Quantity applied	% of plots applied	Quantity applied
	Number	ton/ha	Percent	ton/ha	Percent	Kg/ha
Local varieties	490	1.4	41.4	1.4	58.8	0.06
Improved varieties	618	2.1	34.6	1.2	82.7	0.13

Source: Yamano and Otsuka

Summary of Major Findings about OGR

1. Stall-fed dairy cows produce a lot of manure.
2. Manure tends to be applied to depleted soils, so that yield gains are not easy to observe.
3. Yield is nearly 3 tons per ha, if both organic and chemical fertilizers are applied and improved varieties are adopted simultaneously.
4 According to our statistical analysis, the use of manure increases yield by nearly 50%.
5 The OGR is taking place in highlands of Kenya *without* strong government support.

The Essence of OGR

- Like Asian GR, OGR is characterized by the use of high-yielding (maize) varieties and increased application of fertilizer.
- OGR is essentially recycling system of nutrients, using feeds and cows. Thus, OGR is environmentally friendly.
- OGR is not perfectly sustainable, as nutrients are lost in the form of grains and milk.
- The use of either agroforestry trees or chemical fertilizer is needed to sustain soil fertility.
- OGR enhances women's status, as it is women who take care of dairy cows.

NERICA in Uganda

- NERICA is “New Rice for Africa,” high-yielding and short-maturing upland rice varieties developed by WARDA.
- Like the case of Asian Green Revolution, policy-makers are excited about shining prospects of NERICA in Uganda.
- FASID conducted the first empirical study on NERICA.

NERICA in Uganda

Table 2 Yield of NERICA in Uganda by previous crop and region (ton/ha)

Previous crops	Average	Traditional rice region	New rice region
Rice/maize	1.8	2.4	1.5
Leguminous crops	2.6	3.0	2.1
Tobacco	3.1	3.3	2.5
Average	2.1	2.7	1.5

How Revolutionary is NERICA?

- The average NERICA yield of 2.1 tons/ha is twice as high as the average rice yield in SSA. (In Japan it took 100 years to increase upland rice yield from 1 ton/ha to 2 tons/ha.)
- Yield of 3.3 tons/ha on fields planted previously to fertilizer-using tobacco in traditional rice growing areas is truly revolutionary, suggesting that NERICA is also fertilizer-responsive high-yielding varieties.
- In order to sustain the NERICA Revolution, the application of manure, agroforestry, and/or chemical fertilizer is essential.

Concluding Remarks

1. It is no longer a dream to realize a Green Revolution in SSA, as OGR and NERICA Revolution indicate.
2. In order to realize a GR, we need to invest more in research, development, and diffusion of drought-tolerant, yield-enhancing technologies.
3. In order to sustain a GR, we need to develop effective soil management practices based on crop-livestock-feed-agrogforestry interactions.